To study the effect of Potassium and sulfur on growth And yield of Black gram (*Vigna mungo* L.)

Abstract

A field experiment was conducted during *Zaid* 2021, at Research Farm, Department of Agronomy. The experiment was laid out in Randomized Block Design with nine treatments which are replicated thrice. The treatments details viz., T_1: 20 kg K ha^{-1} + 15 kg S ha^{-1}, T_2: 30 kg K ha^{-1} + 20 kg S ha^{-1}, T_3: 40 kg K ha^{-1} + 25 kg S ha^{-1}, T_4: 20 kg K ha^{-1} + 15 kg S ha^{-1}, T_5: 30 kg K ha^{-1} + 20 kg S ha^{-1}, T_6: 40 kg K ha^{-1} + 25 kg S ha^{-1}, T_7: 20 kg K ha^{-1} + 15 kg S ha^{-1}, T_8: 30 kg K ha^{-1} + 20 kg S ha^{-1}, T_9: 40 kg K ha^{-1} + 25 kg S ha^{-1} was used. The result showed that higher plant height (50.3 cm), maximum number of branches per plant (5.93), highest number of nodules per plant (15.73), maximum dry weight (8.63), CGR g/m2/day (7.90), maximum number of pods per plant (20.13), highest number of seeds per pod (6.20), test weight (33.60), seed yield (1456.67 kg ha^{-1}), harvest index (32.06) and relative growth rate (0.013) were recorded significantly with the application of 40 kg ha^{-1} Potassium pulse 25 kg ha^{-1} Sulphur. Highest crop growth rate (7.90) was recorded with 40 Potassium kg ha^{-1} + 25 Sulphur kg ha^{-1}.

Key words: Black gram, Potassium, Sulphur, Growth.

Introduction:

Pulses, also known as food legumes, are members of the Fabaceae family and have the remarkable capacity to fix biological nitrogen and mobilise insoluble soil elements through their deep root system, earning them the nickname "beautiful gift of nature." **(Priya *et al.*, 2021).** Pulses have a higher protein content than grains, hence they are very important in Indian agriculture **(Prajapati *et al.*, 2017).** One of the most important kharif pulse crops is black gram (*Vigna mungo* L.). It is a member of the Leguminosae family and the papilionaceae subfamily, and has been farmed as a primary crop in Madhya Pradesh and throughout the country for centuries. India is the world's leading producer and user of black gram. **(Jaiswal *et al.*, 2019)** In India, black gram ranks fourth in terms of area, production, and productivity, with a total area of 4.48 million hectares, a production of 2.8 million tonnes per hectare, and a productivity of 632 kilogram per hectare. It is grown on a 5 m/ha scale in Andhra Pradesh, with a yield of 3.29 mt and a productivity of 658 kg/ha. **(Anonymous, 2017).** Black gram is a very significant pulse crop with a high price that is grown in practically every part of India. It contains a perfect balance of all nutrients, including carbs (60%), proteins (26%), fat (1.5%), calcium (154 mg), minerals (3.2%), phosphorous (385 mg), fibre (0.9%), iron (9.1 mg), and vitamin B-complex (9.1 mg) **(Jadhav *et al.*, 2019).** Because of its strong root system and foliage cover, it successfully reduces soil erosion and competes with weeds. It boosted soil fertility by fixing atmospheric nitrogen into the soil. Carbohydrate, protein, fat, and phosphoric acid are all abundant in it **(Parashar *et al.*, 2020)**

Black gram production is low in general due to inadequate management and insufficient soil fertility. The primary black gram-growing states in India include Madhya Pradesh, Maharashtra, Uttar Pradesh, Tamil Nadu, Orissa, and Gujarat. **(Karthikeyan *et al.*, 2020).** An adequate supply of mineral nutrients to legumes enhances nitrogen fixation **(Ganeshamurthy and Reddy 2000).** Insufficient organic matter concentration in light textured soils, along with low and uneven nutrient treatment to crops, reduces yield potential and is the primary obstacle to crop development **(Ghosh *et al.*, 2003).** To increase the output of black gram, proper fertilization is required. It can meet its nitrogen needs by symbiotically fixing nitrogen from the atmosphere. Potassium affects the nodulation of pulse crops, which enhances seed output by improving nitrogen fixation. It is one of the most important elements that the plant absorbs. Potassium is absorbed in greater quantities by plants than any other mineral except nitrogen. It aids in the synthesis of proteins and chlorophyll **(Anandamai *et al.*, 2021).**

Potassium and sulfur are essential components of plant nutrition. These are, in fact, the nutrients that are lacking in the soils. As a result, potassium and sulfur fertilizer application is critical from both a quality and production standpoint. Potassium is a necessary macronutrient for plant growth and development **(Karthikeyan *et al.*, 2020).** Phosphorus and sulfur are the nutrients that require special care. In sulfur-deficient soils, black gram also reacts favorably to sulfur fertilizer. Sulfur is a component of cystein, cystine, and methionine amino acids, and has a significant impact on protein synthesis by pulses **(Phogat *et al.*, 2018).** In this study, sulfur sources such as gypsum, elemental sulfur, and ammonium sulphate were tested at varying amounts of 0, 20, and 40 kg S/ha. Gypsum, elemental sulfur, and ammonium sulfur are some of the most well-known sulfur fertilizers. Gypsum is a low-cost, mine-sourced sulfur source in India, with Rajasthan accounting for more than 90% of the total **(Patel *et al.*, 2018).** At ideal N:K nutritional ratios, higher yields and crop quality can be achieved.

MATERIAL AND METHOD:

Experimental site: The trail was carried out at Central Research Farm, NAI, SHUATS' Prayagraj, which is located at 25° 24′30″N latitude, 81° 51′10″ E longitude, and 98 metres above sea level (MSL) Prayagraj has a subtropical climate with summer and winter extremes.

Soil: The experimental field's soil is a component of the central gangetic alluvium. Pre-sowing soil samples were collected using an auger from a depth of 0-15 cm and tested in a randomized block design that was duplicated three times. Chemical and mechanical analyses were carried out with the composite samples. The soil was sandy loam in texture, low in Organic Carbon (0.23%) med. in potassium (187 kg /ha), and Sulfur (0.24).

Experimental Design and Treatments: A (RBD) was used for experiment by taking K and S with different levels. The plot size 2m x 2m. The recommended dose of fertilizers (RDF) used in the experiment are 20 kg N, 40 kg P_2O_5 and 20 kg K_2O /ha were supplied.

Treatment	**Treatment Combination**
T_1	20 kg K/ha + 15 kg S/ha
T_2	30 kg K/ha + 20 kg S/ha
T_3	40 kg K/ha + 25 kg S/ha
T_4	20 kg K/ha + 15 kg S/ha
T_5	30 kg K/ha + 20 kg S/ha
T_6	40 kg K/ha + 25 kg S/ha
T_7	20 kg K/ha + 15 kg S/ha
T_8	30 kg K/ha + 20 kg S/ha
T_9	40 kg K/ha + 25 kg S/ha

As nutrient sources, Urea, SSP, and MOP were employed. Sulfur are delivered to the plots as a basal whenever soil application is required, based on the treatment combinations. Irrigation was used at vital phases and at the correct sowing time. The growth parameters *viz.* plant height, Number of branches/plants, Number of nodules/plants, Plant dry weight (g) CGR (g/m2/day), RGR (g/g/day) was recorded at harvest. The yield parameters *viz*. number of pods plant^{-1}, grain yield, were recorded with standard process of observation. Analysis of variance (Anova) as applied to Randomized Block Design was used to statistically examine the data.

RESULTS AND DISCUSSION:

The growth parameters like Plant height (cm), Number of branches/plants, Number of nodules/plants, Plant dry weight (g), CGR (g/m2/day), RGR (g/g/day) were significantly influenced by application levels of Potassium and Sulfur on Black gram application of 40 kg K /ha+ 25 kg S /ha resulted with max. Plant height (cm) Number of branches/plants, Number of nodules/plants, Plant dry weight (g), CGR (g/m2/day), RGR (g/g/day) at the time of harvest.

The treatments T_1 recorded the min. plant height of 38.9 cm and the treatment T_9 recorded the max. plant height of 50.3 cm. Potassium influences the synthesis of phytohormones, which is important for meristematic growth. Cytokinin is a plant hormone that plays a key function in plant growth **Thakur *et al.*, (2017).** Sulfur application may have boosted cell elongation and cell expansion during the growth period, resulting in higher plant height.

Treatment T_1 had the min. number of branches plant^{-1} (5.27), whereas treatment T_9 had the max. number of branches plant^{-1} (5.93). The results of this experiment were in accordance with these **Karthikeyan *et al.*, (2020),** who noted that when K was applied, the plants grew quickly and produced more branches plant^{-1}. The increased number of nodules per plant could be related to better root biomass when these nutrients levels rise. Because phosphorus is found in nucleic acid and many forms of protein, it may have spurred cell division, resulting in enhanced plant growth.

The rise in plant dry weight may be attributed to the plant's increased height, number of branches, and nutrient buildup, all of which contributed to the plant's higher dry weight. Due to adequate food supply, additional growth factors such as CGR (g/m2/day) and RGR (g/g/day) rose. Enhanced cell division due to adequate Sulfur and Phosphorus availability could explain the increased growth parameter. New leaves, stems, and nodules are the main components of vegetative growth. Photosynthetic products delivered to these locations are mostly employed in protein synthesis. The results were in accordance with **Parashar (2020).**

The yield parameters such as No. of pods/plant, No. of seeds/pod, Test weight (g), Seed yield (kg/ha), Straw yield (kg/ha), Harvest index (%) were significantly influenced by application levels of Potassium and Sulfur. Black gram application of 40 kg K /ha+ 25 kg S /ha resulted with max. black gram application of 40 kg K /ha+ 25 kg S /ha resulted with max. in yield parameters. The max. number of Pods/plant were recorded in treatment T_9 (20.13), while min. was recorded in treatment T_1 (16.37). While max. number of seeds/pod was observed in Treatment T_9 (6.20) and min. was observed in treatment T_1 (5.13). The max. Test was observed in treatment T_9 (33.60 g) while min. was observed in treatment T_1 (32.70 g).The max. seed yield was observed in Treatment T_9 (1456.67 kg/ha) while min. in treatment T_1 (903.3 kg/ha). The max. Harvest Index was observed in treatment T_9 (32.06%) while min. in treatment T_1 (30.5%). The cumulative effect of enhanced growth and yield parameters resulted in an increase in grain yield. This could be due to a superior supply of Sulphur, phosphorus, and potassium, which results in stronger branch and pod growth and, as a result, increased yield. Phosphorus is known to have an essential function in the production of new shoots and the number of branches/plant. It also controls photosynthesis and carbohydrate metabolism, which is one of the key factors that limits growth, particularly during the reproductive phase. The improved height and leaf number of the plant may have aided in enhancing production characteristics and yield of black gram. Increased yield attributes have resulted from the stimulatory action of Sulphur, phosphorus, and potassium on growth and partitioning of photosynthates to sink development. The fact that these parameters have lower values at lower doses backs up the previous conclusion. Plants produced more pods per plant with a greater quantity of seeds per pod as photosynthetic products increased and translocation became more efficient. Sulfur, phosphorus, and potassium appeared to have good effects on growth and yield qualities, resulting in significant increases in grain yields. Similar results were reported by **Bhat *et al.*, (2009)**

Table:1 Effect of Potassium and sulfur on growth parameters of Black Gram (*Vigna mungo* L.)

TREATMENT	**Plant height (cm)**	**Number of branches/plants**	**Number of nodules/plants**	**Plant dry weight (g)**	**CGR (g/m2/day)**	**RGR (g/g/day)**
T_1 20 kg K/ha + 15 kg S/ha	38.9	5.27	12.60	7.24	5.79	0.010
T_2 30 kg K/ha + 20 kg S/ha	42.1	5.29	13.10	7.35	5.79	0.010
T_3 40 kg K/ha + 25 kg S/ha	43.2	5.60	13.97	7.81	6.83	0.011
T_4 20 kg K/ha + 15 kg S/ha	41.8	5.47	13.37	7.54	6.28	0.011
T_5 30 kg K/ha + 20 kg S/ha	44.2	5.60	14.50	8.09	7.53	0.012
T_6 40 kg K/ha + 25 kg S/ha	45.6	5.73	14.97	8.17	6.97	0.012
T_7 20 kg K/ha + 15 kg S/ha	45.2	5.67	13.63	7.58	6.38	0.011
T_8 30 kg K/ha + 20 kg S/ha	46.8	5.80	15.30	8.40	7.88	0.012
T_9 40 kg K/ha + 25 kg S/ha	50.3	5.93	15.73	8.63	7.90	0.013
F-Test	S	S	S	S	S	S
SEm±	0.43	0.09	0.17	0.06	0.34	0.0016
CD (P=0.05)	0.98	028	0.50	0.19	1.00	0.0013

Fig:1 Graph showing effect of Potassium and sulfur on growth parameters of Black Gram (*Vigna mungo* L.)

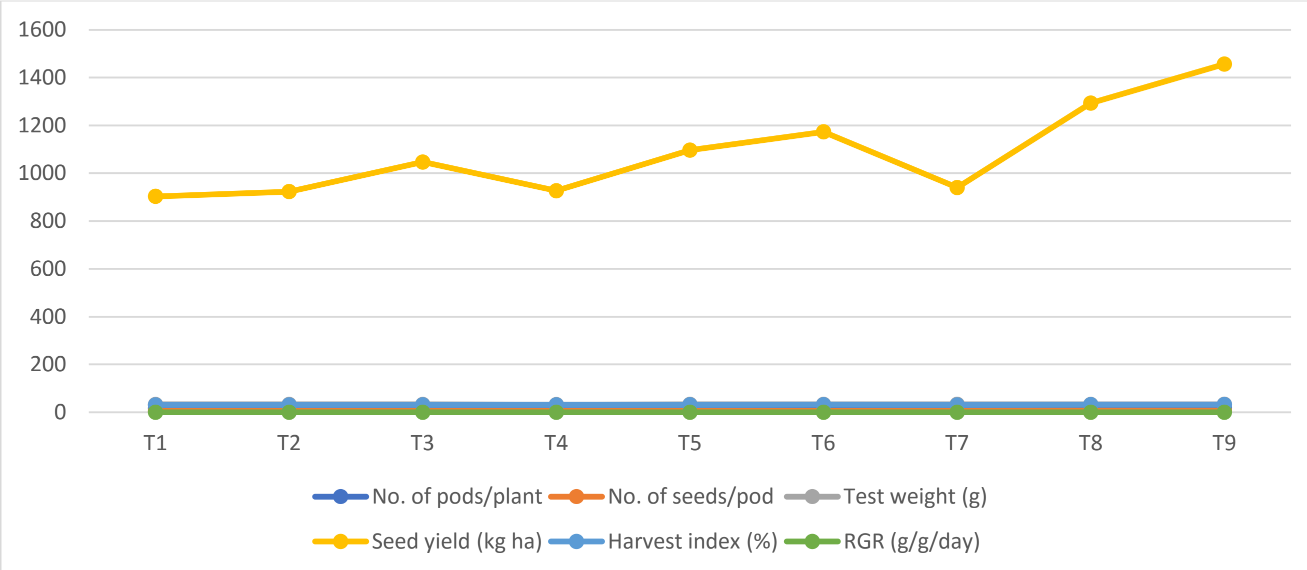
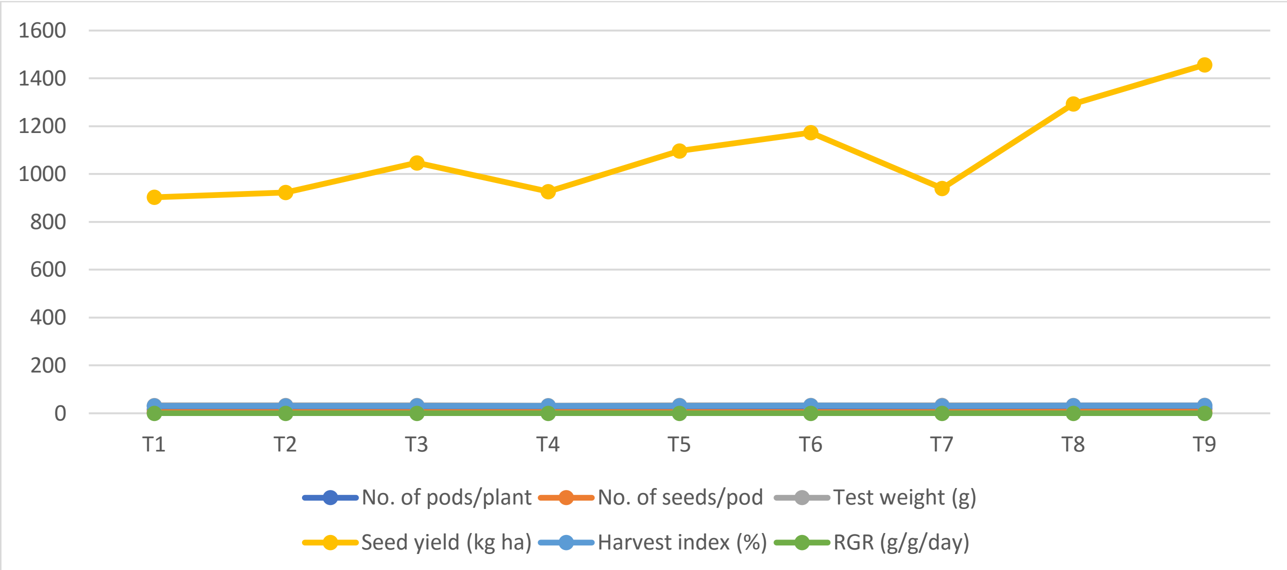


Table:2 Effect of Potassium and sulfur on yield parameters of Black Gram (*Vigna mungo* L.)

TREATMENT	No. of pods/plant	No. of seeds/pod	Test weight (g)	Seed yield (kg ha)	Harvest index (%)
T_1 20 kg K/ha + 15 kg S/ha	16.37	5.13	32.70	903.33	30.51
T_2 30 kg K/ha + 20 kg S/ha	16.80	5.20	32.90	923.33	30.57
T_3 40 kg K/ha + 25 kg S/ha	17.87	5.37	32.83	1046.67	30.87
T_4 20 kg K/ha + 15 kg S/ha	17.03	5.17	32.27	926.67	30.79
T_5 30 kg K/ha + 20 kg S/ha	18.57	5.40	33.13	1096.67	31.17
T_6 40 kg K/ha + 25 kg S/ha	18.77	5.60	33.10	1173.33	31.37
T_7 20 kg K/ha + 15 kg S/ha	17.10	5.07	33.37	940.00	30.58
T_8 30 kg K/ha + 20 kg S/ha	19.37	5.97	32.93	1293.33	31.67
T_9 40 kg K/ha + 25 kg S/ha	20.13	6.20	33.60	1456.67	32.06
F-Test	S	S	NS	S	NS
SEm±	0.20	0.13	0.42	1.82	0.57
CD (P=0.05)	0.60	0.38	-	2.35	-

Figure:2 Graph showing effect of Potassium and sulfur on yield parameters of Black Gram (*Vigna mungo* L.)



Conclusion: From the above investigation it can be concluded that Treatment T_9 (40 kg K/ha + 25 kg S/ha)was observed to the best treatment with respect the growth and yield parameters and can be recommendable to the farmers for better results.

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