International Journal of Plant & Soil Science

Volume 37, Issue 5, Page 399-404, 2025; Article no.IJPSS.135262
ISSN: 2320-7035

Application of Micronutrients for Augmenting Yield and Yield Attributes of Moong Bean (*Vigna radiata*)

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Authors' contributions

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

Article Information

DOI: https://doi.org/10.9734/ijpss/2025/v37i55463

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/135262

Original Research Article

Received: 05/03/2025
Accepted: 08/05/2025
Published: 15/05/2025

ABSTRACT

This experiment aimed to assess the impact of micronutrient application on primed mung bean (*Vigna radiata*). A field experiment was conducted at the Agricultural Farm of University of Calcutta, Baruipur, India (22°21′38″N 88°25′56″E). In this experiment, seven treatments, each with six replications were designed with a view to compare the production potential under different micronutrients application and also to find out the economic viability of this cultivar for soil quality. Maximum growth parameter, Plant height (53.56 cm), Number of branches per plant (6.45), yield attributes, grain yield (436.62 kg/ha), 1000 grains weight (34.43 g) obtained in P_1i.e. slow release micronutrient-polyphosphate fertilizer (N:P:K:: 60:40:30 kg ha^{-1} and Zn: Fe: Cu: Mn :: 0.75: 0.263:

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Cite as: *Dutta, Bedantika, Feroze Hasan Rahman, and Suddhasuchi Das. 2025. "Application of Micronutrients for Augmenting Yield and Yield Attributes of Moong Bean (Vigna Radiata)". International Journal of Plant & Soil Science 37 (5):399-404. https://doi.org/10.9734/ijpss/2025/v37i55463.*

0.075: 0.15 kg ha^{-1}). Only P_1 treatment among other polyphosphate treatments has positive effect on yield of grains and so becomes statistically significant at the 1% level, over control and soluble ones. The increase in yield for P_1treatment was 3.67% and it was also significant at 1% level with respect to S_1i.e. soluble fertilizers (N:P:K:: 60:40:30 kg ha^{-1} and Zn: Fe: Cu: Mn :: 0.75: 0.263: 0.075: 0.15 kg ha^{-1}). The increase in yield was 0.46% for P_2i.e. slow release micronutrient treatment (N:P:K:: 60:40:30 kg ha^{-1} and Zn: Fe: Cu: Mn :: 0.50: 0.175: 0.05: 0.10 kg ha^{-1}). with respect to S_2 i.e. soluble fertilizers treatment (N:P:K:: 60:40:30 kg ha^{-1} and Zn: Fe: Cu: Mn :: 0.50: 0.175: 0.05: 0.10 kg ha^{-1}). But, the yield for the P_3treatment i.e. slow release micronutrient-polyphosphate fertilizer (N:P:K:: 60:40:30 kg ha^{-1} and Zn: Fe: Cu: Mn :: 0.25: 0.088: 0.025: 0.05 kg ha^{-1}) decreases with respect to S_3i.e. soluble fertilizers treatment (N:P:K:: 60:40:30 kg ha^{-1} and Zn: Fe: Cu: Mn :: 0.25: 0.088: 0.025: 0.05 kg ha^{-1}).

Keywords: Moong bean; micronutrients; polyphosphate; growth parameter; yield.

1. INTRODUCTION

The pulses are an excellent source of dietary proteins and play an important role in fulfilling requirements of rapidly increasing population. Pulse production is very low and has become a challenging problem against the requirement of increasing population of our country (Dhaliwal et al., 2023; Yadav et al., 2024). Its shortage in human diet leads to manifold problems, viz., poor growth and development particularly of growing child. In India, the protein status of common man's diet is far less than the minimum recommendations (80 g day^{-1}) of Indian Council of Medical Research (ICMR) (Jamal et al., 2018). Green gram locally called as moong (Vigna radiate L.) belongs to the family leguminaceae. Being a short duration crop and having wider adaptability, it can be grown in kharif as well as in summer season (Chongre et al., 2020).

Along with serving as a vital source of human and animal food, it also maintains the fertility of the soil. It is a drought-resistant crop appropriate for dryland farming that is mostly grown as an intercrop with other crops because it improves the physical qualities of the soil and fixes atmospheric nitrogen (Chongre et al., 2020).

India is the leading producer of moong bean, accounting for approximately 40 per cent of the global production. As per Ministry of Agriculture and Farmers' Welfare (MAFW, 2023), India was projected to produce approximately 2.1 million metric tonnes of moong bean.

Pulse crops improve the soil structure, lower the bulk density of soil and result in better soil aggregation. Incorporation of moong bean stover in a rice-wheat-moong bean sequence results in lower bulk density and higher hydraulic conductivity and percentage of water stable aggregates of >0.25mm.

How much of a micronutrient is needed, when to apply it, and how (soil, foliar spray, seed treatment) to get the higher productivity of moong bean is required to assess. Understanding micronutrient dynamics helps maintain long-term soil health and reduce excessive use of fertilizers. Hence, toassess the efficiency of micronutrient (Fe, Cu, Zn, Mn) polyphosphate in comparison with commonly used water soluble fertilizer along with normal doses of NPK in the forms of urea, DAP and muriate of potash (KCl) were subjected to the field trials at the Baruipur, Agricultural Farm, Calcutta University (Bhamare et al., 2018; Chaurasiya et al., 2020).

2. MATERIALS AND METHODS

By considering soil reaction, slope of the field, fertility gradient and other physical soil properties, a macro plot was selected at the Agricultural Farm of University of Calcutta, Baruipur, West Bengal, India (22°21′38″N 88°25′56″E). From this macro plot, 42 micro plots, each of which having the size of 4x4 m^2 were prepared. In this experiment, 7 treatments, each with 6 replications were designed in the 42 experiment units in the following manner; the statistical design was Randomized Block Design. After preparing the micro plots, the seeds of moong bean were sown in the Rabi season. In each micro plot, seeds were sown uniformly at a spacing of 30 cm. the width between the rows was 25 cm. After few weeks, thinning was done to make plants equal in number in each plot. After broadcasting the fertilizers in each micro-plot, seeds of moong bean were sown. Sowing was done in the Rabi season.

To obtain fine tilth and good crop growth, the field was prepared by cross ploughing with tractor drawn cultivator followed by harrowing and planking. The weeds and crop residues were removed to get weed and stubble free seed bed.

Table 1. Doses of applied fertilizer

Treatments	Recommended dose of N:P:K	Doses of micronutrients (kg/ha)			
		Zn	Fe	Cu	Mn
C	60:40:30	-	-	-	-
S_1	60:40:30	0.75	0.263	0.075	0.15
S_2	60:40:30	0.50	0.175	0.050	0.10
S_3	60:40:30	0.25	0.088	0.025	0.05
P_1	60:40:30	0.75	0.263	0.075	0.15
P_2	60:40:30	0.50	0.175	0.050	0.10
P_3	60:40:30	0.25	0.088	0.025	0.05

Where, "C" indicates control, where only NPK were added in the form of urea, DAP and muriate of potash (KCl), respectively.
"$S_{(1-3)}$"indicates soluble fertilizer.
"$P_{(1-3)}$" indicates slow release micronutrient-polyphosphate fertilizer

Table 2. Soil characteristics of research plot for Moong-Bean

Location	pH	Conductance (dSm^{-1})	Organic Carbon (mg/kg)	% Sand	% Silt	% Clay
Agricultural Farm of Calcutta University, Baruipur, WB	5.9	0.13	6.6	26.7	41.2	32.1

The soil samples were collected from the macro plot (0-15cm). It was dried, powdered, ground and passed through 2 mm sieve.10 g of the soil sample was taken in a 100 ml beaker and 25 ml of distilled water was added to it. Then the content of the beaker was stirred thoroughly for 30 minutes and the pH of the system was measured (Jackson, 1973) with the help of Elico pH meter equipped with a glass-calomel electrode. The soil suspension prepared for the determination of pH was used for soil conductivity measurements. After recording the soil pH, 25ml water was added and allowed to equilibrate for 30 minutes with occasional stirring. Conductance was then measured (Jackson, 1973) with the aid of an Elico-conductivity bridge using a diptype electrode. Total soluble salt content was then evaluated from this conductance value (Jackson, 1973).

Mechanical analysis for measuring sand, silt and clay was done following the methods as in Piper, 1966.

0**.**5 g of air dry sample was taken ina 500 ml conical flask. 10 ml of 1(N) $K_2Cr_2O_7$ was added to it, 20ml of concentrated H_2SO_4 was poured slowly and the flask was swirled, gently. The flask was kept in dark for 30 min. Then 200ml water and 10 ml orthophosphoric acid were added to it after cooling the contents of the flask under tap water. 1ml of diphenyl amine indicator was added to the contents and titrated with standardized ferrous sulphate solution till the color changed from blue to bottle green. A blank titration was carried out simultaneously.

Harvesting was done after 80 days from the date of sowing in two installments. Representative samples were collected from each of the 42 microplots.

The physico-chemical characteristics of soil in which the field trial was carried out are shown in Table 2. The soil is slightly acidic and belongs to clay-loam textural class. Total organic carbon of the soil is 6.6 mg/kg and the conductance is 0.13 dSm^{-1}.

The yield parameters viz. Plant height (cm), leaf area index (LAI), number of branches $plant^{-1}$, dry matter accumulation (g $plant^{-1}$), no. of pods $plant^{-1}$, pod length (cm), no. of grains per pod, grain yield (kg ha^{-1}), 1000 grains weight (g), harvest index (%) were measured before and after harvesting of the crop.

3. RESULTS AND DISCUSSION

The present investigation aimed to observe the effect of slow-release micronutrient polyphosphate fertilizer.

Data presented in Table 3 clearly indicated that the significant variations were recorded among the treatments in case of plant height ranged between 46.73 cm and 53.56 cm. P_1(N:P:K:: 60:40:30 kg ha^{-1} and Zn: Fe: Cu: Mn :: 0.75:

Table 3. Growth parameters of moong-bean due to for application of slow release micro-nutrient polyphosphate fertilizer (Plot size: 4m × 4m)

Treatments	Growth parameters			
	Plant height (cm)	**Leaf area index (LAI)**	**Number of branches per plant**	**Dry matter accumulation (g/ plant)**
Control	46.73	1.97	4.84	93.98
S1	48.30	2.12	5.19	96.01
S2	49.91	2.28	5.65	99.62
S3	49.08	2.21	5.48	97.99
P1	53.56	2.14	6.45	104.35
P2	48.27	2.67	5.24	95.82
P3	50.23	2.33	5.66	98.92
S.Em(±)	0.44	0.04	0.11	0.85
C.D. (P=0.05)	1.28	0.12	0.31	2.48

Table 4. Yield of moong-bean due to application of slow release micro- nutrient polyphosphate fertilizer (Plot size: 4m × 4m)

	Yield attributes					
Treatments	**No. of pods plant^{-1}**	**Pod length (cm)**	**No. of Grains pod^{-1}**	**Grain yield (kg/ha)**	**1000 grains weight (g)**	**Harvest index (%)**
Control	6.36	6.28	4.52	414.96	32.53	30.04
S1	8.76	6.99	6.71	418.17	33.92	30.67
S2	10.50	7.87	7.48	418.05	34.73	31.43
S3	10.71	7.93	7.41	421.53	34.94	31.33
P1	11.35	9.17	7.56	436.62	34.43	31.94
P2	10.30	7.56	5.67	419.61	33.88	30.60
P3	10.50	7.71	6.55	430.26	33.79	30.29
S.Em ±)	0.25	0.16	0.28	1.93	0.22	0.19
C.D. (P=0.05)	0.73	0.47	0.82	5.60	0.65	0.57

0.263: 0.075: 0.15 kg ha^{-1}) registered maximum plant height of 53.56 cm followed by 50.23 cm in P_3treatment (N:P:K:: 60:40:30 kg ha^{-1}and Zn: Fe: Cu: Mn :: 0.2 5: 0.088: 0.025: 0.05 kg ha^{-1}) (Rolhauser et al., 2022; Sankar et al., 2005). Significant variations in the leaf area index (LAI)among the different treatments were observed. P_2 treatment (N:P:K:: 60:40:30 kg ha^{-1}and Zn: Fe: Cu: Mn :: 0.50: 0.0175: 0.050: 0.10 kg ha^{-1}) recorded maximum leaf area index (LAI) of 2.67 followed by 2.33 in P_3 treatment (N:P:K:: 60:40:30 kg ha^{-1} and Zn: Fe: Cu: Mn :: 0.25: 0.088: 0.025: 0.05 kg ha^{-1}) and minimum leaf area index (LAI) was recorded 1.97 in control (Singh et al., 2017). Data revealed from Table 3 on Number of branches per plant that maximum was recorded 6.45 in P_1followed by 5.66 in $P_3$and 5.65 in S2 treatment (N:P:K:: 60:40:30 kg ha^{-1} and Zn: Fe: Cu: Mn :: 0.50: 0.0175: 0.050: 0.10 kg ha^{-1}) which were statistically at par and lowest of 2.17 was recorded in Control (N:P:K:: 60:40:30 kg ha^{-1}) (Sharma & Dayal, 2005). P_1recorded maximum Dry matter accumulation (104.35 g plant^{-1}) followed by S_2 (99.62 g plant^{-1}) and minimum Dry matter accumulation was recorded in Control (93.98 g plant^{-1}) (Pratap & Gupta, 2020; Pratap et al., 2021; Saini et al., 2022).

Investigation concerning to the number of podsplant-^{1} showed in Table 4, P_1 recorded number of podsplant^{-1} (1.31 cm) followed by S_3 (1.30 cm) and minimum number of pods plant^{-1} was recorded in control (1.23 cm) (Kaysha et al., 2020). Significant variations among the treatments were observed in pod length, P_1 recorded maximum pod length (9.17 cm) followed by S3 (7.93 cm) and minimum pod length was recorded in the control (6.28 cm). P_1 recorded maximum number of grains pod^{-1} (7.56) followed by S2 (7.48) and minimum number of grains pod^{-1} was recorded in control (4.52). Data revealed from Table 4 on grain yield that maximum was recorded in P_1 (436.62 kg ha^{-1}) followed by P3 (430.26 kg ha^{-1}), S_3 (421.53 kg ha^{-1}) which were statistically at par and lowest was recorded in control (414.96 kg ha^{-1}). S_3

recorded maximum 1000 grains weight (34.94 g) followed by S2 (34.73 g) and minimum 1000 grains weight (g) was recorded in Control (32.53). Significant variations in the harvest index among the different treatments were observed. P1 recorded maximum harvest index (31.94 %) followed by S_2 (31.43 %) and minimum harvest index was recorded in control (30.04 %). The similar trends of results were also found in the experiment conducted by (Divyashree et al., 2018; Khandelwal et al., 2013).

The percentage yield of both P_1 and P_3 treatments varies in a non-uniform manner (Table 4). In P_1 treatment increase in yield with respect to control was 5.21%, whereas for P_3 treatment, it was 3.68 % and for S_2 treatment, it was 0.74%.

It can be inferred from the statistical data that only P_1 treatment among other polyphosphate treatments has positive effect on yield of grains and so becomes statistically significant over control and soluble ones.

4. CONCLUSION

The yield of moong bean was statistically found to be significant; however, the general increases in yield for the slow release treatments were not good. This is due to the fact that management practices were not up to the desired level, specially the severe climatic changes created serious problem. Furthermore, throughout the experiment, there was man power problem. All these affected the experiment badly, which at the initial stage appear to be good.

In spite of the setbacks referred to above, the P_1 dose of the poly phosphate fertilizer was found to be significantly higher than the control and the soluble ones. This investigation indicates that slow release micronutrient fertilizer is better than commonly used soluble micronutrient fertilizers. Slow release formulation has a number of advantages. Because of its sparing water solubility, it should have high residual effect and of low environmental hazard.

Slow release micronutrient polyphosphate fertilizers offer ample scope for controlling the solubility and nutrient availability in the products by an easy process of controlling chain length. More importantly, they are relatively of low cost than commercially available micronutrient chelates. Leaching loss is also restricted to a great extent. Thus, it ensures a desired soil health and productivity.

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 the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Bhamare, R. S., Sawale, D. D., Jagtap, P. B., Jagdhani, A. D., & Nimbalkar, R. U. (2018). Effect of iron and zinc on quality and nutrient uptake of French bean in iron and zinc deficient inceptisol soil. *Journal of Pharmacognosy and Phytochemistry*, *7*(4), 464–467.

Chaurasiya, Y., Meena, R. S., & Kumar, S. (2020). Effect of INM on nodulation, yield, quality and available nutrient status in soil after harvest of green gram. *Legume Research - An International Journal*, *39*(4), 590–594.

Chongre, S., Mondal, R., Biswas, S., Munshi, A., Mondal, R., &Pramanick, M. (2020). Effect of liquid manure on growth and yield of summer green gram (*Vigna radiata* L. Wilczek). *Current Journal of Applied Science and Technology*, *38*(6), 1–7.

Dhaliwal, S. S., Sharma, V., Shukla, A. K., et al. (2023). Bio-fortification of mung bean (*Vigna radiata* L. (Wilczek)) with boron, zinc and iron alters its grain yield and nutrition. *Scientific Reports*, *13*, 3506. https://doi.org/10.1038/s41598-023-30539-6

Divyashree, K. S., Prakash, S. S., Yogananda, S. B., &Chandrappa. (2018). Seed yield and nutrient content of moong bean and soil nutrient status as influenced by application of micronutrients mixture in a Alfisol. *International Journal of Current Microbiology and Applied Sciences*, *7*(9), 1706–1713.

Jackson, M. L. (1973). *Soil chemical analysis*. Prentice Hall of India Private Limited.

Jamal, A., Khan, M. I., Tariq, M., & Fawad, M. (2018). Response of mung bean crop to different levels of applied iron and zinc. *Journal of Horticulture and Plant Research*, *3*(13), 13-22.

Kaysha, K., Shanka, D., &Bibiso, M. (2020). Performance of mung bean (*Vigna radiata* L.) varieties at different NPS rates and row spacing at Kindo Koysha district, Southern Ethiopia. *Cogent Food & Agriculture*, *6*(1), 1771112.

Khandelwal, R., Choudhary, S. K., Ghoshlya, J., & Singh, P. (2013). Effect of fertilizer and bio-fertilizers on growth, yield and economics of cowpea. *Annals of Plant and Soil Research*, *15*(2), 177–178.

MAFW. (2023). https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1899193

Pratap, A., & Gupta, S. (Eds.). (2020). *The beans and the peas: From orphan to mainstream crops*. Woodhead Publishing.

Pratap, A., Gupta, S., Rathore, M., Basavaraja, T., Singh, C. M., Prajapati, U., & Kumari, G. (2021). *The beans and the peas* (pp. 1–32). Woodhead Publishing.

Rolhauser, A. G., Windfeld, E., Hanson, S., Wittman, H., Thoreau, C., Lyon, A., & Isaac, M. E. (2022). A trait–environment relationship approach to participatory plant breeding for organic agriculture. *New Phytologist*, *235*(3), 1018–1031.

Saini, P., Rohela, G. K., Saini, P., Mandhal, K. S., Singh, G., Nagpal, S., & Shukla, P. (2022). Molecular breeding strategy against yellow mosaic virus in mung bean. In *Molecular response and genetic engineering for stress in plants*, Volume 2: Biotic stress (pp. 6-1). Bristol, UK: IOP Publishing.

Sankar, V., Veeraragavathatham, D., & Kannan, M. (2005, November 25–27). Postharvest storage life of onion influenced by organic farming practices. In *NRCG Report, National Symposium on current trends in onion, garlic, chillies and seed spices – production, marketing and utilization* (pp. 104–105). Rajguru Nagar, Pune.

Sharma, V. K., & Dayal, B. (2005). Effect of organic and inorganic source of nitrogen on growth, yield and nutrients uptake under cowpea-unseed cropping system. *Legume Research - An International Journal*, *28*(2), 79–86.

Singh, M., Deokaran, M. J., & Bhatt, B. P. (2017). Effect of integrated nutrient management on production potential and quality of summer mung bean (*Vigna radiata* L.). *Journal of Krishi Vigyan*, *5*, 39–45. https://doi.org/10.5958/2349-4433.2017.00009.5

Yadav, P. D., Sharma, R., Bagri, R., Mishra, B., & Choudhary, S. (2024). Survey on web blight of mungbean (*Vigna radiata* (L.) Wilczek.) caused by *Rhizoctonia solani* Kuhn in major growing district of Rajasthan. *Journal of Experimental Agriculture International*, *46*(6), 500–506. https://journaljeai.com/index.php/JEAI/article/view/2502

Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/135262