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Green gram (*Vigna radiata* L.) as influenced by integrated nutrient management using organic sources

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Abstract

A field experiment was carried out during the summer season of 2024 at the Research Farm of Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, to assess the impact of various organic and inorganic nutrient sources on the growth and yield of green gram (*Vigna radiata* L.). The trial was designed using a randomized block design (RBD) with eight treatments, including a T₁- Control (no fertilizer), T₂- 100% RDF (15:40:00 NPK), T₃- 25% RDF + 75% N through vermicompost, T₄- 50% RDF + 50% N through vermicompost, T₅- 25% RDF + 75% N through poultry manure, T₆- 50% RDF + 50% N through poultry manure, T₇- 25% RDF + 75% N through farm yard manure, T₈- 50% RDF + 50% N through farm yard manure. The results indicated that the application of 100% RDF (T₂) produced significantly superior growth parameters, including maximum plant height (37.10 and 53.27 cm), number of leaves/plant (14.94 and 21.43), number of branches/plant (6.07 and 6.47) and dry matter accumulation/plant (4.48 and 16.30 g/plant) at 40 DAS and at harvest respectively. In terms of yield attributes 100% RDF (T₂) also recorded the highest values for pods/plant (20.02), seeds/pod (8.02), pod length (5.70 cm), seed yield (980 kg/ha) and stover yield (2746 kg/ha) at harvest. Economically, this treatment achieved highest gross returns of ₹83826/ha, net returns of ₹56530/ha, and B:C ratio of 3.07, indicating its effectiveness in enhancing productivity and profitability. However, the study also revealed that the treatment combining 50% RDF with 50% N through poultry manure (T₆) produced statistically comparable results to 100% RDF. This suggests that 50% RDF with 50% N through poultry manure (T₆) can serve as a sustainable alternative, reducing dependency on chemical fertilizers while maintaining optimal yield and improving soil health.

Keywords: Poultry manure, vermicompost, farm yard manure, green gram, growth and yield

Introduction

Green gram (*Vigna radiata* L.), commonly known as mung bean, is an important pulse crop widely cultivated across Asia, Africa, and parts of South America. It is highly valued for its rich nutritional composition, including high protein content, dietary fiber, vitamins, and essential minerals, making it a staple crop in many vegetarian diets (Kaur *et al.*, 2021) [3]. Its short growth duration, low water requirement, and adaptability to various climatic conditions making it an ideal crop for regions with limited water resources and erratic rainfall patterns (Singh *et al.*, 2022) [9]. Despite its numerous benefits, green gram cultivation faces several challenges that limit its productivity. Pests, diseases, and continuous use of synthetic fertilizers significantly affect its yield potential and deteriorate soil properties (Kumar *et al.*, 2020) [4]. The integrated nutrient management (INM) plays a crucial role in enhancing and sustaining soil fertility, which is essential for long-term crop productivity. Green gram is particularly important in sustainable agriculture because of its ability to biologically fix atmospheric nitrogen, thereby enriching the soil and reducing the dependence on synthetic fertilizers. Organic manures supply both macro and micro nutrients, and their application contributes to better soil structure and increased nitrogen fixation. However, relying solely on organic manures is neither economically viable nor sufficient to sustain the productivity levels of high-yielding crop varieties. A more effective strategy involves the combined use of organic manures and chemical fertilizers, which not only boost crop yields but also maintains soil health over extended periods. Although organic manures alone may not meet the complete nutritional needs of crops, they serve as excellent

supplementary sources when integrated with chemical fertilizers, offering residual benefits that can positively influence subsequent cropping cycles. The increasing global demand for plant-based proteins has further emphasized the significance of green gram as a key food security crop. Given its economic and ecological importance, efforts to enhance its productivity through improved cultivation practices and nutrient management strategies are crucial. Therefore, this study aims to evaluate the performance of different sources and doses of nutrients on growth and yield of green gram.

Materials and Methods

The study was conducted at research farm of Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana during the summer season of 2024 to study the effect of sources and doses of nutrients on green gram. Soil of the experimental field was sandy loam in texture having 56% sand, 31% silt and 13% clay. The soil exhibited low levels of organic carbon (0.32%) and available nitrogen (166.34 kg/ha), while the concentrations of available phosphorus (P_2O_5) and potassium (K_2O) were classified as medium, with values of 13.41 kg/ha and 212.54 kg/ha, respectively. The experiment was laid out in randomized block design (RBD) with eight treatments and three replications. Each treatment consisted of different nutrient applications viz.: T₁- Control (no fertilizer), T₂- 100% RDF (15:40:00 NPK), T₃- 25% RDF + 75% N through vermicompost, T₄- 50% RDF + 50% N through vermicompost, T₅- 25% RDF + 75% N through poultry manure, T₆- 50% RDF + 50% N through poultry manure, T₇- 25% RDF + 75% N through farm yard manure, T₈- 50% RDF + 50% N through farm yard manure. The sowing was carried out on 22 of March 2024 using the variety MH-421. A seed rate of 20 kg/ha was used with row spacing of 30 cm. Nitrogen was applied through different inorganic and organic sources. For inorganic source of nitrogen, urea was used and for organic source of nitrogen, farm yard manure, vermicompost and poultry manure were used as per treatment requirements. On the other hand, phosphorus was supplied using single super phosphate (SSP). In every experimental plot, five plants were randomly selected from net plot and marked to record observations on plant height, number of leaves/plant, number of branches/plant, number of pods/plant, number of seeds/pod, and pod length. For dry matter analysis, samples were periodically taken from five randomly chosen plants located in the second outermost row on either side of each plot. To estimate seed yield, seeds from each net plot were harvested and weighed, while stover yield was calculated by subtracting the seed yield from the total biological yield of the respective plot. The cost of cultivation for each treatment was calculated based on prevailing market rates, and the benefit-cost ratio was derived by dividing the gross return by the cost of cultivation.

$$B:C = \frac{\text{Gross returns}}{\text{Cost of cultivation}}$$

The crop data collected in the field, encompassing various parameters, underwent statistical analysis following the methodology outline by Cochran and Cox (1967) [1].

Results and Discussion

Growth Parameters

The data presented in Table 1 revealed significant effect of

different sources and doses of nutrient on growth parameters viz., plant height, number of leaves/plant, number of branches/plant and dry matter/plant of green gram at 40 DAS and at harvest. The data revealed that significantly higher plant height (37.10 and 53.27 cm), number of leaves/plant (14.94 and 21.43), number of branches/plant (6.07 and 6.47) and dry matter accumulation/plant (4.48 and 16.30 g/plant) was recorded with sole application of 100% RDF (T₂) at 40 DAS and at harvest respectively. Further, this treatment was found to be statistically at par with integrated application of 50% RDF + 50% N through poultry manure (T₆). The increase in growth parameters might be attributed to balanced application of nutrients that substantially enhanced vegetative growth of plant due to adequate nutrient supply. Application of poultry manure may have supplied essential macro and micro nutrients to plant which favoured rapid cell division and ultimately resulting in better growth of plant. Similar findings were also reported by Verma *et al.* (2022) [10] and Sachan *et al.* (2020) [6].

Yield and Yield Attributes

The yield attributes including number of pods/plant, number of seeds/pod, pod length as well as crop yield viz., seed and stover yield were significantly influenced by application of different sources and doses of nutrients as presented in table 2. The data pertaining to yield and yield attributes of green gram revealed that application of 100% RDF (T₂) resulted in significantly higher number of pods/plant (20.02), number of seeds/pod (8.02), pod length (5.70 cm), seed yield (980 kg/ha) and stover yield (2746 kg/ha) and it was found statistically at par with integrated application of 50% RDF and 50% N through poultry manure (T₆). The increase in yield and yield attributes of green gram with application of 100% RDF as well as integrated application of 50% RDF and 50% N through poultry manure (T₆) might be attributed to optimal availability of essential macro and micro nutrients to support yield attributes and yield also, poultry manure enhanced the soil microbial activity and also improved the physical condition of soil in respect of granulation, friability and porosity and ultimately provided a balanced nutritional environment to the soil plant nutrition system. These findings corroborated with the results of Kumar *et al.* (2021) [4], Hekmat *et al.* (2020) [2] and Rajkhowa *et al.* (2003) [5].

Relative economics

Table 3 outlines the economic analysis of green gram cultivation under different nutrient management practices, detailing the cost of cultivation, gross returns, net returns, and benefit-cost (B:C) ratio. Among the treatments, applying 100% of the recommended dose of fertilizers (T₂) resulted in the highest financial gains, achieving a gross returns of ₹83826/ha, a net returns of ₹56530/ha, and a B:C ratio of 3.07, which was found statistically at par with the combined use of 50% RDF and 50% N through poultry manure (T₆), which produced a gross returns of ₹79634/ha, a net returns of ₹52036/ha, and a B:C ratio of 2.89. Increased seed yield contributed to higher gross returns which in conjugation with lower cost of cultivation led to increase in net returns and benefit-cost ratio. These results align with finding by Verma *et al.* (2022) [10], Kumar *et al.* (2021) [4] and Singh *et al.* (2015) [8].

Table 1: Effect of different doses of nutrients on growth parameters of green gram

Treatments	Plant height (cm)		Number of leaves/plant		Number of branches/plant		Dry matter accumulation/plant (g)	
	40 DAS	At harvest	40 DAS	At harvest	40 DAS	At harvest	40 DAS	At harvest
T1 Control	29.12	45.93	10.43	16.77	3.83	4.21	3.42	10.46
T2 100% RDF (15:40:00 N:P:K)	37.10	53.27	14.94	21.43	6.07	6.47	4.48	16.30
T3 25% RDF + N through 75% vermicompost	31.30	45.67	11.33	18.43	4.61	5.11	3.79	13.89
T4 50% RDF + 50% N through vermicompost	32.95	48.63	13.39	19.70	5.32	5.54	4.05	14.79
T5 25% RDF + 75%N through poultry manure	31.46	45.70	11.41	18.57	4.67	5.17	3.80	13.99
T6 50% RDF + 50% N through poultry manure	34.97	50.00	14.25	20.30	5.43	5.97	4.25	15.31
T7 25% RDF + 75% N through farm yard manure	31.40	45.43	11.18	18.20	4.40	5.05	3.61	13.69
T8 50% RDF + 50% N through farm yard manure	32.20	48.27	13.27	19.50	5.00	5.52	3.98	14.76
S.Em±	0.98	1.42	0.39	0.56	0.23	0.22	0.13	0.42
CD at 5%	2.97	4.30	1.19	1.69	0.70	0.66	0.40	1.27

Table 2: Effect of different doses of nutrients on yield attributes and yield of green gram

Treatments	Number of pods /plant	Number of seeds/pod	Pod length (cm)	Seed yield (kg /ha)	Stover yield (kg /ha)
T1 Control	13.38	5.63	4.11	518	1729
T2 100%RDF (15:40:00 N:P:K)	20.02	8.02	5.70	980	2746
T3 25% RDF + 75% N through vermicompost	16.54	6.23	4.50	764	2342
T4 50% RDF + 50% N through vermicompost	17.53	7.00	5.08	899	2523
T5 25% RDF + 75% N through poultry manure	16.77	6.43	4.67	789	2398
T6 50% RDF + 50% N through poultry manure	18.45	7.50	5.15	931	2651
T7 25% RDF + 75% N through farm yard manure	15.33	6.40	4.31	735	2284
T8 50% RDF + 50% N through farm yard manure	17.00	6.99	5.04	893	2514
S.Em±	0.54	0.30	0.24	24	73
CD at 5%	1.65	0.91	0.72	74	222

Table 3: Effect of different doses of nutrients on relative economics of green gram

Treatments	Cost of cultivation ₹/ha	Gross returns ₹/ha	Net returns ₹/ha	B:C
T1 Control	24900	44359	19459	1.78
T2 100% RDF (15:40:00 N:P:K)	27296	83826	56530	3.07
T3 25% RDF + 75% N through vermicompost	31499	65398	33899	2.08
T4 50% RDF + 50% N through vermicompost	30098	76902	46804	2.56
T5 25% RDF + 75% N through poultry manure	27749	67563	39814	2.43
T6 50% RDF + 50% N through poultry manure	27598	79634	52036	2.89
T7 25% RDF + 75% N through farm yard manure	27749	62881	35132	2.27
T8 50% RDF + 50% N through farm yard manure	27598	76437	48839	2.77
S.Em±	-	2084	2084	0.07
CD at 5%	-	6322	6322	0.22

Conclusion

The findings of the study indicated that applying 100% recommended dose of fertilizers RDF (15:40:00 N:P:K) significantly enhanced the growth, yield, and economic returns of green gram. However, this performance was statistically comparable to the integrated nutrient management approach combining 50% RDF with 50% poultry manure. These results highlight the potential of integrating organic and inorganic nutrient sources as an effective strategy to boost green gram productivity and profitability, while also contributing to the sustainability of the agricultural production system.

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