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Effect of NPK and Neem Cake on Physical and Chemical Properties of Soil in Cluster Bean (*Cyamopsis tetragonoloba* L.) Cv. Pusa Navbahar

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A B S T R A C T

A field experiment which was carried out at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences-Deemed to be University, Allahabad during *kharif* season, 2015. The experiment was conducted in factorial randomized block design with three level of N:P:K [control (L_0), $N_{10}P_{20}K_{20}$ (L_1) and $N_{20}P_{40}K_{40}$ (L_2)] and three levels of Neem cake [control (N_0), @ 2.5 q ha^{-1} (N_1) and @ 5.0 q ha^{-1} (N_2)]. The present investigation revealed that among fertility levels application of $N_{20}P_{40}K_{40}$ (L_2) recorded the lowest pH (6.93) and bulk density (1.06 Mg m^{-3}) and highest in pore space, organic carbon, available nitrogen, available phosphorus and available potassium (49.67%, 0.75%, 322.39 kg ha^{-1}, 31.88 kg ha^{-1} and 201.64 kg ha^{-1}, respectively). Among different levels of neem cake, application of 5.0 q ha^{-1} (N_2) neem cake recorded the lowest pH (6.97) and bulk density (1.07 Mg m^{-3}) and highest in pore space, organic carbon, available nitrogen, available phosphorus and available potassium (49.01%, 0.71%, 311.91 kg ha^{-1}, 29.19 kg ha^{-1} and 183.37 kg ha^{-1}, respectively).

Introduction

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub] popularly referred to as "Guar" is a crucial legume crop mainly grown in arid and semi-regions of Rajasthan under rainfed condition during *kharif* season. It is very hardy and drought tolerant crop. Its deep penetrating roots enable the plant to utilize available moisture more efficiently and thus offer better scope for rainfed cropping. The crop also tolerates moderate salinity and

alkalinity conditions. In legume crops there is no other crop so hardy and drought tolerant as cluster bean (Kherawat *et al*., 2013). Due to high degree of drought and salinity tolerance, guar could be a valuable alternative crop for the exploitation of the semi-arid environment, where high temperature, poor erratic rainfall and elevated soil salt content restrict the cultivation of other crops. In India, it is grown in an area of 4.10 million hectares with a production of 1.85 million tonnes and productivity of 451 kg/ha and is annually contributing to around 80% share to the world's total production (Agricultural Statistics at a Glance 2018).

Cluster bean being a legume crop which has the capacity to fix atmospheric nitrogen by its effective root nodules, the major part of nitrogen is met up through *rhizobium* impending in the root nodules hence; crop does not require supernumerary nitrogen for its initial growth and development phase. Fertilizer nitrogen, apart from increasing the content of nitrate in soil that leads to its leaching (Porter *et al.*, 1996), results in changes in soil pH and many other soil properties (Brady and Weil , 2002). An application of phosphorus exerts an influences symbiotic nitrogen fixation, yield and quality of cluster pods. Phosphorus has a positive and significant sway on nodulation and crop yield and also increasing the activity of *rhizobium*. Phosphorus also meliorates the quality of cluster bean grain.

Neem cake acts as a nitrogen inhibitor and supplies the available nitrogen in the soil for a long time (Katyayan, 2012). The composition of neem cake is 5.2% N, 1.0% P_2O_5 and 1.4% K_2O. Neem cake functions as dual performance of both fertilizer and pesticide, acts as a soil enriches, provides essential macro nutrients for all plant, pare down the growth of soil pest and bacteria, redound to the yield of plants for long period, eco-friendly and bio degradable and splendiferous soil conditioner. Application of neem soil conditioner in plantation crops that helps to increase its fertility (Lokanadhan *et al.*, 2012). Neem cake also acts as a nematicide.

Materials and Methods

An experiment was conducted at Dept. of Soil Science Research Farm, of Sam Higginbottom University of Agriculture, Technology and Sciences (Deemed-to-be-University), Allahabad during *kharif* season of 2015 on alluvial soil, to evaluate the effect of NPK and neem cake on growth, yield attributing characters and yield of cluster bean**.** Geographically, the experimental site is situated on the south of Allahabad on the right side of the river Yamuna on the South of Rewa Road at a distance of about 6 km from Allahabad city. It is situated at $25^0 57^{"}$ N latitude, $81^0 59^{"}$ E longitude and at the altitude of 98 meter above the sea level. The area of Allahabad district comes under subtropical belt in the South East of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46^0C–48^0C and seldom falls as low as 4^0C– 5^0C in the winter. The relative humidity ranged between 20 to 94%. The average rainfall in this area is around 1100 mm annually.

The soil of the experimental field was sandy laom in texture, poor in organic carbon (0.47%), low in available nitrogen (235.65 kg ha^{-1}) and medium in phosphorus (20.92 kg ha^{-1}) and potassium (126.82 kg ha^{-1}) (Table 1). The experiment consisted of three levels of fertility [control (L_0), $N_{10}P_{20}K_{20}$ (L_1) and $N_{20}P_{40}K_{40}$ (L_2)] and three levels of neem cake [control (N_0), @ 2.5 q ha^{-1} (N_1) and @ 5.0 q ha^{-1} (N_2)]. The total 9 treatment combinations were tested in factorial randomized block design with three replications. Cluster bean variety 'Pusa Navbahar' was sown at 30cm x

15 cm row and plant to plant spacing on 22th July 2015 with a seed rate of 20 kg ha^{-1}. Fertilizers were applied as per treatment through diammonium phosphate (DAP) containing 46% P_2O_5 and 18% N, urea containing 46% N, MOP containing 60% K_2O and Neem Cake at the time of sowing as per treatment.

Results and Discussion

Effect of fertility levels

Soil physical properties like bulk density (1.06 Mg m^{-3}) and particle density (2.31 Mg m^{-3}) were in the lowest order with the application of $N_{20}P_{40}K_{40}$ and $N_0P_0K_0$, respectively.

The maximum soil pore space was recorded 49.67% with the application of $N_{10}P_{20}K_{20}$ (N_1) and minimum soil pore space was recorded 46.64% with the application of $N_0P_0K_0$ (N_0). Soil chemical properties like pH (6.93) and EC (0.19 dSm^{-1}) were in the lowest order with the application of $N_{20}P_{40}K_{40}$ and control, respectively as compared to other fertilizer treatments.

Increasing dose of NPK slightly decrease pH of the post-harvest soil. The decrease in pH might be due to higher growth of crops as respiration is more. Respiration evolves carbon dioxide and reacts with water to form carbonic acid in soil.

Application of fertilizers @ $N_{20}P_{40}K_{40}$ to cluster bean recorded significantly higher organic carbon (0.75%), available nitrogen (322.39 kg ha^{-1}), available phosphorus (31.88 kg ha^{-1}) and available potassium (201.64 kg ha^{-1}) as compared to control (0.58 %, 287.70 kg ha^{-1}, 23.19 kg ha^{-1} and 143.45 kg ha^{-1}, respectively) (Table 2). Similar findings were recorded by Kumar *et al.,* (2008) and Takase *et al*., (2011).

Effect of neem cake

Soil physical properties like bulk density (1.08 Mg m^{-3}) and particle density (2.42 Mg m^{-3}) were in the lowest order with the application of neem cake @ 5.0 q ha^{-1} (N_2) and control (N_0), respectively. The maximum soil pore space was recorded 49.01% with the application of neem cake @ 5.0 q ha^{-1} (N_2) and minimum soil pore space was recorded 47.99% with the application of neem cake @ 2.5 q ha^{-1} (N_1).

Soil chemical properties like pH (6.97) and EC (0.21 dSm^{-1}) were in the lowest order with the application of neem cake @ 5 kg ha^{-1} and control, respectively as compared to other treatments. Application of neem cake @ 5.0 q ha^{-1} to cluster bean recorded significantly higher organic carbon (0.71%), available phosphorus (29.18 kg ha^{-1}) and available potassium (183.37 kg ha^{-1}) as compared to control (0.64%, 26.34 kg ha^{-1} and 165.55 kg ha^{-1}, respectively) while available nitrogen higher under the treatment N_2 (@ 5.0 q ha^{-1}) (311.97 kg ha^{-1}) which is at par with the treatment N_1 (@ 2.5 q ha^{-1}) (308.42 kg ha^{-1}) (Table 3).

The interaction effect of NPK and neem cake on phosphorus indicated significantly superior performance of $N_{20}P_{40}K_{40}$ and neem cake @ 5.0 q ha^{-1} (33.68 kg ha^{-1}) as compared to remaining treatments combinations and highest organic carbon recorded under the treatment combination of T_8 – $N_{20}P_{40}K_{40}$ and neem cake @ 5.0 q ha^{-1} (0.78%) which is at par with the treatment combination of T_7 – $N_{20}P_{40}K_{40}$ and neem cake @ 2.5 q ha^{-1} (0.75%) while the nitrogen and potassium highest recorded under the treatment T_8 – $N_{20}P_{40}K_{40}$ and neem cake @ 5.0 q ha^{-1} (326.93 kg ha^{-1} and 205.83 kg ha^{-1}, respectively) which is at par with the treatment combination of T_6 – $N_{20}P_{40}K_{40}$ and neem cake @ 0.0 q ha^{-1} (319.60 kg ha^{-1} and

197.27 kg ha^{-1}, respectively) and T_7 – $N_{20}P_{40}K_{40}$ and neem cake @ 2.5 q ha^{-1} (320.65 kg ha^{-1} and 201.83 kg ha^{-1}, respectively) (Table 4). The combined use of neem cake, that in a form of organic manure, and a inorganic fertilizer will increase nutrient use efficiency and reduce environmental stress (Bationo, 2008).

Table.1 Chemical properties of soil

Particulars	Results	Method employed
Soil pH (1:2)	7.6	Digital pH meter (Jackson, 1958)
Soil EC (dSm^{-1})	0.60	Digital EC meter (Wilcox, 1950)
Organic Carbon (%)	0.47	Rapid titrations method (Walkley and Black, 1947)
Available Nitrogen (kg ha^{-1})	235.65	Kjeldhal distillation Method (Subbaih and Asija, 1956)
Available Phosphorus (kg ha^{-1})	20.92	Colorimetric method (Olsen *et al.,* 1954**)**
Available Potassium (kg ha^{-1})	126.82	Flame photometric method (Toth and Price, 1949)

Table.2 Effect of NPK and Neem cake on soil physical properties

Treatments	Physical properties		
	Bulk Density ($Mg\ m^{-3}$)	**Particle Density ($Mg\ m^{-3}$)**	**Pore Space (%)**
Fertility levels (NPK)			
L_0 – Control	1.11	2.31	46.64
L_1 - $N_{10}P_{20}K_{20}$	1.08	2.50	49.67
L_2 - $N_{20}P_{40}K_{40}$	1.06	2.61	49.01
S.Ed	0.02	0.12	1.10
CD (P = 0.05)	0.05	0.25	2.34
Neem Cake			
N_0 – Control	1.10	2.42	48.32
N_1- 2.5 q ha^{-1}	1.09	2.48	47.99
N_2 - 5.0 q ha^{-1}	1.08	2.51	49.01
S.Ed	0.02	0.12	1.10
CD (P = 0.05)	0.05	0.25	2.34

Table.3 Effect of NPK and Neem cake on soil chemical properties

Treatments	pH	EC (dS m^{-1})	Organic carbon (%)	Available nitrogen (kg ha^{-1})	Available Phosphorus (kg ha^{-1})	Available Potassium (kg ha^{-1})
Fertility levels (NPK)						
L_0 – Control	7.12	0.19	0.58	287.70	23.20	143.45
L_1 - $N_{10}P_{20}K_{20}$	6.98	0.22	0.70	309.41	28.22	177.14
L_2 - $N_{20}P_{40}K_{40}$	6.93	0.23	0.75	322.39	31.88	201.64
S.Ed	0.04	0.003	0.01	4.13	0.31	3.61
CD (P = 0.05)	0.09	0.006	0.02	8.83	0.65	7.49
Neem Cake						
N_0 – Control	7.06	0.20	0.64	299.17	26.34	165.55
N_1- 2.5 q ha^{-1}	7.00	0.21	0.67	308.42	27.76	173.31
N_2 - 5.0 q ha^{-1}	6.98	0.22	0.71	311.91	29.19	183.37
S.Ed	0.04	0.003	0.01	4.13	0.31	3.61
CD (P = 0.05)	0.09	0.006	0.02	8.83	0.65	7.49

Table.4 Interactive effect of NPK and Neem Cake on Organic carbon, available nitrogen, phosphorus and potassium

Treatments	Organic carbon (%)	Available nitrogen (kg ha^{-1})	Available Phosphorus (kg ha^{-1})	Available Potassium (kg ha^{-1})
T_0 - L_0N_0 (control)	0.54	274.21	21.70	130.98
T_1 - L_0N_1 (control + neem cake @ 2.5 q ha^{-1})	0.58	293.40	22.90	145.95
T_2 - L_0N_2 (control + neem cake @ 5.0 q ha^{-1})	0.64	295.50	25.10	153.43
T_3 - L_1N_0 ($N_{10}P_{20}K_{20}$ + control)	0.67	303.71	26.94	168.40
T_4 - L_1N_1 ($N_{10}P_{20}K_{20}$ + neem cake @ 2.5 q ha^{-1})	0.69	311.22	28.81	172.14
T_5 - L_1N_2 ($N_{10}P_{20}K_{20}$ + neem cake @ 5.0 q ha^{-1})	0.73	313.31	28.89	190.86
T_6 - L_2N_0 ($N_{20}P_{40}K_{40}$ + control)	0.73	319.60	30.38	197.27
T_7 - L_2N_1 ($N_{20}P_{40}K_{40}$ + neem cake @ 2.5 q ha^{-1})	0.75	320.65	31.58	201.83
T_8 - L_2N_2 ($N_{20}P_{40}K_{40}$ + neem cake @ 5.0 q ha^{-1})	0.78	326.93	33.68	205.83
S.Ed	0.02	7.15	0.31	6.25
CD (P = 0.05)	0.03	9.27	0.73	12.97

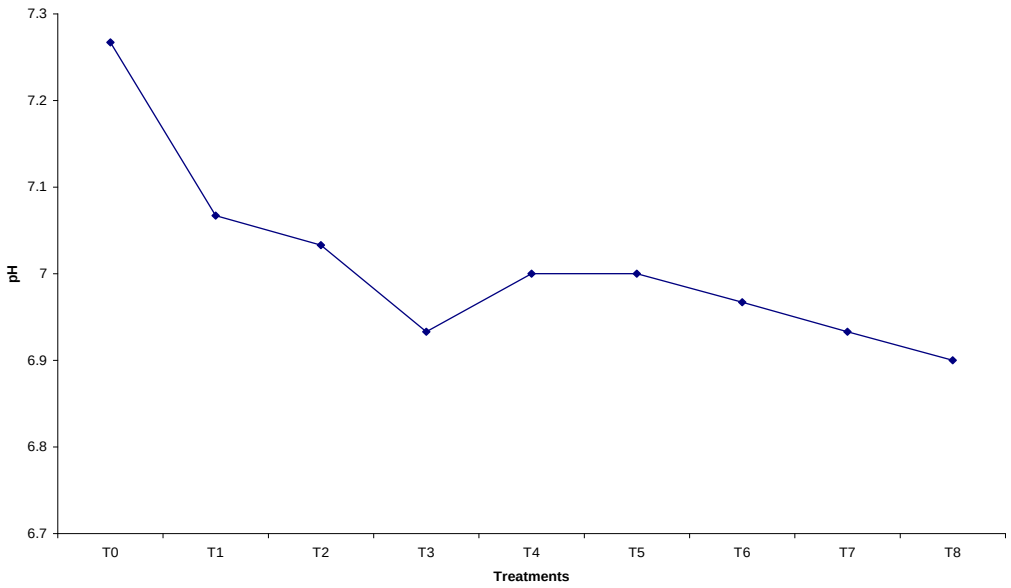

Fig.1 Interaction effect of NPK and Neem cake on soil pH after crop harvest

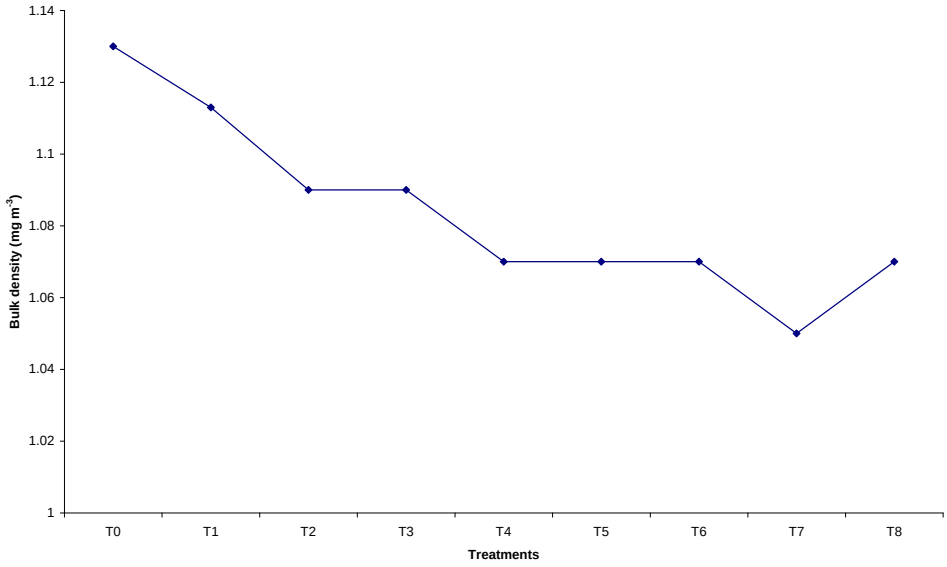

Fig.2 Interaction effect of NPK and Neem cake on Bulk density (Mg m^{-3}) of soil after crop harvest

The results obtained in this experiment indicated that $N_{20}P_{40}K_{40}$ with neem cake @ 5.0 q ha^{-1} improves the soil physical and chemical properties of soil than other treatments. So, physical and chemical properties of soil can be achieved by judicious application of NPK and neem cake.

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References

Agricultural Statistics at a Glance 2018. Directorate of Economics and Statistics. Area, production and yield along with coverage under irrigation, pp-131.

Bationo, A. 2008. Integrated soil fertility management options for agricultural intensification in the Sudano-Sahelian zone of West Africa. *Academic Science Publishers*, Nairobi, Kenya, p. 240.

Brady, A.C. and Weil, R.R. 2002. The Nature and Properties of Soils. 13th Edn. Prentice Hall, New jersey, USA.

Jackson, M.L. 1958. Soil chemical analysis, Second edition Indian Reprint, prentice hall of India, New Delhi. p. 498.

Katyayan, A. 2012. Manures, fertilizers and biofertilizers, Fundamentals of agriculture. *Kushal publications and distributors Varanasi*, 1: 231-254.

Kherawat, B.S., Agarwal, M.L., Yadav, H.K. and Kumar, S. 2013. Effect of applied potassium and manganese on yield and uptake of nutrients by cluster bean (*Cyamopsis tetragonoloba*). *Journal of Agricultural Physics*, 13(1):22-26.

Kumar, J. 2008. Physico-chemical properties of the soil, under the two forest plantation stands around Varanasi (U.P.) India.

Lokanadhan, S., Muthukrishnan, P. and Jeyaraman, S. 2012. Neem products and their agricultural applications, 5:72-76.

Olsen, S.R., Cole, C.V., Watanable, F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. *Circular, United States Department of Agriculture*, p. 932.

Porter, L.K., Follet, R.F. and Halvorson, A.D. 1996. Fertilizer nitrogen recovery in a no-till wheat-sorghum fallow-wheat sequence. *Agronomy Journal*, 88: 750-757.

Subbaih, B.V. and Asija, C.L. 1956. A rapid procedure for the estimation of available nitrogen in soils. *Current sciences*, 25:256-260.

Takase, M., Sam-Amoah, Owusu, L. K. and Sekyere, J. D. 2011. The Effects of Four Sources of Irrigation Water on Soil Chemical and Physical Properties. *Asian Journal of Plant Sciences* 10(1): 92-96

Toth, S.J. and Prince, A.L. 1949. Estimation of cation exchange capacity and exchangeable Ca, K, and Na content of soil by flame photometer technique. *Soil Science*, 67:439-445.

Walkley, A. and Black, I.A. 1947. Critical examination of rapid method for determining organic carbon in soils, effect of variance in digestion conditions and of inorganic soil constituents. *Soil science*, p. 632:251.

Wilcox, L.V. 1950. Electrical conductivity, *American Water Works Association*, 42:775-776.

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