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## The study on the effect of rhizobium culture and phosphate solubilizing bacteria on growth attributes of green gram (*Vigna radiata*) in Chitrakoot region

**Sujeet Gautam, Dr. Pawan Sirothia, Dr. US Mishra and Shikha Rao**

### Abstract

A field study was conducted in the agriculture research farm, faculty of agriculture, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot Satna (M.P.), to determine the effect of bio-fertilizers (rhizobium and PSB) along with inorganic fertilizers on growth attributes on “PDU-139” variety of Green gram (*Vigna radiata*). Experiment was performed during the *kharif* season of session 2021-22. The experiment was comprised of thirteen treatments in three replications including bio-fertilizers and treatments with sole application of inorganic fertilizers. The experiment was laid out in the randomized block design (RBD) and the data was analyzed using analysis of variance (ANOVA). There were a total of five growth parameters taken under consideration for the purpose of study namely plant height, number of branches per plant, number of leaves per plant, number of nodules per plant and root length. The results indicated that treatment with 50% RDF + Rhizobium (T<sub>11</sub>) recorded the maximum plant height that is 44.27 cm, number of branches per plant (15.00), and number of leaves per plant (39) was also recorded to be the highest in T<sub>11</sub> treatment. On the other hand root nodules and root length was observed to be highest in treatment T<sub>12</sub> which was 100% RDF + rhizobium + PSB which was 29.70 and 16.27 respectively. Hence the treatment T<sub>11</sub> and T<sub>12</sub> proved to be the best treatments for various growth attributes of Green gram crop.

**Keywords:** Bio-fertilizers, rhizobium, PSB, green gram, growth attributes

### Introduction

Green gram (*Vigna radiata* L.) commonly known as “mung” or “mung bean” is a native of India and Central Asia and grown in these regions since pre-historic times. Being a leguminous crop it is rich in protein content and highly nutritious. But as the population is rising increase in productivity per unit area is gaining more and more emphasis. For serving the purpose all the attributes of the crop *viz.* growth and yield attributes must be given special focus. The crop production potential also depends upon the supply of essential plant nutrients for their growth development. With almost twice the quantity of nutrients being removed from the soil than what is added through fertilizers, the growing nutrient imbalances poses a major threat to sustain soil health and crop productivity. It has underlined the need for adaptation of integrated nutrient supply system (INSS), which involve the use of different nutrient sources such as chemical fertilizers, bio-fertilizers and organic manures (Rai, 2002) [2].

Mungbean produces a grain yield of one tonne per hectare will remove from the soil approximately 40 kg of nitrogen, 3 to 4 kg of phosphorus and 1.5 to 2 kg of sulphur. These amounts will be increased if in addition the plant residues are removed and not returned to the soil. Except for nitrogen, that can be supplied by nitrogen-fixing activity of appropriate soil rhizobia, the elements need to be replaced to avoid depletion of the soil mineral storehouse (Rai, 2002) [2]. Phosphorus has been referred to as the “master key element” in crop production. Most of the phosphorus present in soil is unavailable to plants, which is made available by action of efficient micro-organisms like bacteria, fungi and even cyanobacteria. These micro-organisms bring about solubilization by the production of organic acid and phosphatase enzyme activity (Behal. K.K., 2011) [1]. By keeping all the above mentioned statements a field experiment was carried out.

### Materials and Methods

The field experiment was conducted at agricultural research farm of Rajaula, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.) to study the effect of rhizobium and PSB along with inorganic fertilizers on growth attributes of Green gram.

The variety that was used was “PDU-139”. There were thirteen treatments with different recommended doses of fertilizers viz. 100%, 75% and 50%. Some of them were incorporated with bio-fertilizers and some of them were given to the plants in purely inorganic forms, the details of the treatment combination is given in Table 1. Farmyard manure was applied at the rate of 7.5 kg per plot and half kg

rhizobium was enough for 20kg of seed and 3kg PSB was applied in the soil along with finely powdered FYM per plot. The data was recorded at 20, 40 and at harvest days after sowing for growth attributes. The experiment was laid out in randomized block design (RBD) and the statistical analysis was done using analysis of variance (ANOVA).

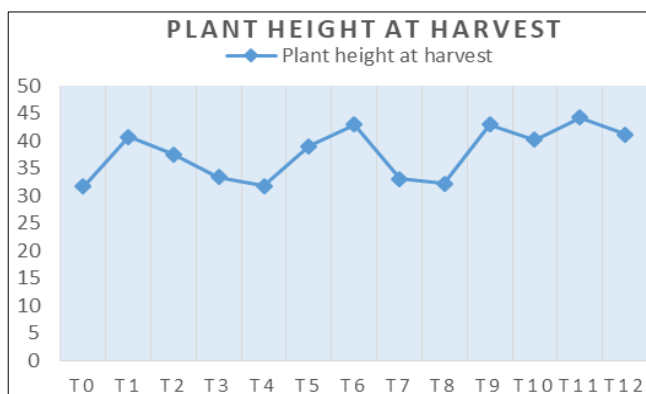
**Table 1:** Treatment combination

S. No.	Symbol	Treatments
1.	T <sub>0</sub>	0 kg fertilizer + no bio fertilizer
2.	T <sub>1</sub>	20 kg N/ha + 40 kg P/ha + 20 kg K/ha + No bio fertilizer
3.	T <sub>2</sub>	15 kg N/ha + 30 Kg P/ha + 15 kg K/ha + No bio fertilizer
4.	T <sub>3</sub>	10 kg N/ha + 20 kg P/ha + 10 kg K/ha + No bio
5.	T <sub>4</sub>	0 kg fertilizer + PSB (soil application)
6.	T <sub>5</sub>	20 kg N/ha + 40 kg P/ha + 20 kg K/ha + PSB
7.	T <sub>6</sub>	15 kg N/ha + 30 kg P/ha + 15 kg K/ha + PSB
8.	T <sub>7</sub>	10 kg N/ha + 20 kg P/ha + 10 kg K/ha + PSB
9.	T <sub>8</sub>	0 kg fertilizer + Rhizobium
10.	T <sub>9</sub>	20 kg N/ha + 40 kg P/ha + 20 kg K/ha + Rhizobium
11.	T <sub>10</sub>	15 kg N/ha + 30 kg P/ha + 15 kg K/ha + Rhizobium
12.	T <sub>11</sub>	10 kg N/ha + 20 kg P/ha + 10 kg K/ha + Rhizobium
13.	T <sub>12</sub>	20 kg N/ha + 40 kg P/ha + 20 kg K/ha + Rhizobium + PSB

**Results and Discussion**

**Effect of Rhizobium and PSB on Plant height of Green gram**

Plant height is one of the major growth attributing factor. The data for plant height was recorded at 20, 40 and at harvest stages, the height steadily increased from 20 DAS to harvest stage. The range of plant height at harvest stage was 31.67 cm to 44.27 cm. Maximum plant height was observed in the treatment T<sub>11</sub>- 50% RDF + rhizobium that is 44.47 cm. On the other hand the lowest plant height was observed in control treatment. Higher plant height could be due to a reduction in the rate of evaporation of the water from the soil providing cooler root zone leading to enhanced root development. (Behal.k.k., 2011) <sup>[1]</sup> Revealed.



**Fig 1:** Plant height

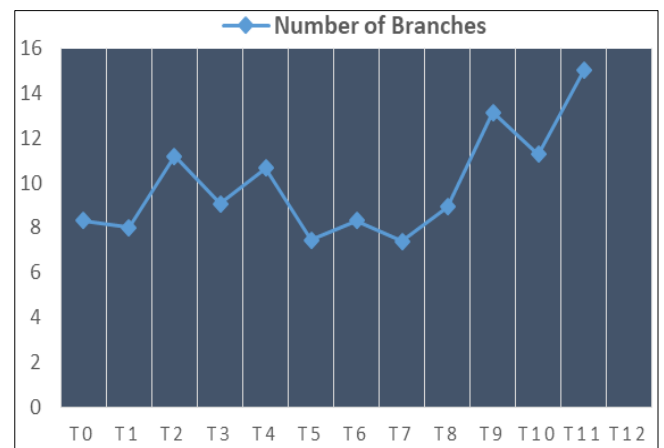
That rhizobium inoculation along with phosphorus and Sulphur doses increased plant height. (Singh, 2015) <sup>[3]</sup> Also reported the similar results.

**Effect of Rhizobium and PSB on Plant branches**

The data for plant branches was recorded at 20 DAS, 40 DAS and at harvest stages. The range of branches was 8 to 15.

Among all treatments the maximum number of branches was recorded.

In treatment T<sub>11</sub>- 50% RDF+ Rhizobium which was 15. Similar results were presented by (Behal. K.K., 2011) <sup>[1]</sup> (Rai, 2002) <sup>[2]</sup> (Singh, 2015) <sup>[3]</sup>. Liquid bio-fertilizer registered significant effect on number of branches per plant at 45 and 60 DAS and maximum number of branches was recorded in B4 (Rhizobium + PSB) in both year of investigation reported by (Singh S. N., 2021) <sup>[4]</sup>.



**Fig 2:** Number of Branches

**Effect of Rhizobium and PSB on Plant leaves**

The data for plant leaves was also taken at 20 DAS, 40 DAS and at harvest stages and number of leaves per plant increased steadily till harvest stage. The range of plant leaves at harvest stage was 23 to 39 leaves. Maximum number of leaves was observed in T<sub>11</sub>- 50% RDF + rhizobium that is 39 leaves. Phosphorous levels also differed significantly with respect to number of branches per plant and recorded maximum number of branches P2 (60 kg/ha) at 45 and 60 DAS in both the years of investigation reported by (Singh S. N., 2021) <sup>[4]</sup>.

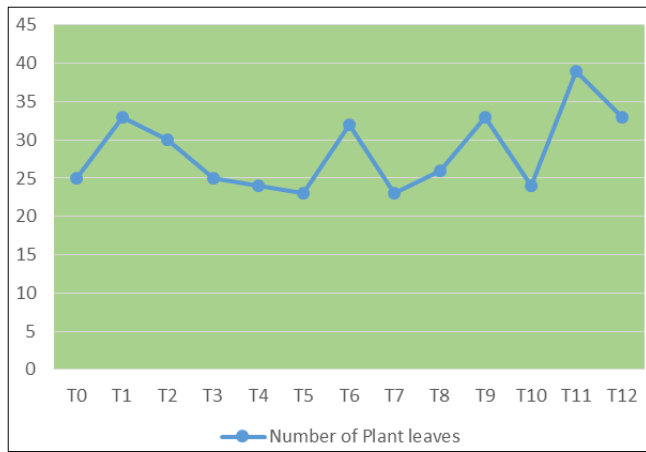


Fig 3: Number of Plant leaves

**Effect of Rhizobium and PSB on Root nodules and root length**

The readings for root nodules was taken at 45 DAS and the data revealed that maximum number of root nodules was present in treatment T<sub>12</sub>- 100% RDF + Rhizobium + PSB which was 29.70. The number of nodules/plant was significantly higher with the application of 40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> + PSB over rest of treatment. It might be due to application of high doses of phosphorus and PSB which create the

favourable condition for better development of nodules reported by (Singh S. N., 2021) [4].

The results for root length was also found to be the maximum in T<sub>12</sub> with 16.27 cm root length due to the positive effect of rhizobium on rhizosphere. Rhizobium inoculation + 40kg P<sub>2</sub>O<sub>5</sub> + 40kg S ha<sup>-1</sup> caused highly significant differences in yield attributes viz. number of pods plant<sup>-1</sup>, length of pod, number of grains pod<sup>-1</sup>, 1000 grain weight, grain yield, straw yield and harvest index in both years reported by (Singh S. N., 2021) [4] (Rai, 2002) [2].

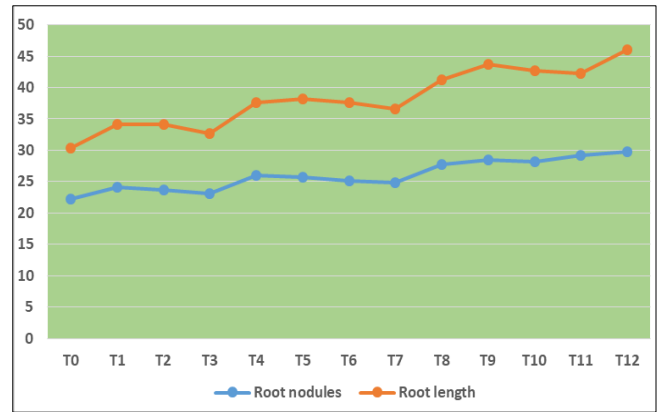


Fig 4: Root nodules and root length

Table 2: Effect of rhizobium and PSB along with inorganic fertilizers on growth attributes of Green gram.

S. No.	Treatments	Plant height (cm)	No. of Branches	No. of Plant leaves	Root Nodules	Root Length
1.	T <sub>0</sub>	31.76	8.33	25	22.27	8.03
2.	T <sub>1</sub>	40.67	8.00	33	24.08	9.98
3.	T <sub>2</sub>	37.47	11.20	30	23.67	10.47
4.	T <sub>3</sub>	33.40	9.06	25	23.12	9.57
5.	T <sub>4</sub>	31.80	10.66	24	26.02	11.59
6.	T <sub>5</sub>	39.00	7.46	23	25.63	12.50
7.	T <sub>6</sub>	42.94	8.33	32	25.13	12.52
8.	T <sub>7</sub>	33.07	7.40	23	24.88	11.70
9.	T <sub>8</sub>	32.20	8.93	26	27.70	13.50
10.	T <sub>9</sub>	42.94	13.13	33	28.47	15.30
11.	T <sub>10</sub>	40.14	11.26	24	28.12	14.53
12.	T <sub>11</sub>	44.27	15.00	39	29.12	13.15
13.	T <sub>12</sub>	41.14	13.66	33	29.70	16.27
	CD 5% =	1.25	3.18	0.09	0.33	0.16
	S.E± =	0.43	0.17	0.59	0.11	0.47

**Conclusion**

On the basis of the data and results obtained, it can be concluded that rhizobium and Phosphate solubilizing bacteria along with 100% and 50% recommended dose of fertilizers should be applied on green gram crop at Vindhyan Region for obtaining the best plant health and growth attributes.

and different levels of phosphorus on growth and yield of green gram *Vigna radiata* L. Prayagraj; c2021. <http://hdl.handle.net/10603/315656>.

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