



Influence of Farmyard Manure and Bio-Fertilizers on Growth and Yield of Green Gram

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A study was conducted with the objective to evaluate the influence of Farmyard Manure and bio-fertilizers on growth and yield of green gram. The field experiment was conducted during Zaid season 2023 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj, Uttar Pradesh, India. The soil of the experimental field was sandy loam in texture, slightly alkaline in soil reaction (pH 8), low level of organic carbon (0.28%), available N (219 kg/ha), P (11.6 kg/ha) and K (217.2 kg/ha). The experiment was conducted in Randomized Block Design consisting of 9 treatments with 3 different levels of FYM 05t/ha, 10t/ha, 15t/ha and different biofertilizers Rhizobium 20g/kg seeds, PSB 20g/kg seeds and Trichoderma 4g/kg seeds with three replications and the treatments were allocated randomly in each replication. The results showed that treatment 7 with the application of FYM 15 tonnes/ha + Rhizobium 20g/kg seeds recorded significantly higher plant height (51.32cm), higher plant nodules

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(30.20), higher plant dry weight (13.69g), maximum crop growth rate (12.53g/m² /day), maximum number of pods/plant (19.47), higher seed yield (1513 kg/ha) compared to other treatments. The maximum gross returns (117257.00NR/ha) and maximum net returns (78577.50 INR/ha), whereas highest benefit ratio (2.86) was recorded in treatment 1 with the application of FYM 15 tonnes/ha + Rhizobium 20g/kg seeds as compared to other treatments.

Keywords: Green gram; FYM; bio-fertilizers; growth; yield and economics.

1. INTRODUCTION

“Green gram is one of the major pulse crops grown in India, cultivated in arid and semi-arid region, and it is also known as moong bean. It is originated in the Indo-Burma region and the areas of East Asia. Green gram is considered to be the hardiest of all pulse crops and belongs to the family Leguminosae. It is India's third most important pulse crop in area cultivated and production after chickpea and pigeonpea. In India, green gram is grown in a 3.38 m ha area with 474kg/ha average productivity. In Uttar Pradesh, it is grown on 25.9 thousand ha with a productivity of 659kg/ha. For over half a century, the world has relied on increasing crop yields to supply an ever-increasing demand for food. World pulse production increased significantly during the last two decades” [1]. India is the largest producer and consumer of pulse globally, accounting for 25% of the global output and 15% consumption. India is producing 42.57 lakh hectares and production 20.09 lakh tons and yields 472 g/ha (Jharkhand accounts for the production of 637 kg per hectare green gram from an area of 16.1(t/ha) with the productivity of 10.3 t/ha. Farmyard manure plays a vital role in improving the fertility and capacity of soils through its positive effects on soil physical, volatility and biological properties and level of plant nutrition. More importantly FYM is known to improve the soil physical environment. Polysaccharides produced by microbes which are involved in decomposition of organic manure are important in binding soil particles together and for creating a stable soil structure. With regular use of FYM, soil erosion is minimized and water retention characteristics are improved [2]. Rhizobium is a soil habitat bacterium (which is able to colonize the legume roots and fixes the atmospheric nitrogen symbiotically). The morphology and physiology of Rhizobium varies from free- living condition. They are the most efficient biofertilizer as per the quantity of nitrogen fixed concerned. Rhizobium in the soil poor in Nitrogen may be helpful in boosting up the production through more nitrogen fixation [3]. “Phosphate Solubilizing Bacteria (PSB) plays

an important role in solubilization of soil P through secretion of various organic acids and helps to be available for plants by the use of PSB decreases the environmental pollution which is caused by the use of chemical fertilizers by the combination of Phosphorus and PSB, the plants uptake more Phosphorus” [4]. “Trichoderma is used as successful plant growth enhancers, bio stimulants, biofertilizers, and as effective biocontrol agents against various pathogens. Some of these positive effects have been related to the microbial release of bioactive metabolites and elicitor proteins in the plant rhizosphere” [5].

2. MATERIALS AND METHODS

A field experiment was conducted during Zaid, 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude, and 98 m altitude above the mean sea level. This area is situated on the right side of the river Yamuna. The soil of the experimental field constitutes a part of central Genetic alluvium and is neutral and deep. The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.2), organic carbon (0.48%), available N (108 kg/ha), available P (22.50 kg/ha), and available K (280 kg/ha). The experiment was laid out in Randomized Block Design with 9 treatments each replicated thrice. The observations were recorded on different growth parameters at harvest viz. plant height(cm), no. of nodules, plant dry weight, test weight, seed per pod, pods per plant, seed yield, stover yield and harvest index. were analyzed statistically to test their significance and the experiment findings have been summarized and discussed below under each heading.

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

Plant Height: At 60 DAS, significantly higher plant height (51.32 cm) was observed in the

treatment 7 with application of FYM 15t/ha + *Rhizobium* 20g/kg seeds. However, all the treatments except treatment 3 (FYM 5t/ha + Trichoderma 4g/kg seeds) were statistically at par with treatment FYM 15t/ha + *Rhizobium* 20g/kg seeds. "The higher plant height at maturity may be due to easily availability of macro and micro nutrient which may have helped in growth attribute of Green gram. Similar finding also confirmed" with Meena et al. [6].

Nodules/Plant: At 60 DAS, significantly higher nodules/plant (23.00) was observed in the treatment FYM 15t/ha + *Rhizobium* 20g/kg seeds. However, treatment FYM 5t/ha + Trichoderma 4g/kg seeds, treatment FYM 10t/ha + *Rhizobium* 20g/kg seeds, treatment FYM 15t/ha + PSB 20g/kg seeds and treatment FYM 15t/ha + Trichoderma 4g/kg seeds were found to be statistically at par with treatment FYM 15t/ha + *Rhizobium* 20g/kg seeds. Significant and higher number of nodules/plant may be due to

better root development as levels of phosphorus increased as phosphorus being a component of nucleic acids and various forms of proteins, which could have stimulated cell division, resulted with increased of nodules/plant. Shete et al. [7-9].

Plant Dry Weight: At 60 DAS, significantly higher plant dry weight (13.69 g) was recorded in treatment 7 with the application of FYM 15t/ha + *Rhizobium* 20g/kg seeds. However, the treatment FYM 5t/ha + *Rhizobium* 20g/kg seeds, treatment FYM 15t/ha + PSB 20g/kg seeds and treatment FYM 15t/ha + Trichoderma 4g/kg seeds were found to be statistically at par with treatment FYM 15t/ha + *Rhizobium* 20g/kg seeds. "Rhizobium inoculation in conjunction with nitrogen might have helped in increased cell size and vegetative growth resulted in increased dry matter accumulation of green gram. Similar results were" also reported by Pramanik and Singh [10-12].

Table 1. Growth parameters

S. No.	Treatment	Plant Height (cm)	AT 60DAS	AT 30 DAS
			Dry Weight (g/plant)	Number of nodules per plant
1.	FYM 5 tonnes/ha + <i>Rhizobium</i> 20g/kg seeds	50.54	12.17	28.07
2.	FYM 5 tonnes/ha + PSB 20g/kg seeds	49.96	11.86	28.90
3.	FYM 5 tonnes/ha + Trichoderma 4g/kg seeds	49.38	11.78	29.87
4.	FYM 10 tonnes/ha + <i>Rhizobium</i> 20g/kg seeds	50.84	12.96	29.93
5.	FYM 10 tonnes/ha + PSB 20g/kg seeds	50.45	12.74	30.87
6.	FYM 10 tonnes/ha + Trichoderma 4g/kg seeds	50.04	12.59	30.60
7.	FYM 15 tonnes/ha + <i>Rhizobium</i> 20g/kg seeds	51.32	13.69	31.50
8.	FYM 15 tonnes/ha + PSB 20g/kg seeds	50.66	13.31	30.20
9.	FYM 15 tonnes/ha + Trichoderma 4g/kg seeds	50.66	13.16	30.30
	F- test	S	S	S
	SEm(±)	0.50	0.30	0.43
	CD (p=0.05)	1.52	0.90	1.30

Table 2. Seed yield parameters and harvest index

S. No	Treatments	Number of pods per plant	Grains per pod	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
1.	FYM 5 tonnes/ha + <i>Rhizobium</i> 20g/kg seeds	16.67	8.7	30.80	1179.33	2550.45	34.13
2.	FYM 5 tonnes/ha + PSB 20g/kg seeds	16.43	8.5	30.60	1128.33	2460.25	34.37
3.	FYM 5 tonnes/ha + Trichoderma 4g/kg seeds	16.13	8.4	30.43	1087.33	2445.68	33.90
4.	FYM 10 tonnes/ha + <i>Rhizobium</i> 20g/kg seeds	17.90	9.2	30.61	1336.66	2505.62	33.94
5.	FYM 10 tonnes/ha + PSB 20g/kg seeds	17.47	8.9	30.23	1239.00	2430.28	33.75
6.	FYM 10 tonnes/ha + Trichoderma 4g/kg seeds	17.17	8.6	30.40	1184.33	2410.65	33.14
7.	FYM 15 tonnes/ha + <i>Rhizobium</i> 20g/kg seeds	19.47	9.5	31.00	1513.00	2435.1	34.89
8.	FYM 15 tonnes/ha + PSB 20g/kg seeds	19.13	9.3	30.80	1446.66	2406.45	31.60
9.	FYM 15 tonnes/ha + Trichoderma 4g/kg seeds	18.8	9.1	30.63	1382.66	2365.35	32.02
	F – Test	S	NS	NS	S	S	NS
	SE m (\pm)	0.47	0.36	0.55	23.04	14.94	72
	CD (p=0.05)	1.43	-	-	69.08	45.45	-

Table 3. Cost of cultivation and economic

S. No	Treatments	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C Ratio
1.	05t/ha FYM + 20g/kg seeds <i>Rhizobium</i>	23680.00	91398.33	67718.33	2.86
2.	05t/ha FYM + 20g/kg seeds PSB	23680.00	87445.83	63765.33	2.69
3.	05t/ha FYM + 4g/kg seeds Trichoderma	23612.00	84268.33	60656.33	2.57
4.	10t/ha FYM + 20g/kg seeds <i>Rhizobium</i>	31180.00	103591.70	72411.67	2.32
5.	10t/ha FYM + 20g/kg seeds PSB	31180.00	96022.50	64842.50	2.08
6.	10t/ha FYM + 4g/kg seeds Trichoderma	31112.00	91785.33	60673.83	1.95
7.	15t/ha FYM + 20g/kg seeds <i>Rhizobium</i>	38680.00	117257.50	78577.50	2.03
8.	15t/ha FYM + 20g/kg seeds PSB	38680.00	112116.70	73436.67	1.90
9.	15t/ha FYM + 4g/kg seeds Trichoderma	38612.00	107156.70	68544.67	1.78

3.2 Yield Attributes

Pods/plant: The number of pods/plant was significantly maximum obtained (19.47) in treatment 7 (FYM 15 tonnes/ha + *Rhizobium* 20g/kg seeds). Whereas, minimum (16.13) was recorded with treatment 3 (FYM 5t/ha + Trichoderma 4g/kg seeds).

Number of grains/pod: The number of grains/pod was maximum obtained (9.5) in treatment 7 (FYM 15 tonnes/ha + *Rhizobium* 20g/kg seeds). Whereas, minimum (8.4) was recorded with treatment 3 (FYM 5t/ha + Trichoderma 4g/kg seeds).

Test Weight: Maximum test weight (31.0) was recorded with treatment 7 (FYM 15 tonnes/ha + *Rhizobium* 20g/kg seeds). Whereas, minimum (30.23) was recorded with treatment 5 (FYM 10t/ha + PSB 20g/kg seeds).

Seed Yield: The significantly higher seed yield (1513kg/ha) was obtained with the application of FYM 15 tonnes/ha + *Rhizobium* 20g/kg seeds (treatment 7). This significant increase in seed yield might be due to the bio-priming with *Rhizobium* which was significantly superior. *Rhizobium* inoculation generally initiated the early nodules formation in the crown root system this might be probably due to effect of proliferation of nodule forming bacteria in the root system and enhance the N-fixation from atmosphere and results in better growth and development of plant [13].

Stover Yield: The significantly higher stover yield (2550.45 Kg/ha) was obtained with the application of FYM 5 tonnes/ha + *Rhizobium* 20g/kg seeds (treatment 1). Whereas, minimum (2406.45 Kg/ha) was recorded with treatment 8 (FYM 15t/ha + PSB 20g/kg seeds).

Harvest Index: Maximum Harvest Index (34.89%) was recorded with the application of FYM 15 tonnes/ha + *Rhizobium* 20g/kg seeds (treatment 7). Whereas, minimum (31.60%) was recorded with treatment 8 (FYM 15t/ha + PSB 20g/kg seeds).

3.3 Economics

The data on the economics of different treatments presented showed that the maximum gross return (₹1,17,257.50/ha) and net return (₹78,577.50/ha) was recorded with application of FYM 15 tonnes/ha + *Rhizobium* 20g/kg seeds (treatment 7). However, maximum benefit-cost ratio was obtained in treatment 1 (2.86) due to low cost of cultivation. Minimum gross return (₹77,633.50/ha) and net return (₹43,687.50/ha) was observed with application of 05t/ha FYM+ 4g/kg seeds Trichoderma (treatment 3) and lowest benefit-cost ratio (1.78) was recorded in treatment 9 (15t/ha FYM + 4g/kg seeds Trichoderma). This could be due to the concurrent rise in the quantity of pods/ plant and seeds/ pod, which surplus assimilates may have stored in the leaves and then translocated into seeds when the plant reached senescence, ultimately increased higher benefit cost ratio. Similar result was reported by Nawhal et al. [14,15].

4. CONCLUSION

On the basis of one season experimentation, the objective undertaken in the experiment, significantly higher Plant height (51.32cm), higher nodules/plant (31.50), higher plant dry weight (13.69 g), higher crop growth rate (12.53 g/m²/day), higher number of Pods/Plant (19.47), higher number of seeds/pod (9.5), higher test weight (31 g), higher seed yield (1513 kg/ha) was recorded with treatment 7 (15t/ha FYM + 20g/kg seeds *Rhizobium*). Higher gross returns (117257.50 INR/ha) and net return (78577.50 INR/ha) was also recorded with treatment 7. So, it can be concluded that application of (FYM 5 tonnes/ha + *Rhizobium* 20g/kg seeds) Treatment 7 in Green gram has recorded highest seed yield, gross return and net return.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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