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YIELD OPTIMIZATION OF BLACK GRAM (*VIGNA MUNGO L.*) USING INTEGRATED NUTRIENT MANAGEMENT

Sahil, Akhil Bharti*, Aaina Sharma, Ranjeet Singh Bochalya, Mohit Kamboj and Mohit Singh
Faculty of Agriculture Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala 133207, India
*Corresponding author E-mail: abharti.bharti@gmail.com
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ABSTRACT

A field experiment was conducted during summer 2024 at the Research Farm of Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, to assess the effect of sources and doses of nutrients on black gram (*Vigna mungo L.*). The experiment was laid out in randomized block design (RBD) with three replications comprising eight treatments of different organic and inorganic sources of nutrient *viz.* T_1- Control (no fertilizer), T_2- 100% RDF (15:40:00 NPK), T_3- 25% RDF + 75% N through vermicompost, T_4- 50% RDF + 50% N through vermicompost, T_5- 25% RDF + 75% N through poultry manure, T_6- 50% RDF + 50% N through poultry manure, T_7- 25% RDF + 75% N through farm yard manure, T_8- 50% RDF + 50% N through farm yard manure. Among all the treatments, application of 100% RDF (T_2) produced significantly superior growth parameters and yield attributes. This treatment resulted in significantly higher plant height (36.97 and 52.03 cm), number of leaves/plant (14.77 and 21.13), number of branches/plant (5.67 and 5.87) and dry matter accumulation/plant (4.43 and 16.04 g/plant) at 40 DAS and at harvest respectively. Additionally, it also produced significantly higher pods/plant (20.01), seeds/pod (7.87), pod length (5.44 cm), seed yield (957 kg/ha) and stover yield (2584 kg/ha) at harvest. Economically, the same treatment also achieved the maximum gross returns of Rs. 66530/ha, net returns of Rs. 39434/ha, and B:C ratio of 2.46, indicating its effectiveness in enhancing productivity and profitability. Further, it was found that treatment 50% RDF + 50% N through poultry manure (T_6) recorded statistically at par results with this treatment in all parameters. Thus, integrated application of 50% RDF with 50% N through poultry manure (T_6) becomes best alternative for RDF for optimizing growth and productivity of black gram, also improving soil health and enhancing the ecological sustainability of the production system.

***Keywords*:** Poultry manure, vermicompost, farm yard manure, black gram, growth and productivity

Introduction

Pulses are considered as one of the most important source of protein in tropical and sub-tropical countries, where diets in general are deficient in protein. They contain a high percentage of protein which is nearly three times as much as cereals. They also provide substantial quantities of minerals and vitamins to the diet. Black gram (*Vigna mungo L.*) is one of the most important pulse crops belonging to family *fabaceae*. It is rich in protein containing about 26% protein, 1.2% fat and 56.6% carbohydrates on dry weight basis and is also a rich source of calcium and iron (Divyavani *et al*., 2020). Apart from this, black gram forms excellent forage due to profuse vegetative growth. It also checks the soil erosion by covering the ground through its vegetative growth. It forms a good quality silage as well and also act as a green manure crop. Being drought tolerant and warm weather crop, black gram is well adopted to the drier regions of the tropics, where most food crops do not perform well. It has ability to fix up to 140 kg of atmospheric nitrogen per hectare with the help of *Rhizobium leguminosarum* (Raju and Menon, 2020). Being a shade tolerant crop, black gram is also compatible as an inter-crop with maize, millet, sorghum, sugarcane, cotton etc. Imbalanced and non-judicious use of chemical fertilizers adversely affects soil health by altering the physical, chemical and biological properties of soil and making the crop

production environmentally unsustainable. Integrated nutrient management (INM) is a key component of sustainable agriculture which involves obtaining maximum benefits from all possible sources of plant nutrients, both organic and inorganic, in an integrated manner and maintaining soil fertility for higher productivity. Among the organic manures, farmyard manure (FYM) is one of the readily available and widely used traditional organic manure by the farmers since ancient times. FYM helps to maintain soil fertility and productivity. Similarly, poultry manure and vermicompost are rich in all essential plant nutrients and have excellent effect on overall plant growth. Both these organic manures improve soil structure, aeration and water holding capacity of soil and prevents soil erosion. Integrating farmyard manure, vermicompost and poultry manure with reduced doses of inorganic fertilizers greatly improves long term soil fertility, growth and yield of crops (Yuganthra *et al*., 2023). Considering the above facts in view, the present study was conducted to evaluate the performance of black gram under different nutrient management practices.

Materials and Methods

A field experiment was conducted during the summer season of the year 2024 at research farm of Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana to study the effect of sources and doses of nutrients on black gram. The experimental site was located at an altitude of 264 meter above mean sea level with geographical coordinates of 30° 17'0" N latitude and 77° 3'0" E longitude and average rainfall of approximately 700 mm. The soil of the experimental site was sandy loam in texture having 56% sand, 31% silt and 13% clay content. Soil was found to be low in organic carbon (0.30%) and available N (168.34 kg/ha), on the other hand it was medium in available P_2O_5 (14.41 kg/ha) and available K_2O (210.54 kg/ha). The experiment was carried out using a randomized block design with eight treatments that were replicated thrice. The treatments consisted of different sources of nutrient *viz.:* T_1- Control (no fertilizer), T_2- 100% RDF (15:40:00 NPK), T_3- 25% RDF + 75% N through vermicompost, T_4- 50% RDF + 50% N through vermicompost, T_5- 25% RDF + 75% N through poultry manure, T_6- 50% RDF + 50% N through poultry manure, T_7- 25% RDF + 75% N through farm yard manure, T_8- 50% RDF + 50% N through farm yard manure. Nitrogen was supplied using urea, farm yard manure, vermicompost and poultry manure on the other hand phosphorus was applied through single super phosphate (SSP) as per treatment requirements. The crop was sown on 22 March 2024 using seed rate of 20 kg/ha with 30 cm row spacing. Variety of black gram used was T-9. In each plot, random five plants were tagged for assessment of plant height, number of leaves/plant, number of branches/plant and pods/plant, seeds/pod and pod length. Dry matter/plant was periodically recorded from five randomly selected plants in the second outermost row on each plot's side. To determine seed yield, seeds were collected from each net plot and weighed to get seed yield and stover yield was determined by deducting seed yield from biological yield of each net plot. The cost of cultivation of each treatment was computed using current market prices and benefit-cost ratio was determined as ratio of gross return to 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).

Result and Discussion

Growth parameters

Table 1 presents the effect of different nutrient doses on growth parameters *viz*., plant height, number of leaves/plants, number of branches/plant and dry matter/plant of black gram at 40 DAS and at harvest. The data revealed that application of 100% RDF (T_2) recorded significantly higher plant height (36.97 and 52.03 cm), number of leaves/plant (14.77 and 21.13), number of branches/plant (5.67 and 5.87) and dry matter accumulation/plant (4.43 and 16.04 g/plant) at 40 DAS and at harvest respectively and further it was found statistically at par with application of 50% RDF + 50% N through poultry manure (T_6). The increase in plant growth parameters might be attributed to appropriate nutrient supply through organic and inorganic amendments which increased the accessibility of macro and micro nutrients to the plant. This may have boosted early root growth and cell division, which consequently increased the absorption of other nutrients from deeper soil layers, thus increasing plant growth parameters and ultimately plant growth rate. These results are in close conformity with the findings of Mahamud *et al*. (2022), Khan *et al*. (2022) and Das *et al*. (2024).

Yield and yield attributes

The yield attributes and yield of black gram *viz*., pods/plant, seeds/pod, pod length, seed yield and stover yield were significantly influenced with the application of different nutrient doses as presented in

Table 2. The results showed that 100% RDF (T_2) recorded significantly higher pods/plant (20.01), seeds/pod (7.87), pod length (5.44 cm), seed yield (957 kg/ha) and stover yield (2584 kg/ha) at harvest and it was found statistically at par with the application of 50% RDF + 50% N through poultry manure (T_6). The significant increase in yield attributes and yield of black gram in these treatments might be attributed to balanced nutrient management which provided a better partitioning of photosynthates in plant that significantly improved yields compared to the control. The integration of 50% RDF along with 50% N through poultry manure may have increased the translocation of macro as well as micro nutrients in the plant system. Almost similar finding was reported by Menariya *et al*. (2024) and De *et al*. (2011).

Relative economics

Relative economics of black gram under different nutrient management practices, including cost of cultivation, gross returns, net returns, and benefit-cost ratio (B:C) has been illustrated in Table 3. Application of 100% recommended dose of fertilizers (T_2) recorded significantly higher gross returns of Rs. 66530/ha, net returns of Rs. 39434/ha, and B:C ratio of 2.46 which was statistically at par with integrated application of inorganic and organic nutrient amendment *viz*., 50% RDF + 50% N through poultry manure (T_6) with gross returns of Rs. 63090/ha, net returns of Rs.35693/ha, and B:C ratio of 2.30. Higher yield levels in these treatments elevated gross returns and the integration of higher gross returns with lower cost of cultivation led to a significant enhancement in net returns and the benefit-cost (B:C) ratio. These economic outcomes are supported by Menariya *et al*. (2024), Khan *et al*. (2022) and Das *et al*. (2024).

Conclusion

The study revealed that application of 100% RDF performed superior in terms of growth, yield and economics of black gram which was found statistically at par with integrated application of 50% RDF with 50% N through poultry manure. This suggests that integrated application of inorganic and organic nutrient amendment 50% RDF with 50% N through poultry manure (T_6) is a promising strategy for augmenting higher productivity and profitability of black gram and also ensuring environmental sustainability in production system.

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

Treatments		Plant height (cm)		Number of leaves/plants		Number of branches/ plants		Dry matter accumulation /plant (g)	
		40 DAS	At harvest	40 DAS	At harvest	40 DAS	At harvest	40 DAS	At harvest
T1	Control	29.87	43.50	10.10	16.87	3.52	3.83	3.37	10.40
T2	100% RDF (15:40:00 N:P:K)	36.97	52.03	14.77	21.13	5.67	5.87	4.43	16.04
T3	25% RDF + N through 75% vermicompost	31.28	45.34	11.67	18.57	4.24	4.55	3.77	13.85
T4	50% RDF + 50% N through vermicompost	32.97	47.73	13.50	19.40	4.93	5.22	4.00	14.74
T5	25% RDF + 75%N through poultry manure	31.39	45.50	11.83	18.81	4.40	4.70	3.77	13.96
T6	50% RDF + 50% N through poultry manure	34.32	49.50	14.27	20.54	5.10	5.35	4.20	15.28
T7	25% RDF + 75% N through farm yard manure	31.17	44.33	11.13	18.47	4.13	4.57	3.58	13.64
T8	50% RDF + 50% N through farm yard manure	32.88	47.38	13.32	19.37	4.87	5.13	3.93	14.70
	SEm±	0.96	1.38	0.41	0.56	0.20	0.21	0.13	0.42
	CD at 5%	2.90	4.18	1.24	1.69	0.62	0.62	0.38	1.26

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

Treatments		Pods/plant	Seeds/pod	Pod length (cm)	Seed yield (kg/ha)	Stover yield (kg/ha)
T1	Control	14.96	5.90	4.01	504	1587
T2	100% RDF (15:40:00 N:P:K)	20.01	7.87	5.44	957	2584
T3	25% RDF + N through 75% vermicompost	16.23	6.53	4.45	751	2254
T4	50% RDF + 50% N through vermicompost	17.42	7.13	4.77	878	2369
T5	25% RDF + 75%N through poultry manure	16.45	6.70	4.51	778	2291
T6	50% RDF + 50% N through poultry manure	18.52	7.63	4.93	908	2514
T7	25% RDF + 75% N through farm yard manure	16.10	6.23	4.40	727	2204
T8	50% RDF + 50% N through farm yard manure	17.25	7.07	4.71	865	2359
	SEm±	0.64	0.20	0.25	24	70
	CD at 5%	1.93	0.62	0.76	73	212

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

Treatments		Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C
T1	Control	24700	35050	10350	1.42
T2	100% RDF (15:40:00 N:P:K)	27096	66530	39434	2.46
T3	25% RDF + N through 75% vermicompost	31299	52221	20922	1.67
T4	50% RDF + 50% N through vermicompost	29898	60990	31092	2.04
T5	25% RDF + 75%N through poultry manure	27549	54037	26488	1.96
T6	50% RDF + 50% N through poultry manure	27398	63090	35693	2.30
T7	25% RDF + 75% N through farm yard manure	27549	50518	22969	1.83
T8	50% RDF + 50% N through farm yard manure	27398	60101	32703	2.19
	SEm±	-	1663	1663	0.06
	CD at 5%	-	5043	5043	0.18

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