**Journal of Agroforestry and Environment**

**Volume 18, Issue 2, 2025**

**Journal DOI:** https://doi.org/10.55706/jae
**Journal homepage:** www.jagroforenviron.com

# Alleviation of Water Stress, Increase Growth, Yield and Quality of Mungbean through Potassium Fertilization

Susmita Rani Saha[1], Md. Sagirul Islam Majumder[1*], Muhammad Iqbal Hossain[2], Mohammad Kabirul Islam[1], Md. Shahin Hossin[1], Md. Rafiq Uddin[1], Samsunnahar Pranto[1], and Arpita Roy[1]

[1] Department of Soil Science, Patuakhali Science and Technology University, Dumki-8602, Patuakhali, Bangladesh.
[2]Department of Plant Pathology, Patuakhali Science and Technology University, Dumki-8602, Patuakhali, Bangladesh.
[*]Correspondence: sagir_mjd@yahoo.com; Phone: +8801712591838.

**Received: 21/06/2025**

**Accepted: 15/09/2025**

**Available online: 16/09/2025**



**Abstract:** The study was conducted at the net house, Department of Soil Science, Patuakhali Science and Technology University, Patuakhali, during February to April 2025 to evaluate the effects of potassium fertilization on the growth, yield, and drought tolerance of mungbean (*Vigna radiata* L., var. BINA Mung-5). A pot experiment was laid out in a Complete Randomized Design (CRD) with seven potassium levels (0, 1.5, 3.0, 4.5, 6.0, 7.5, and 9.0 g K per 10 kg soil) with three replications. The study assessed a range of agronomic characters including plant height, number of branches per plant, number of leaves per plant, number of flowers per plant, root and shoot biomass, number of pods and seeds per pod, pod length, thousand seed weight, and seed yield under controlled moisture conditions. Results revealed that moderate levels of potassium significantly improved growth and reproductive parameters compared to the control. Specifically, treatments with 7.5 and 6.0 g K per 10 kg soil exhibited superior performance in shoot and root biomass, pod number, seed set, and seed weight. Conversely, both potassium deficiency and excessive potassium resulted in reduced growth and yield attributes. The results highlight the critical role of potassium in improving water stress resilience, vegetative vigor, and reproductive success in mungbean. This study highlights the importance of balanced potassium nutrition as a low-cost agronomic strategy to enhance mungbean productivity, especially in drought-prone and salt-affected coastal areas of Bangladesh.

**Keywords:** Water Stress; Potassium Fertilization; Yield and Quality of Mungbean.

## INTRODUCTION

Mungbean (Vigna radiata L.) is one of the important pulse crops of Bangladesh. This widely cultivated pulse crop is a member of the Leguminosae family. Pulses are the primary source of protein for most people, especially those in Bangladesh's poorer neighborhoods. Because they are the least expensive protein source, they are known as "poor men's meat." Yet, because of their high cost and limited supply, pulses are currently out of reach for the poor. The World Health Organization recommends 45.0 g of pulses per person, however Bangladesh consumes only 14.72 g per capita (BBS, 2019). Pulses must be imported to sustain this level of supply, which means the Bangladeshi government must spend a significant sum of foreign currency annually. In order to meet the demand, pulse output must be boosted immediately. When it comes to nutrition, mungbean is regarded as the best pulse. According to Kaul (1982), it has 51% carbohydrates, 26% protein, 4% minerals, and 3% vitamins. In Bangladesh, it ranks third in terms of protein content and fourth in terms of both acreage productions. Compared to cereals, it has nearly twice as much protein. It tastes delicious and is easily digested. The leftovers are turned into manure, while the fresh plants are fed to animals Mungbean (Vigna radiata) is a short duration legume and achieved its full growth period in a short time. It tolerates drought in the wild, and can thrive under nutrient limited conditions. Mungbean is widely spread in Bangladesh because of its ability to grow under a wide range of environmental condition. In pulse crops, it ranks third in terms of area and production but takes the first position in market price which signifies that it is economically most important.

By fixing nitrogen from the atmosphere biologically, pulse cultivation can enhance the physical, chemical, and biological characteristics of soil and raise its fertility level. Bangladesh is an emerging nation. Our nation has a limited quantity of land. But there are a lot of people living there. More food is needed for more people. Given the limited amount of land we have, we must produce more food. Farmers are cultivating more cereal crops to meet the rising demand for food. Both the total cultivable area and the cultivable land for pulses are declining daily as a result of the rising population pressure. Due to farmers' unwillingness to cultivate pulses on their fertile land, pulses are currently grown on marginal ground. Due to its low production and yield, pulse agriculture is also declining. The productivity and fertility of the soil are also impacted by the long-term cultivation of cereal crops. One of the most significant elements influencing agricultural productivity is fertilizer. The process of recommending fertilizer for crops and soils is dynamic (Singh et al., 2018), and one of the key elements that significantly influences mungbean growth, development, and yield is fertilizer management. Application of potassium under drought can reduce the adverse effects of restricted water on plant growth (Singh and Kumar, 2020). As the third most essential macronutrient after nitrogen and phosphorus, potassium is crucial for plant growth and sustainable crop yield.

Sufficient K supply for plants in the growing season can improve the water availability of plants and photo-synthetic efficiency. It maintains osmotic pressure and turgor within the cell, which is important for cell growth. Stomatal movement is controlled by potassium, helping to prevent overindulgence of water loss via transpiration. It also stimulates more than 60 enzymes, including creatine kinase required for protein synthesis, and promotes efficient energy transfer.

Potassium also is involved in plant protection and hardiness. It helps by maintaining the strength the cell wall, increasing heat, drought and water stress tolerance as well as improving resistance to pests and diseases. It is associated with reproductive parameters such as flowering, pod setting and grain filling leading to increased crop yield, particularly in mungbean.

In general, potassium is essential not only for metabolism to occur normally such as photosynthesis and protein synthesis but also for strengthening plants under environmental stress. Involvement of this gene in the regulation of stomatal movement, osmotic adjustment, enzyme activity and structural support confirms its role in maintaining productivity under drought. Increasing the amount of land under mungbean production or improving production techniques, including adjusting the dosage of N, P, and K fertilizers, are two ways to address our nation's mungbean output shortfall. There have been numerous research on the nutritional needs of mungbean in Bangladesh, but relatively few have been written about the requirements for potassium and phosphorus as well as the combined impacts of these elements on mungbean. The aim was to find out the best potassium application stage for improvement in of Water Stress, Increase Growth, potential and the yield performance of Mungbean. By applying different potassium levels under water stress conditions, this research seeks to provide valuable insights into how potassium can be used as an agronomic tool to improve mungbean productivity in water-limited areas.

Research Objectives

i Effect of Potassium Fertilizer on Drought Tolerance of Mungbean (Vigna radiata L.).

ii. To assess the influence of potassium fertilizer on the growth and yield of mungbean.

## MATERIALS AND METHODS

### Experimental Location and Duration

The experiment was conducted in a pot house at the Department of Soil Science, Patuakhali Science and Technology University (PSTU), Bangladesh. The study took place between February 1, 2025, and April 30, 2025.

### Location

The study was carried out in the Department of Soil Science's net house at Patuakhali Science and Technology University (PSTU), Dumki, Patuakhali, which is located at latitude 22.46465°N and longitude 90.38843°E. The region is between 0.9 and 2.1 meters above average sea level.

### Soil

The soil was collected from PSTU research farm. The experimental soil was silt loam having pH value of 5.5. The features of the experimental soil have been presented in Table 3.1. The status of soil was determined in laboratory of the Department of Soil Science, PSTU. The organic matter content was found 2.26%.

### Climate and Weather

Description of the study area Located in a subtropical climate, the study area is characterized by warm to moderately high temperatures and heavy rainfall during Kharif season (April–September). Conversely during Rabi (October–March), there is scant rain, the weather stays relatively cool, and there is plenty of sunshine. The conditions are also conducive to Rabi crops.

### Planting Material

For this study, a high yielding mungbean (*Vigna radiata* L.) variety BINA Mung-5 was used obtained from the Laboratory of Soil Science Department, Patuakhali Science and Technology University (PSTU).

Key Features of BINA Mung-5:

Habit: Semi-erect to medium in stature.

Maturity: Early to mid-season.

DOI: https://doi.org/10.55706/jae1826

Seed Characteristics: Grains are green, shiny and of medium-size.
Yield Potential: High yield potential in the right environment.
Stress tolerance: Tolerate to most of the common diseases.

**Experimental design and layout**

The experiment was set up in a RCBD having Seven treatments with three replications.

Treatment details
T1: 0 mg K/ 8kg soil (control)
T2: 9 g K /10kg soil
T3: 7.5 g K /10kg soil
T4: 6.0 g K /10kg soil
T5: 4.5 g K /10kg soil
T6: 3.0 g K /10kg soil
T7: 1.5 g K/10kg soil

**Collection and preparation of Soil**

During the 1st week of February 2025, the soil was collected. After being collected, the soils were spread out and given time to dry. A wooden hammer was used to break up the soil clods. The previous crop's stubble and weeds were eliminated from the soil. Twenty-one plastic pots containing 10 kg of soil were used.

**Fertilizer application**

Seven days before sowing, 500 g each of cow dung and vermicompost were mixed to the soil for release of nutrients by decomposition and to avoid toxic effects of fresh organic matter on seed germination. Also, when tilling the soil, 250 g of urea, TSP and gypsum each along with two packets of Rhizobium inoculant were mixed in.

**Seed sowing**

Collected fresh and Healthy seeds of BINA moong-5 was sown in the research field at February, 2025 by hand in all the pots, (4-5 seeds in each pot) seeds of mungbean. Light irrigation was given before seed sowing.

**Tagging and labeling**

Then After sowing, each pot was labeled according to soil types and treatment.

**Intercultural operations**

Germination of the seed started on 3 DAS. To keep the optimal plant population, thinning occurred at day 8 post sowing (DAS). Two hand weeding was performed; one during the thinning and other at 35 days after sowing (DAS). Supplemental irrigation was given as per crop requirement. No pest infestation was evidenced at early vegetative growth stages. For preventive control, the product Ripcord 10 EC was sprayed twice at a dosage of 1 mL $L^{-1}$ with one week interval between applications.

Plant height, leaf number per plant and dry matter accumulation at 15, 25 and 40 DAS before final harvest was taken during growth period. For measurement, three randomly sampled plants were selected from the control and each of seven treatments (there are 3 replications).

**Harvesting**

The crops were harvested when the maximum number of pods had simultaneously matured. Initially, 80% of fully grown pods were picked by hand. Ultimately, on the same days as the second pod picking, all plants were uprooted and wrapped separately for harvest. After that, every plant that was harvested was marked, and finally, every harvested pod was stored separately in gunny bags that were appropriately tagged. The roots were meticulously cleaned after being removed from the soil. The weight of the roots and new shoots was noted. The plant samples were then dried in an oven for three days at 70°C. Additionally noted was the samples' dry weight.

**Plant data recording**

Plant height, Number of branches per plant, Number of leaves per plant, Number of flowers per plant, Dry matter accumulation, Pods per plant, Seeds per pod, Pod length (cm), Weight of 1000-seed (g), Seed yield (t/ha), Stover yield (t/ha), Biological yield (t/ha) were recorded following standard protocol.

**Statistical analysis**

Statistical analysis of the collected data with respect to mungbean growth, yield and yield components was carried out through Microsoft Excel and STAR software to detect the significant differences among treatments. The data were analysed by analysis of variance (ANOVA) and average values that differed significantly within each species were separated using Fisher's test at 5% probability level ($p < 0.05$).

## RESULTS

**Plant height (cm)**

The bar graph illustrates the influence of different potassium (K) application rates on plant height (cm) under controlled conditions. Treatment T1, which received no potassium (0 mg K per 8 kg soil), resulted in the lowest average plant height (~10 cm) and was significantly different from all other treatments, as indicated by its separate statistical grouping ('b'). In contrast, treatments T2 (9 g K/10 kg soil), T3 (7.5 g K/10 kg soil), T4 (6.0 g K/10 kg soil), T6 (3.0 g K/10 kg soil), and T7 (1.5 g K/10 kg soil) produced notably greater plant heights, all falling within the same statistical group ('a'), suggesting comparable efficacy in promoting vegetative growth. Treatment T5 (4.5 g K/10 kg soil) yielded a moderate response and was classified under group 'ab', indicating that its effect on plant height was not significantly different from either the control or the higher K doses.

DOI: https://doi.org/10.55706/jae1826

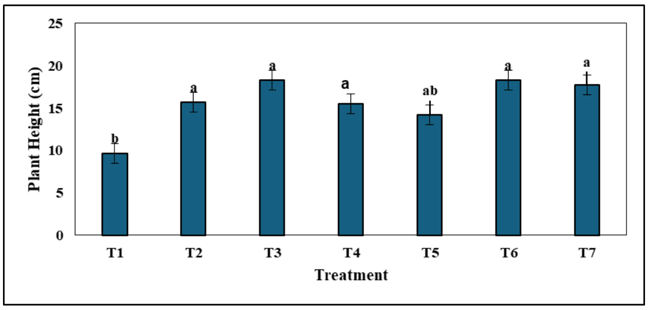


**Figure 1:** Impact of various rates of potassium fertilizer on plant height of BINA Mung-5

### No. of the branch Plant$^{-1}$

The bar graph presents the impact of varying potassium (K) application rates on the number of branches per plant across seven treatments (T1–T7). The control group (T1), which received no potassium, resulted in a lower number of branches (~7 per plant) and was statistically grouped as 'b', indicating it was significantly less effective than the highest treatment. Treatments T2 through T6, which received increasing rates of potassium from 1.5 g to 9 g K per 10 kg of soil, also exhibited statistically similar branch numbers to the control and were similarly assigned to group 'b'. In contrast, treatment T7 (1.5 g K/10 kg soil) significantly outperformed all other treatments, producing the highest mean number of branches (~18 per plant) and being the only group classified as 'a'.

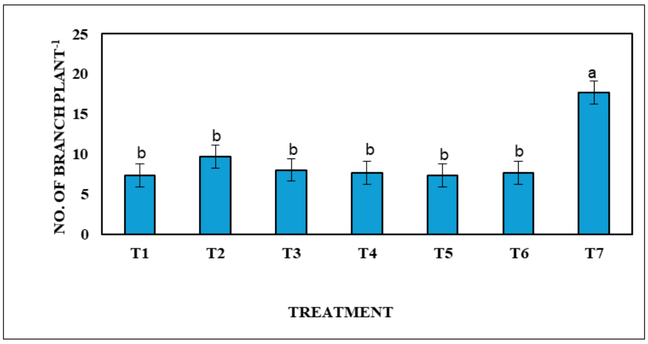


**Figure 2:** Impact of various rates of potassium fertilizer on no. of branch plant$^{-1}$ of BINA Mung-5

### Root dry weight

The line graph illustrates the effect of potassium application on root dry weight (g) across seven treatments (T1–T7). Interestingly, the control group (T1: 0 mg K/8 kg soil) exhibited the highest root dry weight (~0.4 g), followed by a marked decline across T2 to T5, with the lowest value (~0.05 g) observed in T5 (4.5 g K/10 kg soil). A gradual increase was then seen from T6 to T7, though none of these surpassed the root biomass observed under the control condition. These results reveal an inverse relationship between potassium application rate and root biomass, particularly at the higher dose levels (T2–T5), suggesting that potassium application may have a suppressive effect on root growth in this context.

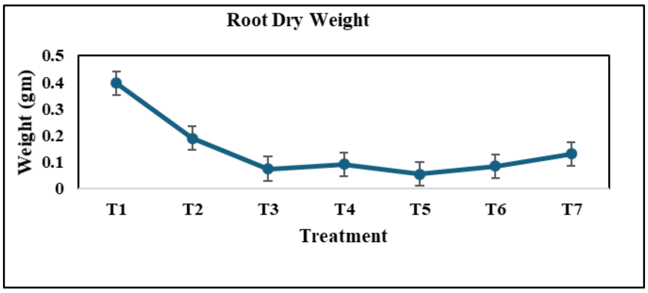


**Figure 3:** Impact of various rates of potassium fertilizer on root dry weight of BINA Mung-5

### Root fresh weight

The graph illustrates the response of root fresh weight (g) to varying levels of potassium application across seven treatments (T1–T7). Treatments T1, T2, T5, T6, and T7 produced negligible root fresh weights, close to zero, with little variation. In stark contrast, treatments T3 (7.5 g K/10 kg soil) and T4 (6.0 g K/10 kg soil) recorded significantly higher root fresh weights, peaking at approximately 20 g and 17 g, respectively. These results suggest that moderate potassium levels (T3 and T4) are highly effective in enhancing root water content and biomass accumulation, while both the absence of potassium (T1) and higher/lower doses (T2, T5–T7) failed to elicit a positive response.

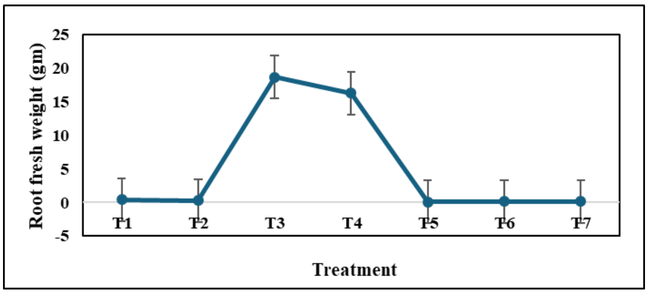


**Figure 4:** Impact of various rates of potassium fertilizer on root fresh weight of BINA Mung-5

### Shoot fresh and dry weight

The bar graph compares the effect of seven potassium treatments (T1–T7) on shoot fresh weight and shoot dry weight of plants. Among the treatments, T6 (3.0 g K/10 kg soil) produced the highest shoot dry weight (~4.0 g), followed closely by T1 (control), both indicating robust dry matter accumulation. On the other hand, shoot fresh weight peaked under T3 (7.5 g K/10 kg soil) at approximately 2.3 g, with relatively lower values observed in T1, T5, T6, and T7. Treatment T5 showed the lowest biomass in both fresh and dry forms. This pattern suggests that potassium availability plays a complex and dose-dependent role in influencing shoot hydration and structural development.

DOI: https://doi.org/10.55706/jae1826

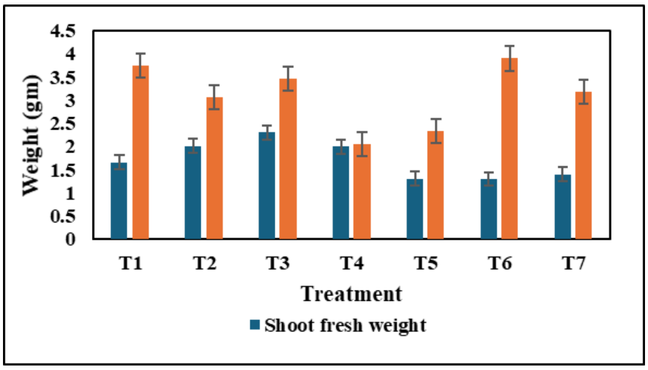


**Figure 5:** Impact of various rates of potassium fertilizer on the shoot fresh and dry weight of BINA Mung-5

### Number of seeds pod$^{-1}$ and Pod length

The graph illustrates the response of two key reproductive parameters—pod length (cm) and total number of seeds per pod—to seven potassium treatments (T1–T7). Pod length remained relatively consistent across treatments, ranging from approximately 5.5 cm to 7 cm, with the highest length observed in T1 (control) and a slight decline through T4, followed by minor increases in T5 to T7. In contrast, the total number of seeds per pod exhibited significant variation. Treatment T5 (4.5 g K/10 kg soil) produced the highest number of seeds (~8.5), statistically grouped as 'a', while T1 and T7 resulted in the lowest seed counts (~4.5–5.0), both classified as 'cd'. Treatments T3 and T4 also demonstrated relatively high seed numbers and were grouped as 'ab', suggesting favorable effects of moderate potassium levels.

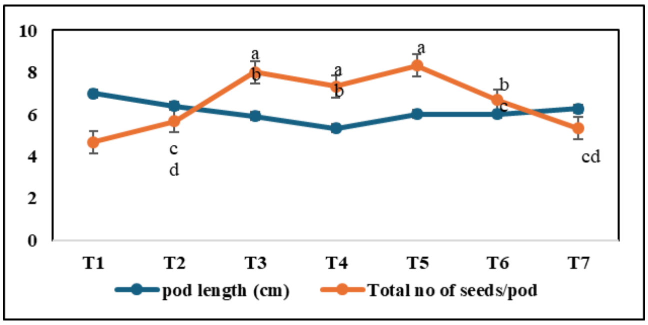


**Figure 6:** Impact of various rates of potassium fertilizer on the number of seeds pod$^{-1}$ and the Pod length of BINA Mung-5

### Total number of leaves

The graph displays the variation in the total number of leaves per plant under seven potassium treatments (T1–T7). Treatment T1 (control, 0 mg K/8 kg soil) resulted in the lowest number of leaves (~12) and was statistically grouped as 'c', reflecting a significant deficiency in vegetative growth. Treatments T2, T3, T4, and T7 produced the highest number of leaves (ranging from ~19 to 20), all grouped under a', suggesting an optimal potassium-induced promotion of leaf development. In contrast, T5 (4.5 g K/10 kg soil) produced a noticeably lower number of leaves (~14), falling under the 'bc' group, while T6 (3.0 g K/10 kg soil) showed a moderate response and was classified as 'ab'.

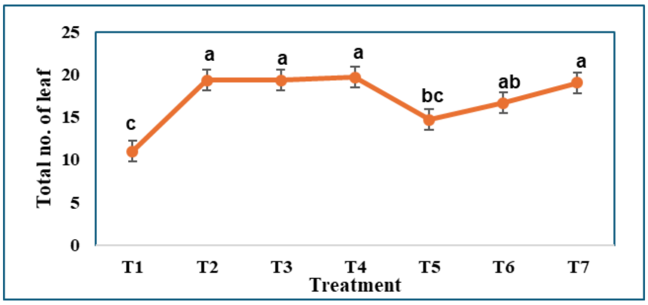


**Figure 7:** Impact of various rates of potassium fertilizer on the total number of leaf of BINA Mung- 5

### Root length

The bar graph depicts the variation in root length (cm) in response to seven potassium treatments (T1–T7). The control treatment (T1: 0 mg K/8 kg soil) produced the shortest roots (~8.5 cm) and was statistically distinct, classified under group 'd', reflecting a significant restriction in root elongation under potassium deficiency. The longest roots were observed under T3 (7.5 g K/10 kg soil) and T4 (6.0 g K/10 kg soil), measuring approximately 14 cm and 13 cm, respectively, indicating favorable effects of moderate potassium supplementation. T5 (4.5 g K/10 kg soil) followed closely (~13 cm), statistically grouped as 'ab'. Treatments T6 and T7 produced slightly shorter roots (~11 cm and ~10 cm, respectively), grouped as 'bc' and 'cd', showing a mild suppression of root elongation at lower potassium levels.

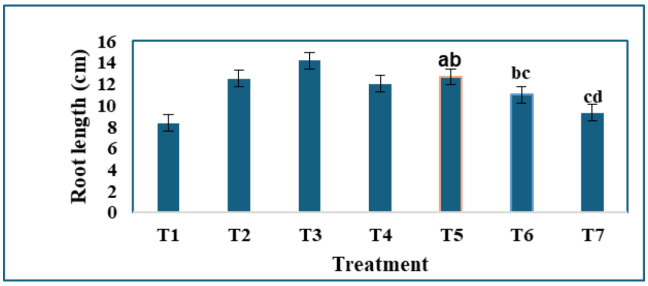


**Figure 8:** Impact of various rates of potassium fertilizer on the root length of BINA Mung-5

### Total number of flowers

The bar graph presents the mean total number of flowers under seven different treatments (T1-T7), with error bars representing the standard error of the mean. Treatment T2 recorded the highest flower production, averaging around 3.4 flowers, followed closely by T5 and T7, suggesting the favorable effects of the applied treatment on floral initiation. In contrast, T3 exhibited the lowest mean flower number, indicating a less effective treatment in promoting reproductive growth. While the differences among treatments are visually apparent, overlapping error bars highlight the need for post-hoc significance testing to confirm whether these differences are statistically meaningful.

DOI: https://doi.org/10.55706/jae1826

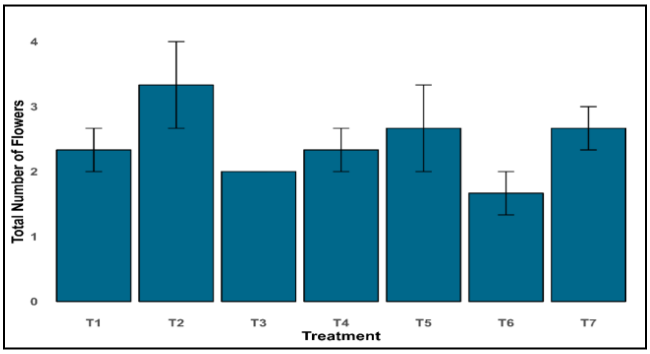


**Figure 9:** Impact of various rates of potassium fertilizer on the total number of flowers of BINA Mung-5 (Data are mean values)

**Thousand seed weight**

The bar graph illustrates the mean thousand seed weight (gm) across seven treatments (T1–T7), with standard error bars indicating within-treatment variation. Treatment T3 recorded the highest thousand seed weight (~56.8g) and was statistically distinguished with the letter 'a', indicating significant superiority over other treatments at the given confidence level. In contrast, treatments T1, T2, T4, T5, T6, and T7 showed no statistically significant differences among themselves, all grouped under the letter 'b', with values ranging between approximately 33g and 40g. The results suggest that T3 had a unique and notable effect on seed weight enhancement compared to the other treatments.

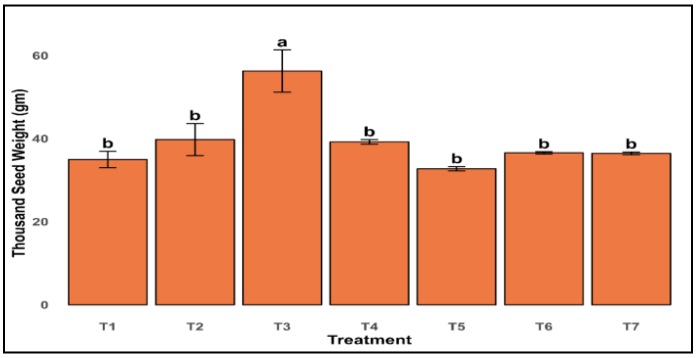


**Figure 10:** Impact of various rates of potassium fertilizer on thousand seed weight of BINA Mung-5 (Data are mean values)

## DISCUSSION

**Effect of different levels of potassium fertilizer on root plant height of BINA Mung-5**

These findings underscore the critical role of potassium in enhancing plant vegetative development. Potassium contributes to a range of physiological processes that directly impact plant height, including osmotic regulation, enzyme activation, protein synthesis, and photosynthate transport. The observed increase in plant height with K supplementation aligns with established literature demonstrating the importance of adequate potassium in maintaining cell turgor and supporting stem elongation (Marschner, 2012). Furthermore, Ruan et al. (2020) highlighted that optimized potassium nutrition enhances water use efficiency and photosynthetic capacity, leading to improved biomass accumulation and growth performance in field crops. The results of this study affirm that potassium application, even at lower rates, significantly benefits plant height, whereas potassium deficiency markedly restricts vegetative development.

**Effect of different levels of potassium fertilizer on no. of the branches plant$^{-1}$ of BINA Mung-5**

These findings suggest that lower levels of potassium may play a more favorable role in promoting axillary branching than either no potassium or excessively high levels. Potassium is known to regulate several physiological and hormonal pathways, including those involved in apical dominance and lateral bud development. Adequate K enhances carbohydrate allocation and cytokinin activity, both of which are essential for stimulating branch emergence and development (Mollier & Pellerin, 2015). The significant increase in branch number under T7 indicates an optimal threshold for K-induced stimulation of branching, while higher doses may inhibit this response, possibly due to nutrient imbalance or antagonistic interactions. These results underscore the importance of precise potassium management to optimize structural plant traits that contribute to overall productivity.

**Effect of different levels of potassium fertilizer on root dry weight of BINA Mung-5**

Potassium is essential for many metabolic functions in plants; however, excessive or imbalanced supply can alter carbon partitioning and reduce root system development. Root biomass reduction under high K levels can be attributed to the preferential allocation of assimilates to aboveground parts, which promotes shoot growth at the expense of root development. Furthermore, high potassium concentrations in the rhizosphere may suppress lateral root proliferation due to osmotic or ionic stress (López-Bucio et al., 2003). The observed trend suggests that low to moderate potassium levels may favor balanced root-shoot growth, while the absence of K, as seen in T1, may induce compensatory root expansion in search of nutrients. Thus, potassium management must consider both above- and belowground growth dynamics for optimal plant development.

**Effect of different levels of potassium fertilizer on root fresh weight of BINA Mung-5**

Potassium plays a pivotal role in maintaining osmotic balance, enzyme activity, and water uptake, which are critical for promoting fresh biomass development in roots. The significant spike in root fresh weight observed under T3 and T4 may be attributed to improved root hydration and turgor pressure facilitated by optimal K availability. However, extremely low (T1, T2) or possibly excessive or imbalanced K levels (T5-T7) may disrupt cellular homeostasis or reduce root growth via ionic stress or antagonistic nutrient interactions (Wang et al., 2013). These findings are consistent with previous reports indicating that moderate potassium supplementation improves root hydration and biomass, while sub-optimal levels fail to

DOI: https://doi.org/10.55706/jae1826

support effective root system development (Zhao et al., 2016).

### Effect of different levels of potassium fertilizer on shoot fresh-dry weight of BINA Mung-5

The results indicate that potassium significantly affects both water content and dry matter partitioning in the shoot. While dry weight reflects the accumulation of structural biomass, fresh weight is influenced by both growth and water retention. Potassium is critical for osmotic adjustment, photosynthate translocation, and enzymatic activity, all of which contribute to shoot biomass production. The elevated shoot dry weights under T1 and T6 suggest that either low K stress (T1) induced conservative dry matter buildup or that optimal potassium in T6 stimulated efficient biomass production. Conversely, the high shoot fresh weight under T3 may reflect enhanced water uptake and cell turgidity, typically associated with K-mediated water balance regulation. These findings underscore the dual role of potassium in modulating both tissue hydration and biomass accumulation, with different treatments benefiting different physiological outcomes.

### Effect of different levels of potassium fertilizer on a number of seeds pod$^{-1}$ and the Pod length of BINA Mung-5

These findings highlight the differential impact of potassium on reproductive performance. While pod length appeared less sensitive to K application, the number of seeds per pod responded strongly to changes in potassium levels. Potassium is essential for pollen viability, ovule fertilization, and seed set—processes that directly influence seed number (Hafsi et al., 2014). The enhanced seed production observed in treatments T3–T5 may be attributed to potassium's role in facilitating assimilate transport, maintaining turgor, and supporting reproductive development under optimal nutrient conditions. Conversely, the reduced seed counts in T1 (no K) and T7 (very low K) reflect the adverse effects of K deficiency on reproductive efficiency. These results suggest that moderate potassium levels optimize seed production, even when pod structural traits remain relatively unchanged.

### Effect of different levels of potassium fertilizer on the total number of leaf of BINA Mung- 5

These findings demonstrate the positive influence of potassium on leaf initiation and development, particularly when applied at moderate levels. Potassium is a key regulator of photosynthesis, stomatal conductance, and enzyme activation—all of which are closely associated with vegetative growth and leaf expansion Pettigrew (2008). The poor performance of the control (T1) confirms the detrimental effects of K deficiency, which limits carbohydrate synthesis and cell division, ultimately reducing leaf number. The optimal responses in T2–T4 and T7 suggest that potassium at these doses supports efficient assimilation and shoot morphogenesis. Meanwhile, the dip in performance under T5 may indicate nutrient imbalance or localized toxicity. Overall, the data suggest that balanced potassium fertilization is critical for maximizing foliar development, which is vital for sustaining photosynthetic productivity and overall plant vigor.

### Effect of different levels of potassium fertilizer on the root length of BINA Mung-5

These results emphasize the important role of potassium in promoting root development, particularly in facilitating cell expansion, division, and elongation. Potassium enhances water uptake and regulates root system architecture through osmotic control and hormonal signaling. The superior root length under moderate potassium application (T3–T5) supports previous findings suggesting that optimal K levels stimulate deeper and more extensive root systems, enhancing nutrient acquisition and drought tolerance. On the other hand, both potassium deficiency (T1) and suboptimal K levels (T6, T7) appeared to constrain root elongation, likely due to impaired metabolic and cellular activity. These findings suggest that moderate potassium supplementation is optimal for promoting root growth, which is crucial for plant establishment and resilience.

### Effect of different levels of potassium fertilizer on the total number of flowers of BINA Mung-5

These variations in floral response across treatments may be attributed to differential potassium application, as potassium plays a vital role in improving flower initiation, enzyme activation, and photosynthate transport key processes linked to reproductive development in plants. Potassium has been shown to enhance flower number and quality in several crops by improving physiological efficiency and stress tolerance (Usherwood, 1985). Recent research also supports this, showing that potassium-enriched treatments significantly increased flower production in vegetable and field crops by stimulating assimilate allocation to reproductive organs (Bose & Mishra, 2021). These findings align with the observed trends in the graph, emphasizing the importance of potassium management in maximizing floral output.

### Effect of different levels of potassium fertilizer on thousand seed weight of BINA Mung-5

The observed differences in thousand seed weight likely reflect the impact of nutrient treatments, particularly potassium, which is essential for assimilate transport and seed filling processes. Potassium enhances seed weight by improving carbohydrate translocation and enzyme activation, leading to better grain development (Zörb et al., 2014). Similar outcomes were reported by Singh et al. (2020), who demonstrated that appropriate potassium fertilization significantly improved seed size and weight in cereal crops. The results in this graph align with such findings, highlighting T3 as the most effective treatment for maximizing seed weight, potentially due to superior potassium availability or uptake dynamics.

## CONCLUSION

The study findings highlight that balanced potassium nutrition enhances water-use efficiency, promote healthy root development, and supports photosynthate allocation toward reproductive organs, all of which are critical for improving mungbean yield under limited Water availability. The visual observations and Statistical analysis further confirm that potassium application helps plants better withstand drought stress by maintaining cellular turgor and physiological balance.

In light of these results, it can be concluded that applying potassium at a rate of 6.0 to 7.5 g per 10 kg soil is optimal for maximizing mungbean Productivity under water stress conditions. This recommendation is especially valuable for farmers in drought-prone and saline coastal areas of Bangladesh, where potassium deficiency and irregular rainfall are common. Therefore, potassium fertilization stands out as an effective, low-cost and sustainable agronomic practice for improving food security and crop performance in climate- vulnerable regions.

**Acknowledgements**

The authors gratefully acknowledge the Department of Soil Science, Patuakhali Science and Technology University, Dumki, Patuakhali-8602 for their technical support in terms of research work.

**Conflict of Interest**

This study was conducted without conflicts of interest.

**Ethical Approval**

Because this research did not include humans or animals, no ethical approval is required.

**Consent for Publication**

All authors read and approved the manuscript and agreed for publication.

## REFERENCES

BBS (Bangladesh Bureau of Statistics). 2019. Statistical Yearbook of Bangladesh.

Bose, T. K., & Mishra, S. 2021. Influence of potassium on growth, flowering and yield of horticultural crops: A review. International Journal of Chemical Studies, 9(2), 1238–1244.

Hafsi, C., Debez, A., & Abdelly, C. 2014. Potassium deficiency in plants: Effects and signaling cascades. Acta Physiologiae Plantarum, 36, 1055–1070. https://doi.org/10.1007/s11738-014-1486-7

Kaul, A. K. 1982. Pulses in Bangladesh. Bangladesh Agricultural Research Council.

López-Bucio, J., Cruz-Ramírez, A., & Herrera-Estrella, L. 2003. The role of nutrient availability in regulating root architecture. Current Opinion in Plant Biology, 6(3), 280–287. https://doi.org/10.1016/S1369-5266(03)00035-9

Marschner, H. 2012. Marschner's Mineral Nutrition of Higher Plants. 3rd Edition. Academic Press.

Mollier, A., & Pellerin, S. 2015. Potassium nutrition and lateral branch development in higher plants: Role of hormonal control and nutrient signaling. Plant Physiology and Biochemistry, 95, 64–71. https://doi.org/10.1016/j.plaphy.2015.07.007

Ruan, J., Xu, Y., Wang, L., & Luo, Y. 2020. Potassium nutrition improves growth, water use efficiency, and yield in field crops: A review. Agronomy, 10(5), 715. https://doi.org/10.3390/agronomy10050715

Singh, D., et al. 2018. Impact of integrated nutrient management on productivity and soil health in mungbean. Legume Research, 41(6), 911–916.

Singh, V., Kumar, A., & Yadav, R. K. 2020. Potassium nutrition in relation to grain weight and yield of wheat. Indian Journal of Agronomy, 65(1), 38–42.

Usherwood, N. R. 1985. The role of potassium in crop quality. Potash and Phosphate Institute Bulletin, 2, 1–12.

Wang, M., Zheng, Q., Shen, Q., & Guo, S. 2013. The critical role of potassium in plant stress response. International Journal of Molecular Sciences, 14(4), 7370–7390. https://doi.org/10.3390/ijms14047370

Zörb, C., Senbayram, M., & Peiter, E. 2014. Potassium in agriculture – Status and perspectives. Journal of Plant Physiology, 171(9), 656–669. https://doi.org/10.1016/j.jplph.2013.08.008