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Effect of potassium mobilizing bacteria on growth and yield of black gram (*Vigna mungo* L.)

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Abstract

A field experiment was conducted during the *Kharif* season of 2025 at the Research Farm, Department of Soil Science, College of Agriculture, Latur, to evaluate the effect of potassium mobilizing bacteria on growth and yield of black gram. The experiment was laid out in a Randomized Block Design comprising eight treatments with three replications. The treatments included T₁-Control, T₂- 100% RDF, T₃-100% RDNP + 75% RDK + KMB Seed treatment, T₄-100% RDNP + 50% RDK + KMB Seed treatment, T₅-100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 DAS, T₆-100% RDNP + 50% RDK + KMB Seed treatment + Drenching of KMB at 20 DAS, T₇-100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS and T₈-100% RDNP + 50% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS. Among the treatments, 100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS (T₇) recorded the highest plant height at 30, 45 and 60 DAS (16.81 cm, 28.89 cm and 38.98 cm, respectively) and leaf area at 30 and 45 DAS (482.62 cm², 515.77 cm², respectively). The same treatment also recorded the highest seed yield (11.16 q ha⁻¹) and straw yield (17.78 q ha⁻¹). The performance of T₇ was statistically at par with 100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 DAS (T₅) and 100% RDNP + 50% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS (T₈) for the major growth parameters and yield. The study demonstrated that the integration of KMB seed treatment with soil drenching, particularly with 75% RDK, improved the growth and yield performance of black gram under field conditions.

Keywords: Black gram, potassium mobilizing bacteria, integrated nutrient management, growth parameters, yield

Introduction

Black gram (*Vigna mungo* L.), also known as Urd bean, is an important short-duration pulse crop belonging to the Fabaceae family, widely cultivated in India because of its high nutritional value, adaptability to diverse agro-climatic conditions and ability to contribute to soil fertility through biological nitrogen fixation making it suitable for sustainable cropping system. This pulse crop is rich in nutrients, containing 20-25% protein, 55-65% carbohydrates, 1.3% fats and 40-47% starch as well as various minerals such as phosphorus, potassium, calcium, iron, magnesium, sodium, zinc, copper and essential vitamins (Vitamin A, Vitamin B₁, Vitamin B₃, Vitamin C and trace amounts of thiamine, riboflavin, niacin) (Swaminathan *et al.*, 2020) ^[12]. Owing to its high nutritional value, black gram forms an important component of the vegetarian diet in India and holds considerable significance in sustainable pulse-based production systems. Despite its importance, the productivity of black gram remains constrained by several factors, including inadequate and imbalanced nutrient supply. Among the major plant nutrients, potassium plays an important role in growth and yield as it is involved in assimilation, transport, and storage tissue development (Nathiya *et al.*, 2015) ^[7]. Potassium is required in relatively large quantities by plants and has a significant influence on several biochemical and physiological processes. It regulates stomatal movement, maintains cellular osmotic balance, enhances photosynthetic activity and contributes to the efficient translocation of assimilates from source to sink. In black gram, potassium has been known to significantly improve growth, yield and nutrient uptake, demonstrating the importance of potassium management for achieving higher productivity (Athokpam *et al.*, 2009; Karthikeyan *et al.*, 2020) ^[1, 5]. However, the total potassium content in

soil does not necessarily reflect its availability in the plants, as a major proportion of soil potassium exists in mineral and non-exchangeable forms that are not readily accessible to the crops. Despite potassium being the seventh most abundant element found in the Earth's crust, only 1 to 2% of this element is available to plants (Sparks and Huang, 1985) ^[10]. About 90 to 98% of the total potassium present in the soil is found locked within primary minerals in insoluble forms such as feldspar, mica, and illite, which are unavailable to plants (Olaniyan *et al.*, 2022; Meena *et al.*, 2014) ^[8, 6]. K in soil is present in several forms, including mineral K, non-exchangeable K, exchangeable K and solution K. Continuous cropping and intensive cultivation have accelerated the depletion of available potassium from their reserves, thereby resulting in reduced crop productivity and nutrient use efficiency. Consequently, improving the availability of native soil potassium is a necessary component of efficient potassium management. Potassium mobilizing bacteria (KMB) can be used as a promising biological approach for increasing the availability of otherwise inaccessible forms of potassium in soil. These microorganisms are capable of releasing potassium in soluble forms through mechanisms such as production of organic and inorganic acids, chelation, acidolysis, polysaccharides production, complexolysis and exchange reactions (Etesami *et al.*, 2017) ^[3]. Through these mechanisms, KMB enhance the release of potassium from soil minerals and improves its availability in the rhizosphere. Inoculation with KMB may consequently improve plant nutrient acquisition and create more favourable conditions for plant growth and yield formation. Efficient nutrient management is essential for achieving higher productivity in black gram. Integrated nutrient management provides a sustainable and environmentally sound strategy for improving crop performance while reducing the dependency on chemical fertilizers. In this context, the present study was undertaken to evaluate the influence of potassium mobilizing bacteria (KMB) biofertilizer in combination with varying levels of soil-applied potassium fertilizer on the growth and yield of black gram.

Materials and Methods

The field experiment was conducted during *Kharif* 2025 at the Research Farm of the Department of Soil Science, College of Agriculture, Latur. Black gram (*Vigna mungo* L.) variety NUL-7 (Vishwas) was used for the study. The experimental field was uniform and levelled. The soil of the research farm was dark grey to brown in colour, clayey in texture and dominated by 2:1 type smectite clay minerals. The site falls under hyperthermic temperature regimes, and is characterized by very gentle slopes with moderate erosion.

The experiment was laid out in a Randomized Block Design (RBD) comprising eight treatments, each replicated three times. The treatments were T₁- Control, T₂- 100% RDF, T₃- 100% RDNP + 75% RDK + KMB Seed treatment, T₄- 100% RDNP + 50% RDK + KMB Seed treatment, T₅- 100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 DAS, T₆- 100% RDNP + 50% RDK + KMB Seed treatment + Drenching of KMB at 20 DAS, T₇- 100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS and T₈- 100% RDNP + 50% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS. The gross plot size was 3.9 m x 4.0 m. Black gram was sown at a spacing of 30 cm between rows and 10 cm between plants. Nitrogen, phosphorus, and potassium were

supplied through urea, single superphosphate (SSP), and muriate of potash (MOP), respectively.

The biochemical analysis involved assessing parameters such as plant height, leaf area, seed yield, and straw yield. The recorded data were subjected to appropriate statistical analysis for an RBD, and the treatment means were compared using the critical difference (CD) test at the 5% level of significance.

Results and Discussion

Growth parameters

The data presented in Table 1 indicated that the numerically higher growth parameters, namely plant height (cm) and leaf area (cm² plant⁻¹) were recorded with T₇ (100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS). The highest plant height of 16.81 cm, 28.89 cm and 38.98 cm at 30, 45 and 60 DAS, respectively, and leaf area of 482.62 and 515.77 cm² plant⁻¹ at 30 and 45 DAS, respectively were recorded under T₇ and it was found to be statistically at par with, T₅ (100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 DAS) and T₈ (100% RDNP + 50% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS). The lowest value was recorded under T₁ (control).

The superior growth performance observed under T₇ may be attributed to the combined effect of potassium fertilization and KMB application. Potassium mobilizing bacteria (KMB) can enhance the availability of potassium in the soil through the production of organic acids and other biochemical processes that facilitate the dissolution and mobilization of potassium from their fixed forms into plant accessible forms. Improved potassium availability may have promoted photosynthetic activity, enzyme activation, cell growth and efficient translocation of assimilated nutrients, thereby supporting plant growth. Furthermore, the nutrients made available through KMB application may have enhanced metabolic activities, cell division and cell elongation, resulting in better plant development. Thus, all of these combined may have created a favourable condition for vegetative growth and development of black gram. The result was in accordance with the findings of Sree *et al.* (2026) ^[11], Thuvaraka *et al.* (2023) ^[13], Bhat *et al.* (2022) ^[2] and Ghetiya *et al.* (2018) ^[4].

Yield

The data presented on Table 2 revealed that the application of KMB in combination with different levels of potassium significantly improved seed yield and straw yield of black gram. Among the treatments, T₇ recorded the highest seed yield (11.16 q ha⁻¹) and straw yield (17.78 q ha⁻¹). The performance of T₇ was statistically at par with that of T₅ and T₈, whereas the lowest values for seed yield (7.50 q ha⁻¹) and straw yield (11.75 q ha⁻¹) were recorded under T₁ (control).

The superior performance under T₇ may be attributed to the synergistic effect of KMB application and potassium fertilization, which improved the availability and utilization of potassium and other nutrients. Improved nutrient uptake and translocation may have promoted reproductive development, carbohydrate synthesis and assimilate partitioning, resulting in a greater higher seed yield. Enhanced vegetative growth and dry matter accumulation due to continuous nutrient supply during critical growth stages may have further contributed to the higher straw yield recorded under T₇. These findings are in agreement with the findings of Sree *et al.* (2026) ^[11] and Rohan *et al.* (2022) ^[9].

Table 1: Effect of potassium mobilizing bacteria on the growth of black gram

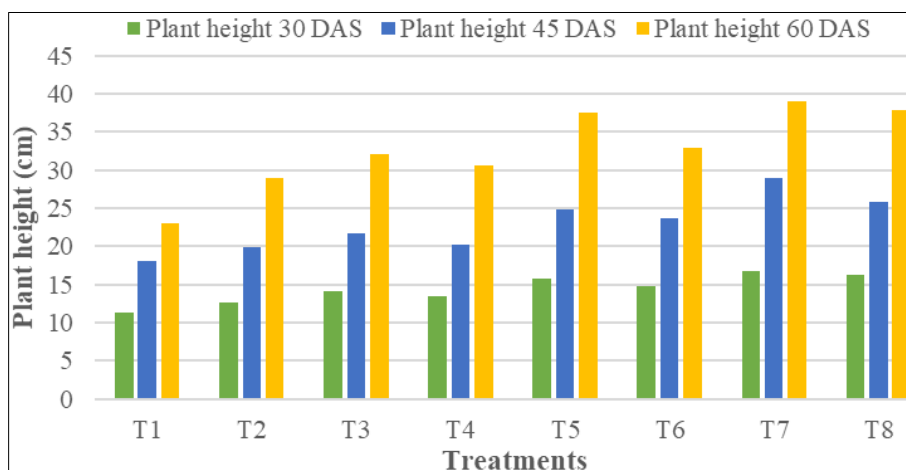
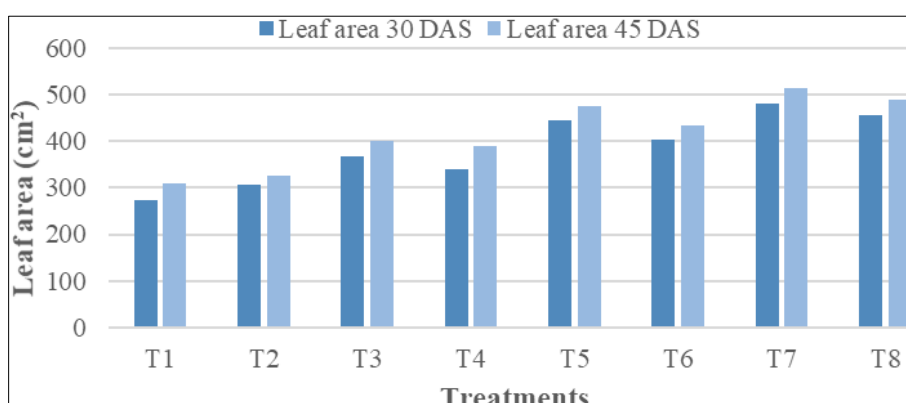
Treatments	Growth parameters				
	Plant height (cm)			Leaf area (cm ² plant ⁻¹)	
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS
T ₁ : Control	11.36	18.02	23.10	273.37	309.93
T ₂ : 100% RDF	12.57	19.97	28.94	306.20	327.17
T ₃ : 100% RDNP + 75% RDK + KMB Seed treatment	14.12	21.69	32.03	368.01	400.03
T ₄ : 100% RDNP + 50% RDK + KMB Seed treatment	13.42	20.30	30.58	339.58	389.82
T ₅ : 100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 DAS	15.77	24.90	37.47	444.69	475.90
T ₆ : 100% RDNP + 50% RDK + KMB Seed treatment + Drenching of KMB at 20 DAS	14.81	23.67	32.87	403.53	433.30
T ₇ : 100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS	16.81	28.89	38.98	482.62	515.77
T ₈ : 100% RDNP + 50% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS	16.29	25.80	37.93	455.23	488.70
SE±	0.65	1.41	1.73	24.79	25.84
CD at 5%	1.99	4.28	5.24	75.20	78.39

(*RDF-Recommended dose of fertilizer, **RDNP-Recommended dose of nitrogen and phosphorus, ***RDK-Recommended dose of potassium, ****KMB-Potassium mobilizing bacteria, *****DAS-Days after sowing)

Table 2: Effect of potassium mobilizing bacteria on the seed yield and straw yield of black gram

Treatments	Seed Yield (q ha ⁻¹)	Straw Yield (q ha ⁻¹)
T ₁ : Control	7.50	11.75
T ₂ : 100% RDF	8.72	12.98
T ₃ : 100% RDNP + 75% RDK + KMB Seed treatment	9.14	14.50
T ₄ : 100% RDNP + 50% RDK + KMB Seed treatment	9.09	13.87
T ₅ : 100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 DAS	10.78	16.85
T ₆ : 100% RDNP + 50% RDK + KMB Seed treatment + Drenching of KMB at 20 DAS	9.38	14.65
T ₇ : 100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS	11.16	17.78
T ₈ : 100% RDNP + 50% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS	10.93	17.10
SE±	0.58	0.89
CD at 5%	1.76	2.71

(*RDF-Recommended dose of fertilizer, **RDNP-Recommended dose of nitrogen and phosphorus, ***RDK-Recommended dose of potassium, ****KMB-Potassium mobilizing bacteria, *****DAS-Days after sowing)

**Fig 1:** Effect of potassium mobilizing bacteria on plant height (cm) at 30, 45 and 60 DAS of black gram.**Fig 2:** Effect of potassium mobilizing bacteria on leaf area (cm² plant⁻¹) at 30 and 45 DAS of black gram.

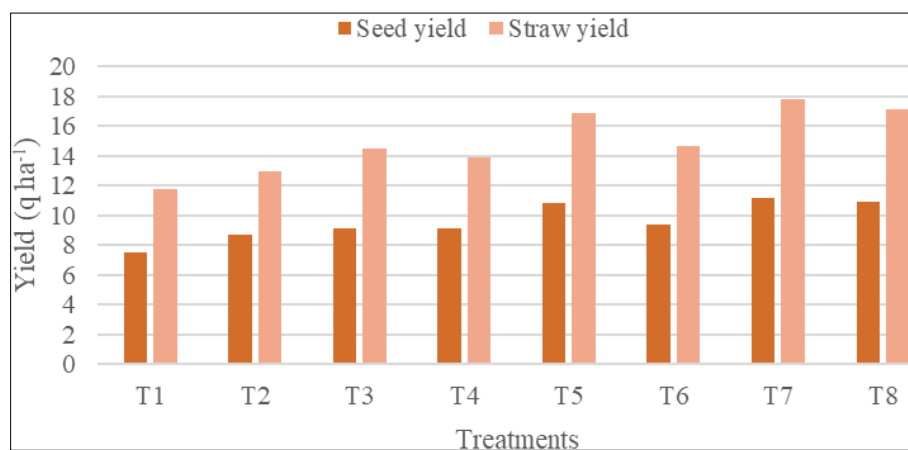


Fig 3: Effect of potassium mobilizing bacteria on seed yield (q ha⁻¹) and straw yield (q ha⁻¹) after harvest of black gram.

Conclusion

Based on the above results, it can be concluded that the growth parameters such as plant height, leaf area and yield (seed yield and straw yield) of black gram increased with the combined application of 100% RDNP + 75% RDK + KMB Seed treatment + Drenching of KMB at 20 and 40 DAS as compared to the control and other treatments.

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