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ASSESSMENT OF PHYSICO-CHEMICAL PROPERTIES OF SOIL DUE TO APPLICATION OF NPK WITH NEEM CAKE ON OKRA (*ABELMOSCHUS ESCULENTUS* L.) VAR. ARKA ANAMIKA

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Abstract– The field experiment took place at the Sam Higginbottom University of Agriculture, Technology and Sciences' Soil Science Research Farm in Prayagraj during the Kharif season of 2021. Three different pairing were used in the investigation: three levels of NPK at 0%, 50%, and 100% ha^{-1}, and three levels of neem cake at 0%, 50%, and 100% ha^{-1}. The result obtained with treatment T_9 [100% NPK +100% neem cake] Maximum Bulk density 1.272 Mg m^{-3} in 0-15cm and 1.333 Mg m^{-3} in 15-30cm, Particle density 2.550 Mg m^{-3} in 0-15cm and 2.580 Mg m^{-3} in 15-30cm, % Pore space 50.11% in 0-15cm and 48.33% in 15-30cm, Water holding capacity (%) 58.32% in 0-15cm and 58.00% in 15-30cm, pH 7.53 in 0-15cm and 7.54 in 15-30cm, EC (dSm^{-1}) 0.341 in 0-15cm and 0.337 in 15-30cm, % Organic Carbon 0.425% in 0-15cm and 0.412% in 15-30cm, Available Nitrogen 279.38 kg ha^{-1} in 0-15cm and 273.28 kg ha^{-1} in 15-30cm, Available Phosphorus 16.86 kg ha^{-1} in 0-15cm and 16.15 kg ha^{-1} in 15-30cm and Available Potassium 179.87 kg ha^{-1} in 0-15cm and 175.0 kg ha^{-1} in 15-30cm. The use of Neem cake, as well as its blend with complete NPK, significantly improves the growth and overall production of Okra.

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) belongs to the Malvaceae family and has chromosome 2n=130. It is also known as lady's finger or bhindi, is one of the most important vegetable crops grown extensively throughout the country during summer and rainy seasons due to its high adaptability over a wide range of environmental conditions. Okra is one of the most affordable vegetables in India's tropical and subtropical regions. Okra is a popular tropical and subtropical vegetable grown all over the world. Okra is a semi-pollinated in nature and plays a vital role in meeting the need for vegetables in a place where they are scarce. Calcium, protein, oil, and carbs are among the nutritional components of okra, as are iron, magnesium, and phosphorus. The majority of okra is consumed in a cooked or processed form. Young fruits can be eaten uncooked, and the oil content is comparable to that of poultry eggs and soyabeans (Adesida and colleagues, 2019).

The benefit of employing inorganic fertilizer is that the nutrients are immediately available to the plants and the extract amount of a given nutrient can be determined prior to feeding the plants. Besides, the financial expenditure, continual cultivation of chemical fertilizer in the tropics is insufficient to maintain crop productivity. (Nnah *et al*., 2016). Neem cake is a natural manure that has no harmful effects on the soil, plants, or living organisms. It can be useddirectly by mixing with the soil or it can be blended with urea and otherorganic manure. By soaking neem cakes and leaves in oil, plant roots can be protected from nematodes and white ants. Neem cake is a botanical product that is

totally organic and contains 100 percent natural NPK and other micronutrients in organic form, which are essential for plant growth. Neem cake is completely organicand other micronutrients in organic form, essential for plant growth. Macronutrients content in neem cake such as Nitrogen (2.0-5.0%), Phosphorus (0.5-4.0%), Potassium (1.0-2.0%), Calcium (0.5-3.0%), Magnesium (0.3-1.0%) and Sulphur (0.2-3.0%) while micronutrients such as Zinc (15-60ppm), Copper (4-20ppm), Iron (500-1200ppm) and manganese (20-60ppm) found in it. Neem is compatible with soil microbes, promotes rhizosphere microflora, and provides stable oil structure, high water holding capacity, and aeration in the soil for improved root development because it is fully natural and organic. (Gupta, 2022)

MATERIALS AND METHODS

The methods employed and materials which are used for conducting the study pertaining to the present topic under field investigation are entitled "The impact of different level NPK and Neem cake on Physico-Chemical properties of soil and yield attributes of okra (*Abelmoschus esculentus* L.) *var*. Arka Anamika." in (SHUATS) Prayagraj, during the kharif season 2021 was 25°24'30" North latitude 81°51'10" East longitude and 98 m above mean sea level. The soil in the experimental area is classified as Inceptisol, and the soil in the experimental plots is alluvial in character. The soil texture (%sand, siltand clay) of the Departmental Research farm at depths of 0-15cm and 15-30cm. The soil texture was sandy loam, with 55% sand, 30 % silt and 15 % clay. The soil color (dry and wet method) sample was taken on depth 0-15cm and the soil color- yellowish brown was found at dry condition. At wet condition the soil color- brown was found and on depth 15-30cm the soil color- light yellowish brown was found at dry condition and at wet condition the soil color- yellowish brown was found. The trial used a randomised block design (RBD) with three replications and nine treatments, using varied levels of Neem Cake (0, 50, and 100 percent). Basal doses of nitrogen, phosphorus, and potassium are applied to the field where RDF was found (110:50:80 NPK kg ha^{-1}). The sources of NPK were Urea, SSP, MOP. Neem Cake were applied at their recommended dose 5 q ha^{-1}. The soil depth 0-15cm and 15-30cm both were taken for analysis of soil physico-chemical properties.

RESULTS AND DISCUSSION

Effects of various treatment combinations on soil physical properties

During the trail of field experiment, A perusal of data reveals the application of NPK and neem cake was observed that Bulk density ranged from 1.272 Mg m^{-3} to 1.281 Mg m^{-3} at 0-15cm soil depth and 1.322 Mg m^{-3} to 1.333 Mg m^{-3} at 15-30cm 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_2 and T_1) in both soil depth. Soil Particle density ranged from 2.55 Mg m^{-3} to 2.56 Mg m^{-3} in 0-15cm and 2.58 Mg m^{-3} to 2.52 Mg m^{-3} in 15-30cm soil depth. Neem cake impact on particle density positively means lowest particle density observed in T_9. Porosity ranged from 49.9% to 50.11% and Water holding capacity ranged from 51.86% to 58.32% in 0-15cm soil depth respectively, but when depth increase porosity and water holding capacity decreased means at 15-30cm soil depth porosity varied 48.6% to 48.33% and water holding capacity 51.64% to 58.00%. Similar results were also reported by Bhambhu *et al*., (2016).

Effects of various treatment combinations on soil chemical properties

The application of NPK and Neem cake significantly, affect the soil pH at 0-15cm and 15-30cm soil depth. Minimum soil pH was recorded under the treatment T_9 i.e., 100% NPK+% Neem cake (which was at par with T_8 and T_7) followed by T_6 (which was at par with T_5 and T_4) followed by T_3 (which was at par with T_2 and T_1). Increasing the rate of Neem cake increase organic carbon these organic carbon release organic acid and organic acid decease the soil pH. EC (dSm^{-1}) was influenced significantly it is ranged from 0.314 dSm^{-1} to 0.337 dSm^{-1}. Maximum EC was recorded into T_9 and Minimum in T_1, recorded into both soil depth. % Organic carbon maximum found in T_8 0.425% and 0.412% in 0-15cm and 15-30cm soil depth respectively (which was at par with 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_2 and T_1). The Available Nitrogen content in soil ranged from 248.79 kg ha^{-1} to 279.38 kg ha^{-1} at 0-15cm soil depth and 248.73 kg ha^{-1} to 273.28 kg ha^{-1} at 15-30cm soil depth. Maximum T_9 and minimum in T_1, recorded both soil depth. Available Phosphorus at 0-15cm soil depth, phosphorus levels ranged from 16.86 kg ha^{-1} to 14.20 kg ha^{-1} at 15-30cm soil

Table 1. Effect of NPK and Neem cake on Physico-chemical properties of post-harvest soil of Okra

Soil Parameters →	Bulk density ($Mg\ m^{-3}$)		Particle density ($Mg\ m^{-3}$)		% Pore space		WHC (%)		pH (1:2)		EC (dSm^{-1})		OC (%)		Nitrogen ($kg\ ha^{-1}$)		Phosphorus ($kg\ ha^{-1}$)		Potassium ($kg\ ha^{-1}$)	
Depths (cm) → / Treatments ↓	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
T_1	1.281	1.322	2.560	2.572	49.9	48.6	51.86	51.64	7.56	7.57	0.318	0.314	0.386	0.373	248.79	248.73	14.20	13.14	160.0	158.2
T_2	1.280	1.324	2.558	2.573	49.96	48.5	52.81	52.61	7.56	7.56	0.320	0.319	0.389	0.378	251.76	251.42	14.55	13.31	162.1	160.5
T_3	1.279	1.326	2.556	2.574	50	48.46	53.25	53.07	7.56	7.56	0.322	0.321	0.391	0.382	253.58	252.12	14.83	13.94	164.0	162.2
T_4	1.278	1.327	2.555	2.575	50.07	48.45	53.75	53.71	7.55	7.56	0.327	0.325	0.394	0.386	255.71	254.14	15.21	14.47	166.6	163.2
T_5	1.276	1.329	2.554	2.576	50.03	48.40	54.51	54.34	7.55	7.55	0.330	0.327	0.406	0.389	259.36	257.66	15.48	14.56	168.1	165.9
T_6	1.275	1.330	2.553	2.577	50.05	48.38	55.24	55.07	7.55	7.55	0.333	0.329	0.412	0.394	262.29	261.57	15.91	14.90	170.8	169.0
T_7	1.274	1.331	2.552	2.578	50.07	48.37	55.95	55.84	7.54	7.55	0.337	0.332	0.417	0.397	268.12	266.79	16.13	15.07	172.5	170.9
T_8	1.273	1.332	2.551	2.579	50.09	48.35	57.02	56.88	7.54	7.54	0.339	0.335	0.421	0.408	270.41	269.42	16.40	15.13	176.0	173.7
T_9	1.272	1.333	2.550	2.580	50.11	48.33	58.32	58.00	7.53	7.54	0.341	0.337	0.425	0.412	279.38	273.28	16.86	16.15	179.8	175.0
F-Test	NS	NS	NS	NS	S	S	S	S	NS	NS	S	S	S	S	S	S	S	S	S	S
S. Em. (±)	-	-	-	-	0.33	0.25	0.17	0.18	-	-	0.002	0.006	0.007	0.008	2.01	1.28	0.19	0.21	1.18	0.84
C.D. (P=0.05)	-	-	-	-	0.99	0.78	0.52	0.54	-	-	0.007	0.019	0.023	0.025	6.06	3.38	0.57	0.63	2.52	1.80

depth.13.14 kg ha^{-1} to 16.15 kg ha^{-1} and 13.14 kg ha^{-1} T_9 had the most accessible phosphorus in both soil depths, owing to increased soil organic carbon, which boosted the activity of phosphorus solubilizing microorganism in the soil. The maximum Available Potassium in 0-15cm and 15-30cm soil depth i.e., 179.8 kg ha^{-1} and 175.0 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) followed by T_3 (which was at par with T_2 and T_1) in both soil depth by Neem cake and NPK application availability of potassium (kg ha^{-1}) slightly increased. Similar results were also reported by Akhila *et al.*, (2019), Bhambhu *et al*., (2016), Solangi *et al*., (2015), and Kumar *et al.,* (2015).

CONCLUSION

The effect of different levels in the experiment was concluded based on the trail. Treatment T_9(100% NPK and 100% Neem cake) was shown to be the best in terms of Physico-Chemical parameters of soil such as Bulk density, Particle density, % pore space, Water holding capacity, pH, EC, % Organic carbon, Available Nitrogen, Available Phosphorus, Available Potassium. Fertilizer requirements in okra are critical for early development and overall fruit yield generation. Crop productivity can be improved by combining organic and inorganic fertilizers, and using Neem Cake with fertilizers enhances nutrient absorption, which accelerates cell division, cell elongation, and hence plant metabolic activity. Farmers are required to maintain soil nutrient status, adopt suitable management practices and provide nutrition to the soil for Okra growth and for profitable production of okra and good for soil health.

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