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Effect of different levels of n p k and rhizobium on soil physico-chemical properties and yield attribute of green gram (*Vigna radiata* L.) var. hum-2

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Abstract
The field experiment was carried out at soil science research farm of Sam Higgin bottom University of Agriculture, Technology and Sciences, Praygraj during summer season 2017-18. The design applied was 3x3 factorial randomized block design having three factors with three levels of NPK @ 0, 50, and 100 % ha^{-1}, three levels of Rhizobium @ 0, 50 and 100% ha^{-1} respectively. The result obtained with treatment T_8-[NPK@ 50% + Rhizobium @ 100%] that showed the highest yield regarding, gave the best results with respect to plant height 60.16 cm, number of leaves $plant^{-1}$ 33, No. of pod $plant^{-1}$ 38.77, it gave highest yield 12.10 q ha^{-1}. The maximum cost benefit ratio was recorded 1: 2.29 and net profit. rs. 20843.2ha^{-1} in treatment combinationT_8-L_2M_2 [@ 100% NPK ha^{-1}+ 100% Molybdenum ha^{-1}] combined use of NPK resulted in significant increase on enrichment of soil fertility status. Rhizobium in combination resulted in a slight increase in pH 7.24, EC 0.26 dSm^{-1}. In post soil of NPK fertilizers observations were resulted in significant increase in OC 0.77 %, Particle density 2.60 g/cm^3, Bulk density 1.24 g/cm^3,Porespace 56.22% and available N 337.32 $kgha^{-1}$, P 35.62 kg ha^{-1}, K 205.54 kg ha^{-1}, significant increase in case of Nitrogen (kg ha^{-1}), Phosphorus (kg ha^{-1}), Potassium (kg ha^{-1}) was found to be significant among other treatments in Green gram cultivation and soil quality improvement. It was also revealed that the application of NPK with Rhizobium were excellent source for fertilization than fertilizers. The treatment (T_8) also showed greater benefit cost ratio followed by other treatments.

Keywords: Green gram NPK and physico-chemical rhizobium properties content, yield attributes etc.

Introduction
Pulses are the main source of protein particularly for vegetarians and contribute about 14% of the total protein of average Indian diet. Production of pulses in the county is far below the requirement to meet even the minimum level per capita consumption. The per capita availability of pulses in India has been continuously decreasing which is 32.52 g/day against the minimum requirement of 80 g/day per capita prescribed by Indian Council of Medical Research (ICMR).Therefore, it is necessary for agricultural scientists to evolve strategies to increase production of pulses to meet the protein requirements of increasing population of the country. Rapid population growth and low production especially to pulses have enhanced the problem of food security. Indian pulses production has been stuck in between 14 and 15 MT since mid-nineties, resulting in poor consumption (33g/capita/day) during 2010 (Ali and Gupta, 2012) [1]. The mung bean (*Vigna radiata* L.) is under cultivation since prehistoric time in India. It is also known as green gram and serve are a major source of dietary protein for the vast majority of people. The food legumes, particularly the grain or pulses are important food stuff in all tropical and subtropical countries (Mohbe *et al*. 2015 and 2017) Green gram [*Vigna radiata* (L.) Wilczek] also known as mung bean is a self-pollinated leguminous crop, which is grown during kharif (July-October) as well as summer (March-June) seasons in arid and semiarid regions of India. It is primarily a rainy season crop but with the development of early maturing varieties, it has also proved to be an ideal crop for spring and summer season. It is tolerant to drought and can be grown successfully on drained loamy to sandy loam soil in areas of erratic rainfall. It is a native of Central Asia. It is a short duration crop, fits well in various multiple and intercropping systems. After picking of pods, mung bean plants may be used as green fodder or green manure. Besides these, the crop also enriches soil by fixing atmospheric nitrogen. In India, it is the third important pulse crop after chickpea and pigeon pea, mung bean is cultivated in state of Rajasthan, Madhya Pradesh, Punjab, Haryana, U.P. Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. It is rich in protein and

vitamin B. Green gram is an excellent source of protein (24.5%) with high quality of lysine (460mg/g N) and tryptophan (60mg/g N). It contains also remarkable quantity of ascorbic acid and riboflavin (0.21mg /100g). (Azadi *et al*. 2013).

Materials and method

Study area

The experiment was conducted at research Farm of Soil Science and Agricultural Chemistry at Sam Higgin bottom University of Agriculture Technology and Sciences, Prayagraj. The area is situated on the south of Prayagraj on the right side of the river Yamuna on the South of Rewa Road at a distance of about 6 Km from Prayagraj city. It is situated at $25^0 24' 23"$N latitude, $81^0 50' 38"$Elongitude and at the altitude of 98 meter above the sea level.

Sampling and analysis

1. Collection of the soil samples

Soil samples were collected randomly from a site using soil auger and screw auger, Khurpa Knife at the depth of 0- 15cm. All these samples will be mixed and the mixed sample has been divided into four parts and then among them two samples are collected and only half kg sample is being taken for the soil analysis by the conning and quartering method.

2. Processing of soil samples

After sampling the samples were air dried in shade and then these samples were processed for various physical and chemical tests. The processing was done as follows:

After drying all the unwanted materials like roots, stones and others were removed.

The clods formed were broken by using wooden mallet

Then the samples were sieved with 2mm sieve

Sieved samples were stored in polybags for further estimation of different physical and chemical parameters.

3. Analysis of the soil

Analysis of the soil samples have been done under the following steps-

Post-harvest soil properties

1. Soil Colour
2. Bulk density (Mgm^{-3})
3. Particle density (Mgm^{-3})
4. Pore space (%)
5. pH of soil
6. Electrical conductivity (dSm^{-1})
7. Organic carbon (%)
8. Available nitrogen ($Kgha^{-1}$)
9. Available phosphorus ($Kgha^{-1}$)
10. Available potassium ($Kgha^{-1}$)

Results and discussion

Table 1: Soil colour

Parameters	Hue	Value	Chroma	Soil Colour
Dry condition	2.5YR	6/	/4	(2.5YR6/4) Light Yellowish Brown
Wet condition	2.5 YR	4/	/4	(2.5YR 4/4) Olive Brown

Table 2: Bulk density

Treatment	Post harvesting Bulk Density(Mgm^{-3}) Mean value
T_0	1.24
T_1	1.22
T_2	1.20
T_3	1.20
T_4	1.16
T_5	1.13
T_6	1.13
T_7	1.10
T_8	1.09
F-test	NS
S. EM+	0.05
C.D. (P= 0.05)	0.11

Table 3: Partial density

Treatment	Post harvesting Particle Density(Mgm^{-3}) Mean Value
T_0	2.23
T_1	2.33
T_2	2.28
T_3	2.51
T_4	2.34
T_5	2.51
T_6	2.38
T_7	2.60
T_8	2.54
F-test	NS
S. EM+	0.33
C.D. (P= 0.05)	0.69

Table 4: % Pore space

Treatment	Post harvesting Pore space (%) Mean Value
T_0	44.22
T_1	48.42
T_2	47.35
T_3	53.77
T_4	50.43
T_5	54.40
T_6	52.59
T_7	55.75
T_8	56.22
F-test	S
S. EM+	1.38
C.D. (P= 0.05)	2.94

Table 5: pH

Treatment	Mean Value of Post harvesting pH
T_0	7.24
T_1	7.20
T_2	7.06
T_3	7.07
T_4	7.00
T_5	6.97
T_6	6.94
T_7	6.87
T_8	6.80
F-test	S
S. EM+	0.06
C.D. (P= 0.05)	0.12

Table 6: EC

Treatment	Mean Value of Post harvesting EC(dSm-1)
T0	0.16
T1	0.17
T2	0.19
T3	0.20
T4	0.21
T5	0.22
T6	0.22
T7	0.23
T8	0.26
F-test	NS
S. EM±	0.28
C.D. (P= 0.05)	0.06

Table 7: Organic carbon (%)

Treatment	Post harvesting Organic carbon (%) Mean Value
T_0	0.55
T_1	0.57
T_2	0.63
T_3	0.61
T_4	0.62
T_5	0.67
T_6	0.69
T_7	0.73
T_8	0.77
F-test	S
S. EM±	0.01
C.D. (P= 0.05)	0.03

Table 8: Available nitrogen

Treatment	Post harvesting Available Nitrogen (Kgha^{-1}) Mean Value
T_0	288.30
T_1	301.83
T_2	305.88
T_3	311.11
T_4	314.31
T_5	322.77
T_6	323.54
T_7	325.93
T_8	337.32
F-test	S
S. EM±	3.24
C.D. (P= 0.05)	6.87

Table 9: Available phosphorus

Treatment	Post harvesting Available Phosphorus (Kgha-1) Mean Value
T0	24.44
T1	26.78
T2	27.19
T3	28.68
T4	29.38
T5	30.68
T6	32.58
T7	33.54
T8	35.62
F-test	S
S. EM±	0.56
C.D. (P= 0.05)	1.18

Table 10: Available potassium

Treatment	Post harvesting Available Potassium (Kgha^{-1}) Mean Value
T_0	132.90
T_1	145.18
T_2	154.43
T_3	156.27
T_4	167.40
T_5	172.84
T_6	190.90
T_7	198.27
T_8	205.54
F-test	S
S. EM±	7.78
C.D. (P= 0.05)	16.49

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