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# Effect of Potassium and Sulphur on Growth and Yield of Greengram (*Vigna radiata* L.)

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

Greengram is scientifically known as (*Vigna radiata* L.) and commonly known as mung bean. India is the producer of pulses, accounting for 27 per cent of the world's production. Sulphur is also a constituent of vitamin biotin and thiamine, and also of iron-Sulphur protein ferredoxin. Potassium (K) is one of the essential nutrients for plant growth and vital for sustaining modern high-yield agriculture. The paper aims to investigate the effect of potassium and Sulphur on the growth and yield of Greengram (*Vigna radiata* L.). A field experiment was conducted during the Zaid season of 2025 at the Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P., India. The experiment was laid out in a randomized block design with ten treatments and replicated thrice. The observations were recorded

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for plant height, number of branches per plant, number of nodules per plant, plant dry weight, crop growth rate, relative growth rate, pods per plant, seeds per pod, test weight, 0-grain yield and straw yield. The factors are Potassium (10, 20 and 30 kg/ha) and Sulphur (5, 10 and 15 kg/ha) along with a control (NPK 20-40-20 kg/ha). The result of the experiment showed that the application of T9: Potassium at 30 kg/ha. + Sulphur at 15 Kg/ha significantly The highest application rates of Potassium and Sulphur (T9) resulted in significant increases across all measured growth and yield parameters compared to the control, Plant dry weight (25.87), Crop growth rate (18.74), Relative growth rate (0.03), No of Pods/ plant (21.47), No of seeds/pod (7.30), Test Weight (62.30), Grain Yield (1.82), Straw Yield (3.24), Harvest Index (35.95). Maximum gross return (INR/ha 152080), Net return (112897.02), and B:C ratio (2.88) were obtained highest in treatment 9 (Potassium at 30 kg/ha+ Sulphur at 15 kg/ha). It is concluded that application of Potassium at 30 Kg/ha +Sulphur at 15 kg/ha has performed better in growth parameters, yield attributes, and benefit cost ratio of Greengram.

*Keywords: Greengram; potassium; Sulphur; growth; yield; economics.*

## 1. INTRODUCTION

"Greengram is an important pulse crop of India and believed to originate from India. It belongs to the family Leguminosae and subfamily Papilionaceous. Greengram is scientifically known as (*Vigna radiata* L.) and commonly known as mung bean. India is the producer of pulses accounting for 27 per cent of the world production. It is commonly known as moong, an important pulse crop in India, and about 1.5 to 2.0 million tons of moong are annually produced from 4.0million ha with an average productivity of 500 kg ha$^{-1}$, and accounts for about 10-12 per cent of total pulse production" (Kathiravan et al., 2023; Yadav & Maxton, 2024). "Green gram ranks third among all the pulses in India after chickpea and pigeon pea. Green gram output accounts for about 10-12% of total pulse production in the country. It is one of the major Kharif pulse crops in India, covering 34.4 lakh/ ha. of area in the country with total production of 14 lakh tonnes and productivity of 415.70 kg/ ha. In India, major green gram-producing states are Madhya Pradesh, Rajasthan, Maharashtra, Gujarat and Bihar. In Maharashtra it occupies an area of 4.13 lakh/ ha with a total production of 1.23 lakh tonnes and the productivity of 248 kg/ ha. However, the availability of pulses per capita in the country is much lesser (30-35 g) than the recommendations of WHO (80 g per capita) and thereby around 80 million children in the country are still protein-energy undernourished. Hence, there is a need to increase average pulse productivity to fulfil protein requirements. The important Kharif pulse crop is highly nutritious. Currently, the productivity of this crop is very low, mainly because of its cultivation on marginal land under a reduced rate of fertilizer. Among the several constraints, improper nutritional management is an important impediment to increasing the productivity of legumes. Potassium is one of the major essential plant nutrients which play a vital role in various physiological and biochemical activities and are required in high amounts to maintain adequate crop growth and sustainable crop production" (Mengel and Kirkby, 2001). "Due to intensive cropping, continuous manuring and limited or no use of K fertilizers, the available K status of the soils has depleted. The adequate supply of potassium during the growth period improves the water relations of the plant and photosynthesis" (Garg et al*.,* 2005). "Sufficient amounts of K are required for improving the yield and quality of different crops because of its effect on photosynthesis, water use efficiency and plant tolerance to diseases, drought and cold as well as for maintaining the balance between proteins and carbohydrates. In soils with low levels of both exchangeable and non-exchangeable K, K application must be done to realize the full yield potential of crops" (Srinivasarao et al*.,* 2010). "Sulphur plays an important role in the growth and development of crops. It plays an important role in the formation of S-containing amino acids like cystine (27% S), Cysteine (26% S), methionine (21% S), which act as building blocks in the synthesis of proteins. It has a role to play in increasing chlorophyll formation and aiding photosynthesis. Sulphur also plays a role in the activation of enzymes, nucleic acids and forms a part of biotin and thiamine. In recent years, an increased frequency of Sulphur deficiency has been observed in crops, and S may become a factor limiting the yield and quality of crops. It takes considerably more time for Sulphur to become available, compared to soluble sulphate forms of fertilizers. The positive response of Sulphur to cowpea and lentil has been reported by earlier authors" (Jat et al. 2013, Upadhyay, 2013). "Gypsum has been found either superior or equal to other S-containing fertilizers in pulse crops" (Kumar et al. 2014). Green gram, one of the important kharif pulse crops, is sensitive to the deficiencies of potassium and Sulphur. So far, inadequate information is available regarding the effect of K and S on green gram in the Agra condition. This study was, therefore, conducted to evaluate the effect of K and S on the yield, nutrient uptake and quality of green gram.

"Sulphur is also required for the production of vitamins (biotin and thiamine). It also containing amino acids (cystine, cysteine, and methionine) and legume nodulation. Sulphur treatment resulted in the maximum seed and straw production of Greengram. It is also involved in the activation of enzymes and the production of chlorophyll" (Parashar et al., 2020; Ranjan et al., 2025). "Sulphur is also a constituent of vitamin biotin and thiamine, and also of iron-Sulphur protein ferredoxin. Sulphur also enhances quality of grains by increasing their nutritional values. Thus, an experiment was conducted to study the effect of Sulphur and iron fertilization on the growth and yield of green gram. Sulphur has been recognized as an essential major nutrient for plant and it ranks 4th macronutrient after N, P and K because of its role in the synthesis of proteins, vitamins enzyme and flavored compounds in plant. About. These amino acids are the building blocks of protein. Sulphur is also a constituent of vitamin biotin and thiamine, and also of iron-Sulphur protein ferredoxin. Sulphur also enhances the quality of grains by increasing their nutritional values" (Parashar et al., 2020). Thus, an experiment was conducted to study the effect of Sulphur and iron fertilization on the growth and yield of greengram.

"Potassium (K) is one of the essential nutrients for plant growth and vital for sustaining modern high-yield agriculture. Plants need large quantities of K, which not only improves the crop yield, but also crop quality. Hence, K fertilization results in a higher value product and therefore provides a greater return to farmers. It is a prime factor for deciding the market price of green gram grown, which improves the income of farmers just by improving the quality of produce" (Baligar et al. 2011). "It is becoming an important crop, as it is the best alternative to meet the food needs of the large population of developing countries due to its nutritional superiority and N2 fixing characteristics. Potassium status of these soils varies considerably depending on parent material, texture, and management practices. In general, K deficiencies are most common on well-drained, coarse-textured soils. Soils of this region are not only light-textured but are also low in organic matter and deficient in nutrients. Earlier, about 82% soils of Haryana were high and 18% were medium in available K but due to intensive cropping, continuous mining and limited use of K fertilizer, about 8, 42 and 59% of the soils are low medium and high in available K status, Upon intensive cropping with high yielding varieties with higher dose of N and P application with practically very little or no K application, the soils which were considered to be sufficient in available K, are becoming K deficient. The judicious use of potassium is necessary to maintain its proper level in the soil" (Parashar et al., 2020).

## 2. MATERIALS AND METHODS

The experiment was carried out during *zaid* season of 2025 at crop research farm of Naini agricultural institute, Sam Higginbottom university of agriculture, technology and sciences, Prayagraj, which is located at $25^0$ 24' 42" n latitude, $81^0$ 50' 56" e longitude and 98 m altitude above the mean sea level. This area is situated on the right side of the river *Yamuna* by the side of Prayagraj Rewa Road, about 5 km away from Prayagraj city. The experiment was conducted in randomized block design with 10 treatments each replicated thrice. The plot size of each treatment was 3 m x 3 m. The factors are Potassium (10, 20 and 30 kg/ha) and Sulphur (5, 10 and 15 kg/ha) along with a control (NPK 20-40-20 kg/ha). The treatment combinations are T1: Potassium at 10 kg/ha. + Sulphur at 5 Kg/ha. T2: Potassium at 10 kg/ha. + Sulphur at 10 Kg/ha. T3: Potassium at 10 kg/ha. + Sulphur at 15 Kg/ha. T4: Potassium at 20 kg/ha. + Sulphur at 5 Kg/ha. T5: Potassium at 20 kg/ha. + Sulphur at 10 Kg/ha. T6: Potassium at 20 kg/ha. + Sulphur at 15 Kg/ha. T7: Potassium at 30 kg/ha. + Sulphur at 5 Kg/ha. T8: Potassium at 30 kg/ha. + Sulphur at 10 Kg/ha. T9: Potassium at 30 kg/ha. + Sulphur at 15 Kg/ha. T10: N-P-K – 20-40-20 kg/ha (Control). Greengram Seeds were sown manually in line. Seeds were covered with soil immediately after sowing. The Greengram crop was sown on 28 November 2024. Harvesting was done by taking 1 $m^2$ area from each. And from it, five plants were randomly selected for recording growth and yield parameters. The observations were recorded for plant height, number of branches per plant, number of nodules per plant, plant dry weight, crop growth rate, relative growth rate, pods per plant, seeds per pod, test weight, 0-grain yield and straw yield. The data was subjected to statistical analysis by the Analysis of variance method. Economics was calculated, viz., the cost of cultivation, gross return, net return, and benefit-cost ratio were calculated.

## 3. RESULTS AND DISCUSSION

### 3.1 Plant Height (cm)

The Plant height of Greengram was observed from 15 DAS to 60 DAS, and the highest plant height was observed at 60 DAS. The effect of Potassium and Sulphur on increasing plant height was observed among all the treatments. The significantly highest plant height (54.11 cm) was recorded in treatment T9 (Potassium at 30 kg/ha + Sulphur at 15 kg/ha). However, the treatments $T_3$ and $T_4$ were found to be statistically at par with $T_9$. Whereas the minimum plant height (54.11) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

The highest plant height may be due to the positive effects of potassium and micronutrients on the vegetative growth and accumulation of metabolic materials. Similar findings have been reported by Ali et al*.,* (2007) and Kumar et al*.,* (2014).

### 3.2 Number of Nodules Per Plant

The Number of nodules per plant of Greengram was observed from 15 DAS to 60 DAS, and the highest Number of nodules per plant was observed at 60 DAS. The effect of Potassium and Sulphur on the Number of nodules per plant was observed among all the treatments. The significantly higher number of nodules per plant (5.33) was recorded with the treatment $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. However, the treatments T2, T3, T4, T5, T6 and T7 were found to be statistically at par with $T_9$. Whereas the minimum number of nodules per plant (4.00) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

The application of potassium and Sulphur significantly influenced the nodulation process in Greengram. The highest number of nodules was observed with the combined application of 30 kg/ha potassium and 15 kg/ha Sulphur, indicating a synergistic effect on nitrogen fixation. The positive impact of Sulphur on nodulation can be attributed to its role in enhancing the activity of nitrogenase and ferredoxin, enzymes crucial for nitrogen fixation in leguminous plants. Similar findings were reported by Kumar et al., (2002). S application significantly improved the nodule numbers at all the growth stages at varying levels.

### 3.3 Number of Branches Per Plant

The Number of branches per plant of Greengram was observed from 15 DAS to 60 DAS, and the highest Number of branches per plant was observed at 60 DAS. The effect of Potassium and Sulphur on the Number of branches per plant was observed among all treatments. A significantly higher number of branches per plant (7.90) was recorded with the treatment $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. However, the treatments T7 were found to be statistically at par with $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. Whereas the minimum number of branches per plant (6.67) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

The consistent and significant increase in the number of tillers with the application of potassium (30 kg/ha) and Sulphur (15 kg/ha) may be attributed to improved soil physical conditions and balanced nutrient availability, which enhance protein synthesis and cell division, creating a favorable environment for branches.

### 3.4 Plant Dry Weight (g/plant)

The Plant dry weight of Greengram was observed from 15 DAS to 60 DAS and highest plant dry weight was observed at 60 DAS. The effect of Potassium and Sulphur on increasing plant dry weight was observed among all the treatments. The significantly higher dry weight (g) per plant (25.87) was recorded with the treatment $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. However, the treatments T1 were found to be statistically at par with $T_9$. Whereas the minimum dry weight (g) per plant (22.00) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

In case of effect of P, significantly higher nodule dry weight was recorded at all the growth stages with 60 kg P2 05 ha-1. A similar result was also observed by Ganesha Murthy et al., (2005). This leads to greater nutrient uptake and dry matter accumulation as growth progresses through different stages. These findings are in line with results reported by Fageria (2004).

**Table 1. Effect of Potassium and Sulphur on Growth and yield attributes of Greengram**

| S. No. | Treatments | Plant Height | Number of nodules per plant | Number of branches per plant | Dry weight (g) per plant | Crop growth rate (g/m$^2$/ day) | Relative growth rate (g/g/day) |
|---|---|---|---|---|---|---|---|
| 1. | Potassium at 10Kg/ha + Sulphur at 5kg/ha | 49.72 | 4.10 | 6.70 | 22.16 | 15.46 | 0.03 |
| 2. | Potassium at 10Kg/ha + Sulphur at10kg/ha | 50.75 | 4.23 | 6.74 | 22.22 | 15.57 | 0.03 |
| 3. | Potassium at 10Kg/ha + Sulphur at15kg/ha | 51.63 | 4.40 | 6.78 | 22.51 | 15.70 | 0.03 |
| 4. | Potassium at 20Kg/ha + Sulphur at 5kg/ha | 51.73 | 4.43 | 6.87 | 22.76 | 15.45 | 0.02 |
| 5. | Potassium at 20Kg/ha + Sulphur at10kg/ha | 51.78 | 4.50 | 6.92 | 23.06 | 16.10 | 0.03 |
| 6. | Potassium at 20Kg/ha + Sulphur at15kg/ha | 51.79 | 4.53 | 6.97 | 23.37 | 16.50 | 0.03 |
| 7. | Potassium at 30Kg/ha + Sulphur at 5kg/ha | 51.85 | 4.60 | 7.07 | 23.55 | 16.43 | 0.03 |
| 8. | Potassium at 30Kg/ha + Sulphur at 10kg/ha | 52.73 | 4.83 | 7.07 | 24.20 | 17.88 | 0.03 |
| 9. | Potassium at 30Kg/ha + Sulphur at 15kg/ha | 54.11 | 5.33 | 7.90 | 25.87 | 18.74 | 0.03 |
| 10. | NPK -20-40-20 Kg/ha (Control) | 44.97 | 4.00 | 6.67 | 22.00 | 17.30 | 0.02 |
| | F – Test | S | S | S | S | NS | NS |
| | S.Em (±) | 1.51 | 0.22 | 0.22 | 0.67 | 2.09 | 0.00 |
| | CD (p = 0.05) | 4.50 | 0.65 | 0.65 | 2.01 | - | - |

**Table 2. Effect of Potassium and Sulphur on Growth and yield on Post Harvest Observation of Greengram.**

| S. no | Treatment combination | Post - Harvest Observations | | | | | |
|---|---|---|---|---|---|---|---|
| | | Number of Pods / Plant | Number of Seed / Pod | Test Weight (g) | Grain yield (t/ha) | Straw yield (t/ha) | Harvest Index (%) |
| 1. | Potassium at 10Kg/ha + Sulphur at 5kg/ha | 18.22 | 5.87 | 51.90 | 1.43 | 2.27 | 38.66 |
| 2. | Potassium at 10Kg/ha + Sulphur at10kg/ha | 18.40 | 5.90 | 53.15 | 1.45 | 2.63 | 35.53 |
| 3. | Potassium at 10Kg/ha + Sulphur at15kg/ha | 18.43 | 6.07 | 53.57 | 1.49 | 2.58 | 36.61 |
| 4. | Potassium at 20Kg/ha + Sulphur at 5kg/ha | 18.93 | 6.10 | 53.77 | 1.49 | 2.61 | 36.26 |
| 5. | Potassium at 20Kg/ha + Sulphur at10kg/ha | 18.97 | 6.10 | 53.92 | 1.58 | 2.63 | 37.28 |
| 6. | Potassium at 20Kg/ha + Sulphur at15kg/ha | 19.00 | 6.13 | 54.37 | 1.65 | 2.60 | 38.55 |
| 7. | Potassium at 30Kg/ha + Sulphur at 5kg/ha | 19.02 | 6.23 | 56.12 | 1.74 | 2.78 | 38.5 |
| 8. | Potassium at 30Kg/ha + Sulphur at 10kg/ha | 19.13 | 6.53 | 57.23 | 1.81 | 2.88 | 38.56 |
| 9. | Potassium at 30Kg/ha + Sulphur at 15kg/ha | 21.47 | 7.30 | 62.30 | 1.82 | 3.24 | 35.95 |
| 10. | NPK -20-40-20 Kg/ha (Control) | 17.77 | 5.80 | 51.33 | 1.28 | 1.98 | 39.21 |
| | F – Test | S | S | S | S | S | NS |
| | S.Em (±) | 0.58 | 0.23 | 1.78 | 0.10 | 0.08 | 1.33 |
| | CD (p = 0.05) | 1.72 | 0.71 | 5.29 | 0.29 | 0.24 | - |

**Table 3. Effect of Potassium and Sulphur on Growth and yield on Economics of Green Gram**

| S. no | Treatment combination | Economics | | | |
|---|---|---|---|---|---|
| | | Cost of cultivation (INR/ha) | Gross return (INR/ha) | Net return (INR/ha) | B:C ratio |
| 1. | Potassium at 10Kg/ha + Sulphur at 5kg/ha | 37786.73 | 118940 | 81153.2 | 2.14 |
| 2. | Potassium at 10Kg/ha + Sulphur at 10kg/ha | 37786.73 | 121260 | 83473.2 | 2.20 |
| 3. | Potassium at 10Kg/ha + Sulphur at 15kg/ha | 37786.73 | 124360 | 86573.2 | 2.29 |
| 4. | Potassium at 20Kg/ha + Sulphur at 5kg/ha | 38484.73 | 124420 | 85935.2 | 2.23 |
| 5. | Potassium at 20Kg/ha + Sulphur at 10kg/ha | 38484.73 | 131660 | 93175.2 | 2.42 |
| 6. | Potassium at 20Kg/ha + Sulphur at 15kg/ha | 38484.73 | 137200 | 98715.2 | 2.56 |
| 7. | Potassium at 30Kg/ha + Sulphur at 5kg/ha | 39182.98 | 144760 | 105577 | 2.69 |
| 8. | Potassium at 30Kg/ha + Sulphur at 10kg/ha | 39182.98 | 150560 | 111377 | 2.84 |
| 9. | Potassium at 30Kg/ha + Sulphur at 15kg/ha | 39182.98 | 152080 | 112897.02 | 2.88 |
| 10. | NPK -20-40-20 Kg/ha (Control) | 37088.98 | 106360 | 69271 | 1.86 |

## 3.5 Crop Growth Rate (g/m$^2$/ day)

The data pertaining to crop growth rate (g/m$^2$/ day) of Greengram was recorded at intervals 15-30 DAS, 30-45 DAS, and 45-60 DAS. At 45-60 DAS, a non-significantly higher crop growth rate (g/m$^2$/ day) (18.74) was recorded with the treatment $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. Whereas the minimum crop growth rate (g/m2/ day) (17.30) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

## 3.6 Relative Growth Rate (g/g/day)

The data pertaining to the relative growth rate (g/g/day) of Greengram was recorded at intervals 15-30 DAS, 30-45 DAS, and 45-60 DAS. At 45-60 DAS, the data was found to be non-significantly higher relative growth rate (g/g/day) (0.03) was recorded with the treatment $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. However, the treatments Potassium at 30 kg/ha + Sulphur at 10 kg/ha and Potassium at 30 kg/ha + Sulphur at 5 kg/ha. Whereas the minimum relative growth rate (g/g/day) (0.02) was found in treatment $T_{10}$ NPK–20–40–20 kg/ha (Control).

## 3.7 Yield Attributes and Yield

### 3.7.1 Number of pods per plant

Significantly higher number of pods per plant was observed (21.47) with the treatment $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. However, the treatments T6 and T7 were found to be statistically at par with $T_9$. Whereas the minimum number of pods per plant (17.77) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

These results corroborated the findings of Sengupta et al. (2001), who observed that Sulphur application at higher levels significantly increased the number of pods per plant in chickpea. Further, noted that phosphorus and Sulphur, either individually or in combination, had a significant impact on the number of pods per plant, attributing it to improved nutrient availability, photosynthetic efficiency, and better translocation of assimilates to the sink

### 3.7.2 No. of seed/pod

Significantly higher number of seeds per pod (7.30) was observed with the treatment $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. However, the treatments T6 and T7 were found to be statistically at par with $T_9$. Whereas the minimum number of seeds per pod (5.80) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

Significant and maximum number of seeds/pod (7.30) was recorded with $T_9$ (30 kg/ha potassium along with 15 kg/ha Sulphur), which was superior over all other treatments. However, $T_8$ (30 kg/ha potassium along with 10 kg/ha Sulphur) was found to be statistically at par with $T_9$. Higher seeds/pods may be attributed to better nitrogen uptake and effective photosynthate translocation to the spike during the grain filling stage.

### 3.7.3 Test weight (g)

Significantly higher test weight (g) was (62.30 g) observed with the treatment $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. However, the treatments T6 and T7 were found to be statistically at par with $T_9$. Where as the minimum test weight (g) (51.33) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

Significantly higher test weight (62.30 g) was recorded with $T_9$ (30 kg/ha potassium along with 15 kg/ha Sulphur) followed by $T_8$ (30 kg/ha potassium along with 10 kg/ha Sulphur), and $T_7$ (30 kg/ha potassium along with 5 kg/ha Sulphur). These treatments were found to be statistically at par with $T_9$. Higher test weight might be due to zinc-enhanced enzymatic activities involved in grain filling and accumulation of starch and protein. Similar results were also reported by

### 3.7.4 Seed yield (t/ha)

Significantly higher seed yield (t/ha) was observed (1.82 t/ha) with the treatment $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. However, the treatments T7 and T8 were found to be statistically at par with $T_9$. Whereas the minimum seed yield (t/ha) (1.28) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

The results are in close agreement with those reported by earlier researchers. observed that phosphorus applications improved test weight by enhancing seed filling efficiency. They reported that phosphorus in combination with Sulphur significantly increased 100-seed weight in chickpea by improving assimilate translocation to developing seeds. Similarly, confirmed that phosphorus and Sulphur nutrition had a positive effect on seed size and test weight, attributing it to improved metabolic activity and grain development These results corroborated with the findings of Patel et al. (2013).

### 3.7.5 Straw yield (kg/ha)

Significantly higher stover yield (t/ha) was observed (3.24 t/ha) with the treatment $T_9$ Potassium at 30 kg/ha + Sulphur at 15 kg/ha. However, the treatments T7 and T8 were found to be statistically at par with $T_9$. Whereas the minimum stover yield (t/ha (1.98) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

The present results are in conformity with earlier reports, which observed that phosphorus fertilization significantly increased stover yield in chickpea by enhancing growth and biomass production. that the combined application of phosphorus and Sulphur improved total dry matter accumulation and stover yield in pulses. also confirmed that higher levels of phosphorus and Sulphur led to increased stover yield due to better nutrient availability and improved photosynthetic efficiency.

### 3.7.6 Harvest index (%)

Non-Significantly higher harvest index (%) was observed with the Potassium at 30 Kg/ha +Sulphur at 15 kg/ha (35.95). Whereas the minimum harvest index (%) (39.21) was found in treatment $T_{10}$ NPK – 20-40-20 kg/ha (Control).

### 3.7.7 Economic analysis

The Highest benefit-cost ratio (2.88) was recorded in T9 (Potassium at 30 Kg/ha +Sulphur at 15 kg/ha) as compared to other treatments.

## 4. CONCLUSION

It is concluded that application of Potassium at 30 Kg/ha +Sulphur at 15 kg/ha has performed better in growth parameters, yield attributes, and benefit-cost ratio of Greengram. Due to its role in the synthesis of proteins, vitamins, enzymes, and flavoring compounds in plants, sulfur has been identified as an essential major nutrient and ranks fourth among macronutrients after N, P, and K. roughly. The building blocks of protein are these amino acids. Additionally, sulfur is a component of the iron-sulfur protein ferredoxin, as well as the vitamins biotin and thiamine.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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