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Implication of integrated nutrient management on soil properties of cluster bean

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Abstract
An experiment was conducted during *Zaid* season (May-July) 2021 to study the "Response of Integrated Nutrient Management on Soil Properties, Growth and Yield of Cluster Bean (*Cyamopsis tetragonoloba* L.) Var. Deepti*"* on crop research farm department of Soil Science & Agricultural chemistry. The experiment was laid out in Randomized Block Design having three levels of NPK @ 0%, 50%, 100%, three levels of FYM @ 0%, 50%, 100% and three levels of Vermicompost @ 0%, 50% and 100% respectively. The treatment combinations were replicated three times and allocated at random in each replication. The result shows that the application of different levels combination of NPK, FYM and Vermicompost increased growth, yield of cluster bean and improved soil chemical properties. However, some parameter of soil physical properties decreased. It was recorded from the application of NPK, FYM and Vermicompost) treatment T_9 [NPK @ 100% + FYM@ 100% + Vermicompost@ 100%] maximum Bulk density 1.359 Mg m^{-3} in 0-15 cm and 1.360 Mg m^{-3} in 15-30 cm, Particle density 2.552 Mg m^{-3} in 0-15 cm and 2.557 Mg m^{-3} in 15-30 cm, % pore space 46.630% in 0-15 cm and 46.656% in 15-30 cm, Water holding Capacity 70.02% in 0-15 cm and 72.56% in 15-30 cm, pH 7.73 in 0-15 cm and 7.71 in 15-30 cm, EC 0.260 dSm^{-1} in 0-15cm and 0.230 dSm^{-1} in 15-30 cm,% Organic Carbon 0.515% in 0-15 cm and 0.464% in 15-30 cm, Available Nitrogen 289.02 kg ha^{-1}in 0-15cm and 292.05 in 15-30 cm kg ha^{-1}, Available Phosphorus 29.06 kg ha^{-1} in 0-15 cm and 28.01 kg ha^{-1} in 15-30 cm, Available Potassium 161.96 kg ha^{-1} in 0-15 cm and 196.10 kg ha^{-1} in 15-30 cm. The economy of different treatment concerned, the treatment T_9 provides highest net profit of Rs. 94826.56 with Benefit Cost ratio 2.31:1.

Keywords: Physico-chemical properties of soil, NPK, FYM, vermicompost

Introduction
Guar is a cluster bean (*Cyamopsis tetragonoloba* (L.). The word "Guar" comes from the Sanskrit word "Gau Aahar," which meaning "cow fodder" or "animal fodder." This exceptional legume crop is grown mostly in rainfed conditions in dry and semi-arid areas of Rajasthan during the Kharif season. It is a robust and advanced desert crop that is well-suited to Rajasthan's soil and environment. Its deep penetrating roots help the plant to more efficiently absorb available moisture, increasing the amount of rainfed cropping potential. Even under moderate salinity and alkalinity circumstances, the crop assures. It maintains an important position in the national economy among dry land crops due to its industrial importance, primarily due to 35 to 40 per cent gum in its endosperm Ayub *et al.*, (2012) [1].
Organic elements are intrinsic and necessary components of all soils, and they help to create a living, dynamic system in the soil that nourishes all of the life that lives there. Organic matter is important for enhancing soil's physical, chemical, and biological conditions. Organic Manures, in addition to providing N, P, and K, are a possible source of micronutrients and improve soil structure by binding soil aggregates, boosting water holding capacity, and enhance soil buffering capacity (Rathore *et al.*, (2007) [14].

Materials and Method
Experimental site
The methods employed and material which are used for conducting the study pertaining to the present topic under field investigation are entitled "Response of Integrated Nutrient Management on Soil Properties, Growth and Yield of Cluster Bean *(Cyamopsis tetragonoloba) var*, Deepti." in *Zaid* season 2021 at Research Farm, Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during *Zaid* Season 2020, was 25º 24'30"N latitude, 81º

51'10"E longitude, and 98 m above sea level. District of Uttar Pradesh have been executed in this chapter under appropriate headings. Details of the test site, soil and climate are described in the chapter as well as the exploration design, building plan, cultural practices and techniques used in the boundaries. The Prayagraj region is below the subtropical belt in South East Uttar Pradesh, experiencing extreme summer temperatures and inclement winters. The maximum local temperature is 46ºC - 48ºC and is rarely as low as 4ºC - 5ºC. The relative humidity was between 20-94%. The average rainfall in this area is approximately 1100 mm. It has a tropical environment with an average annual rainfall of 1100mm, with the wettest months being July to October. During the winter, however, rain was unusual. The winters were brutally cold, and the summers were burning hot and dry. During the growth season, the minimum temperature was 27.1ºC and the maximum was 39.94ºC. Humidity levels varied from 57.70% to 75.37%. The test was carried out on sandy loam soil. Each structure was 2 × 2 m^2 in size. The trial consisted of 9 treatments and the field was placed in a Randomized Block Design with three duplicates by taking FYM (0%, 50%, 100%) and Vermicompost (0%, 50%, 100%) with different levels. Nitrogen, Phosphorus and Potassium are applied basal does into the field. The sources of NPK were urea, SSP, MOP. The NPK, FYM and Vermicompost were applied at their recommended doses Nitrogen @ 80 kg ha^{-1}, Phosphorus @ 80 kg ha^{-1}, Potassium @ 60 kg ha^{-1}, FYM @ 10 t ha^{-1} and Vermicompost @ 2 t ha^{-1}. The soil physic-chemical parameters were analysed at two depths: 0-15 cm and 15-30 cm. Bulk density, particle density, pore space, and water holding capacity are physical properties, while PH, EC, Organic carbon, available nitrogen, available phosphorus, and available potassium are chemical properties.

Results and Discussions

Effect on soil physical properties

Application of NPK, FYM and Vermicompost change in bulk density at 0-15 cm and 15-30 cm soil depth. Lowest bulk density was recorded into T_9 i.e.1.320.Mg m^{-3} and 1.321.Mg m^{-3}in 0-15 cm and 15-30cm respectively and maximum bulk density was recorded in T_1i.e. 1.320.Mg m^{-3} at 0-15cm and 1.321.Mg m^{-3} in 15-30 cm. Lowest particle density was recorded into T_9 i.e.2.430 Mg $m^{-3}$and 2.431Mg m^{-3} at 0-15 cm and 15-30 cm soil depth respectively and maximum particle density was recorded in absolute control into T_1 i.e. 2.552 Mg $m^{-3}$and 2.557 Mg m^{-3} at 0-15 cm and 15-30 cm soil depth respectively. Porosity varied 45.679% to 46.630% in 0-15 cm soil depth but when depth increase porosity decreased means at 15-30 cm soil depth porosity varied 45.660% to 46.656%. Water holding capacity varied from a minimum of 50.72% in control (T_1) to a maximum of 70.02% in T_9 at 0-15 cm soil depth. When increase soil depth water holding capacity of soil slightly changed. It is varied from 51.90% to 72.56% at 15-30 cm soil depth.

Application of NPK, FYM and Vermicompost significantly not affect the soil pH at 0-15 cm and 15-30 cm soil depth. It is ranged from 7.51 to 7.73 at 0-15 cm and 7.49 to 7.71 15-30 cm depth. Minimum soil pH were recorded under the treatment T_1. Electrical conductivity (dSm^{-1}) was significantly changed due to different combination of NPK, FYM and Vermicompost. It is ranged from 0.41 dSm^{-1} to 0.84 dSm^{-1} at 0-15 cm and 0.40 dSm^{-1} to 0.81 dSm^{-1}15-30 cm depth of soil. Maximum electrical conductivity was recorded into T_9 it decreased in following manner T_8, T_7, T_6, T_5, T_4, T_3, T_2 and minimum electrical conductivity in T_1. Percent organic carbon was influenced due to NPK, FYM and Vermicompost. It was found that positive influence of Organic on organic carbon. Percent organic carbon maximum determined is. 0.846% and 0.844% in 0-15 cm and 15-30 cm soil depths respectively and lowest organic carbon were recorded in absolute control i.e. T_1 0.623% and 0.620% 0-15 cm and 15-30 cm soil depths respectively Similar trend recorded in both soil depth.

Maximum available nitrogen was recorded in treatment T_9i.e.289.02 kg ha^{-1} and 292.05 kg ha^{-1} 0-15 cm and 15-30 cm soil depth respectively.Minimum available nitrogen was recorded in treatment T_1i.e. 260.45 kg ha^{-1} and 263.21 kg ha^{-1} 0-15 cm and 15-30 cm soil depth respectively. Highest available phosphorus was recorded in both soil depth T_9 i.e. to 29.06 kg ha^{-1} and 28.01 kg ha^{-1} 0-15 cm and 15-30 cm soil depth respectively. Maximum Available potassium (kg ha^{-1}) in 0-15 cm and 15-30 cm soil depth i.e. 161.96 kg $ha^{-1}$and 166.23 kg ha^{-1} respectively and lowest available potassium (kg ha^{-1}) in T_1 145.23 kg $ha^{-1}$and 147.82 kg ha^{-1}similar trend were recorded in both soil depth**.**

Table 1: Effect of nutrients on Physico-Chemical properties of soil

Treatments	Depth (cm)	BD (Mg m^{-3})	PD (Mg m^{-3})	Pore Space (%)	WHC (%)	pH	EC dSm^{-1}	OC (%)	N (Kg/ha)	P (Kg/ha)	K (Kg/ha)
	0-15	1.320	2.430	45.679	50.72	7.51	0.41	0.623	260.45	20.92	145.23
T_1 Absolute control	15-30	1.321	2.431	45.660	51.90	7.49	0.40	0.620	263.21	20.80	147.82
T_2 P@ 0% + S@ 0%+RDF	0-15	1.329	2.432	45.353	53.74	7.55	0.48	0.667	263.66	21.09	148.02
	15-30	1.331	2.434	45.316	54.02	7.53	0.45	0.665	264.78	20.46	151.01
T_3 P@ 0% + S@ 0%+RDF	0-15	1.331	2.489	46.524	56.27	7.59	0..51	0.692	268.74	21.98	151.34
	15-30	1.333	2.491	46.487	58.01	7.57	0.49	0.690	271.02	20.12	157.31
T_4 P@ 0% + S@ 0%+RDF	0-15	1.335	2.502	46.642	58.11	7.61	0.58	0.731	272.14	23.18	154.59
	15-30	1.337	2.506	46.648	59.54	7.58	0.55	0.731	277.01	21.46	158.02
T_5 P@ 0% + S@ 0%+RDF	0-15	1.339	2.514	46.738	61.01	7.65	0.66	0.723	275.87	24.15	155.10
	15-30	1.340	2.515	46.719	63.45	7.63	0.62	0.320	276.89	23.03	158.95
T_6 P@ 0% + S@ 0%+RDF	0-15	1.341	2.520	46.785	64.52	7.67	0.71	0.765	279.01	26.92	157.43
	15-30	1.343	2.522	46.748	66.19	7.64	0.69	0.763	281.04	25.68	159.05
T_7 P@ 0% + S@ 0%+RDF	0-15	1.351	2.531	46.621	65.23	7.69	0.77	0.784	284.24	27.00	159.47
	15-30	1.352	2.534	46.645	67.51	7.68	0.74	0.782	286.49	25.85	162.53
T_8 P@ 0% + S@ 0%+RDF	0-15	1.357	2.538	46.532	67.47	7.70	0.80	0.817	287.32	27.08	161.07
	15-30	1.359	2.540	46.496	69.49	7.69	0.78	0.815	289.34	26.78	164.72
T_9 P@ 0% + S@ 0%+RDF	0-15	1.359	2.552	46.630	70.02	7.73	0.84	0.846	289.02	29.06	161.96
	15-30	1.360	2.557	46.656	72.56	7.71	0.81	0.844	292.05	28.01	166.23

F-test		NS	NS	S	S	NS	S	S	S	S	S
		NS	NS	S	S	NS	S	S	S	S	S

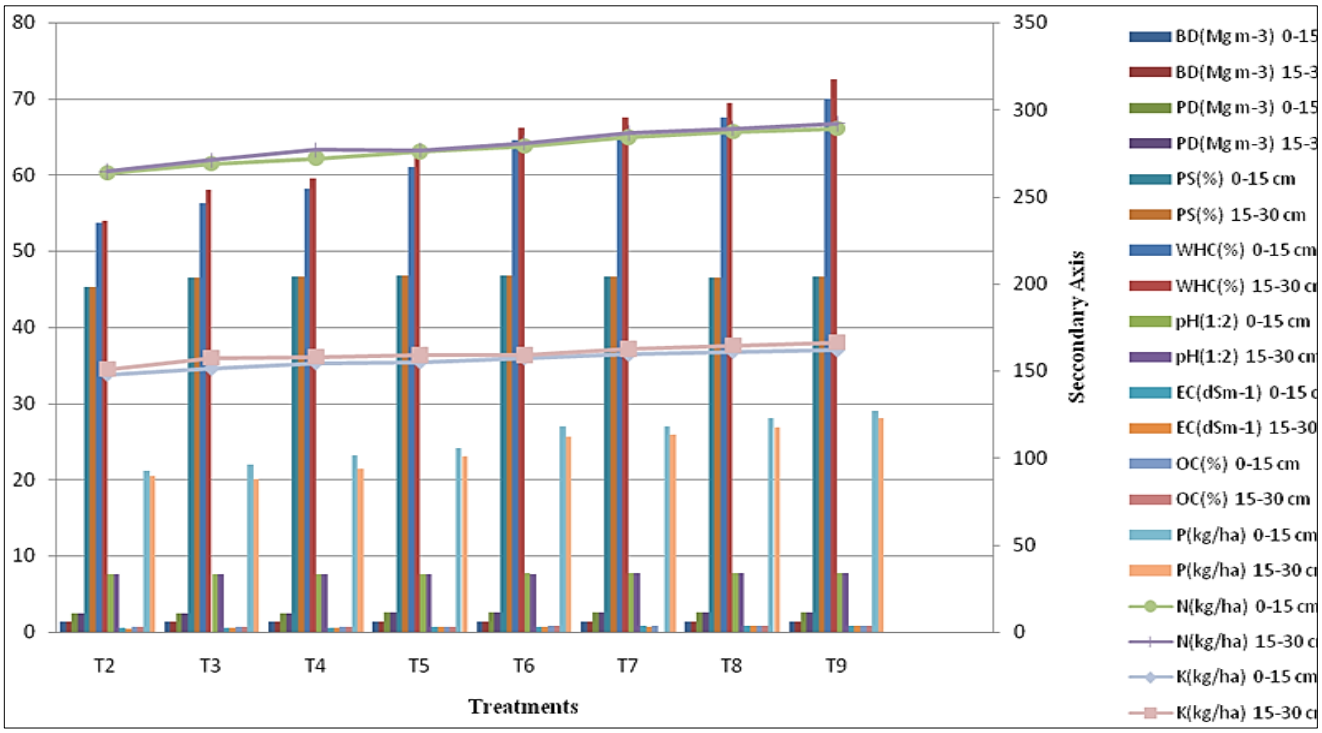

Fig 1: Effect of nutrients on Physico-Chemical properties of soil

Conclusion

This study found that NPK, FYM, and Vermicompost were beneficial to soil physical and chemical characteristics because they promoted soil nutrient status and cluster bean growth and yield characteristics. The field trial concluded that using NPK, FYM, and Vermicompost enhances soil physico-chemical properties, resulting in suitable BD, PD, pore space, and water retention capacity. FYM and Vermicompost stimulate microbial activity in the soil, making it more porous. Soil fertility with high organic content and low to medium concentrations of macronutrients, such as Nitrogen, Potassium and phosphorus and a pH range of neutral to alkaline for cluster bean growth. Farmers must maintain soil nutrient status, use appropriate management strategies.

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