The Journal of Rural and Agricultural Research Volume 25, No. 2, 74-77 (2025)
Received Sepetmber 2025; Acceptance November 2025
RNI UP BILL/2001/7990 ISSN 2348-6643 (Online) ISSN 0972-4370 (Print)

Enhancing Mung bean [*Vigna radiata* (L.) Wilczek] Growth with Phosphorus and Bio-Organics in an Inceptisol

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Abstract

A pot experiment was conducted to evaluate the effect of phosphorus and bio-organics on the growth attributes of mungbean (Vigna radiata L.) in an Inceptisol. The study revealed that the combined application of phosphorus and bio-organics significantly improved growth parameters. The treatment comprising 40 kg P_2O_5 ha^{-1} + poultry manure 2.5 t ha^{-1} + Rhizobium + PSB resulted in maximum plant height (54.65 cm), branches per plant (6.57), pods per plant (17.67), grains per pod (8.63), and test weight (37.38 g). These findings suggest that integrated nutrient management using phosphorus and bio-organics can be an effective strategy for enhancing mungbean productivity.

Keywords: Mungbean, Phosphorus, Bio-organics, Rhizobium, PSB, Yield Enhancement

Introduction

Mungbean (Vigna radiata L.) is one of the most important pulse crops in India, serving as a primary source of protein and nutrients for millions of people. In addition to its nutritional value, mungbean is also valued for its ability to fix atmospheric nitrogen, improve soil fertility, and provide a valuable source of income for farmers. Despite its importance, mungbean productivity in India remains low, largely due to inadequate nutrient management practices. Phosphorus is a critical nutrient for mungbean production, playing a key role in plant growth, nodulation, and yield formation. However, phosphorus deficiency is a widespread problem in many Indian soils, particularly in regions where mungbean is commonly grown. Bio-organics like vermicompost and poultry manure have been shown to enhance soil fertility, promote plant growth, and improve crop yields. These organic amendments can also help to reduce the environmental impact of chemical fertilizers, making them an attractive option for sustainable agriculture. This study aims to investigate the impact of phosphorus and bio-organics on mungbean growth attributes, with the goal of identifying an effective nutrient management strategy for improving productivity and sustainability in mungbean production systems.

Materials and Methods

A pot experiment was conducted during the kharif season of 2017 in the greenhouse of the Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar

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Pradesh.The experimental soil was sandy loam in texture, alkaline in reaction, low in available nitrogen, and medium in available phosphorus and potassium.The experiment was laid out in a factorial completely randomized design (CRD) with three replications. The experiment consisted of three levels of phosphorus (0, 20, and 40 kg P_2O_5 ha^{-1}) and five levels of bio-organics (Control, VM t 2.5 t ha^{-1}, VM t 2.5 + Rhizobium + PSB t ha^{-1}, PM t 2.5 t ha^{-1} and PM t 2.5 + Rhizobium + PSB t ha^{-1}). Mungbean was grown in an Inceptisol, and growth attributes were recorded.

Results and Discussion

Plant Height

The results indicated that maximum plant height was observed under treatment P_3 (40 kg P_2O_5 ha^{-1}), followed by P_2 (20 kg P_2O_5 ha^{-1}), compared to the control (P_1 : 0 kg P_2O_5 ha^{-1}) at 15 DAS (Table 1). The increase in plant height was statistically non-significant at 15 DAS but became significant at 30 and 45 DAS. Application of 40 kg P_2O_5 ha^{-1} and 20 kg P_2O_5 ha^{-1} resulted in increases of 20.6 and 10.8% at 30 DAS, and 14.9 and 8.16% at 45 DAS, respectively, over the control. Among bio-organic treatments, maximum plant height was recorded in BO_4 (Poultry manure 2.5 t ha^{-1} + *Rhizobium* + PSB), followed by BO_3 (Vermicompost 2.5 t ha^{-1} + *Rhizobium* + PSB) at 15 DAS, while the minimum was observed in BO (Control). The increase in plant height was non-significant at 15 DAS but significant at 30 and 45 DAS. Application of poultry manure 2.5 t ha^{-1} + *Rhizobium* + PSB and vermicompost 2.5 t ha^{-1} + *Rhizobium* + PSB resulted in increases of 14.8 and 13.4% at 30 DAS, and 11.5 and 10.6% at 45 DAS, respectively, compared to the control. These findings are consistent with Balu et al., (2015), Maurya, et al., (2015) and Meena (2017).

Number of branches per plant

The maximum number of branches per plant was observed in treatment P3 (40 kg P_2O_5 ha^{-1}), followed by P2 (20 kg P_2O_5 ha^{-1}), compared to the control (P1 0 kg P_2O_5 ha^{-1}) at 15 DAS (Table 2). Similar trends were observed at 30 DAS and 45 DAS.The increase in the number of branches per plant was non-significant at 15 DAS and 30 DAS, but significant at 45 DAS. Application of 40 kg P_2O_5 ha^{-1} and 20 kg P_2O_5 ha^{-1} resulted in increases of 28.1 and 11.1% over the control at 45 DAS, respectively. The maximum number of branches per plant was

Table 1: Effect of phosphorus and bio-organism levels on plant height at different growth stages of mung bean

Treatments	Plant height (cm)		
	15DAS	30DAS	45DAS
Phosphorus levels			
P_0	24.02	28.91	46.17
P_1	25.38	32.05	49.94
P_2	26.01	34.87	53.05
CD (P=0.05)	NS	0.34	0.45
Bio-Organics levels			
BO_0	24.27	29.39	46.50
BO_1	25.09	31.48	49.08
BO_2	25.39	33.33	51.43
BO_3	25.27	31.90	49.74
BO_4	25.67	33.62	51.85
CD(P=0.05)	NS	0.44	0.58

Table 2: Effect of phosphorus and bio-organism levels on number of branches per plant at different stages of mungbean

Treatments	No. of branches plant^{-1}		
	15DAS	30DAS	45DAS
Phosphorus levels			
P_0	1.18	4.08	4.52
P_1	1.27	4.23	5.02
P_2	1.41	4.52	5.79
CD (P=0.05)	NS	0.28	0.18
Bio-Organicslevels			
BO_0	1.14	4.06	4.60
BO_1	1.23	4.24	4.89
BO_2	1.37	4.33	5.46
BO_3	1.26	4.32	4.99
BO_4	1.43	4.43	5.61
CD (P=0.05)	NS	NS	0.25

observed in treatment BO_4 (Poultry manure 2.5 t ha^{-1} + Rhizobium + PSB), followed by BO_3 (Vermicompost 2.5 t ha^{-1} + Rhizobium + PSB) at 15 DAS. The minimum number of branches per plant was observed in treatment BO_0 (Control). The increase in the number of branches per plant was non-significant at 15 DAS and 30 DAS, but significant at 45 DAS. Application of poultry manures 2.5 t ha^{-1} + Rhizobium + PSB and vermicompost 2.5 t ha^{-1} + Rhizobium + PSB resulted in increases of 22.0 and 18.7% over the control at 45 DAS, respectively. These findings are consistent with Singh et al., (2010), Meena, and Singh (2011) and Meena, et al., (2012).

Number of grains per pod

The number of grains per pod (Table 3) significantly increased with the application of higher levels of phosphorus in combination with different bio-organics. Maximum number of grains per pod (7.58) was recorded with the application of phosphorus @ 40 kg ha^{-1}, compared to the control (4.87). The application of 40 kg P_2O_5 ha^{-1} and 20 kg P_2O_5 ha^{-1} significantly increased the number of grains per pod over the control by 55.2 and 25.9%, respectively. The results showed that the maximum number of grains per pod was observed in treatment BO_2 (poultry manure 2.5 t ha^{-1} + Rhizobium + PSB) (6.88), compared to the control (4.94). However, this was found to be at par with treatment BO_3 (vermicompost 2.5 t ha^{-1} + Rhizobium + PSB). The application of poultry manures 2.5 t ha^{-1} + Rhizobium + PSB and vermicompost 2.5 t ha^{-1} + Rhizobium + PSB significantly increased the number of grains per pod over the control by 44.4 and 34.7%, respectively. These results are consistent with the findings of Meena, et al., (2014), Meena, et al., (2017) and Singh et al., (2017),

Table 3: Effect of phosphorus and bio-organism levels on number of grains per pod, number of pods per plant and test weight of mungbean

Treatments	No. of grains pod^{-1}	No. of pods $plant^{-1}$	Test weight (g)
Phosphorus levels			
P_0	4.87	11.40	33.37
P_1	6.13	13.39	34.98
P_2	7.58	16.04	36.39
CD(P=0.05)	0.22	0.37	0.34
Bio-Organicslevels			
BO_0	4.94	11.39	32.96
BO_1	5.89	13.24	34.65
BO_2	6.88	14.56	35.86
BO_3	6.11	13.51	34.98
BO_4	7.14	15.33	36.12
CD(P=0.05)	0.29	0.48	0.44

Number of pods per plant

A critical examination of the data presented in Table 3 revealed that the maximum number of pods per plant (16.04) was recorded with the application of phosphorus at 40 kg ha^{-1}, compared to the control (11.40). The application of 40 kg P_2O_5 ha^{-1} and 20 kg P_2O_5 ha^{-1} significantly increased the number of pods per plant over the control by 40.7 and 17.5%, respectively. The results showed that the maximum number of pods per plant was observed in treatment BO_2 (poultry manure 2.5 t ha^{-1} + Rhizobium + PSB), followed by BO_3 (vermicompost 2.5 t ha^{-1} + Rhizobium + PSB), as compared to the control. The applications of poultry manure 2.5 t ha^{-1} + Rhizobium + PSB and vermicompost 2.5 t ha^{-1} + Rhizobium + PSB significantly increased the number of pods per plant over the control by 34.6 and 27.8%, respectively. These results are in conformity with the findings of Meena, et al., (2013), Singh et al., (2014), Shukla, et al., (2016),

Test weight

The data on test weight of mung bean as influenced by different treatments and their combinations are presented in Table 3. The results showed that the maximum test weight was recorded in treatment P_3 (40 kg P_2O_5 ha^{-1}) (36.39 g), followed by P_2 (20 kg P_2O_5 ha^{-1}) (34.98 g), as compared to the control (33.37 g). The application of 40 kg P_2O_5 ha^{-1} and 20 kg P_2O_5 ha^{-1} resulted in significant increases of 9.1 and 4.8% over the control, respectively. The results indicated that the maximum test weight was observed in treatment BO_2 (poultry manure 2.5 t ha^{-1} + Rhizobium + PSB) (36.12 g), followed by BO_3 (vermicompost 2.5 t ha^{-1} + Rhizobium + PSB) (35.86 g), as compared to the control (32.96 g). It was observed that there was no significant difference between treatments BO_2 and BO_3 . The application of poultry manures 2.5 t ha^{-1} + Rhizobium + PSB and vermicompost 2.5 t ha^{-1} + Rhizobium + PSB increased the test weight by 9.6 and 8.8% over the control, respectively. These results are in conformity with the findings of Meena, et al., (2013), Singh et al., (2014), Shukla, et al., (2016),

Conclusion

The study suggests that the combined application of phosphorus and bio-organics can significantly improve the growth attributes of mung bean. The use of 40 kg P_2O_5 ha^{-1} along with poultry manure 2.5 t ha^{-1} + Rhizobium + PSB can be recommended for maximizing mung bean production.

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