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Influence of Organic and Inorganic Nutrient Sources on Mungbean Growth and Yield

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Abstract

A field experiment was conducted during the Kharif season of 2024 at the Crop Research Farm, Department of Agronomy, Vivekananda Global University, Jaipur (Rajasthan). The study aimed to evaluate the influence of different phosphorus levels and organic nutrient sources on the growth, yield, nutrient uptake, quality traits, and economic performance of mungbean. The results revealed that phosphorus application significantly influenced various growth and yield parameters of mungbean. Phosphorus at 40 kg P_2O_5 ha^{-1} produced significantly taller plants, higher dry matter accumulation, greater number of branches per plant, and more nodules, along with improved yield attributes such as pods per plant and seeds per pod. Although seed weight remained unaffected, seed, straw, and biological yields increased significantly with phosphorus application up to 60 kg P_2O_5 ha^{-1}. Among organic manures, vermicompost at 4.0 t ha^{-1} recorded the highest plant height, dry matter accumulation, number of branches, nodulation, and yield attributes. It also resulted in the highest seed, straw, and biological yields. Farmyard manure (FYM) at 10 t ha^{-1} also improved these parameters significantly over the control and performed statistically at par with vermicompost in most cases.

Keywords: Growth, Farmyard manure (FYM), Yield and Vermicompost

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Introduction

Mungbean (Vigna radiata L. Wilczek) is a short-duration pulse crop that contributes significantly to protein security in India and other South and Southeast Asian countries. With its high protein content, digestibility, and nitrogen-fixing ability, it has gained importance in sustainable agricultural systems Ali [1]. However, the productivity of mungbean in India, particularly in Rajasthan, remains suboptimal due to nutrient limitations and improper nutrient management strategies Anonymous [2].

Mungbean's growth and productivity are greatly influenced by phosphorus and organic nutrient management. Phosphorus plays a vital role in root development, nodule formation, and energy transfer, significantly impacting growth and yield traits Kumar [3]. Organic amendments such as FYM and vermicompost are known to improve soil structure, microbial activity, and nutrient availability. Their integration with inorganic sources enhances nutrient use efficiency and supports sustainable productivity Bano, [4] and Yadav [5].

Recent studies suggest that integrated nutrient management (INM) leads to better growth and yield by combining the benefits of quick nutrient availability from inorganic fertilizers and long-term soil fertility improvements from organic sources Saini [6]. Despite this, the adoption of INM in mungbean cultivation remains limited, especially in semi-arid regions like Rajasthan. Hence, this study aims to evaluate the effects of different organic and inorganic nutrient combinations on growth parameters and yield performance of mungbean.

Materials and Methods

A field experiment was conducted at the Crop Research Farm, Vivekananda Global University, Jaipur during the Kharif season of 2024. The location lies at 26°05′ N latitude, 75°28′ E longitude with an altitude of 427 m above mean sea level, falling under Agro-climatic Zone IIIa (Semi-Arid Eastern Plains). The experiment was laid out in Factorial Randomized Block Design (RBD) with three replications. Full dose of phosphorus was applied at the time of sowing as per treatment through SSP (16% P_2O_5). FYM having 0.5% N, 0.25% P_2O_5 and 0.5% K_2O and vermicompost having 1.40% N, 0.80% P_2O_5 and 1.00% K_2O was applied in the field as per treatments and was thoroughly mixed before

sowing. The seeds of vriety RMG-268 were treated with Bavistin @ 3 g kg^{-1} seed to prevent it from seed borne diseases. The crop was sown by "Kera" method in rows spaced at 30 cm apart on 20th July 2024 using seed rate of 20 kg ha^{-1}.

Treatments details with their symbols

S. No.	Treatments	Symbols
A.	Phosphorus levels (kg ha^{-1})	
1.	Control	P_0
2.	20	P_1
3.	40	P_2
4.	60	P_3
B.	Organic manures	
1.	Control	OM_0
2.	FYM @ 10 t ha^{-1}	OM_1
3.	Vermicompost @ 4.0 t ha^{-1}	OM_2

The mungbean variety used was RMG-268. Sowing was done at a spacing of 30 × 10 cm. Observations on growth and yield traits were recorded at regular intervals. Data were statistically analyzed using standard ANOVA techniques. The initial soil properties (0-15 cm depth) were characterized prior to experimentation. Mechanical composition analysis revealed a sandy loam texture consisting of 70.1% sand, 19.3% silt, and 9.12% clay. Physical property measurements showed a bulk density of 1.42 Mg m^{-3} and particle density of 2.32 Mg m^{-3}, Electrical conductivity (0.24 dS m^{-1} at 25°C) and pH (7.65 in 1:2 soil:water suspension) measured.

Results and Discussion

Growth Parameters

Table 1 Effect of phosphorus and organic manure on growth traits of mungbean

Treatments	Plant population (m^{-1} row length)		Plant height (cm)			Dry matter accumulation (g m^{-1} row length)			Number of branches $plant^{-1}$ at harvest	Number of nodules $plant^{-1}$ at 40 DAS	
	At 20 DAS	At harvest	At 25 DAS	At 50 DAS	At harvest	At 25 DAS	At 50 DAS	At harvest		Total	Effective
Phosphorus (kg ha^{-1})											
0	9.82	9.12	12.24	31.23	45.40	1.68	7.37	12.13	7.77	32.44	25.77
20	9.92	9.22	12.45	34.61	53.78	1.73	8.04	14.81	8.47	40.81	34.15
40	10.02	9.32	12.96	37.07	58.24	1.81	8.71	16.47	9.13	45.27	38.60
60	10.14	9.44	12.98	37.81	58.98	1.80	8.91	16.67	9.33	46.01	39.34
SEm±	0.305	0.305	0.30	0.73	1.21	0.04	0.22	0.27	0.19	1.21	0.95
CD (p=0.05)	NS	NS	NS	2.13	3.55	NS	0.65	0.80	0.56	3.55	2.77
Organic manures											
Control	9.94	9.24	12.39	32.81	49.81	1.72	7.54	13.74	8.00	36.81	31.51
FYM @ 10 t ha^{-1}	9.98	9.28	12.62	35.34	54.84	1.75	8.47	15.45	8.86	41.94	35.14
Vermicompost @ 4 t ha^{-1}	10.01	9.31	12.96	36.64	57.65	1.79	8.77	15.88	9.17	44.65	36.75
SEm±	0.264	0.264	0.26	0.63	1.05	0.03	0.19	0.24	0.17	1.05	0.82
CD (p=0.05)	NS	NS	NS	1.84	3.08	NS	0.56	0.69	0.49	3.08	2.40
CV (%)	9.16	9.85	7.07	6.23	6.72	6.40	8.08	5.45	6.63	8.83	8.23

Phosphorus application significantly influenced plant height and dry matter accumulation (**Table 1**). The highest plant height at harvest (58.98 cm) and dry matter accumulation (16.67 g at harvest) were recorded with 60 kg P_2O_5 ha^{-1}, showing significant improvement over control. This may be attributed to the role of phosphorus in cell division, root development, and photosynthesis [2, 3]. Similarly, FYM and vermicompost improved growth parameters over control. Vermicompost @ 4 t ha^{-1} recorded the highest plant height (57.65 cm) and dry matter (15.88 g), owing to better nutrient availability and microbial activity [4, 5]. Phosphorus also enhanced nodulation, with the highest number of

total and effective nodules (46.01 and 39.34, respectively) observed at 60 kg P_2O_5 ha^{-1}. Vermicompost also showed a notable increase (44.65 total, 36.75 effective nodules), indicating improved rhizobial activity and root vigor [6].

Table 2 Effect of phosphorus and organic manure on yield attributes and yields of mungbean

Treatments	Yield attributes			Yield (kg ha-1)			Harvest index (%)
	Number of pods plant^{-1}	Number of seeds pod^{-1}	Test weight (g)	Seed	Straw	Biological	
Phosphorus (kg ha^{-1})							
0	21.70	8.26	41.88	871	1919	2791	31.02
20	25.08	9.14	42.41	1011	2130	3121	31.69
40	27.54	9.80	42.92	1122	2322	3444	32.54
60	28.54	10.00	43.53	1146	2377	3523	32.46
SEm±	0.73	0.22	1.20	31	63	86	0.522
CD (p=0.05)	2.13	0.65	NS	92	186	252	NS
Organic manures							
Control	24.01	8.79	41.52	783	1709	2487	31.15
FYM @ 10 t ha^{-1}	26.12	9.42	42.58	1134	2363	3492	32.27
Vermicompost @ 4 t ha^{-1}	27.02	9.70	43.95	1196	2489	3680	32.36
SEm±	0.63	0.19	1.04	27	55	75	0.452
CD (p=0.05)	1.84	0.56	NS	79	161	219	NS
CV (%)	8.47	7.17	8.43	9.41	8.69	8.02	4.91

Yield Attributes and Yield

Yield attributes such as pods/plant, seeds/pod, and test weight improved with increasing phosphorus levels. The application of 60 kg P_2O_5 ha^{-1} significantly increased pods/plant (28.54), seeds/pod (10.00), and seed yield (1146 kg/ha) over lower levels. These enhancements are attributed to better nutrient uptake, flowering, and reproductive success [7, 8].

Among organic sources, vermicompost outperformed FYM and control, recording the highest seed yeld (1196 kg/ha), number of pods/plant (27.02), and test weight (43.95 g). This is due to its higher nutrient content, especially available phosphorus and micronutrients, and stimulation of plant hormone production [9, 10].

Straw yield and biological yield followed similar trends, with maximum values in P_3 and O_2 treatments. The interaction effect was statistically significant for all yield parameters, although harvest index remained unaffected statistically, ranging between 31.02% to 32.54%.

Conclusion

Based on results of one year experimentation, it may be concluded that application of phosphorus @ 40 kg ha^{-1} produced significantly higher seed, straw and biological yield and net returns. Further, application of vermicompost @ 4.0 t ha^{-1} or FYM at 10 t ha^{-1} brought about significantly higher seed, straw and biological yield. Therefore, application of phosphorus @ 40 kg P_2O_5 ha^{-1} and vermicompost @ 4.0 t ha^{-1} or FYM at 10 t ha^{-1} may be recommended for higher productivity and profitability of mungbean crop. However, these results are only indicative and require further experimentation to arrive at some more consistent and final conclusion

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