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EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON PHYSICO-CHEMICAL PROPERTIES OF SOIL AND CLUSTER BEAN

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Key words: Physico-chemical properties of soil, Neem Cake, Rhizobium, Yield.

Abstract– An experiment was conducted during *Kharif* season (July – October) 2021 on crop research farm Department of Soil Science & Agricultural chemistry at SHUATS. The experiment was laid out in Randomized Block Design having three levels of Neem Cake @ 0%, 50%, 100% and three levels of Biofertilizer (Rhizobium) @ 0%, 50% and 100% respectively. The results show that the application of different levels combination of Neem Cake and Biofertilizer increased growth, the yield of cluster bean and improved soil chemical properties. However, some parameters of soil's physical properties decreased. It was recorded from the application of Neem Cake and Biofertilizer (Rhizobium) treatment T_9[NC @ 100% + R @ 100%] maximum Bulk density 1.177 Mg m^{-3} at 0-15 cm and 1.382 Mg m^{-3} at 15-30 cm, Particle density 2.145 Mg m^{-3} at 0-15 cm and 2.410 Mg m^{-3} at 15-30 cm, % pore space 45.11% at 0-15 cm and 42.66% at 15-30 cm, Water holding Capacity 59.09 % in 0-15 cm and 48.44 % at 15-30 cm, pH 7.25 at 0-15 cm and 7.46 at 15-30 cm, EC 0.260 dSm^{-1} at 0-15 cm and 0.230 dSm^{-1} at 15-30 cm, % Organic Carbon 0.615 % at 0-15 cm and 0.464 % at 15-30 cm, Available Nitrogen 215.12 kg ha^{-1} at 0-15 cm and 286.90 at 15-30 cm kg ha^{-1}, Available Phosphorus 30.72 kg ha^{-1} at 0-15 cm and 28.35 kg ha^{-1} at 15-30 cm, Available Potassium 232.55 kg ha^{-1} at 0-15 cm and 196.10 kg ha^{-1} at 15-30 cm.

INTRODUCTION

Cluster bean [*Cyamopsis tetragonoloba (L.)]* commonly known as Guar. The word "Guar derives from Sanskrit word "Gau aahar" which means cow fodder or otherwise fodder of the animals. This crop is an outstanding legume crop grown mainly under a rainfed situation in arid and semi- arid regions of Rajasthan throughout *Kharif* season. It is pretty hardy and sophisticated dryness crop which is especially suited for soil and climate of Rajasthan. Its deep penetrating roots allow the plant to uptake available moisture more efficiently and thus extend the much scope for rainfed cropping. The crop also ensures even at reasonable salinity and alkalinity situations. Amidst dry land crops, it holds a significant status in the national economy because of its industrial value principally due to 35 to 40 per cent gum in its endosperm Ayub *et al.,* (2012).

Guar gum has been used extensively in several industries like textiles, paper, oil, pharmaceuticals, food processing cosmetics, mining explosives, oil drilling etc. The demand of cluster bean is growing rapidly at international market due to the presence of natural polysaccharide, galactomannan gum content in seed endosperm. It also gives nutritional concentrate and fodder for animals and supplements to the fruitfulness of soil by fixing a substantial quantity of atmospheric nitrogen (37-196 kg N ha^{-1} per year). In India, cluster bean has covered 5.6 million hectares with the total yearly production of 2.7 million tonnes (Anonymous, 2016-17).

Organic materials are intrinsic and essential components of all soils and it makes a living dynamic system in the soil that supports all life

residing in soil. Organic matter plays a vital role in improving the physical, chemical and biological condition of soil. Besides, addition of N, P, K, organic Manures are a potential source of micronutrients and improve soil structure by providing binding action to soil aggregates, increases water holding capacity and improve buffering capacity of soils (Rathore *et al.,* 2007).

MATERIALS AND METHOD

Experimental site

The field experimental is to be conducted out during Kharif Season 2021-2022, on variety desi malini at the Research farm of Department of Soil Sciences and Agricultural Chemistry at SHUATS Located at, 25° 24'30''N latitude, 81° 51'10''E longitude, and 98 m above sea level. The trial consisted of 9 treatments and the field was placed in a Randomized Block Design with three duplicates by taking Neem Cake (0%, 50%, 100%) and rhizobium (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 Neem Cake and Rhizobium were applied at their recommended doses *Rhizobium* @ 200g 10 kg^{-1}, Neem Cake 500 kg ha^{-1}. The soil depth 0-15 cm and 15-30 cm both were taken for analysis of soil physic-chemical properties. Physical properties are bulk density, particle density, pore space, water holding capacity was done by 100ml measuring cylinder (muthuevel *et al.,* 1992) and chemical properties are PH was done by digital pH meter (Jackson, 1973), EC by digital EC meter (Wilcox, 1950), Organic carbon by wet oxidation method (Walkley and Black, 1947), available nitrogen by alkaline permanganate method (Subbiah and Asija, 1956), available phosphorus by photoelectric calorimetric method (Olsen *et al.,* 1954), available potassium by flame photometer method (Toth and Prince, 1949).

RESULTS AND DISCUSSION

Effect on soil physical properties

Application of Organic and Inorganic fertilizer change in bulk density at 0-15 cm and 15-30 cm soil depth. Maximum bulk density was recorded in absolute control into T_1, i.e. 1.190 Mg m^{-3}, 1.403 Mg m^{-3} and Lowest bulk density was recorded into (Neem cake @100%+*Rhizobium*@100% + RDF) T_9, i.e. 1.177 Mg m^{-3}, 1.382 Mg m^{-3} at 0-15 cm and 15-30 cm soil depth respectively (which was at par with T_8 and T_7) followed by T_6. Lowest particle density was recorded into T_9, i.e. 2.145 Mg $m^{-3}$and 2.410 Mg 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. 2.160 Mg m^{-3} and 2.423 Mg m^{-3} at 0-15 cm and 15-30 cm soil depth respectively. Similar result were recorded by Yaduvanshi *et al.* (2013) and Singh *et al.* (2015). The highest pore space (%) of soil found at T_9 45.11, 42.66 and the minimal effect (%) of pore space values found in T_1 44.91, 42.10 at 0-15 cm and 15-30 cm soil depth respectively (which was at par with T_2 and T_3) followed by T_4. Maximum Water holding capacity was recorded into T_9, i.e. 59.09, 48.44 per cent and minimum water holding capacity recorded in absolute control into T_1, i.e. 53.17, 42.45 per cent at 0-15 cm and 15-30 cm soil depth respectively. Similar result reported by Demir and Demir (2019) and Choudhary *et al.* (2020).

Chemical Properties

Application of Organic and Inorganic fertilizer affect the soil pH at 0-15 cm and 15-30 cm soil depth. Maximum soil pH observed in absolute control, i.e. T_1 7.49, 7.62 and minimum into (Neem cake @100%+*Rhizobium*@100% + RDF) T_9, i.e. 7.25, 7.46 at 0-15 cm and 15-30 cm soil depth respective (which was at par with T_8 and T_7) followed by T_6. Similar result were recorded by Sutaria *et al.* (2010). Maximum electrical conductivity (dSm^{-1}) was observed in absolute control T_9, i.e. 0.260, 0.230 dSm^{-1} and minimum in absolute control, i.e. T_1 0.246, 0.216 dSm^{-1} at 0-15 cm and 15-30 cm soil depth respectively (which was at par with T_2 and T_3) followed by T_4. Percent organic carbon maximum found in T_9 (100 % Organic with 100 % *Rhizobium* and RDF), i.e. 0.615 %, 0.464 % in 0-15 cm and 15-30 cm soil depths respectively and lowest organic carbon were recorded in absolute control, i.e. T_1 0.481,0.325 % 0-15 cm and 15-30 cm soil depths respectively. Maximum amount of Nitrogen (kg ha^{-1}) was recorded in treatment T_9, i.e. 215.12 kg ha^{-1} and 167.88 kg ha^{-1} 0-15 cm and 15-30 cm soil depth respectively. Minimum available nitrogen was recorded in treatment T_1, i.e. 190.86 kg ha^{-1} and 149.11kg ha^{-1} 0-15 cm and 15-30 cm soil depth respectively (which was at par with T_2 and T_3) followed by T_4. Maximum available phosphorus was recorded in treatment T_9, i.e. 30.72 kg ha^{-1} and 28.35 kg ha^{-1} 0-15 cm and 15-30 cm soil depth respectively and minimum available phosphorus was recorded

in treatment T_1, i.e 19.51 kg ha^{-1} and 16.63 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 30.72 kg ha^{-1} and 28.35 kg ha^{-1} 0-15

Table 2. Effect of Organic and Inorganic Fertilizer 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^{-1})	P (Kg ha^{-1})	K (Kg ha^{-1})
T_1 Absolute control (no fertilizer)	0-15	1.19	2.16	44.91	53.17	7.49	0.246	0.481	190.86	19.51	208.57
	15-30	1.403	2.423	42.1	42.45	7.62	0.216	0.325	149.11	16.63	176.79
T_2 Neem cake @0% +	0-15	1.186	2.159	45.06	54.87	7.44	0.247	0.498	191.98	21.75	210.38
Rhizobium@0% + RDF	15-30	1.397	2.421	42.14	43.89	7.59	0.217	0.341	150.02	17.27	178.55
T_3 *Rhizobium*@0% + RDF	0-15	1.185	2.157	45.05	54.94	7.43	0.249	0.501	192.65	22.83	212.41
	15-30	1.396	2.42	42.32	43.96	7.57	0.218	0.345	150.36	19.69	177.51
T_4 Neem cake@50% + RDF	0-15	1.184	2.155	45.07	55.43	7.4	0.25	0.552	197.65	25.36	228.77
	15-30	1.395	2.419	42.29	44.58	7.56	0.22	0.375	147.86	21.28	185.61
T_5 Neem cake@50% +	0-15	1.183	2.153	45.05	55.84	7.39	0.252	0.562	200.98	26.94	227.65
Rhizobium@50% + RDF	15-30	1.392	2.418	42.42	44.99	7.55	0.223	0.392	150.27	22.86	183.72
T_6 Neem cake@50% +	0-15	1.181	2.151	45.08	55.94	7.3	0.255	0.573	203.65	27.87	229.5
Rhizobium@100% + RDF	15-30	1.389	2.416	42.46	45.09	7.53	0.226	0.403	153.68	23.09	186.12
T_7 Neem cake @100% + RDF	0-15	1.18	2.15	45.13	58.09	7.28	0.257	0.601	210.59	28.07	230
	15-30	1.388	2.414	42.47	47.44	7.5	0.227	0.45	165.1	24.08	192.76
T_8 Neem cake @100% +	0-15	1.179	2.147	45.08	58.18	7.26	0.258	0.604	213.32	29.17	231.55
Rhizobium@50% + RDF	15-30	1.385	2.413	42.58	47.53	7.47	0.228	0.454	166.48	25.79	194.5
T_9 Neem cake @100% +	0-15	1.177	2.145	45.11	59.09	7.25	0.26	0.615	215.12	30.72	232.55
Rhizobium@100% + RDF	15-30	1.382	2.41	42.66	48.44	7.46	0.23	0.464	167.88	28.35	196.1
S.Em+z				0.26	0.093	0.06	0.005	0.004	1.13	0.38	1.04
				0.65	0.108	0.06	0.008	0.005	2.02	1.34	2.53
C.D.(P=				0.77	0.279	0.18	0.015	0.011	3.38	1.15	3.12
				1.95	0.322	0.19	0.024	0.016	6.06	4.01	7.57
F-test		NS	NS	NS	S	NS	S	S	S	S	S
		NS	NS	NS	S	NS	NS	S	S	S	S

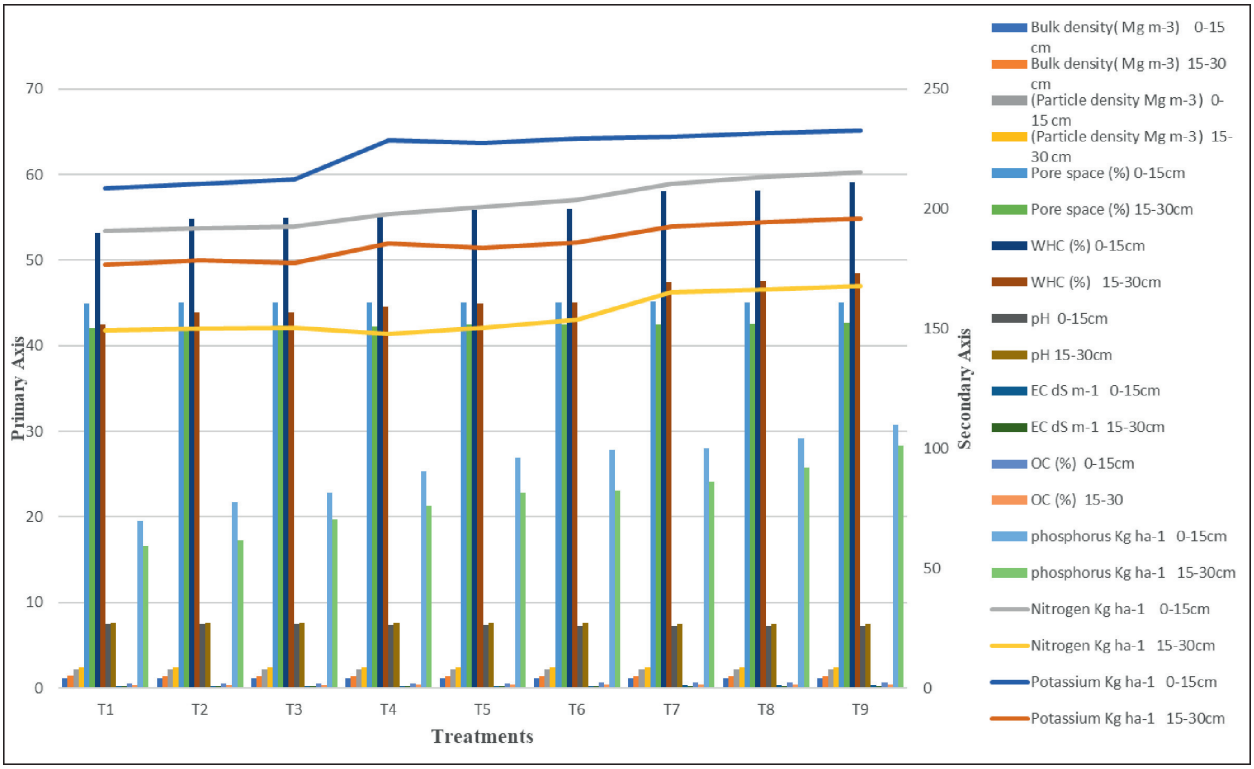

Fig. 1. Effect of organic and inorganic fertilizers on physico- chemical properties of soil

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. 232.55 kg ha^{-1} and 196.10 kg ha^{-1} respectively.

Conclusion

This study was that concluded that when Neem cake applied 100 % with 100 % *Rhizobium* and RDF was favorable to soil physical and chemical properties because its increase soil nutrient status as well as increased growth and yield attributes of cluster bean. It is concluded from the field trial that the use of Neem Cake and Biofertilizer improves the soil Physico-chemical properties with adequate BD, PD, pore space and water holding capacity. Neem Cake increases soil Microbial Activity and hence makes Soil more porus. Soil pH is neutral to alkaline as favourable electrical conductivity for cluster bean growth, Soil fertility with high organic content and low to medium of macronutrients viz. Nitrogen. Phosphorous and Potassium. Farmer's are required to maintain soil nutrient status, adopt suitable management practices and provide proper nutrition to the soil for cluster bean growth.

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