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Impact of integrated nutrient management on soil properties, growth and yield attributes of green gram (*Vigna radiata* L.) var. MH-421

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Abstract
An experiment was conducted on "Impact of Integrated Nutrient Management on Soil Physico-Chemical properties, Growth and Yield attributes of Green gram (*Vigna radiata* L.) var. MH-421" at research farm of soil science and agricultural chemistry, Sam Higginbottom university of agriculture, technology and sciences, Prayagraj, during the *Zaid* season of 2021. In the present investigation experiment 9 treatments T_1 (Farmers practice inorganic fertiliser [RDF: N. P. K.]), T_2 (RDF @ 100% + FYM @ 50%), T_3 (RDF @ 100% + FYM @ 100%), T_4 (RDF @ 100%+ POULTRY MANURE @ 50%), T_5 (RDF @ 100%+ POULTRY MANURE @ 100%), T_6 (RDF @ 100%+ NEEM CAKE @ 50%), T_7 (RDF @ 100%+ NEEM CAKE @ 50%), T_8 (RDF @ 100%+ CROP RESIDUE @ 50%) and T_9 (RDF @ 100% + CROP RESIDUE @ 100%), were laid out in randomized block design (RBD) with three replications. Green gram was taken for study and the pre sowing soil sample analysis and soil is sandy loam in texture, medium to high nitrogen with deficiency of micro nutrients. The results revealed that the Yield (grain and biological yield) and their attributing characteristics of green gram respond significantly with the different treatment combination. The highest grain (11.19 q ha^{-1}) and highest C:B ratio was (1:1:60) was obtained in T_9 - (RDF @ 100% + CROP RESIDUE @ 100%). The treatment combination T_9 - (RDF @ 100% + CROP RESIDUE @ 100%) gave the best result in terms of yield and their attributing characteristics.

Keywords: Soil parameters, green gram, yield attributes, grain, biological yield, nitrogen, micronutrient, neem cake etc.

Introduction

The most important states growing pulses are Madhya Pradesh, Uttar Pradesh, Maharashtra, Andhra Pradesh, Karnataka and Bihar which together account for 80% of total production. The decreasing per capita availability of pulses from 69 g in 1961 to 37 g in 2011 in the country has been a serious concern. To alleviate protein energy malnutrition, a minimum of 50g pulses $capita^{-1}day^{-1}$ should be available in addition to other sources of protein such as cereals, milk, meat and eggs. At least 23.88 million tonnes of pulses are required by 2015 which is expected to touch 29.30 million tonnes by 2020 (Kumar and Muthukrishnan 2015) [13].

Pulses enrich the soil fertility by fixing atmospheric nitrogen in the root nodules and improve the soil structure. The tap root system open the soil into deeper strata and heavy leaf protein increases the soil organic matter and improves the soil structure. Pulses are an ideal crop for mixed and intercropping and also serve as nutritious vegetables and fodders. The seeds of lablab, peas, pigeon pea and chickpeas are used as green vegetables while Green gram, urd bean and cowpea are used as green fodders for cattle. Foliar application is more beneficial than soil application because less quantity of fertilizer is required for the foliar application as compare to soil application. The prices of fertilizers are increasing day by day therefore, it is necessary to reduce the cost of fertilizers by using foliar application of nutrients to increase yield of legume crop. In Maharashtra there was regularly dry spell of 15 to 35 day during *kharif* season, which severely affect the growth and yield of green gram. It is evident from the literature that the foliar nutrition with nutrients helps in increasing drought resistant in plant and reduces the loss of water through evapotranspiration.

The major green gram states in India are Bihar, UP, Punjab, Rajasthan, MP and Gujarat. In Punjab, it was grown on area of 3.5 thousand hectares with a production of 3.0 thousand tonnes during 2015-16. The average yield of green gram was 8.38 quintals per hectare. Green gram seed contains 24.7% protein, 0.5% fat, 0.9% fibre, 57.6% carbohydrates and 3.7% ash.

Green gram (*Vigna radiata* L. *Wilkzek*) commonly known as "Mung Bean" is a principal important short duration and drought tolerent pulse crop in India. It belongs to the family leguminosae and sub family papilionaceae. It cover the annual world production area about 5.5 million hectare. In India, its rank third after Bengal gram and red gram in area, production and productivity. India contributes 75% of world's production in green gram (Taunk *et al.*, 2012).) [19] and adequate amount of phosphorous, calcium and key vitamins. Its protein is rich in lysine making it an excellent complement to rice. Green gram also improves the soil physical properties. Mung bean having low productivity because cultivation of this crop on marginal and submarginal lands with inadequate fertilization and poor management practices. Mung bean gave low yield at farmers field due to less awareness of farmers about optimum date of sowing, effective weed control, balance use of fertilizers, pest management practices and proper planting pattern. Mungbean in delay planting results reduction in number of pods plant^{-1}, number of grains pod^{-1}, grain weight and ultimately grain yield. The time of sowing is the most important agronomic factor for realizing the yield potential of improved varieties; it helps in achieving complete harmony between vegetative and reproductive stages of the crop. Therefore sowing of the crop at optimum time plays a key role in obtaining the high seed yields (Rathore *et al.*, 2010) [17].

Green gram is capable of fixing atmospheric nitrogen, it responds to small quantity of nitrogenous fertilizers applied as starter dose. Application of 15-20 Kg ha^{-1} has been found optimum to get better response. Application of higher dose of nitrogen may reduce nodule number and nodule growth and thus adversely affect the nitrogen fixation capacity (Choudhary *et al.*, 2017) [6].

Application of phosphorous fertilizers generally has great impact on crop yields because its deficiency limits the response of plants to other nutrients (Akinrinde and Adigun, 2005) [1]. Phosphorus is considered the most important nutrient for increasing yield of mungbean. Studies have shown that phosphorus application to mungbean has increased plant height, number of branches, number of pods plant^{-1}, number of grains pod^{-1}, 1000^{-1} grains weight, biological yield and grain yield (Ayub *et al*., 2002) [2].

Potassium is one of the essential nutrient for plant growth and vital for sustaining modern high yield agriculture. Plant needs large quantities of potassium which not only improves the crop yield, but crop quality also. Hence potassium fertilization results in higher value product and therefore in a greater return to farmers. It is a prime factor for deciding the market price of green gram grown, which improve the income of farmers just by improving the quality of produce (Krishna, 1995) [12].

Neem cake is a potential source of organic manure. Neem has demonstrated considerable potential as a fertilizer. Our Neem cake also reduce alkalinity in soil, as it produce organic acid on decomposition, being totally natural, the Neem cake we offer hence ensure fertility of the soil, it also improve the organic matter contain of the soil, helping improvement in soil texture, water holding capacity, soil aeration for batter root development.

The addition of Neem cake also positively affected the available soil organic carbon, N P K and Mn content of soil resulting better growth and grain yield of mung bean (*Vigna radiata* L.) besides suppressing soil borne pathogens (Murugan, 2011) [14]. The composition of Neem cake is 5.2% N, 1.0% P, 1.4% K. Neem cake act as a nitrogen inhibitor means reduce the nitrification. It supplies the available nitrogen for a long time in the soil (katayan, 2012).

Farmyard manure (FYM) is one of the important organic manures, which supplies a suitable mineral balance and improves nutrient availability by enzymes. FYM seems to act directly for increasing the crop yield either by acceleration of respiratory process with increasing cell permeability and hormonal growth action or by combination of all these processes (Gaur, 1991) [9]. It supplies nitrogen, phosphorus, potassium, sulphar and micronutrients like Fe, S, Mo and Zn etc. in available form to the plants through biological decomposition and improves physical-chemical properties of soil such as aggregation, aeration, permeability, water holding capacity, slow release of nutrients, increase in cation exchange capacity, stimulation of soil flora and fauna etc (Dick and Gregorich, 2004) [7].

Poultry droppings have higher nutrient contents. It has nitrogen (4.55 to 5.46%), phosphorus (2.46 to 2.82%), potassium (2.02 to 2.32%), calcium (4.52 to 8.15%), magnesium (0.52 to 0.73%) and appreciable quantities of micronutrients like Cu, Zn, Fe, Mn, *etc*. In addition to this cellulose (2.26 to 3.62%), hemicellulose (1.89 to 2.77%) and lignin (1.07 to 2.16%) are also present in poultry waste. These components upon microbial action can be converted to value added compost with high nutrient status. In poultry droppings, nearly 60% of nitrogen which is present as uric acid and urea is lost through ammonia volatilization by hydrolysis. This loss of nitrogen reduces the agronomic value of the product, besides causing atmospheric pollution. Composting with amendment seems promising in conservation of nitrogen in poultry droppings. Nitrogen in poultry waste can be effectively conserved by composting with suitable organic amendment. The technologies developed will be highly useful to the poultry farmers.

Crop residues are a potential source of organic matter in soils. Essentially, the presence of organic matter in soils is responsible for improved chemical and physical properties of the soil through mineralization and gelation of soil particles. Crop straw can be incorporated into soil to provide readily available nutrients and to minimize the loss of crop straw (Bhowate *et al.*, 2017) [3].

Materials and Methods

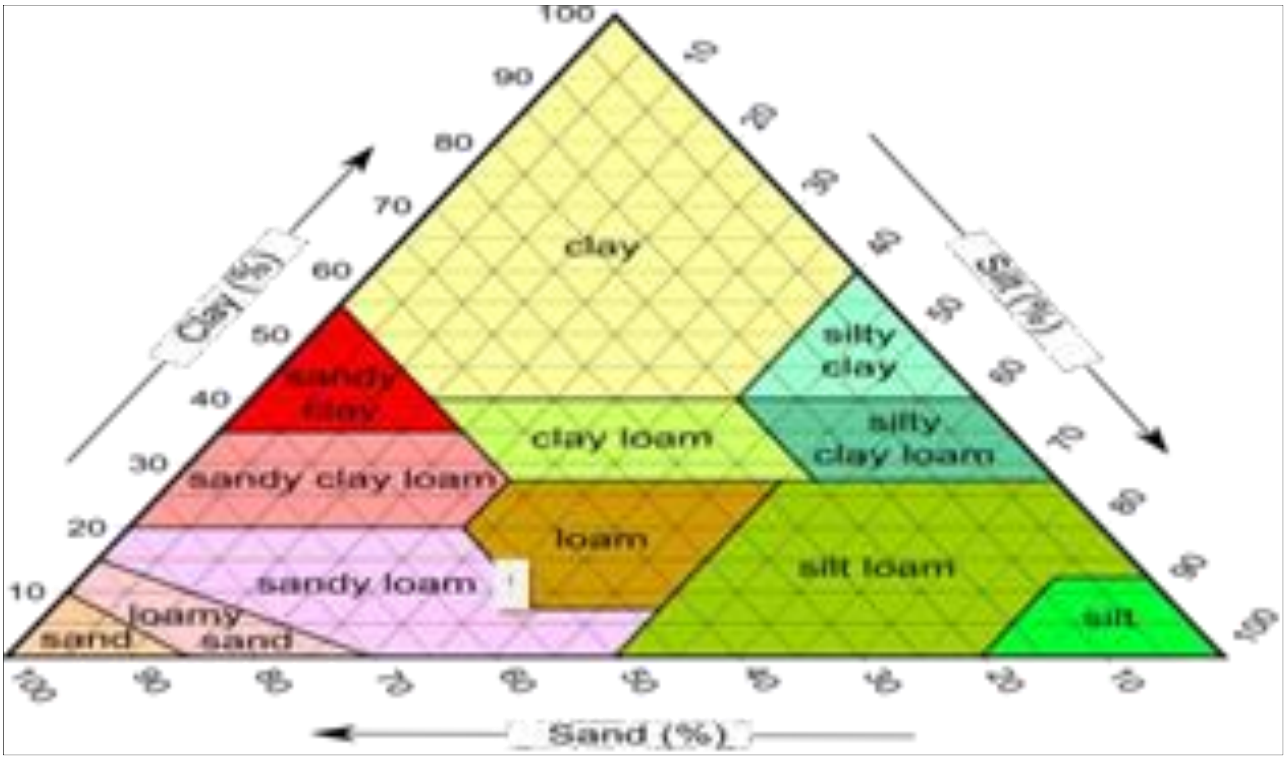
The details of the materials used and technologies adopted during the courses for present investigations entitled "Impact of integrated nutrient management on soil properties growth and yield attributes of green gram (*Vigna radiata* L.) Var. MH-421" This chapter provides complete description of soil, planting materials used and climatic conditions prevalent in the locality during the experimental period.

Experimental sites

This experiment was conducted during kharif season 2021 on crop research farm of the department of Soil Science and Agricultural Chemistry, Naini, SHUATS. The right bank of the river Yamuna and about 6 km. away from prayagraj station. It is positioned at 25.57^{0}N Latitude and 81.5^{0}E latitude and about 98 meter above sea level.

Climatic condition in the experimental area

Agro climatically, Prayagraj district represents the subtropical belt of the South East of Uttar Pradesh, and is endowed with extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46°C- 48°C and seldom falls as low as 4°C-5°C. The relative humidity ranges between 20 – 94%. The average rainfall of this area is around 1100 mm annually.



Metrological Conditions

The district Prayagraj comes under sub-tropical climate.

Table 1: Treatment combinations

Treatment	Treatment combination
T_1	Farmers practice inorganic fertiliser [RDF: N. P. & K.]
T_2	RDF @ 100% + FYM @ 50%
T_3	RDF @ 100% + FYM @ 100%
T_4	RDF @ 100%+ POULTRY MANURE @ 50%
T_5	RDF @ 100%+ POULTRY MANURE @ 100%
T_6	RDF @ 100%+ NEEM CAKE @ 50%
T_7	RDF @ 100%+ NEEM CAKE @ 100%
T_8	RDF @ 100%+ CROP RESIDUE @ 50%
T_9	RDF @ 100% + CROP RESIDUE @ 100%

Table 2: Particulars of the treatment levels for Green gram var. MH-421

Treatment	DOSAGE
NPK @ 100%	20:40:20 kg ha^{-1}
FYM @ 50%	12.5 t ha^{-1}
FYM @ 100%	25 t ha^{-1}
POULTRY MANURE @ 50%	3 t ha^{-1}
POULTRY MANURE @ 100%	6 t ha^{-1}
NEEM CAKE @ 50%	150 Kg ha^{-1}
NEEM CAKE @ 100%	300 Kg ha^{-1}
CROP RESIDUE @ 50%	300 Kg ha^{-1}
CROP RESIDUE @ 100%	600 Kg ha^{-1}

Table 3: Mechanical analysis of soil

Ingredients	Percentage (%)	Method employed
Sand	70.4	Bouyoucous hydrometer method
Silt	12.0	Bouyoucous hydrometer method
Clay	17.6	Bouyoucous hydrometer method
Textural class	Sandy loam	

Table 4: Physical and Chemical analysis of soil sample before sowing of crop

Particular	Rating	Method used	Scientist (year)
Bulk density (Mg m^{-3})	1.64	Graduated Measuring Cylinder	(Muthuaval *et al.*,1992) [15]
Particle density (Mg m^{-3})	2.70	Graduated Measuring Cylinder	(Muthuaval *et al.*,1992) [15]
Pore space (%)	58.12	Graduated Measuring Cylinder	(Muthuaval *et al.*,1992) [15]
Water holding capacity (%)	59.65	Volumetric flask method	(Muthuaval *et al.*, 1992) [15]
Soil pH (1:2)	7.85	Digital, pH meter	(Jackon 1958)
Soil EC. (Mill mho/cm)	0.44	Digital Conductivity meter	(Wilcox 1950) [22]
Organic carbon (%)	0.41	Wet Oxidation Method	(Walkley and Black's method 1934) [21]
Available Nitrogen (Kg ha^{-1})	210.35	Kjeldhal Method	(Subbaih and Asija, 1956)
Available Phosphorus (Kg ha^{-1})	20.00	Colorimetric method	(Olsen *et al.* 1954) [16]
Available Potassium (Kg ha^{-1})	240.90	Flame photometric method	(Toth and Price, 1949) [20]

Table 5: Response of inorganic fertilizers, neem cake and rhizobium on Bulk density, Particle density and Pore space of green gram of Post-harvest Soil

Treatment	Bulk density (Mg m^{-3})		Particle density (Mg m^{-3})		Pore space (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	1.301	1.522	2.312	2.542	44.82	44.59
T_2	1.253	1.474	2.345	2.575	45.01	44.78
T_3	1.147	1.363	2.432	2.665	48.07	47.84
T_4	1.181	1.401	2.381	2.614	46.22	45.99
T_5	1.073	1.291	2.476	2.702	50.11	49.88
T_6	1.215	1.432	2.363	2.594	45.89	45.66
T_7	1.140	1.323	2.454	2.683	48.97	48.74
T_8	1.172	1.394	2.411	2.645	47.33	47.10
T_9	1.013	1.235	2.483	2.711	51.02	50.79
F – test	S	S	S	S	S	S
S.Em (±)	0.019	0.006	0.03	0.02	0.03	0.07
CD at (5%)	0.033	0.004	0.07	0.09	2.59	1.58

Table 6: Response of inorganic fertilizers, neem cake and rhizobium on pH, EC, and Organic C carbon of green gram of post harvest soil

Treatment	pH (w/v)		EC (dS m^{-1})		Organic carbon (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	7.7	7.7	0.09	0.21	0.56	0.44
T_2	7.6	7.7	0.11	0.23	0.59	0.47
T_3	7.6	7.7	0.16	0.28	0.68	0.56
T_4	7.4	7.5	0.14	0.26	0.64	0.52
T_5	7.3	7.4	0.18	0.32	0.71	0.59
T_6	7.3	7.4	0.12	0.24	0.62	0.54
T_7	7.2	7.3	0.17	0.29	0.69	0.57
T_8	7.2	7.2	0.14	0.26	0.66	0.54
T_9	7.2	7.2	0.19	0.31	0.73	0.61
F – test	S	S	S	S	S	S
S.Em (±)	0.04	0.07	0.05	0.03	0.01	0.07
CD at (5%)	0.09	0.08	0.02	0.06	0.02	0.11

Table 7: Response of inorganic fertilizers, neem cake and rhizobium on Nitrogen, Phosphorous and Potassium of green gram of post harvest soil

Treatment	Nitrogen (Kg ha^{-1})		Phosphorous (Kg ha^{-1})		Potassium (Kg ha^{-1})	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	251.12	241.2	23.30	20.97	117.65	105.78
T_2	262.09	252.17	24.11	21.78	127.30	115.43
T_3	288.12	278.2	27.34	25.01	170.32	158.45
T_4	270.63	260.71	25.98	23.65	148.54	136.67
T_5	301.42	291.50	31.66	29.33	186.67	174.80
T_6	266.74	256.82	25.49	23.16	135.49	123.62
T_7	295.87	285.95	29.74	27.41	177.87	166.00
T_8	278.57	268.65	26.64	24.31	160.71	148.84
T_9	308.15	298.23	33.12	30.79	198.45	186.58
F – test	S	S	S	S	S	S
S.Em (±)	1.09	2.16	0.67	0.63	0.90	0.88
CD at (5%)	2.32	1.45	1.42	2.07	1.90	1.27

Table 8: Effect of different cost benefit ratio (C:B) of Different Treatment Combination with green gram crop

Treatment	Yield (q ha^{-1})	Selling rate (q^{-1})	Gross return (ha^{-1})	Total cost of cultivation (ha^{-1})	Net profit (ha^{-1})	Cost benefit ratio (C:B)
T_1	6.89	8000	55120	50900	4220	1.08
T_2	7.06	8000	56480	45107	11373	1.25
T_3	8.74	8000	69920	46157	23763	1.51
T_4	7.91	8000	63280	51557	11723	1.23
T_5	10.12	8000	80960	59057	21903	1.37
T_6	7.56	8000	60480	47807	12673	1.27
T_7	9.23	8000	73840	51557	22283	1.43
T_8	8.04	8000	64320	50057	14263	1.28
T_9	11.19	8000	89520	56057	33463	1.60

Conclusion

It is concluded from experiment that the various levels of N P K, FYM, Poultry manure and Neem cake used from different sources in the trail, the treatment combination T_9 (RDF @ 100% + CROP RESIDUE @ 100%) was found to be the best treatment which gave maximum benefit of 33463.00 ₹ ha^{-1}

with highest cost benefit ratio is 1:1.60. Soil chemical properties as pH, EC, available N and K were found to be significant. Soil physical properties as Bulk density (Mg m^{-3}), Particle density (Mg m^{-3}), and Pore space (%) were found to be significant.

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