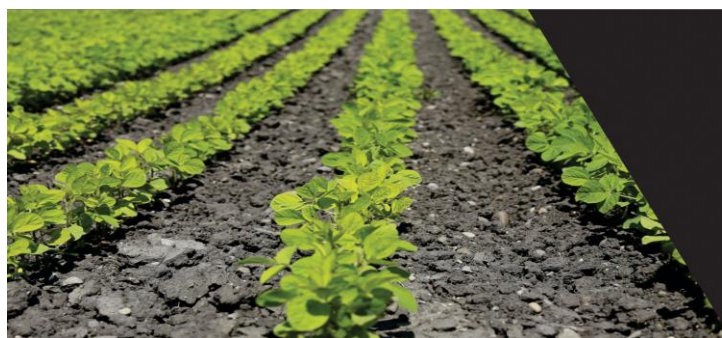




International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(7): 1168-1172
Received: 06-04-2026
Accepted: 10-05-2026

Vaishnavi Srivastava
M.Sc. Scholar, Department of
Agronomy, Naini Agricultural
Institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences,
Prayagraj, Uttar Pradesh, India

Vikram Singh
Professor, Department of
Agronomy, Naini Agricultural
Institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences,
Prayagraj, Uttar Pradesh, India

Joy Dawson
Professor and Head, Department
of Agronomy, Naini Agricultural
Institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences,
Prayagraj, Uttar Pradesh, India

Effect of Biofertilizer and Phosphorus on growth and yield of Greengram (*Vigna radiata* L.)

Vaishnavi Srivastava, Vikram Singh and Joy Dawson

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i7o.6075>

Abstract

A field experiment entitled “Effect of Biofertilizer and Phosphorus on growth and yield of Green gram (*Vigna radiata* L.)” was conducted during Kharif season 2025 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) on Greengram. The experiment was carried out in a randomized block design with ten treatments and were replicated thrice as T₁ - VAM 25 g/kg Seed + Phosphorus 40 kg/ha, T₂ - PSB 25 g/kg Seed + Phosphorus 40 kg/ha, T₃ - VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 40 kg/ha, T₄ - VAM 25 g/kg Seed + Phosphorus 50 kg/ha, T₅ - PSB 25 g/kg Seed + Phosphorus 50 kg/ha, T₆ - VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 50 kg/ha, T₇ - VAM 25 g/kg Seed + Phosphorus 60 kg/ha, T₈ - PSB 25 g/kg Seed + Phosphorus 60 kg/ha and T₉ - VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 60 kg/ha T₁₀ - Control (RDF) (20:40:20). The results indicated that differences among treatments were statistically non-significant for most growth and yield parameters, whereas plants height at 60 DAS, and test weight showed a significant response. highest plant height (68.43 cm) in T₃ (VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 40 kg/ha), dry weight (7.73 g/plant) in T₉ (VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 60 kg/ha), number of branches/plant (14.86) in T₆ (VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 50 kg/ha), no. of nodules/plant (16.53) in T₄ (VAM 25 g/kg Seed + Phosphorus 50 kg/ha), CGR (g/m²/day) (0.875) in T₁₀ (Control (RDF) (20:40:20), RGR (g/g/day) (0.637) in T₅ (PSB 25 g/kg Seed + Phosphorus 50 kg/ha), number of pods/plant (19.13) in T₁ (VAM 25 g/kg Seed + Phosphorus 40 kg/ha), number of seeds/pods (8.26) in T₇ (VAM 25 g/kg Seed + Phosphorus 60 kg/ha), test weight (32.64) in T₄ (VAM 25 g/kg Seed + Phosphorus 50 kg/ha), seed yield (1613.333 kg/ha) in T₇ (VAM 25 g/kg Seed + Phosphorus 60 kg/ha), stover yield (750.000 kg/ha) in T₉ (VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 60 kg/ha), harvest index (78.67) in T₄ (VAM 25 g/kg Seed + Phosphorus 50 kg/ha), Maximum gross return (INR 142623.733/ha), net returns (INR 94426.43/ha) and benefit cost ratio (2.95) were obtained in the same treatment T₇ (VAM 25 g/kg Seed + Phosphorus 60 kg/ha) in Greengram.

Keywords: Biofertilizer, phosphorus, green gram, yield and economics

Introduction

Green gram (*Vigna radiata* L.) is an important pulse crop of India and central Asia which is known as the “poor man’s meat” because of its richness in protein. In India, green gram can be sown during the kharif and zaid season. Green gram locally known as “moong dal”. In India, it occupied an area of 3.44 million hectares having total production of 1.4 million tons of grain with productivity of 407 kg/ha) with an annual yield of 3.65 tonnes and a yield of 898 kg ha⁻¹. In India, major green gram producing states are Orissa, Madhya Pradesh, Rajasthan, Maharashtra, Gujarat and Bihar The protein content of green gram is two to three times more than that of cereals. It is considered as a whole grains as well as dal in variety of way in homes; being easily digestible it is preferred by patients. When moong beans are allowed to sprout, ascorbic acid (Vitamin ‘C’) is synthesized besides riboflavin and thiamine is also increased. In India, Green gram occupies an area of about 34.3 lakh hectare producing 14 lakh 2 tonnes whereas in Uttar Pradesh it is grown over lakhs hectare Rao *et al.* (2021) ^[1]. Green gram is the third important pulse crop cultivated through India. Pulses form an integral part of vegetarian diet of large population of India. Besides being rich source of proteins and amino acids, they maintain soil fertility through the process of nitrogen fixation in symbiotic association with Rhizobium bacteria present in their nodules. Thus, they play a vital role as nitrogen fixing manufactories, which help in sustain productivity of agricultural soil (Jat *et al.* 2012). Green gram (*Vigna radiata* L.) occupies prime position among

Corresponding Author:
Vaishnavi Srivastava
MSc Scholar, Department of
Agronomy, Naini Agricultural
Institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences,
Prayagraj, Uttar Pradesh, India
Gmail ID:
vaishnavi95184@gmail.com

pulses by virtue of its short growth period, high tonnage capacity and outstanding nutrient value as food, feed and forage. Among the pulses, greengram is one of the most important and extensively cultivated pulse crops Patel *et al.* (2019) ^[2]. Biofertilizers contains microorganisms which promote the adequate supply of nutrients to the host plants to ensure their proper development of growth and regulation in their physiology. Living microorganisms are used in the preparation of biofertilizers (Mishra *et al.*, 2013) ^[3]. Shelf life is the first and foremost problem of the carrier based biofertilizer which is up to 3 months and it does not retain throughout the crop cycle. LBF on the other hand facilitates the long survival of the organisms by providing the suitable medium which is sufficient for the entire crop cycle. Shravani *et al.* (2019) ^[4]

Biofertilizers on the other hand are cost-effective and renewable source of plant nutrients to supplement the parts of chemical fertilizers. Biofertilizers are known to play an important role in increasing availability of nitrogen and phosphorus besides improving biological fixation of atmospheric nitrogen and enhance phosphorus availability to crop. Dual inoculation of vermi compost and bacteria biofertilizers proved more effective in increasing the growth of different crop plants. Dubey *et al.* (2019) ^[5]

VAM fungi are one of the important components of the soil micro biota and obviously interact with other microorganisms in the rhizosphere. The effect of VAM on the growth of transplanted chillies under field conditions and found a significant increase in the plant growth due to mycorrhizal inoculation. VAM cause greater uptake of P by their expanded network of hyphae and also help in the uptake of Zn, Cu, Fe, Mn, etc. VAM fungal hyphae play an important role in soil aggregation by creating the skeletal structure of macro aggregates through physical entanglement of soil particles and organic materials. Such aggregates enhance carbon and nutrients storage and create conducive environment for the survival and growth of soil microorganisms. Dubey *et al.* (2019) ^[5]

VAM fungi are particularly important in organic and/or sustainable farming systems that rely on biological processes rather than agrochemicals to control plant diseases. Dubey *et al.* (2019) ^[5]

Phosphate Solubilizing Bacteria (PSB) are a group of beneficial bacteria capable of hydrolyzing insoluble compounds of organic and inorganic phosphorus. Many heterotrophic bacteria and fungi efficiently solubilize insoluble phosphate of soil and rock phosphate. Inoculation of phosphate solubilizing microorganism increase crop yield by 5-10 per cent. Since the process of nodulation and nitrogen fixation is inhibited at higher levels of fertilizer nitrogen in the soil but there is a demand of nitrogen of the crop at post flowering period Rao *et al.* (2021) ^[1]

PSB in agricultural practice would not only offset the high cost of manufacturing phosphate fertilizers but would also mobilize insoluble in the fertilizers and soils to which they are applied. Among the whole microbial population in soil. Megha Dubey *et al.* (2019) ^[5]

The seed inoculation with proper strain of phosphorus solubilizing bacteria (PSB) is a low cost input for enhancing yield, as it solubilizes the unavailable phosphorus in to the available form, which reduce the high cost of inorganic phosphorus fertilizer (Patel *et al.*, 2018) ^[6].

Phosphorus (P) is one of the most needed elements for pulse production. Phosphorus, although not required in large quantities, is critical to green gram yield because of its multiple effects on nutrition. Phosphorus plays a key role in various physiological processes like root growth and dry matter production, nodulation

and nitrogen fixation and also in metabolic activities especially in protein synthesis. Patel BN *et al.* (2019) ^[2]

The availability of phosphorus to the crop can be augmented by providing appropriate strains of microbes which are known to solubilise the fixed phosphorus and mobilize the deeply placed phosphorus to root zone by their activity. Besides increasing the availability of native P in the soil also help in enhancing the use efficiency of applied phosphorus Patel BN *et al.* (2019) ^[2].

Materials and Methods

This experiment was carried out during kharif 2025 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, (U.P), to check the effect of biofertilizer and phosphorus on growth and yield of Greengram. The experimental field soil was sandy loam with less availability of nitrogen. The experiment was laid out in randomised block design consisting of ten treatments viz T₁ VAM 25 g/kg Seed + Phosphorus 40 kg/ha, T₂ PSB 25 g/kg Seed + Phosphorus 40 kg/ha, T₃ VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 40 kg/ha, T₄ VAM 25 g/kg Seed + Phosphorus 50 kg/ha, T₅ PSB 25 g/kg Seed + Phosphorus 50 kg/ha, T₆ VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 50 kg/ha, T₇ VAM 25 g/kg Seed + Phosphorus 60 kg/ha, T₈ PSB 25 g/kg Seed + Phosphorus 60 kg/ha, T₉ VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 60 kg/ha, T₁₀ N-P-K (20-40-20 kg/ha). Which were replicated thrice. 15 kg/ha seed of Green gram variety Samrat the spacing adopted was plant to plant 10 cm and row to 30 cm according to the treatment details and the seeds were drilled at 2-3 cm depth in the net plot area 3m x 3m on 22 July 2025. VAM and PSB was applied to all of the plots as per the treatments through seed treatment application and Phosphorus was applied to all the plots as per soil treatment application.

The observation on growth parameters i.e. Plant height (cm), Plant dry weight (g), Crop growth rate (g / m² / day) and relative growth rate (g/g/day), No. of Branches/ plant No. of nodules/plant were recorded whereas yield attributing parameters i.e.

Number of pods/plant(no.), Number seeds/pod, Test Weight(g), Seed yield (kg/ha), Stover yield (kg/ha), and Harvest Index (%) from the net plot area these observation were recorded. The recorded data were analysed statistically by ANOVA technique.

Results and Discussion

Growth parameters

Plant Height

At 60 DAS, maximum plant height (68.43 cm) was observed in treatment T₃ (VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 40 kg/ha). Which was statistically at par with treatment T₂ (PSB 25 g/kg Seed + Phosphorus 40 kg/ha). The increased plant height may be attributed to improved phosphorus availability and nutrient uptake through the combined action of VAM and PSB". Similar findings were reported by Singh *et al.* (2024) ^[7] and Rekha *et al.* (2016) ^[8].

Plant dry weight

At 60 DAS, highest plant dry weight (7.73g/plant) was observed in treatment T₉ (VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 60 kg/ha). Which was statistically at par with treatment T₇ (VAM 25 g/kg Seed + Phosphorus 60 kg/ha) and treatment T₆ (VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 50 kg/ha).

The increased dry matter accumulation under this treatment may be attributed to improved phosphorus availability, enhanced nutrient uptake and better root development through the combined action of VAM and PSB. Similar findings were reported by Singh *et al.* (2024) ^[7], Kumari *et al.* (2025) ^[9] and Rekha *et al.* (2016) ^[8], who observed improved growth and dry

matter production in green gram with the combined application of biofertilizers and phosphorus.

Crop Growth Rate (g/m²/day)

At 45-60 DAS, highest crop growth rate (0.875 g/m²/day) was observed in treatment T₁₀ (Control (RDF) 20:40:20 NPK kg/ha) and lowest crop growth rate (0.512g / m² / day) was obtained in treatment T₁ (VAM25 g/kg Seed + Phosphorus 40 kg/ha).

Relative Growth Rate (g/g/day)

At 45-60 DAS, highest relative growth rate (0.637 g/g/day) was observed in treatment T₅ (PSB 25 g/kg Seed + 50 kg/ha Phosphorus) and lowest relative growth rate (0.343 g/g/day) was obtained in treatment T₁ (VAM25 g/kg Seed + Phosphorus 40 kg/ha). There was no significant difference among all the treatment combinations.

The improvement in growth may be attributed to enhanced phosphorus availability, better root development and increased nutrient uptake through the synergistic action of VAM and PSB. Similar findings were reported by Singh *et al.* (2024)^[7], Kumari *et al.* (2025)^[9], Rekha *et al.* (2016)^[8] and Sai Teja *et al.* (2023)^[10].

Branches of Green gram

At 60 DAS, highest plant branches (14.86/plant) was observed in treatment T₆ (VAM 25 g/kg + PSB25 g/kg Seed + Phosphorus 50 kg/ha). Which was statistically at par with treatment T₂ (PSB 25 g/kg Seed + Phosphorus 40 kg/ha) and treatment T₁ (VAM25 g/kg Seed + Phosphorus 40 kg/ha).

The increase in branching may be attributed to enhanced phosphorus availability and improved nutrient uptake due to PSB inoculation. Similar findings were reported by Singh *et al.* (2024)^[7], Kumari *et al.* (2025)^[9] and Rekha *et al.* (2016)^[8].

Nodules of Green gram

At 60 DAS, highest nodules (16.53/plant) was observed in treatment T₄ (VAM25 g/kg Seed + Phosphorus 50 kg/ha). Which was statistically at par with treatment T₅ (PSB 25 g/kg Seed + Phosphorus 50 kg/ha) and treatment T₆ (VAM 25 g/kg + PSB25 g/kg Seed + Phosphorus 50 kg/ha).

The number of nodules in green gram increased numerically due to the application of biofertilizers and phosphorus. The increase may be attributed to enhanced root growth, improved phosphorus availability and increased activity of beneficial microorganisms, which promoted biological nitrogen fixation and nodulation. Similar observations were reported by Kumari *et al.* (2015), Singh *et al.* (2006), Tomar *et al.* (2023)^[11] and Teja *et al.* (2023)^[10]. However, the differences among treatments were statistically nonsignificant.

Yield parameters

Number of Pods/Plant

Number of pods/plant recorded at harvest stage, The data shown that The number of pods per plant was not significantly influenced by different biofertilizer and phosphorus treatments. Numerically, the highest number of pods per plant (19.13) was recorded under T₁ (VAM 25 g/ kg seed + Phosphorus 40 kg/ ha), which was at par with all other treatments due to non-significant variation among treatments. The lowest number of pods per plant (16.60) was observed under T₁₀ (Control RDF 20:40:20 NPK kg ha⁻¹).

The increase in pod formation under biofertilizer inoculation may be attributed to improved nutrient availability, enhanced root development and increased biological nitrogen fixation. Similar findings were reported by Kumar *et al.* and Patel *et al.*, who observed increased pod production in mung bean due to the combined application of biofertilizers and phosphorus.

Number of Seeds/Pod

Number of seeds/pod recorded at harvest stage, The data shown that The number of seeds per pod did not differ significantly among treatments. The maximum number of seeds per pod (8.26) was recorded under T₇ (VAM 25 g /kg seed + phosphorus 60 kg ha⁻¹), which remained statistically at par with all other treatments. The minimum number of seeds per pod (5.86) was observed under T₄ (VAM 25 g /kg seed + phosphorus 50 kg/ ha). However, treatment T₉ (VAM 25 g/kg + PSB25 g/kg Seed + Phosphorus 60 kg/ha) was found to be statistically at par with treatment T₇.

Improved phosphorus nutrition and beneficial microbial activity might have contributed to better reproductive development and seed setting. Similar results were reported by Meena and Singh and Yadav *et al.*^[12].

Test weight (g)

The significant maximum Test weight (32.64g) was observed in (T₄) (VAM 25 g/kg Seed + Phosphorus 50 kg/ha). compared to the control (28.40g). While lowest test weight was observed in treatment T₁₀ (N-P-K 20-40-20 kg/ha (control)).

The improvement in test weight may be attributed to enhanced phosphorus uptake and efficient translocation of photosynthates to developing seeds. Similar observations were reported by Singh *et al.* and Kumawat *et al.*

Seed yield (kg/ha)

Seed yield did not differ significantly among treatments; however, the highest seed yield (1613.33 kg/ ha) was recorded under T₇ (VAM 25 g/ kg seed + phosphorus 60 kg/ ha), while the lowest seed yield (1476.67 kg/ ha) was observed under T₅. The higher seed yield may be attributed to better nutrient availability, enhanced nodulation and improved photosynthetic activity under biofertilizer inoculation coupled with phosphorus application. Similar findings were reported by Rathore *et al.* and Jat *et al.*

Stover yield (kg/ha)

Maximum stover yield (750.000 kg/ha) was observed in treatment T₉ (VAM 25 g/kg + PSB25 g/kg Seed + Phosphorus 60 kg/ha). whereas the lowest value (423.333 kg/ha) was observed under T₄. Enhanced vegetative growth resulting from improved nutrient uptake and microbial activity might have contributed to higher biomass production. Similar results were reported by Verma *et al.* and Choudhary *et al.*

Harvest index (%)

Maximum harvest index (78.67%) was recorded in treatment T₄ (VAM 25 g/kg Seed + Phosphorus 50 kg/ha) whereas, minimum harvest index (68.02%) was recorded in treatment T₉ (VAM 25 g/kg + PSB25 g/kg Seed + Phosphorus 60 kg/ha), respectively. The higher harvest index indicates efficient partitioning of assimilates towards economic yield. Similar observations were reported by Sharma *et al.* and Khandelwal *et al.*

Table 1: Effect of Biofertilizer and Phosphorus on Growth and Yield of Green gram (*Vigna radiata* L.)

	Treatments	Plant height (cm)	Plant dry weight (g/plant)	Crop Growth Rate (g/m ² /day)	Relative Growth Rate (g/g/day)	No. of Branches/plant	No. of Nodules/plant
T ₁	VAM 25 g/kg Seed + Phosphorus 40 kg/ha	63.43	6.46	0.512	0.343	14.33	14.93
T ₂	PSB 25 g/kg Seed + Phosphorus 40 kg/ha	67.96	6.53	0.668	0.489	14.73	15.86
T ₃	VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 40 kg/ha	68.43	7.13	0.776	0.546	13.33	16
T ₄	VAM 25 g/kg Seed + Phosphorus 50 kg/ha	66.06	6.8	0.553	0.361	14.00	16.53
T ₅	PSB 25 g/kg Seed + Phosphorus 50 kg/ha	62.1	6.86	0.824	0.637	14.00	16.4
T ₆	VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 50 kg/ha	60.26	7.46	0.823	0.557	14.86	16.33
T ₇	VAM 25 g/kg Seed + Phosphorus 60 kg/ha	59.83	7.66	0.763	0.462	13.33	15.53
T ₈	PSB 25 g/kg Seed + Phosphorus 60 kg/ha	64.46	6.93	0.625	0.405	13.6	16.33
T ₉	VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 60 kg/ha	57.9	7.73	0.819	0.500	14.33	16.33
T ₁₀	N-P-K 20-40-20 kg/ha (control)	56.46	7.26	0.875	0.612	14.06	15.13
	F - Test	S	NS	NS	NS	NS	NS
	S.Em (±)	2.45	0.50	0.00	0.009	0.37	1.15
	CD (p = 0.05)	7.27					

Table 2: Effect of Biofertilizer and Phosphorus on Growth and Yield of Green gram (*Vigna radiata* L.)

	Treatments	No. of pods/plant	No. of seeds/pod	Test Weight	Seed yield (kg/ha)	Stover Yield (kg/ha)	Harvest index (%)
T ₁	VAM 25 g/kg Seed + Phosphorus 40 kg/ha	19.13	7.2	31.14	1576.67	576.667	75.53
T ₂	PSB 25 g/kg Seed + Phosphorus 40 kg/ha	17.66	7.46	28.67	1573.33	506.667	75.66
T ₃	VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 40 kg/ha	17.26	6.73	29.51	1513.33	516.667	74.84
T ₄	VAM 25 g/kg Seed + Phosphorus 50 kg/ha	17.93	5.86	32.64	1556.67	423.333	78.67
T ₅	PSB 25 g/kg Seed + Phosphorus 50 kg/ha	18.13	6.86	31.38	1476.67	620.000	70.39
T ₆	VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 50 kg/ha	17.33	7.26	31.034	1523.33	640.000	70.82
T ₇	VAM 25 g/kg Seed + Phosphorus 60 kg/ha	17.2	8.26	31.20	1613.33	583.333	73.54
T ₈	PSB 25 g/kg Seed + Phosphorus 60 kg/ha	18.93	7.26	30.40	1496.67	510.000	74.73
T ₉	VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 60 kg/ha	18.13	7.46	31.63	1560.00	750.000	68.02
T ₁₀	N-P-K 20-40-20 kg/ha (control)	16.6	6.86	28.40	1480.00	570.000	72.24
	F - Test	NS	NS	S	NS	NS	NS
	S.Em (±)	0.90	0.62	0.637	54.176	84.2337	2.7277
	CD (p = 0.05)			1.893	-	-	-

Table 3: Effect of Biofertilizer and Phosphorus on economics of Green gram (*Vigna radiata* L.)

	Treatments	Cost of Cultivation	Gross Return	Net Return	B:C ratio
T ₁	VAM 25 g/kg Seed + Phosphorus 40 kg/ha	48194.8498	139395.467	91200.61	2.89
T ₂	PSB 25 g/kg Seed + Phosphorus 40 kg/ha	48169.7248	138963.2	90793.47	2.88
T ₃	VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 40 kg/ha	48194.8498	133722.4	85527.55	2.77
T ₄	VAM 25 g/kg Seed + Phosphorus 50 kg/ha	48196.6075	137335.2	89138.59	2.84
T ₅	PSB 25 g/kg Seed + Phosphorus 50 kg/ha	48171.4825	130714.133	82542.65	2.71
T ₆	VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 50 kg/ha	48196.6075	134845.867	86649.25	2.79
T ₇	VAM 25 g/kg Seed + Phosphorus 60 kg/ha	48197.2978	142623.733	94426.43	2.95
T ₈	PSB 25 g/kg Seed + Phosphorus 60 kg/ha	48172.1728	132247.733	84075.56	2.74
T ₉	VAM 25 g/kg + PSB 25 g/kg Seed + Phosphorus 60 kg/ha	48197.2978	138280.8	90083.50	2.86
T ₁₀	Control (RDF) (20:40:20) NPK kg/ha	48166.6	130906.4	82739.8	2.71

Economic

Cost of Cultivation: The Cost of Cultivation of greengram (*Vigna radiata* L.) was discussed in Table 3. The Total Cost of cultivation INR 48197.2978 was found to be highest in treatment T7 (VAM

25 g/kg Seed + Phosphorus 60 kg/ha).

Gross returns: The Gross return of greengram was discussed in Table 3. The higher Gross return INR 142623.733/ha were obtained in treatment T7 (VAM 25 g/kg Seed + Phosphorus 60

kg/ha).

Net returns: The Net return of greengram was discussed in Table 3. The higher Net return INR 94426.43/ha were obtained in treatment T7 (VAM 25 g/kg Seed + Phosphorus 60 kg/ha).

Benefit-Cost Ratio: The benefit-cost ratio of greengram was discussed in Table 3. The higher B:C (2.95) were obtained in T7 (VAM 25 g/kg Seed + Phosphorus 60 kg/ha)

Conclusion

The present investigation demonstrated that the integration of phosphorus with biofertilizers showed several growth, yield attributes, productivity, and economic parameters of greengram, although most differences among treatments were statistically non-significant. Phosphorus supplementation improved nutrient availability and uptake, while biofertilizers such as VAM and PSB contributed to better root development and nutrient acquisition. Among the treatments, T₇ (VAM 25 g/kg seed + Phosphorus 60 kg/ha) recorded the highest seed yield and the maximum gross return, net return, and benefit-cost ratio, whereas T₉ (VAM 25 g/kg + PSB 25 g/kg seed + Phosphorus 60 kg/ha) recorded the highest stover yield. Thus, the integration of phosphorus with biofertilizers showed potential for improving productivity and profitability of greengram and may be considered a sustainable and economically viable practice for greengram cultivation during the Kharif season.

Competing Interests

Authors have declared that no competing interest exist.

References

1. Rao D, Sachan CP, Pashwan VR, Sakpal AV. Effect of biofertilizer and zinc levels on growth and yield of green gram (*Vigna radiata* L.). The Pharma Innovation. 2021;10(11):197-204.
2. Patel BN, Patel KH, Singh N, Shrivastava A. Effect of Phosphorus, FYM and bio-fertilizers on yield and nutrient content of summer green gram (*Vigna radiata* L.). Journal of Pharmacognosy and Phyto-Chemistry. 2019;1379-1382.
3. Mishra S, Jain DA. Influence of Integrated Supply of Bio Fertilizers, Chemical Fertilizers and Vermicompost on Soil Nutrient Status. Advances in Zoology and Botany. 2013;1(3):62-64.<https://doi.org/10.13189/azb.2013.010303>
4. Shravani K, Triveni S, Latha PC, Ramulu V. Biofertilizers formulations and their effect on morphological characters in green gram (*Vigna radiata* L.). Journal of Pharmacognosy and Phytochemistry. 2019;8(3):2460-2465.
5. Dubey M, Verma VK, Barpete RD, Verma N. Effect of Biofertilizers on Growth of Different Crops. Plant Archives. 2019;19:1083-1086.
6. Patel J, Vaddoria M. Seed Technology: Progress and Recent Advances. 2018.<https://doi.org/10.59317/9789390083923>
7. Singh U, Debbarma V, Choudhary M, Saini H. Effect of biofertilizer and phosphorus on growth and yield of greengram (*Vigna radiata* L. Wilczek). International Journal of Research in Agronomy. 2024;7(5):451-455.
8. Rekha K, Pavaya RP, Chaudhary N, Patel S. Effect of FYM, Phosphorus and PSB on growth, yield and quality of greengram. International Journal of Bio-resource and Stress Management. 2016;7(2):293-297.
9. Kumari M, Debbarma V, Kumar S, Divyanshi, Piri S. Effect of biofertilizers and phosphorus on growth and yield of greengram (*Vigna radiata* L.). International Journal of Advanced Biochemistry Research. 2025.
10. Sai Teja M *et al.* Different levels of phosphorus and

phosphorus solubilizing bacteria influence growth, yield and economics of green gram (*Vigna radiata* L.). Journal of Food Legumes. 2023.

11. Tomar SS, Singh N, Kishore A, Sharma JD, Parashar A. Response of green gram (*Vigna radiata* (L.) Wilczek) to application of biofertilizers and phosphorus. Journal of Food Legumes. 2023;36(4):395-399.
12. Yadav J, Verma JP. Effect of Phosphorus and biofertilizers on growth and nodulation of mungbean. The Bioscan. 2014;9(1):227-230.
13. Rathore RS, Jat BL, Meena ML. Effect of biofertilizers and phosphorus on productivity of mungbean. Journal of Food Legumes. 2016;29(2):120-123.
14. Sharma V, Kumawat N, Kumar R. Response of Green gram to phosphorus and biofertilizers application. International Journal of Current Microbiology and Applied Sciences. 2018;7(8):2208-2215.
15. Kumawat N, Sharma OP, Kumar R, Kumari A. Yield and yield attributes of mungbean (*Vigna radiata* L.) as affected by organic manures, PSB and phosphorus fertilization. Environment and Ecology. 2010;28(1A):332-335.