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# Effect of Potassium and Sulphur Levels on Growth and Yield of Groundnut (*Arachis hypogaea* L.)

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**ABSTRACT: A field experiment was laid out during the kharif 2020 at Prakasam Krishi Vignan Kendra (KVK), Jayaprakashnagar, Jammikunta, Karimnagar District-505122 Telangana State to know the effect of Potassium and Sulphur on growth and yield of groundnut. Groundnut is cultivated in 2.0 lakh hectares across Telangana region making it one of the major crops of the state. It is widely grown in Mahbubnagar, Warangal, Nalgonda and Karimnagar Districts. The experiment consists of 12 treatments which included 4 levels of Potassium (0kg, 25kg, 50kg and 75kg) and 3 levels of Sulphur (0kg, 20kg and 40kg). The treatment receiving 75 kg potassium and 40kg Sulphur produced significantly higher plant height (49.93), number of nodules/plant (127.47), plant dry weight (37.43), crop growth rate (24.45), number of pods/plant (12.23), number of seeds/pod (2.08), test weight (41.32), seed yield (2677.97), halum yield (4573.89), harvest index (36.91), gross return (1,36,576.30 INR/ha) net return (90,292.86 INR/ha) and B:C ratio (1.95). This experiment shows treatment receiving 75kg Potassium and 40kg Sulphur was more productive and economic.**

**Keywords:** Groundnut, Potassium and Sulphur.

## INTRODUCTION

Groundnut (*Arachis hypogea* L., Fam: *Fabaceae*), also known as wonder legume, originated from Brazil, Peru and South America. It is the 3rd major oilseed crop next to soybean and cotton, accounting for 432 million tonnes, with China (17.30 million tonnes) being largest producer of groundnut followed by India (6.70 million tonnes) accounting for 37% and 14% of the total world production of 46.01 million tonnes during 2018-19 (Anon., 2020).

Oil seeds are important as are the pulses in the country. The principal oilseeds include groundnut, rapeseeds and mustard seeds. Groundnut (*Arachis hypogaea* L.) is an important oilseed legume crop; India is the second largest producer of groundnut after china. Groundnut is also is known as "The king of oilseeds". It has another synonym such as peanut, earthnut, monkey-nut. According to Patra *et al*., (2012), groundnut is primarily used for extraction of oil, with an analysis it contains about 46.70%. It is also consumed directly because of its high food value, which is again due to its higher content of protein (22.0%), carbohydrate (10%) and minerals (3%). Balanced nutrition is considered as one of the basic needs to achieve the potential yield (Yadav *et al*, 2017). Groundnut is feeder of soil nutrients. Association studies for the yield contributing in *Arachis hypogaea* has been done for several varieties, which shall be rewarding for yield improvement in groundnut (Roy *et al.*, 2021).

In groundnut, flowers, pegs formation and developing pods are major yielding factors, thus, the application of potassium, sulphur and calcium is too essential for better production. Though potassium is not a constituent of any compound or structurally bound in groundnut, it is required for translocation of assimilates and involved in maintenance of water status of plant especially the turgor pressure of cells and opening and closing of stomata and increase the availability of metabolic energy for the synthesis of starch and proteins. Besides, it increased peg formation, nodulation, synthesis of sugar and starch and help in pod growth and filling. The productivity of groundnut under water deficit conditions increased due to K application.

Potassium is one of the 3 main pillars of balanced fertilizer use, along with nitrogen (N) and phosphorus (P). Groundnut is a heavy feeder of potassium and an adequate supply of this nutrient is indispensable to harvest a good crop of groundnut. Potassium plays a vital role in maintaining balance in enzymatic, stomatal activity (water use), transport of sugars, water and nutrient and synthesis of protein, photosynthesis and starch thus K application increases growth and yield attributes in groundnut (Krauss and Jiyun 2000; Rathore *et al*., 2014). Out of large percentage of area in India, very little or no potassium (K) fertilizers are being applied and therefore it mainly comes from potassium reserves of the soil.

Groundnut is the heavy feeder of Potassium. It plays a major role in balance in the enzymatic, stomatal activity, transport of sugars, water and nutrients, and synthesis of protein, photosynthesis and starch thus K application increases growth and yield attributes in groundnut (Rathore *et al*., 2014).

Besides, and it also increases the peg formation, nodulation in oil synthesis sulphur plays an important. Groundnut plays an important role in synthesis of

protein, requirement Sulphur on this crop is substantial. In addition, application sulphur in soil also regulates the pH and increase the availability of other nutrients. It improves nodulation and pod yield reduces the incidence of diseases. Sulphur increases chlorophyll and decreases chlorosis.

Global reports of Sulphur deficiency and consequent crop response, particularly in oilseed crops like groundnut are quite ostensible (Schonhof *et al*., 2007). Deficiency of Sulphur has been frequently observed due to a number of reasons like increased removal of Sulphur by the crop, high yielding fertilizer responsive crop varieties, increasing cropping intensity and extensive use of Sulphur free fertilizers. The positive response of Sulphur application to groundnut has been reported by Ramdevputra *et al.*, (2010); Dash *et al.*, (2013). Application of 10 t/ha FYM and 40 kg/ha Sulphur resulted in highest dry pod yield and haulm yield (Kadam *et al*., 2009).

## MATERIALS AND METHODS

Experimentwas laid out during *kharif* at prakasam Krishi Vigyan Kendra (KVK), Jayaprakashnagar, Jammikunta Karimnagar District-505122 Telangana state, which is located at an altitude of 243.3m above main sea level on 18494°N latitude and 78545°E longitude and soil having basic soil pH (6.83), organic carbon (0.62%), available nitrogen (197.12 kg/ha), phosphorus (31.21 kg/ha) and potassium (198.71 kg/ha). Treatment comprised of $T_1$ - Potassium-0kg/ha + sulphur-0kg/ha, $T_2$-Potassium-0kg/ha + Sulphur-20kg/ha, T3-Potassium-25kg/ha + Sulphur-40kg/ha, T4-Potassium-25kg/ha + sulphur-0kg/ha, $T_5$-Potassium-25kg/ha + Sulphur-20kg/ha, $T_6$-Potassium-25kg/ha + Sulphur-40kg/ha, $T_7$ - Potassium-50kg/ha + Sulphur-0kg/ha, $T_8$ - Potassium-50kg/ha + Sulphur-20kg/ha, $T_9$ - Potassium-50kg/ha + Sulphur-40kg/ha, $T_{10}$ - Potassium-75kg/ha + Sulphur-0kg/ha, $T_{11}$-Potassium-75kg/ha + Sulphur-20kg/ha, $T_{12}$-Potassium-75kg/ha + Sulphur-40kg/ha. These were replicated thrice on Randomized Block Design recommended dose of fertilizers was applied at the sowing time in Urea, SSP, MOP form.

## RESULT AND DISCUSSION

*A. Growth attributes*

**(i) Plant height:** At 90 DAS the highest plant height was observed with the application of Potassium - 75kg/ha + Sulphur- 40kg/ha (49.93cm) which is significantly superior over all treatments except with application of Potassium- 75kg/ha + Sulphur - 20kg/ha (49.60cm) and Potassium-75kg/ha + Sulphur-0kg/ha (49.07cm). The probable reason for increasing plant height the microbial secretion of organic acid helps in the improving soil conditions which is required for better root proliferation. Availability of nitrogen, phosphorus and potassium at early stages which is helped in better absorption and better nutrient utilization which increases plant height. The results are conformity with the Der *et al.*, (2015).

**(ii) Number of Nodules/Plant:** At 90 DAS the highest number of nodules was observed with the application of Potassium - 75kg/ha + Sulphur - 40kg/ha (43.90) which is significantly superior over all treatments except with the application of Potassium - 75kg/ha + Sulphur - 20kg/ha (43.00) and Potassium - 75kg/ha + Sulphur- 0 kg/ha (42.63). Plants required more Potassium and Sulphur for growth and development of groundnut plants. The secretion of organic acid might improve soil conditions for better root proliferation, proteins metabolism leading to a greater number of nodules per plant similar results were observed by Singh, (2007).

**(iii) Dry weight:** At 90 DAS the significantly higher dry height was observed with the application of Potassium -75kg/ha + Sulphur - 40kg/ha (37.43g/plant) which is significantly superior over all treatments except with the application of Potassium -75kg/ha + Sulphur 20kg/ha (37.33 g/plant) and potassium - 75kg/ha + Sulphur - 0kg/ha (37.13 g/plant) probable reason is due to its profound influence stress resistance and the vegetative crop growth resulting in higher growth attributing characters. Increasing potassium rates increased dry weight/plant.

**Table 1: Effect of potassium and sulphur levels on Growth attributes of Groundnut.**

| Sr.No. | Treatments | Plant Height (cm) | Nodules/Plant | Dry Weight (g) | Crop Growth Rate ($g/m^2/day$) |
|---|---|---|---|---|---|
| 1. | 0 kg/ha Potassium + 0 kg/ha Sulphur | 42.47 | 107.30 | 32.33 | 9.63 |
| 2. | 0 kg/ha Potassium + 20 kg/ha Sulphur | 43.33 | 106.97 | 32.50 | 8.96 |
| 3. | 0 kg/ha Potassium + 40 kg/ha Sulphur | 44.43 | 106.17 | 33.33 | 9.37 |
| 4. | 25 kg/ha Potassium + 0 kg/ha Sulphur | 45.77 | 116.63 | 33.73 | 9.19 |
| 5. | 25 kg/ha Potassium + 20 kg/ha Sulphur | 46.53 | 118.93 | 34.17 | 9.33 |
| 6. | 25 kg/ha Potassium + 40 kg/ha Sulphur | 46.90 | 120.10 | 34.70 | 9.41 |
| 7. | 50 kg/ha Potassium + 0 kg/ha Sulphur | 47.83 | 124.23 | 35.20 | 9.26 |
| 8. | 50 kg/ha Potassium + 20 kg/ha Sulphur | 47.63 | 125.20 | 35.60 | 8.07 |
| 9. | 50 kg/ha Potassium + 40 kg/ha Sulphur | 48.70 | 125.47 | 36.03 | 9.48 |
| 10. | 75 kg/ha Potassium + 0 kg/ha Sulphur | 49.07 | 125.53 | 37.13 | 10.15 |
| 11. | 75 kg/ha Potassium + 20 kg/ha Sulphur | 49.60 | 126.87 | 37.33 | 10.37 |
| 12. | 75 kg/ha Potassium + 20 kg/ha Sulphur | 49.93 | 127.47 | 37.43 | 11.59 |
| | F test | S | S | S | S |
| | Sem(±) | 0.13 | 1.23 | 0.18 | 0.57 |
| | CD (5%) | 1.03 | 3.62 | 0.54 | 1.67 |

These findings also confirmed the results obtained by Dutta *et al.*, (2004). The increase in dry matter production with K might be due to better nodulation of crop owing to better availability of K. The improvement in nodulation might have resulted in higher amount of nitrogen fixation and there by better vegetative growth and dry matter production. Similar results were also reported by Ponnuswami *et al.*, (1993).

**(iv) Crop growth rate:** At 75-90 DAS the higher crop growth rate was observed with the application of Potassium - 75kg/ha + Sulphur - 40kg/ha/ha (11.59 g/m²) which is significantly superior over all treatments expect with potassium - 75kg/ha + Sulphur- 20kg/ha (10.37 g/m²/day) and potassium 75kg/ha + Sulphur- 0kg/ha (10.15 g/m²/day). The overall nutritional environment increases due to the application of Sulphur application of the Rhizosphere as well as plant system which could be more advantageous for profused vegetative and growth which activated higher absorption of nutrients from the soil and improved metabolic activities inside the plant. The results are in conformity with Naiknaware *et al*., (2015).

*B. Yield Attributes and yield*

**(i) Pods/plant:** The highest number of pods/plants was recorded with the application of 75 kg/ha Potassium + 40 kg/ha Sulphur (12.23) which is superior over all treatments except with the application of 75 kg/ha Potassium + 20 kg/ha Sulphur (12.03), 50 kg/ha Potassium + 40 kg/ha Sulphur (12.18) and 50 kg/ha Potassium + 0 kg/ha Sulphur (11.63).

The positive influence of these treatments through immediate supply of potassium at the early stage of the crop, which might have improved adequate biomass production and improvement in yield parameters resulting in higher pod yield. Similar results were reported by Gashti *et al.*, (2012).

**(ii) Seeds/pod:** The highest number of seeds/pod was recorded with the application of 75kg/ha Potassium + 40 kg/ha Sulphur (2.08) which is superior over all treatments except with the application of 75 kg/ha Potassium + 20kg/ha Sulphur (2.07) and 75 kg/ha Potassium + 0kg/ha Sulphur (1.92).

The increase in yield attributes of plant might be due to the potassium play a vital role in maintaining balance in enzymatic, stomatal activity, transport of sugar and synthesis of protein, photosynthesis and starch. Similar results were reported by Sahay *et al.*, (2013).

**(iii) Test weight:** The highest test weight was observed with the application of 75 kg/ha Potassium + 40 kg/ha Sulphur (41.32g) and lowest was observed with application of 0kg/ha Potassium + 0kg/ha Sulphur (41.26g). There was no significant difference.

**(iv) Seed yield:** The high Seed yield was recorded with the application of 75 kg/ha Potassium + 40 kg/ha Sulphur(2677.97kg/ha) which is superior over all treatments except with the application of 75 kg/ha Potassium + 20kg/ha Sulphur (2581.85kg/ha) and the lowest seed yield was observed in 0 kg/ha Potassium + 0 kg/ha Sulphur (998.39kg/ha).

Significant increase in number of pod yield and haulm yield by interaction of potassium and sulphur might be due to the synergistic effect of potassium and sulphur application in improving yield of plant. This finding is supported by Singh, (2007). Improvement in yield might have resulted from favourable influence of sulphur on growth and efficient partitioning and translocation of metabolites to reproductive structures. Similar results of higher growth, yield attributes pod yield were also reported by Kalaiyarasan *et al*., (2003)

**(v) Haulm yield:** The highest haulm yield was recorded by the 75 kg/ha Potassium + 40 kg/ha Sulphur(4573.89kg/ha)application which is superior over all treatments except with the application of 75 kg/ha Potassium + 20 kg/ha Sulphur (4475.44 kg/ha) and the lowest haulm yield was observed in 0 kg/ha Potassium + 0 kg/ha Sulphur (2254.2 kg/ha).

Better growth environment created by microorganisms might be one of the most probable reasons for significantly higher haulm yield. Kulkarni *et al.*, (2018) found similar results in groundnut.

**(vi) Harvest Index:** The highest harvest index was recorded with the application of 75 kg/ha Potassium + 40 kg/ha Sulphur (36.91%) which is superior over all the treatments except with the application of 75 kg/ha Potassium + 20 kg/ha Sulphur (36.52%) and the lowest Harvest index was observed in 0 kg/ha Potassium + 0kg/ha Sulphur (30.71%).

**Table 2: Effect of Potassium and Sulphur levels on yield attributes of Groundnut.**

| Sr. No. | Treatments | Pods/Plant | Seeds/Pod | Test Weight (g) | Seed Yield (kg/ha) | Haulm Yield (kg/ha) | Harvest Index (%) |
|---|---|---|---|---|---|---|---|
| 1. | 0 kg/ha Potassium + 0 kg/ha Sulphur | 8.13 | 0.75 | 41.26 | 998.39 | 2254.2 | 30.71 |
| 2. | 0 kg/ha Potassium + 20 kg/ha Sulphur | 9.03 | 0.77 | 41.27 | 1003.37 | 2287.82 | 30.49 |
| 3. | 0 kg/ha Potassium + 40 kg/ha Sulphur | 9.35 | 0.81 | 41.27 | 1039.97 | 2354.09 | 30.65 |
| 4. | 25 kg/ha Potassium + 0 kg/ha Sulphur | 10.02 | 1.07 | 41.28 | 1176.32 | 2599.78 | 31.14 |
| 5. | 25 kg/ha Potassium + 20 kg/ha Sulphur | 10.95 | 1.13 | 41.28 | 1425.78 | 2789.19 | 33.83 |
| 6. | 25 kg/ha Potassium + 40 kg/ha Sulphur | 10.90 | 1.31 | 41.29 | 1453.01 | 3246.2 | 30.92 |
| 7. | 50 kg/ha Potassium + 0 kg/ha Sulphur | 11.63 | 1.55 | 41.28 | 1566.96 | 3537.75 | 30.69 |
| 8. | 50 kg/ha Potassium + 20 kg/ha Sulphur | 11.87 | 1.68 | 41.29 | 1656.20 | 3936.71 | 29.61 |
| 9. | 50 kg/ha Potassium + 40 kg/ha Sulphur | 12.18 | 1.69 | 41.29 | 2052.18 | 4121.03 | 33.23 |
| 10. | 75 kg/ha Potassium + 0 kg/ha Sulphur | 12.03 | 1.92 | 41.30 | 2405.48 | 4349.15 | 35.60 |
| 11. | 75 kg/ha Potassium + 20 kg/ha Sulphur | 12.17 | 2.07 | 41.31 | 2581.85 | 4475.44 | 36.52 |
| 12. | 75 kg/ha Potassium + 40 kg/ha Sulphur | 12.23 | 2.08 | 41.32 | 2677.97 | 4573.89 | 36.91 |
| | F test | S | S | NS | S | S | NS |
| | SEm (±) | 0.29 | 0.07 | 0.04 | 47.2 | 42.49 | 1.95 |
| | CD (P=0.05) | 0.86 | 0.22 | 0.11 | 138.42 | 124.63 | 0.67 |

The number of pods/plants, number of seeds/plants, Test weight, seed yield and haulm yield might be due to positive of these treatments through immediate supply of Potassium at the early stage of the crop, which might have improved adequate biomass production and improvement in yield parameters resulting in higher pod yield. Similar results were reported by Gashti *et al*., (2012). Due to the application of potassium Increases in yield attributes of plant, potassium plays a vital role in maintaining balance in enzymatic, Similar results were reported by Sahay *et al*., (2013). But the combination of Potassium and Sulphur the increase in pod yield and haulm yield was improved plant. This finding is supported by Singh, (2007), significantly higher haulm yield was observed due to microorganisms which creates better growth environment. Kulkarni *et al*., (2018) found similar results in Groundnut.

The improvement in yield attributes of groundnut might be due to better nutritional environment in root zone for growth and development. Besides, Sulphur is involved in the formation of S containing amino acids, vitamins and has direct role in root growth and developmental processes (Jat and Ahlawat, 2009).

*C. Effect of Potassium and Sulphur levels on Economics of Groundnut*

Application of 75 kg/ha Potassium + 40 kg/ha Sulphur recorded the maximum Gross return (1,36,576.30 INR/ha), Net return (90,292.86 INR/ha) and B:C ratio (1.95) which is superior over all the treatments.

**Table 3: Effect of Potassium and Sulphur levels on yield attributes of Groundnut.**

| Sr.No. | Treatments | Cost of cultivation (INR/ha) | Net return (INR/ha) | Gross return (INR/ha) | B:C ratio |
|---|---|---|---|---|---|
| 1. | 0 kg/ha Potassium + 0 kg/ha Sulphur | 41,278.44 | 9,639.62 | 50,918.06 | 0.23 |
| 2. | 0 kg/ha Potassium + 20 kg/ha Sulphur | 42,718.44 | 8,453.26 | 51,171.70 | 0.19 |
| 3. | 0 kg/ha Potassium + 40 kg/ha Sulphur | 44,158.44 | 8,880.20 | 53,038.64 | 0.20 |
| 4. | 25 kg/ha Potassium + 0 kg/ha Sulphur | 41,986.44 | 18,005.88 | 59,992.32 | 0.42 |
| 5. | 25 kg/ha Potassium + 20 kg/ha Sulphur | 43,426.44 | 29,288.17 | 72,714.61 | 0.67 |
| 6. | 25 kg/ha Potassium + 40 kg/ha Sulphur | 44,866.44 | 29,237.07 | 74,103.51 | 0.65 |
| 7. | 50 kg/ha Potassium + 0 kg/ha Sulphur | 42,694.44 | 37,220.52 | 79,914.96 | 0.87 |
| 8. | 50 kg/ha Potassium + 20 kg/ha Sulphur | 44,134.44 | 40,331.76 | 84,466.20 | 0.91 |
| 9. | 50 kg/ha Potassium + 40 kg/ha Sulphur | 45,574.44 | 59,086.57 | 10,4661.00 | 1.29 |
| 10. | 75 kg/ha Potassium + 0 kg/ha Sulphur | 43,403.44 | 79,276.04 | 12,2679.50 | 1.82 |
| 11. | 75 kg/ha Potassium + 20 kg/ha Sulphur | 44,843.44 | 86,830.74 | 13,1674.20 | 1.93 |
| 12. | 75 kg/ha Potassium + 40 kg/ha Sulphur | 46,283.44 | 90,292.86 | 13,6576.30 | 1.95 |

## CONCLUSION AND FUTURE SCOPE

Based on the findings it may be concluded that for optimum Seed yield and economics, the performance of Groundnut at 75 kg/ha Potassium + 40 kg/ha Sulphur is the best. Groundnut is generally grown on coarse-textured or sandy soils which are inherently low in $SO_4^2$ and -S and are highly prone to leaching losses of $SO_4^2$. Grain legumes and oil seeds have high sulphur requirement therefore Groundnut being a both a legume and an oilseed crop has high sulphur requirement. The conclusion drawn based on one season data only which require for further conformation for recommendation.

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