J. Agric. Res. Technol., 51 (3) : 313-317 (2026) https://doi.org/10.56228/JART.2026.51306

Impact of PROM and PSB Application on Green Gram Yield and Economic Performance

G. S. Tonde1, N. J. Danawale2, S. S. Ilhe3, A. G. Durgude4, M. R. Patil5 and P. S. Bodake6
Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
Corresponding author Email : niteendanawale@rediffmail.com
(Received : 14.02.2026 Accepted : 30.07.2026)

Abstract

Green gram (*Vigna radiata* L.) is a crucial crop globally, serving as a staple food for a vast population. Its productivity faces various challenges such as nutrient imbalance in India. To address this issue, a study was conducted during the *Kharif* season of 2024-2025 at the Instructional Farm, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, with a view to study the "Response of green gram to phosphorus management through PROM and PSB". The experiment was conducted in Split Plot Design with 3 replications. The study evaluated various levels of PROM application (50%, 75%, and 100% of recommended PROM) and different methods of liquid PSB inoculation. The results demonstrated a significant positive effect of integrated phosphorus management on nutrient assimilation by the green gram crop. Application of 100% P_2O_5 through PROM (M_3) produced significantly higher green gram seed yield (1228 kg ha^{-1}) which was at par with M_2 (75 % P_2O_5 through PROM) (1194 kg ha^{-1}). Among PSB treatments, the green gram seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + drenching with liquid PSB @ 5 lit ha at 30 DAS (S_4) produced significantly higher seed yield (1136 kg ha^{-1}) which was at par with S3 (1127 kg ha^{-1}). The interaction between phosphorus levels and PSB was significant. The highest gross monetary returns (Rs. 88205 ha^{-1}) were recorded with the application of treatment M_3 i.e. 100% P_2O_5 through PROM. While it was at par with M_2 (Rs.81458 ha^{-1}) The PSB treatment S4 i.e. Seed treatment with liquid PSB + drenching with liquid PSB @ 5 lit^{-1} at 30 DAS also recorded the highest gross monetary returns (Rs. 81708 ha^{-1}) and it was at par with S_3 (Rs. 79866 ha^{-1}) and S_2 (Rs. 78207 ha^{-1}). The highest net monetary returns were recorded with the treatment M_3 i.e. application of 100% P_2O_5 through PROM (Rs. 41193 ha^{-1}), while it was at par with treatments M_1 and M_2 (Rs. 33069 ha^{-1} and Rs. 36749 ha^{-1}) respectively. The PSB treatment S_3 i.e. Seed treatment with liquid PSB + drenching with liquid PSB @ 5 lit^{-1} at 30 DAS also recorded the highest net monetary returns (Rs. 36841 ha^{-1}) and it was at par with treatments S_3 and S2 (Rs. 35060 ha^{-1} and Rs. 33712 ha^{-1}) respectively.

Key words : Yield, Harvest index, Monetary returns, PROM and PSB.

Green gram (*Vigna radiata* L.), commonly known as Mungbean, is an ancient and widely recognized pulse crop. It belongs to the Papilionoideae family and is thought to have originated in South East Asia (Mogotsi, 2006). Mungbean seeds are highly valued for their nutritional profile. They typically contain 20-24% protein, 2.1% oil, 2.05% fats, 6.4% fiber, 9.4 % moisture, and supply 343.5 kcal of energy per 100 grams. They are also a source of carbohydrates and a good amount of Vitamins A and B. Notably, the protein and carbohydrates found in mungbean are more readily digestible compared to those in many other legumes. (Dainavizadeh and Mehranzadeh, 2013).

Phosphate Rich Organic Manure (PROM) is an alternative fertilizer that can be used in place of chemical fertilizers like diammonium phosphate (DAP) and single super phosphate (SSP). PROM is created by co-composting finely ground rock phosphate (with a high-grade content of 32% P_2O_5 ± 2%) with organic material. The finer the rock phosphate particles (e.g., 80% finer than 54 microns), the greater its agronomic efficiency. This organic manure is considered a more environmentally aligned method of adding phosphorus to the soil. It is

efficient, supplying phosphorus to a second crop planted in the same area as effectively as the first. Furthermore, PROM can be produced by utilizing acidic waste solids recovered from the discharge of biogas plants. Phosphate Solubilizing Bacteria (PSB) are beneficial microorganisms that play a role in converting insoluble inorganic phosphorus compounds in the soil into forms that plants can readily absorb (Chen *et al*., 2006). PSB strains facilitate this process by releasing low molecular weight organic acids into the soil. These organic acids, possessing hydroxyl and carboxyl groups, can chelate the cations that are bound to phosphate, thus converting the insoluble phosphorus into its soluble forms. The use of PSB in conjunction with pulse crops is a cost-effective and effective method of phosphate fertilization that also enhances overall soil fertility for legumes.

Materials and methods

An investigation titled "Response of green gram to phosphorus management through PROM and PSB" was conducted during the *Kharif*, 2024 season. The experiment took place at the Post Graduate Institute Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahilyanagar, Maharashtra. The primary objective was to evaluate how various Phosphorus Rich Organic Manure (PROM) levels and methods of Phosphate Solubilizing Bacteria (PSB) application affect the growth, yield, quality, and economic returns of green gram. The study also assessed the economic viability of the fertilizer and microbial treatments.

In the present study, treatment 100% P_2O_5 through PROM recorded significantly higher growth and yield attributes *viz*., plant height, number of leaves plant^{-1}, Leaf area, dry matter plant^{-1} grain yield of green gram. In case of Phosphate solubilizing bacteria (PSB) treatments the application of Seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + Drenching with liquid PSB @ 5 lit ha^{-1} at 30 DAS recorded significantly maximum growth and yield attributes, *viz*., plant height, number of leaves plant^{-1}, number of pod plant^{-1}, grain yield.

Based on the investigation's results, the following treatments are concluded to be the most appropriate for green gram cultivation 100% P_2O_5 through PROM (M_3) Seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + Drenching with liquid PSB @ 5 lit ha^{-1} at 30 DAS (S_4) These two treatments were found to be optimal for achieving the highest grain yield, chlorophyll content, and crude protein in the crop. Economically, they also yielded the highest gross monetary returns, net monetary returns, and Benefit: Cost (B:C) ratio.

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads (Table 1).

The data in respect of yield of green gram as influenced by different treatments during *Kharif* season of 2024-2025 are presented in Table 1. The mean seed, straw and biological yield of green gram were 1120, 1581 and 2701 kg ha^{-1} respectively obtained during investigation.

Application of 100% P_2O_5 through PROM (M_3) produced significantly higher green gram seed yield (1228 kg ha^{-1}) which was at par with M_2 (75% P_2O_5 through PROM) (1194 kg ha^{-1}). Among PSB treatments, the green gram seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + drenching with liquid PSB @ 5 lit ha at 30 DAS (S_4) produced significantly higher seed yield (1136 kg ha^{-1}) which was at par with S_3 (1127 kg ha^{-1}). The highest seed yield (1246 kg ha^{-1}) was recorded in M3S4 (100% P_2O_5 through PROM + seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + drenching with liquid PSB @ 5 lit ha^{-1} at 30 DAS).

Table 1. Seed yield, Straw yield, biological yield and Harvest index of green gram as influenced by the different treatments

Treatments	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index %
A. Main factor (Phosphorus level)				
M_0 - Absolute control	962	1378	2341	41.12
M_1 - 50% P_2O_5 through PROM	1095	1526	2620	41.27
M_2 - 75% P_2O_5 through PROM	1194	1672	2890	41.30
M_3 - 100% P_2O_5 through PROM	1228	1700	2920	42.06
S. Em. ±	12.2	16.1	14.3	
C.D. at 5%	36.5	50.1	44.9	
B. Sub Factor (Phosphate solubilizing bacteria (PSB)				
S_1 - Seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed	1101	1561	2662	41.34
S_2 - Drenching with liquid PSB @ 5 lit ha^{-1} at 15 and 30 DAS	1115	1574	2689	41.47
S_3 - Seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + Drenching with liquid PSB @ 5 lit ha^{-1} at 15 DAS	1127	1588	2719	41.44
S_4 - Seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + Drenching with liquid PSB @ 5 lit ha^{-1} at 30DAS	1136	1603	2739	41.48
S. Em. ±	6.5	8.2	17.1	
C.D. at 5%	19.1	24.9	22.2	
C. Interaction effect				
S. Em. ±	12.23	3.10	13.90	
C.D. at 5 %	38.20	8.90	40.60	
General Mean	1120	1581	2701	

Application of 100% P_2O_5 through PROM produced significantly higher green gram straw yield (1700 kg ha-1) and it was at par with application of 75% P_2O_5 through PROM (1672 kg ha^{-1}). Among PSB treatments, the green gram seed treatment with liquid Phosphorous solubilizing bacteria @ 20-25 ml kg^{-1} seed + drenching with liquid PSB @ 5 lit ha^{-1} at 30 DAS (S4) produced significantly higher straw yield (1603 kg ha^{-1}) which was at par with S3 (1588 kg ha^{-1}). The treatment 100% P_2O_5 through PROM (M_3) recorded numerically higher harvest index (42.06), followed by 75% P_2O_5 through PROM (M_2). Minimum harvest index observed in treatment absolute control i.e. M_0 (41.12). Harvest index significantly influenced by Effect of Phosphorous solubilizing bacteria (PSB) treatments. The Seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + Drenching with liquid PSB @ 5 lit ha^{-1} at 30 DAS (S_4) treatment recorded the highest harvest (41.48).

These results are in collaboration with findings of Vyas *et al*., (2013), Sharif *et al*., (2015) and Wahid *et al*., (2015) where integrated use of phosphorus sources enhanced nutrient use efficiency.

The economics of different treatments were significantly influenced by both phosphorus levels and PSB treatments are presented in Table 2.

The highest gross monetary returns (Rs. 88205 ha^{-1}) were recorded with the application of treatment M_3 i.e. 100% P_2O_5 through PROM. While it was at par with M_2 (Rs.81458 ha^{-1}) whereas absolute control i.e. M_0 were

Table 2. Economics of green gram as influenced by different treatments

Treatments	Cost of Cultivation (Rs. ha^{-1})	Gross monetary returns (Rs. ha^{-1})	Net monetary returns (Rs. ha^{-1})	B:C ratio
A. Main factor (Phosphorus level)				
M_0 - Absolute control	41602	68201	26600	1.64
M_1 - 50% P_2O_5 through PROM	43422	76491	33069	1.76
M_2 - 75% P_2O_5 through PROM	44709	81458	36749	1.82
M_3 - 100% P_2O_5 through PROM	47013	88205	41193	1.88
S. Em. ±	-	2833	2833	-
C.D. at 5%	-	8504	8511	-
B. Sub Factor (Phosphate solubilizing bacteria (PSB)				
S_1 - Seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed	42577	74574	31997	1.75
S_2 - Drenching with liquid PSB @ 5 lit ha^{-1} at 15 and 30 DAS	44495	78207	33712	1.76
S_3 - Seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + Drenching with liquid PSB @ 5 lit ha^{-1} at 15 DAS	44806	79866	35060	1.78
S_4 - Seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + Drenching with liquid PSB @ 5 lit ha^{-1} at 30DAS	44806	81708	36841	1.82
S. Em. ±	-	2336	2098	-
C.D. at 5%	-	6978	6178	-
C. Interaction effect				
S. Em. ±	-	1219	1219	-
C.D. at 5 %	-	3654	3654	-

recorded the lowest gross monetary return (Rs. 68201 ha^{-1}) followed by M_1 (76491 kg ha^{-1}). These results are in conformity with Majeed *et al*., (2014) and Majeed *et al*., (2018).

The PSB treatment S_3 i.e. Seed treatment with liquid PSB + drenching with liquid PSB also recorded the highest gross monetary returns (Rs. 81708 ha^{-1}) and it was at par with S_3 (Rs. 79866 ha^{-1}) and S_2 (Rs. 78207 ha^{-1}). These results are in conformity with Majeed *et al*. (2014) and Majeed *et al*. (2018).

The highest net monetary returns were recorded with the treatment M3 i.e. application of 100% P_2O_5 through PROM M_3 (Rs. 41193 ha^{-1}), while it was at par with treatments M_2 and M3 (Rs. 33069 ha-1 and Rs. 36749 ha^{-1}) respectively. The higher seed and straw yield, combined with a lower cost of cultivation, were responsible for achieving the highest net monetary returns in the green gram crop. The lowest net monetary returns was recorded in absolute control treatment (26600 kg ha^{-1}).

The PSB treatment S3 i.e. Seed treatment with liquid PSB + drenching with liquid PSB also recorded the highest net monetary returns (Rs. 36841 ha^{-1}) and it was at par with treatments S3 and S2 (Rs. 35060 ha^{-1} and Rs. 33712 ha^{-1}) respectively. The lowest net monetary returns was recorded in absolute control treatment (Rs. 31997 kg ha^{-1}).

The higher seed and straw yield with lower cost of cultivation were responsible for getting the highest net monetary returns in green gram crop. These results are in conformity with Majeed *et al*., (2018) and Majeed *et al*., (2014).

Conclusion

The application of 100 % N (20 kg ha^{-1}) and 75% P_2O_5 (30 kg P_2O_5 ha^{-1}) through PROM along with Seed treatment with liquid PSB @ 20-25 ml kg^{-1} seed + Drenching with liquid PSB @ 5 lit ha^{-1} at 15 or 30 DAS to green gram found beneficial for obtaining higher yield and economics.

Acknowledgement

We are very thankful to the Post Graduate Institute, MPKV, Rahuri for providing all facilities and research grants to carry out this experimental work and authors cited in references for providing necessary literature material.

Conflict of Interest

The authors declare there are no conflict of interest relevant to this article.

References

Chen, Y. P., Rekha, P. D., Arun, A. B. and Young, C. C. V. 2006. Phosphate solubilizing bacteria from subtropical soil and their tricalcium phosphate solubilizing abilities. Applied Soil Ecology 34: 33-41.

Dainavizadeh, P. and Mehranzade, H. M. 2013. Effect of seed rate on growth, yield components and yield of mung bean grown under irrigated conditions in the North of Khuzestan. International Journal of Agriculture and Crop Sciences 5(20): 2359-2365.

Majeed, M., Ahmad, R., Tahir, M., Tanveer, A. and Ahmad, M. 2014. Effect of phosphorus fertilizer sources and rates on growth and yield of wheat (*Triticum aestivum* L.). Asian Journal of Agriculture Biology 2 (1): 14-19.

Majeed, M., Ahmad, R., Tahir, M., Tanveer, A. and Ahmad, M. 2018. Effect of phosphorus fertilizer sources and rates on growth and yield of wheat (*Triticum aestivum* L.). Asian Journal of Agriculture Biology 2(1): 14-19.

Mogotsi, K. 2006. Mung bean (*Vigna radiata* L.). In M. Brink & G. Belay (Eds.), PROTA 1: Cereals and pulses/Cereals legumes, CD-Rom : 23–29. PROTA

Sharif, M., Khan, M., Khan, M., Wahid, F., Marwat, K., khattak, A. and Naseer, M. 2015. Effect of rock phosphate and farmyard manure applied with effective microorganisms on the yield and nutrient uptake of wheat and sunflower crops. Pakistan Journal of Botany 47(1): 219 - 226.

Vyas, K. G., Patel, A. M., Raval, C. H. and Bhatt, P. K. 2013. Effect of rock phosphate, FYM and phosphobacteria on growth, yield and economics of wheat in north Gujarat. Agriculture Journal 100(4): 477-479.

Wahid, F., Sharif, M., Khan, M., Ali, A., Khattak, A. and Saljoqi, A. 2015. Addition of rock phosphate to different organic fertilizers influences phosphorus uptake and wheat yield. Pakistan Journal of Science 30(1): 223-254.