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OPTIMIZATION OF PRIMARY NUTRIENTS FOR ENHANCING GROWTH AND PRODUCTIVITY OF BLACK GRAM (*VIGNA MUNGO* L.)

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ABSTRACT

A field experiment was carried out at research farm of Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, during the summer season of 2024. The experiment was laid out in randomized block design with three replications. The treatments consisted of different nutrient levels *viz.*: T_1 RDF (18:40:00 NPK), T_2-15:40:00 N P K kg/ha, T_3-15:40:20 N P K kg/ha, T_4-20:40:00 N P K kg/ha, T_5-20:40:20 N P K kg/ha, T_6 - 15:50:00 N P K kg/ha, T_7-20:60:20 N P K kg/ha and T_8-Control. Urea, single super phosphate (SSP) and muriate of potash (MOP) were applied to attain needed quantity of nutrients as per treatment requirements. Crop sown with the application of 20 kg N, 60 kg P_2O_5 and 20 kg K_2O was found superior in all growth parameters yield attributes and yield. Significantly higher plant height (45.60cm), number of leaves per plant (15.50), number of branches per plant (5.63), dry matter (16.73), pods per plant (15.07), seeds per pod (10.60), pod length (8.50 cm) and seed yield (959 kg/ha) were recorded with the application of 20 kg N, 60 kg P_2O_5 and 20 kg K_2O (T_7). It was also observed that application of 20 kg N + 40 kg phosphorous +20 kg potassium/ha (T_5) was statistically at par with T_7 in almost every observation. Upon studying relative economics of the experiment, it was observed that gross returns (66,651 Rs/ha) and net returns (40,674 Rs/ha) were highest in T_7, which were closely followed by T_5, while T_5 recorded superior B:C (2.24). Results thus depicted that both T_7 and T_5 greatly enhanced performance of black gram. T_7 was more profitable treatment while T_5 fetched highest return per rupee spent.

Keywords **:** Black gram, Nitrogen, Phosphorous, Potassium and Yield.

Introduction

Pulses form a major component of dietary protein across various regions of India and play a vital role in sustaining soil health through biological nitrogen fixation. Among these, black gram (*Vigna mungo* L.), a member of the *Leguminosae* family, is a particularly important pulse crop. It contributes significantly to soil fertility, making it valuable not only as a food crop but also as a green manure and a nutritive fodder, especially for milch animals. Cultivated primarily for its protein-rich seeds consumed as dal, black gram holds substantial agricultural and nutritional importance. Nutritionally, black gram seeds contain approximately 24% protein, 60% carbohydrates, 1.4% fat, 0.9% fiber, and 3.2% minerals. They are also rich in phosphoric acid, and vitamins such as thiamine (B1), riboflavin (B2), and niacin (B3), along with several essential minerals (Reddy *et al*., 2025). India stands as the world's largest producer and consumer of black gram, contributing around 70% to global production. It accounts for nearly 19% of the total pulse acreage and 23% of overall pulse production in the country (Nandhakumar *et al*., 2025). Despite its importance, black gram yields in India remain relatively low due to multiple constraints such as poor seed quality, lack of improved and short-duration varieties, cultivation on marginal lands, low fertilizer use, inadequate pest and disease management, moisture stress, and suboptimal post-harvest and storage practices. However, there exists considerable scope to improve productivity by optimizing nutrient management, particularly through the use of inorganic fertilizers. Chemical fertilizers play a critical role in

fulfilling the nutrient demands of black gram. In light of these considerations, the present study was undertaken to investigate the effect of different doses of inorganic nutrients on black gram, aiming to identify effective strategies for enhancing its overall performance.

Materials and Methods

A field experiment was carried out at research farm of Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, located at 30^0 17'0" N latitude, 77^0 3'0" E longitude and 264 meter above mean sea level to study the effect of different doses of nutrients on black gram. The average annual rainfall of the area is approximately 700 mm. The soil of the experimental field was sandy loam in texture with 56% sand, 31% silt and 13% clay. Soil was also found low in organic carbon (0.32%) and available N (170.01 kg/ha) while it was medium in available P_2O_5 (14.61 kg/ha) and available K_2O (211.62 kg/ha). The experiment was laid out in randomized block design in 3 replications with 8 treatments consisted of different nutrient levels *viz.*: T_1-RDF (18:40:00 NPK), T_2 - 15:40:00 NPK kg/ha, T_3-15:40:20 NPK kg/ha, T_4-20:40:00 NPK kg/ha, T_5-20:40:20 NPK kg/ha, T_6 - 15:50:00 NPK kg/ha, T_7-20:60:20 NPK kg/ha and T_8 - Control (no fertilizer). Macro nutrients *viz* nitrogen, phosphorous and potassium were applied to the experimental plots using Urea, Single super phosphate (SSP) and muriate of potash (MOP) respectively as per treatment requirements. The crop was sown on 22 march 2024 using 20 kg/ha seed rate. Black gram variety T-9 was used for sowing at 25 cm row spacing. Five plants per plot were selected randomly in the net plot area and were tagged for assessment of plant height, number of leaves per plant, number of branches per plant and pods per plant, seeds per pod, and pod length. Dry matter 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 returns 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

Growth parameters *viz* plant height, number of leaves per plant, number of branches per plant and dry matter accumulation were recorded at 40 DAS and at harvest. The data present in Table 1 revealed that application of 20 kg nitrogen, 60 kg phosphorous and 20 kg potassium/ha (T_7) recorded significantly higher plant height (37.77 & 53.13 cm), number of leaves per plant (15.00 & 20.97), number of branches per plant (5.70 & 5.90) and dry matter accumulation (4.43 & 14.73 g per plant) at 40 DAS and at harvest respectively. It was also observed that the application of 20 kg N + 40 kg phosphorous +20 kg potassium/ha (T_5) was also statistically at par in all the growth parameters. The increase in growth parameters might be attributed to higher dose of nitrogen, phosphorous and potassium application which increased the availability of macro nutrients in soil and ultimately enhanced the growth and development of black gram. Nitrogen is crucial for leaf and stem growth; phosphorous supports root development and potassium enhances enzyme synthesis and activation. Thus, leading to progressively superior growth of the plants. Almost similar findings were also reported by Athokpam *et al*. (2009) and Parashar *et al*. (2020).

Yield and yield attributes

The data pertaining to yield attributes *viz.* pods per plant, seeds per pod, pod length, seed yield and stover yield as presented in Table 2 revealed that application of 20 kg nitrogen, 60 kg phosphorous, and 20 kg potassium/ha (T_7) resulted in significantly higher pods per plant (15.07), seeds per pod (10.60), pod length (8.50 cm), seed yield (953 kg/ha) and stover yield (2453 kg/ha), while 20 kg nitrogen + 40 kg phosphorous +20 kg potassium/ha (T_5) recorded statistically at par values of pods per plant (14.47), seeds per pod (10.03), pod length (8.17), seed yield (931 kg/ha) and stover yield (2375 kg/ha). The increase in yield and yield attributes was possibly due to higher doses of nitrogen, phosphorus and potassium application in soil which led to superior root growth, photosynthesis, energy transfer, better partitioning of photosynthetic assimilates in plants eventually enhancing reproductive growth. Thus, resulting in superior yield attributes ultimately enhancing yield. Almost similar findings were reported by Amruta *et al.* (2015).

Economic parameters

Highest cost of cultivation (Rs. 29977/ha) was recorded in 20 kg N + 60 kg phosphorous + 20 kg potassium/ha (T_7), while lowest (Rs. 25250/ha) was

observed in T_8 (Control). Numerically highest gross returns (Rs. 66651/ha) were recorded in T_7, which was closely followed by 20 kg N + 40 kg phosphorous +20 kg potassium/ha (T_5), similar result was also found by Ganjare *et al*. (2023). The maximum net returns (Rs. 36674/ha) were obtained in T_7, followed by T_5 (Rs. 35828/ha). On the other hand, T_5 recorded highest B:C (2.24), which was followed by T_7 as shown in Table 3. 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 in these treatments. Similar results were also found by Abraham *et al.* (2021).

Conclusion

Based on the experimental findings, it may be concluded that application of 20 kg N, 60 kg phosphorous and 20 kg potassium/ha resulted in significantly higher growth, yield and yield attributes of black gram. However, it was also observed that treatment T_5 (20 kg N + 40 kg phosphorous +20 kg potassium/ha) was statistically at par with T_7 in all the parameters. Further scrutiny of relative economics revealed that treatment T_7 recorded highest cost of cultivation, gross returns and net returns while treatment T_5 recorded highest B:C. Thus, it can be concluded that resource rich farmers, who can afford higher cost of cultivation should opt for 20 kg N + 60 kg phosphorous + 20 kg potassium /ha fertilization for higher net returns, while resource poor farmers should opt 20 kg N + 40 kg phosphorous + 20 kg potassium/ha fertilization for higher B: C.

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

	Treatments	Plant height (cm)		Number of leaves per plant		Number of branches per plant		Dry matter accumulation (g /plant)	
		40 DAS	At harvest	40 DAS	At harvest	40 DAS	At harvest	40 DAS	At harvest
T_1	100% RDF (18:40:00)	32.60	47.63	12.07	18.53	4.24	4.73	3.58	13.07
T_2	15 kg N + 40 kg phosphorous/ha	31.97	47.00	11.67	18.20	4.13	4.63	3.55	12.57
T_3	15 kg N + 40 kg phosphorous + 20 kg potassium/ha	35.07	48.17	14.07	19.97	4.97	5.22	4.03	13.93
T_4	20 kg N+40 kg phosphorous/ha	33.37	47.93	12.43	18.87	4.40	4.80	3.63	13.20
T_5	20 kg N + 40 kg phosphorous +20 kg potassium/ha	35.17	52.40	14.73	20.67	5.10	5.35	4.30	14.23
T_6	15 kg N+50 kg phosphorous/ha	33.70	48.13	13.33	19.23	4.57	4.73	3.77	13.32
T_7	20 kg N + 60 kg phosphorous + 20 kg potassium /ha	37.77	53.13	15.00	20.97	5.70	5.90	4.43	14.73
T_8	Control	30.97	44.67	10.27	17.00	3.30	3.90	3.23	10.30
	SEm±	**1.03**	**1.53**	**0.37**	**0.23**	**0.21**	**0.23**	**0.09**	**0.46**
	CD at 5 %	**3.12**	**4.66**	**1.15**	**0.71**	**0.64**	**0.71**	**0.29**	**1.40**

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

	Treatments	Pods per plant	Seeds per pod	Pod length (cm)	Seed yield (kg /ha)	Stover yield (kg/ha)
T_1	100% RDF (18:40:00)	13.57	9.10	7.13	796	1,983
T_2	15 kg N + 40 kg phosphorous/ha	12.93	8.90	7.10	753	1,673
T_3	15 kg N + 40 kg phosphorous + 20 kg potassium/ha	13.57	10.00	8.13	876	2,303
T_4	20 kg N+40 kg phosphorous/ha	13.23	9.27	7.23	823	2,072
T_5	20 kg N + 40 kg phosphorous +20 kg potassium/ha	14.47	10.03	8.17	931	2,375
T_6	15 kg N+50 kg phosphorous/ha	13.47	9.30	7.40	852	2,239
T_7	20 kg N + 60 kg phosphorous + 20 kg potassium /ha	15.07	10.60	8.50	953	2,453
T_8	Control	11.37	7.63	6.10	553	1,418
	SEm ±	**0.47**	**0.28**	**0.31**	**25**	**64**
	CD at 5 %	**1.45**	**0.85**	**0.96**	**76**	**194**

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

	Treatments	Cost of cultivation (Rs/ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C
T_1	100% RDF (18:40:00)	27685	55,299	27,614	2.00
T_2	15 kg N + 40 kg phosphorous/ha	27646	52,333	24,687	1.89
T_3	15 kg N + 40 kg phosphorous + 20 kg potassium/ha	28812	60,887	32,075	2.11
T_4	20 kg N+40 kg phosphorous/ha	27711	57,199	29,488	2.06
T_5	20 kg N + 40 kg phosphorous +20 kg potassium/ha	28877	64,705	35,828	2.24
T_6	15 kg N+50 kg phosphorous/ha	28196	59,237	31,041	2.10
T_7	20 kg N + 60 kg phosphorous + 20 kg potassium /ha	29977	66,210	36,233	2.21
T_8	Control	25250	38,459	17,183	1.52

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