Integrated Nutrient Management in Green gram (*Vigna radiata* L.) for Enhancing Soil Health

ABSTRACT

Integrated nutrient management (INM) is a holistic approach that involves the application of organic and inorganic fertilizers to improve soil health and crop productivity. The research study was conducted to demonstrate the effective use of INM on soil health in Green gram. We used a randomized block design (RBD) with four levels of poultry manure @ 0, 50, 75 and 100% ha^{-1}, four levels of nitrogen, phosphorous and potassium@ 0, 50, 75 and 100% ha^{-1} and rhizobium seed treatment. The revealed that treatment T_9 ($N_{20}P_{40}K_{40}$ kg ha^{-1} + PM @ 5 t ha^{-1} and *Rhi* @ 200g 10 kg^{-1} Seed) resulted in a slight change in soil pH 6.82, electrical conductivity (EC) 0.198 dS m^{-1}. In post-harvest soil of fertilizers observations showed significant increase in pore space 49.20 %, water holding capacity 47.59 %, organic carbon 0.49 %, and available N 334.23 kg ha^{-1}, P 34.58 kg ha^{-1}, K 202.83 kg ha^{-1}. The increase in NPK was found to be significant ($P<0.05$) among other treatments in Green gram cultivation and soil quality improvement. The application of N P K with poultry manure was a magnificent source of fertilization.

Keywords: *Green gram, INM, Poultry manures, Rhizobium and Soil heath parameters.*

Introduction:

Soil health refers to the capacity of soil to function. Healthy soil is vital for farm profitability, sustainable crop production, nutrient and water cycling, and climate regulation. Soil health assessment is designed to evaluate soil quality in supporting land productivity, as well as management sustainability in the context of soil functions. Several soil properties have been identified as indicators of soil health. Scientists have been conducting extensive studies on measuring soil health in research plots under various soil health management treatments.

Green gram is popularly known as “Moong Dal”. “It is widely cultivated throughout Asia, including India. Pulses are the main source of protein particularly for vegetarians and contribute about 14 % of the total protein of average Indian diet”. (Yadav et. Al., 2020) “The per capita availability of pulses in India has been continuously decreasing which is 32.52 g day^{-1} against the minimum requirement of 80 g day^{-1} per capita prescribed by Indian Council of Medical Research (ICMR). Therefore, agricultural scientists must to evolve strategy to

increase production of pulses to meet the protein requirements of increasing population of the country". (Khangaroat et. Al., 2020)

"Poultry manure is relatively resistant to microbial degradation. However, it is essential for establishing and maintaining the optimum soil physical condition for plant growth. It is a good source of N for sustainable crop production, but its availability remains an important issue due to its bulky nature, while inorganic fertilizer is no longer affordable to poor farmers due to its high cost**.** Poultry Manure contains high amount of nutrients especially nitrogen that are easily taken up by plants for fast growth. These manures provide a source of all necessary macro and micro-nutrients in available forms, thereby improving the physical and biological properties of the soil" **Muhammad *et al.*, (2020).**

Methodology:

The detailed treatment combination was shown in table.1 and field experiment has been conducted during the Zaid season 2022 central research farm of department of soil science and agricultural chemistry, Naini Agricultural Institute, Prayagraj (Allahabad) 211 007, (U.P.), located at 25°24'30'' North latitude 81°51'10'' East longitude and 98m above mean sea level. Representing the Agro-ecological sub region [North Alluvium plain zone (0-1% slop)] and Agro-climatic zone (Upper gangetic plain region). "Argo climatically, Prayagraj district represents the subtropical belt of the South East of (U.P.), and is endowed with extremely hot summer and fairly cold winter. The maximum temperature of the location ranges between 46℃ and seldom falls below 4℃-5℃. The relative humidity ranges between 20-94%. The average rainfall of this area is around 1100mm annually". (Yadav et. Al., 2020) The soil samples will be randomly collected from one site in the experiment plot prior to tillage operation from a depth of 0-15 cm. The volume of the soil sample will be reduced by conning and quartering the composites soil sample will be air dried and passed through a 2 mm sieve by way of preparing the sample for physical and chemical analyses. Soil physical analysis is done after post-harvest operation. After 60 days crop harvest soil sample was collected from field. Physical properties textural class **(Bouyoucos, 1927),** soil colour **(Albert, 1971),** bulk density Mg m^{-3}, particle density Mg m^{-3}, pore space %, water holding capacity % **(Muthuvel *et al.*, 1992)** were analysed. Soil chemical analysis is done after post-harvest operation were following, pH **(Jackson, 1958)**, EC dS m^{-1} **(Wilcox, 1950)**, organic carbon % **(Walkley and Black, 1947)**, available N kg ha^{-1} **(Subbaih and Asija, 1956)**, P kg ha^{-1} **(Olsen *et al.*, 1954)**, K kg ha^{-1} **(Toth and Price, 1949).**

Result and Discussion:

The detailed significant results was shown in table.2 were composition of NPK and poultry manure have significant increasement on the soil health parameters. The increasement of pore space %, water holding capacity %, organic carbon (%), available nitrogen kg ha^{-1}, phosphorus kg ha^{-1} and potassium kg ha^{-1} with the improvement of soil parameters, table 2. revealed that application of different levels of NPK and poultry manure have significant roll, on soil health. In treatment T_1 lowest data observed, pore space 42.41%, water holding capacity 40.80%, organic carbon 0.37%, nitrogen 295.50 kg ha^{-1}, phosphorus 23.60 kg ha^{-1}, potassium 130.11 kg ha^{-1} and T_9 shows the highest pore space 49.20%, water holding capacity 47.59%, organic carbon 0.49%, nitrogen 334.23 kg ha^{-1}, phosphorus 34.58 kg ha^{-1}, potassium 202.83 kg ha^{-1}. As depicted in fig. 1. and fig. 2. the treatment T_9 is the maximum potential of soil health that improve the soil parameters followed to T_8. It eventually shows that the N P K and poultry manure application is the beneficial effect on the soil, that maintained the soil parameters. T_1 shows that lowest effect on the soil parameters.

Conclusion

In conclusion, the use of INM practices such as application of organic manures, use of chemical fertilizers and use of biofertilizers can improve the soil health parameters in green gram and increase crop productivity. The treatment combination T_9 was concluded from trial that the various level of N P K, poultry manure and rhizobium is best for significant increase of soil physical and chemical properties. These practices can also help in the sustainable management of soil fertility and conservation of soil resources.

Reference

Bouyoucos, G.J. (1927) The Hydrometer as a New Method for the Mechanical Analysis of Soils. Soil Science, 23, 343-353.

Jackson, M. L. (1958) Soil Chemical Analysis. Prentice-Hall Inc., Englewood Cliffs, NJ, 498 p.

Muhammad, M., Kutawa, A. B. and Adamu, M. (2020) Influence of NPK Fertilizer and Poultry Manure on the Growth of Okra (Abelmoschus esculentus L. Moench) in

Northern Sudan Savanna Region of Nigeria. International journal of Horticulture, *Agriculture and Food science (IJHAF)*, **4 (6).**

Albert, M. H. (1954) Munsell Soil Color Charts. Munsell Color Company Inc., Baltimore.

Muthuvel, P., Udayasoorian, C., Natesan, R. and Ramaswami, P. R. (1992) *Introduction to Soil Analysis*, Tamil Nadu Agricultural University, Coimbatore.

Olsen, S. R., Cole, C. V., Watanabe, F. S. and Dean, L. A. (1954) Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA Circular 939. US Government Printing Office, Washington DC.

Pathak, K., Kalita, M. K., Barman, U., Hazarika, B. N. and Saha, N. N. (2001) Response of summer green gram (*Vigna radiata*) to inoculation and nitrogen levels in Barak valley zone of Assam. *Annals of Agri. Res.*, **22**: 123-124.

Sipai, A. H., Jat, J. R. and Rathore, B. S. (2016) Effect of Phosphorus, Sulphur and Biofertilizer on Growth, Yield and Nodulation in Mungbean on Loamy Sand Soils of Kutch. *A Scitechnol Journal*, **51 (1)**: 51-56.

Subbiah, B. V. and Asija, G. L. (1956) A Rapid Procedure for the Estimation of Available Nitrogen in Soils. *Current Science*, **25**: 259-260.

Toth, S. J. and Prince, A. L. (1949) Estimation of cation exchange capacity and exchangeable calcium, potassium, and sodium contents of soils by flame photometer techniques. *Soil Sci.*, **67**: 439-445.

Walkley, A. and Black, I. A. (1934) An examination of Degtjareff method for determining soil organic matter, and proposed modification of the chromic acid tritation method. *Soil Science*, **37**: 29-38.

Wilcox, R. R. (1950) STDs: Definition. A Textbook of STDs, 11.

Abhishek Singh Yadav, Tarence Thomas and Arun Alfred David. (2020) Effect of different Organic Manures on Yield and Physico-chemical Properties of Soil by Kharif Maize (Zea mays L.) on Eastern Plain Zone of Uttar Pradesh of Prayagraj Region. Int.J.Curr.Microbiol.App.Sci (2020) 9(9): 634-640

Manvender Singh Khangaroat, Tarence Thomas and Arun Alfred David. Effect of different level of NPK and biochar on soil physico - chemical properties, yield and attributes of green

gram (Vigna radiata L.) Var. – RMG 975 (Keshwanand Mung 1). International Journal of Chemical Studies 2020; 8(5): 1302-1307

Table 1. Treatment combination for study to enhance soil parameters in green gram var. Samrat

S. No.	Treatment combination	Symbol
T_1	**Absolute Control,**	$L_1P_1R_1$
T_2	**($N_0P_0K_0$ kg ha^{-1} + PM @ 2.5 t ha^{-1} and *Rhi* @ 200g 10kg^{-1} Seed),**	$L_1P_2R_2$
T_3	**($N_0P_0K_0$ kg ha^{-1}+ PM @ 5 t ha^{-1} and *Rhi* @ 200g 10 kg^{-1} Seed),**	$L_1P_3R_1$
T_4	**($N_{10}P_{20}K_{20}$ kg ha^{-1} + PM $_0$ and *Rhi* @ 200g 10 kg^{-1} Seed),**	$L_2P_1R_2$
T_5	**($N_{10}P_{20}K_{20}$ Kg ha^{-1} + PM @ 2.5 t ha^{-1} and *Rhi* @ 200g 10 kg^{-1} Seed),**	$L_2P_2R_2$
T_6	**($N_{15}P_{30}K_{30}$ kg ha^{-1} + PM @ 5 t ha^{-1} and *Rhi* @ 200g 10 kg^{-1} Seed),**	$L_3P_3R_2$
T_7	**($N_{15}P_{30}K_{30}$ kg ha^{-1} + PM $_0$ and *Rhi* @ 200g 10 kg^{-1} Seed),**	$L_3P_1R_2$
T_8	**($N_{20}P_{40}K_{40}$ kg ha^{-1} + PM @ 2.5 t ha^{-1} and *Rhi* @ 200g 10 kg^{-1} Seed),**	$L_4P_2R_2$
T_9	**($N_{20}P_{40}K_{40}$ kg ha^{-1} + PM @ 5 t ha^{-1} and *Rhi* @ 200g 10 kg^{-1} Seed).**	$L_4P_3R_2$

Treatments	Pore space (%)	Water holding capacity (%)	Organic Carbon (%)	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})
T_1	42.41	40.80	0.37	295.50	23.60	130.11
T_2	43.73	40.42	0.41	303.83	25.59	149.30
T_3	44.00	42.44	0.44	309.88	26.19	154.43
T_4	45.91	43.45	0.42	313.31	27.79	156.27
T_5	46.65	44.35	0.45	314.32	28.81	167.40
T_6	45.00	46.09	0.47	319.10	30.38	172.14
T_7	46.60	45.00	0.45	320.65	31.27	183.73
T_8	48.60	46.27	0.47	326..98	33.68	197.27
T_9	49.20	47.59	0.49	334.23	34.58	202.83

Table 2. Significant effect of different levels of NPK, poultry manure and rhizobium on soil health parameters