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Anand Raj
M.Sc. Scholar, Department of
Agronomy, Naini Agricultural
institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences,
Prayagraj, Uttar Pradesh, India

Joy Dawson
Professor, Department of
Agronomy, Naini Agricultural
institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences,
Prayagraj, Uttar Pradesh, India

Anup Kumar Srivastava
M.Sc. Scholar, Department of
Agronomy, Naini Agricultural
institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences,
Prayagraj, Uttar Pradesh, India

Shubham Kumar
M.Sc. Scholar, Department of
Agronomy, Naini Agricultural
institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences,
Prayagraj, Uttar Pradesh, India

Corresponding Author:
Anand Raj
M.Sc. Scholar, Department of
Agronomy, Naini Agricultural
institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences,
Prayagraj, Uttar Pradesh, India

Effects of potassium and molybdenum on growth and yield of Greengram (*Vigna radiata* L.)

Anand Raj, Joy Dawson, Anup Kumar Srivastava and Shubham Kumar

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Abstract

A field experiment was conducted during *Kharif* Season 2025 to study the “Effects of Potassium and Molybdenum on growth and yield of Greengram (*Vigna radiata* L.)” at Department of Agronomy, SHUATS, Prayagraj (U.P) India. The present one season field experiments were carried out at Crop Research Farm (25.40° N latitude, 81.85° E longitude, and 112.05 m above mean sea level). The experiment was laid out in a randomized block design with ten treatments replicated thrice. The treatments consist of Potassium levels (10, 20 and 30 kg/ha) and Molybdenum (1, 2, and 4 kg/ha) along with Recommended doses of fertilizers (20:40:20 kg NPK/ha). The experimental field soil was sandy loam in texture, moderately basic in reaction (pH 6.8), available medium organic Carbon (0.562%) low in available nitrogen (220.0 kg/ha), and very high accessible phosphorus (28.2 kg/ha) and available potassium (240.7 kg/ha). The result showed that significantly higher growth parameters viz., plant height (42.12 cm), maximum plant dry weight (18.09 g), number of nodules (20.82), pods per plant (19.31), seeds per pod (9.41), test weight (37.12 g), seed yield (1484.00 kg/ha), stover yield (2675.00 kg/ha), and harvest index (35.67%) was observed in treatment - 9 with application of Potassium at 30 kg/ha along with Molybdenum 4 kg/ha has recorded highest. The aforesaid treatment also recorded maximum gross return (INR 1,24,639.00/ha), net return (INR 86,275.00/ha) and B:C ratio (2.25).

Keywords: Greengram, potassium, molybdenum, growth, economics and yield

Introduction

Among the significant legume plants belonging to the *Fabaceae* family, Greengram (*Vigna radiata* L.) stands out. It is used as a crop for green manure and goes by many names, including mungbean, mungo, Oregon pea, or just plain mung. One of the most important pulse crops grown in India during the Zaid season, it is actually a catch crop grown in the interim between the two main harvests. Its seed is more flavorful, nutritious, easy to digest, and gas-free than other pulses grown around the world. According to Sherawat *et al.* (2013), green gram seeds typically have 20-24% protein, 62.5% carbs, 1.4% fat, 4.2% fiber, and other vitamins and minerals. Its high iron and fiber content makes it easy for the digestive system to process. It has a lot of potential uses because to its adaptability, rapid growth rate, high tonnage capacity, and great nutritional qualities for food, feed, and forage. It also works well in intercropping systems with other crops. Pulses are sometimes called "poor man's meat" in the second-generation world due to their lower cost compared to meat (Patel *et al.*, 2020). Green gram is grown in almost every state of India and is hence the world's top producer. Covering an area of 40.38 lakh hectares and producing 31.5 lakh metric tons at a productivity of 783 kg/ha, it accounts for 11% of the total pulse production in 2021–2022. Gujarat, Uttar Pradesh, and Madhya Pradesh are the top three states in India for green gram production, with respective yields of 0.30 lakh/ha, 1.57 lakh/ha, and 20.89 lakh/ha (GOI, 2021).

The soil application of Sulphur and foliar sprays of Molybdenum during the crop growth period significantly enhances the seed yield and seed quality parameters of Greengram. For Greengram to grow and flourish, Sulphur is essential. It is known to improve nodulation activity, which raises atmospheric nitrogen fixation, and is necessary for the synthesis of vitamins and proteins. Since Sulphur is a key source of three amino acids - cysteine and methionine. it is crucial for plants to produce protein. Currently, 42% of Indian soils lack enough Sulphur (Rakesh *et al.*,

2012)^[15].

For crops to thrive, especially pulses, Sulphur is a must-have fertilizer. For pulse crops to produce vitamins and proteins, sulfur is a must. Another way that sulfur improves N-fixation is by making legumes more active nodulation activity. During the growth season, sulfur affects green gram plants in various ways, including their height, branching, nodulation, pod number, and seed per pod. Kumar *et al.* (2012)^[10] has published on the subject. Biotin and thiamine both include sulfur, and it also plays a role in enzyme and nucleic acid activation. Elemental sulfate and soluble sulfate are the two most common types of Sulphur fertilizers. Elemental Sulphur is completely ineffective for plant use. Soil uptake, yield, and Greengram bacteria convert it to Sulphur, which crops can then consume. Consequently, the rate of Sulphur availability is significantly slower than that of fertilizers containing soluble sulfurate. Upadhyay (2013)^[21] and Jat *et al.* (2013)^[8] both noted that Sulphur had a positive effect on cowpea and lentil.

A novel family of agricultural compounds known as plant growth regulators (PGRs) has received attention. To enhance flower, pod, and fruit retention, they are known to alter plant architecture, enhance source-sink connections, and boost the transfer of photo assimilates. boost seed quality, yield, and growth. In addition to significantly increasing grain yield and reproductive efficacy, foliar treatments of nutrients and growth regulators during the pre-flowering and blooming stages also reduced flower loss and shed (Ganapathy *et al.*, 2008)^[4]. Plant growth regulators have the ability to improve a plant's physiological efficiency, including photosynthetic growth, which facilitates the formation of blooms, fruit, and seeds. According to Solamani *et al.* (2011), this raises crop output overall. According to Raoofi *et al.* (2014)^[16], cell division, proliferation, vascular tissue differentiation, root initiation, apical dominance, leaf aging, fruit aging, fruit setting, and blooming are all dependent on nutrients.

Materials and Methods

The Crop Research Farm of the Department of Agronomy, SHUATS, Prayagraj, U.P., was the site of a *Kharif season* 2025 field experiment in alluvial soil. A randomized block design was employed, with ten treatment combinations being replicated three times each. Soil reaction was almost neutral (pH 6.8), organic carbon was medium (0.562%), available nitrogen was low (220 kg/ha), potassium was medium (240.7 kg/ha), and accessible phosphorus was extremely high (28.2 kg/ha) in the sandy loam soil that was used for the experiment. The present one season field experiments were carried out at Crop Research Farm (25.40° N latitude, 81.85° E longitude, and 112.05 m above mean sea level). The experiment was laid out in a randomized block design with ten treatments replicated thrice. The treatments consist of Potassium levels (10, 20 and 30 kg/ha) and Molybdenum (1, 2, and 4 kg/ha) along with Recommended doses of fertilizers (20:40:20 kg NPK/ha). The method of hand hoeing was used to dig furrows that were 4-5 cm deep along the seed rows. At 25 and 35 DAS, Thinning was done by removing surplus plants to maintain the necessary spacing, while gap filling was done 10 DAS. At 15 and 30 DAS, intercultural operations were repeated twice to decrease weed competition and crop density. Starting from seed germination to harvest, root nodules, plant height in cm, and dry weight in g/plant were measured at regular intervals of 15 days. Conversely, analysis of variance (ANOVA) for randomized block design was used to statistically assess a number of yield parameters that were measured during harvest. Pods per plant, seeds per pod, test

weight, seed yield, stover yield, and harvest index were some of the parameters that were measured (Gomez and Gomez., 1984)^[6].

Soil analysis of the experiment field

A. Physical Characteristics

Soil Characteristics	Composition
Soil texture class	Sandy loam
Sand	55.50
Silt	28.10
Clay	16.40

B. Chemical Analysis of the soil

Soil Characteristics	Composition
pH	6.8
EC _e (dSm ⁻¹)	0.409
Organic matter (%)	0.562
Available N (kg)	220.00
Available Phosphorus P ₂ O ₅ (kg)	28.2
Available Potassium K ₂ O	240.7

Results and Discussion

Effect of Potassium and Molybdenum on plant height (cm) of Greengram

Plant height during research was recorded at 15, 30, 45 and 60 DAS which was significantly influenced by Potassium and Molybdenum in (Table 1). Based on the data at 60 DAS, the effect of Potassium and Molybdenum have higher plant height (42.12 cm) was recorded in (Treatment – 9) Potassium at 30 kg/ha + Molybdenum 4 kg/ha. This could be because Potassium is involved in the production of growth attributes and development of plant like chlorophyll, photosynthetic activities, and stimulation of cell division (Arunraj *et al.*, 2018)^[1]. Additionally, the application of Molybdenum stimulated the plant's development by making the cell wall more flexible, which in turn allowed starch to be hydrolysed into sugars, and by lowering the cell's water potential, which allowed water to enter the cell and cause elongation. These outcomes were consistent with (Aucharmal *et al.*, 2017)^[2].

Effect of Potassium and Molybdenum on number of nodules/plants

Conversely, the increase in root nodules persisted until 45 DAS, at which point they started to decrease. Given that the nitrogen accumulated in the nodules through symbiotic fixation is utilized for the growth of generative components, this may be the result of the root nodules dying, which happens after flowering. According to data collected at 60 DAS, (Treatment - 9) Potassium at 30 kg/ha + Molybdenum 4 kg/ha showed the highest number of nodules/plant (20.82). An increase in leg haemoglobin pigment production in nodules may be the cause of the nodule count increase (Parry *et al.*, 2018). Moreover, supplemental nutrients are essential for promoting faster root growth and improved nutrient absorption from the soil. The present findings are within the proximity of (Sridhar *et al.*, 2021)^[18].

Effect of Potassium and Molybdenum on Dry matter accumulation of Greengram

The amount of dry matter accumulated rose with crop age up to 60 DAS, when maximum amounts were reached. Based on data spanning 60 DAS, it was found that both the application of Molybdenum and the basal dose of Potassium had a substantial

impact on dry weight. According to the data at 60 DAS, the effect of Potassium and Molybdenum have higher plant dry weight (18.09 g) was recorded in (Treatment - 9) Potassium at 30 kg/ha + Molybdenum 4 kg/ha at 45 DAS. It could be because the administration of nutrients to facilitates the translocation of stored photo assimilates toward the growth of reproductive organs, with the amount of total dry matter serving as a barometer of overall resource use efficiency and improved light interception. These outcomes were consistent with those of (Rajesh *et al.*, 2014) ^[14].

Effect of Potassium and Molybdenum on growth rate of Greengram

The pace of crop growth was greatly affected by applying a basal dose of Potassium and t applications of Molybdenum. Table 1. According to the result, the effect of Potassium and Molybdenum during 45-60 DAS, the significantly higher crop growth rate (20.20 g/m²/day) was recorded in (Treatment - 9) Potassium at 10 kg/ha + Molybdenum 1 kg/ha. However, (Treatment - 8) Potassium at 30 kg/ha + Molybdenum 2 kg/ha were found to be statistically at par with (Treatment - 9) Potassium at 30 kg/ha + Molybdenum 4 kg/ha. It may be because growth parameter increases might be the consequence of cell division, enlargement, and elongation, which would improve plant organs generally and speed up and uniformize the crop's vegetative growth when Sulphur is applied. These findings concur with the conclusion of (Yadav *et al.*, 2022) ^[22].

Effect of Potassium and Molybdenum on yield attributes of Greengram

Table 2. displays data regarding the characters that contribute to yield. Treatment 9 (Potassium at 30 kg/ha along with Molybdenum 4 kg/ha) produced the most pods per plant (19.31), which was statistically equivalent to other treatments. Whereas number of seeds per pod was recorded at harvest, (Treatment - 9) Potassium at 30 kg/ha along with Molybdenum 4 kg/ha was recorded significant and maximum number of seeds/pod (9.41) which was superior over all other treatments. However, out of all the treatments, T₉ had the greatest test weight (37.12 g). Greengram growth and yield, including test weight, number of seeds per pod, and number of pods per plant, were significantly affected by Potassium and Molybdenum. The results demonstrated that T₉ resulted in the best plant growth and yield characteristics. Potassium may enhance plant metabolism and photosynthetic activity, leading to improved yield quality. In a similar vein, Jat *et al.* (2013) ^[8] have also observed results. According to Mahesh *et al.* (2022) ^[11], who found similar results, using can improve growth characteristics, which boosts photosynthetic rate and metabolite translocation to reproductive pods, perhaps leading to an even higher seed yield.

Effect of Potassium and Molybdenum on yield of Greengram

Applying Potassium as a basal dose and Molybdenum topically had a substantial impact on seed and stover yields. Treatment -9 including Potassium at 30 kg/ha along with Molybdenum 4 kg/ha resulted in the highest seed yield (1484.15 kg/ha) (Table 2.) Outperforming all other treatments except for Potassium at 30 kg/ha along with Molybdenum 4 kg/ha at 60 DAS (1358.92 kg/ha). Similarly, a basal dose of Potassium at 30 kg/ha along with Molybdenum 4 kg/ha at 60 DAS resulted in a maximum stover production of 2675 kg/ha, a 49.03% improvement over the control treatment of 1393 kg/ha. Applying Potassium in combination with Molybdenum may have resulted in the highest and most abundant stover yield (Arunraj *et al.*, 2018) ^[1] since

nutrients contribute to chlorophyll production, photosynthetic process, enzyme activation, and grain development.

Effect of Potassium and Molybdenum on Economics of Greengram

Experimental results revealed that application of Potassium and Molybdenum was significantly influenced the economics of Greengram. Higher gross return was obtained with applying of Potassium at 30 kg/ha of Table 2. Shows that the basal dose of Potassium at 30 kg/ha along with Molybdenum 4 kg/ha at 60 DAS (1,24,677.30 INR/ha) were considerably better than the other treatments, except Potassium at 30 kg/ha along with Molybdenum 4 kg/ha at 60 DAS (1,14,639.00 INR/ha). The basal dose of Potassium at 30 kg/ha along with Molybdenum 4 kg/ha at 60 DAS (86,275.00 INR/ha) yielded a better net return than the other treatments, except for 35 kg of Potassium and Molybdenum at 60 DAS (76,323.00 INR/ha). At 60 DAS (2.25) benefit cost ratio was observed in treatment -9 with application of Potassium at 30 kg/ha along with Molybdenum 4 kg/ha resulted in a higher benefit-cost ratio that was noticeably better than the other treatments (1.99) Kavya *et al.* (2021).

Conclusion

It is concluded that application of Potassium at 30 kg/ha along with Molybdenum 4 kg/ha (Treatment - 9) in Greengram has recorded highest grain yield, gross return, net return and benefit cost ratio.

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