Nutrient Content, Uptake, Quality of Chickpea (*Cicer arietinum* L.) and Fertility Status of Soil as Influenced by Fertilization of Potassium and Sulphur

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**A B S T R A C T**

An field experiment was conducted at Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh during *rabi* season of 2014-15 to evaluate soil application of potassium and sulphur on nutrient content, uptake, quality and yield parameter of chickpea (*Cicer arietinum* L.) under south Saurashtra region of Gujarat. The experiment comprising of four levels of potassium *viz.*, 0, 40, 60 and 80 kg K$_2$O ha$^{-1}$ and sulphur *viz.*, 0, 20, 40, 60 kg S ha$^{-1}$ and experiment was laid out in Factorial Randomized Block Design and replicated thrice. The results revealed that the content and uptake nutrient, yield of chickpea were significantly influenced by the various levels of potassium and sulphur. The application of potassium 60 and 80 kg K$_2$O ha$^{-1}$ and sulphur 40 and 60 kg S ha$^{-1}$ significantly increased the content, uptake, quality and yield of chickpea.

**Keywords**

*Cicer arietinum*, Potassium, Sulphur

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India is one of the major pulses growing country of the world, accounting roughly for one third of total world area under pulse cultivation and one fourth of total world production. Pulses occupy a key position in Indian diet and meet about 30 per cent of the daily protein requirement. Among the pulses; chickpea is a most important *Rabi* crop with high acceptability and wider use. India is the largest producer of chickpea in the world sharing 71.08 and 71.51 per cent of total area (11.55 m ha) and production (10.46 m tonnes), respectively (Singh, 2011).

The medium black calcareous soils of Saurashtra region in Gujarat are tended to decline in available potassium due to intensive cropping and gradually shifted towards negative K balance. The decreasing K availability in calcareous soil because of dominant black clay might be due to Ca$^{+2}$ which limits the chances of K absorption. Simultaneously, the balance application of potassium not only gave higher yield but also improved the quality of economic produced. Sulphur plays an important role in enhancing the productivity and quality of chickpea. The importance of S in balance plant nutrition is realized with an increasing S deficiency in...
several areas due to intensive cropping and focus on high yielding varieties. In Gujarat, 17% of soils are deficient in available sulphur (Golakiya and Shobhana, 2000). No work has been carried out on the effect of potassium and sulphur in chickpea in Saurashtra region. The potassium increases yield and quality of chickpea whereas, sulphur enhancing the productivity and quality of chickpea. Therefore, an experiment planned to know the effect of potassium and sulphur on content and uptake of nutrient, quality, yield of chickpea and post-harvest soil fertility.

**Materials and Methods**

The experiment was conducted at Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh during rabi season of 2014-15. The soil of the experimental field was clayey in texture and alkaline in reaction (pH of 8.06 and EC of 0.41 dS m⁻¹). The soil was low in available nitrogen (244.20 kg ha⁻¹), medium in available phosphorus (28.80 kg ha⁻¹), medium in available potassium (218.45 kg ha⁻¹), medium in available sulphur (10.64 ppm), medium in iron (5.24 ppm), high in zinc (0.74 ppm), high in manganese (17.87 ppm) and high in copper (1.26 ppm). The experiment comprised of total sixteen treatment combinations in which four levels of potassium (0, 40, 60 and 80 K₂O kg ha⁻¹) and four levels of sulphur (0, 20, 40 and 60 S kg ha⁻¹) were laid out in Randomized Block Design having factorial concept with three replications. The fertilizer application was done with fixed doses of nitrogen at 20 kg ha⁻¹ and phosphorus at 40 kg ha⁻¹. Potassium and sulphur application was done according to the treatments. The nutrients of N, P, K and S were applied by using sources of Urea, DAP, MOP and Cosavate (WG 90% S), respectively. The chickpea variety “Gujarat Gram-3” was planted in second week of October with spacing of 45 m × 10 m and seed rate of 60 kg ha⁻¹. The crop was raised with all the standard package of practices and protection measures also timely carried out as they required. The experimental data recorded for growth parameters, yield attributes and yield parameters were statistically analyzed for level of significance.

**Results and Discussion**

**Effect of potassium levels on nutrient content, uptake and yield of chickpea**

Potassium content and uptake by seed of chickpea increased significantly due to successive levels of potassium. Significantly maximum K content (1.330 %) and uptake (27.53 kg ha⁻¹) by seed of chickpea were recorded with 60 kg K₂O ha⁻¹. It was showed superiority over rest of treatment. But the K content (1.577 %) and uptake (83.10 kg ha⁻¹) by stover of chickpea were significantly found in 60 kg K₂O ha⁻¹ and 80 kg K₂O ha⁻¹, respectively. This was at par with 80 kg K₂O ha⁻¹ and 60 kg K₂O ha⁻¹. Potassium is a third major plant nutrient because of the large amount in which it is absorbed by plants and its significant place for the production of high yield. This nutrient plays an essential role in plant growth and metabolism. It regulates the major functions of enzymes involved in photosynthesis, metabolism of carbohydrate and protein. Similar results have also been reported by Mondal et al., (2005) and Mallarino and Higashi (2009).

A perusal of data (Table 1) revealed that different levels of potassium exerted their significant influence on 100-seed weight. Application of 60 kg K₂O ha⁻¹ recorded significantly the higher 100-seed weight (23.57 g) which was remain statistically at par with 80 kg K₂O. Seed yield affected significantly by potassium levels up to the 60 kg ha⁻¹ and beyond that level the differences were remained on par (Table 1).
Table 1  Effect of levels of potassium and sulphur on nutrient content and uptake, quality, yield of chickpea and after harvest fertility status of soil

| Treatments | Potassium content (%) | Potassium uptake (kg ha\(^{-1}\)) | Sulphur content (%) | Sulphur uptake (kg ha\(^{-1}\)) | Protein content in seed | Available Potassium (kg ha\(^{-1}\)) | Available Sulphur (ppm) | Seed yield (kg ha\(^{-1}\)) | Stover yield (kg ha\(^{-1}\)) | 100 seed weight (g) |
|------------|-----------------------|----------------------------------|---------------------|---------------------------------|------------------------|--------------------------------------|------------------------|----------------------------|------------------------|------------------------|
| K\(_0\)–Control | 1.253  | 0.791   | 21.60  | 36.99  | 0.410  | 0.428  | 6.99  | 20.41  | 24.32  | 225.70  | 12.81  | 1704  | 4757  | 22.26  |
| K\(_1\) – 40 | 1.281  | 1.249   | 25.02  | 64.89  | 0.419  | 0.400  | 8.16  | 20.65  | 24.44  | 230.21  | 13.11  | 1948  | 5172  | 22.68  |
| K\(_2\) – 60 | 1.330  | 1.577   | 27.53  | 82.98  | 0.421  | 0.440  | 8.79  | 23.37  | 24.52  | 246.75  | 13.91  | 2086  | 5262  | 23.57  |
| K\(_3\) – 80 | 1.297  | 1.510   | 26.37  | 83.10  | 0.425  | 0.411  | 8.63  | 22.49  | 24.39  | 246.59  | 13.85  | 2037  | 5515  | 23.20  |
| S.Em±      | 0.018  | 0.031   | 0.95   | 2.33   | 0.005  | 0.013  | 0.25  | 0.77   | 0.05   | 3.98    | 0.39   | 59.86 | 168.16 | 0.26   |
| C.D. at 5%  | 0.053  | 0.09    | 2.74   | 6.74   | NS     | NS     | 0.72  | 2.23   | 0.13   | 11.48   | NS     | 172.89 | 485.68 | 0.76   |
| C.V.%      | 4.69   | 8.42    | 13.11  | 12.06  | 4.29   | 10.88  | 10.65 | 12.30  | 0.676  | 14.68   | 10.06  | 10.67 | 11.25 | 3.67   |

Potassium levels (kg K\(_2\)O ha\(^{-1}\))

| S\(_0\) – Control | 1.261  | 1.267   | 22.84  | 61.82  | 0.413  | 0.343  | 7.51  | 16.27  | 24.35  | 223.48  | 11.28  | 1810  | 4808  | 22.39  |
| S\(_1\) – 20 | 1.296  | 1.276   | 24.55  | 65.26  | 0.420  | 0.409  | 7.90  | 20.63  | 24.33  | 225.17  | 12.79  | 1889  | 5075  | 22.21  |
| S\(_2\) – 40 | 1.307  | 1.323   | 27.02  | 71.77  | 0.431  | 0.470  | 8.82  | 25.07  | 24.53  | 231.35  | 15.00  | 2060  | 5359  | 23.60  |
| S\(_3\) – 60 | 1.296  | 1.259   | 26.12  | 69.13  | 0.417  | 0.458  | 8.34  | 24.95  | 24.35  | 232.26  | 14.61  | 2015  | 5464  | 23.50  |
| S.Em±      | 0.018  | 0.031   | 0.951  | 2.33   | 0.005  | 0.013  | 0.25  | 0.77   | 0.05   | 3.98    | 0.39   | 59.89 | 168.16 | 0.26   |
| C.D. at 5%  | NS     | NS      | 2.74   | 6.74   | 0.015  | 0.038  | 0.72  | 2.23   | 0.13   | 1.13    | NS     | 172.89 | 485.68 | 0.76   |
| Interaction (K x S) | NS     | NS      | NS    | NS     | NS     | NS     | NS     | NS     | NS     | NS      | NS     | NS    | NS    | NS    |
| C.V.%      | 4.69   | 8.42    | 13.11  | 12.06  | 4.29   | 10.88  | 10.65 | 12.30  | 0.676  | 14.68   | 10.06  | 10.67 | 11.25 | 3.67   |

Sulphur levels (kg S ha\(^{-1}\))

C.V.% = Coefficient of Variation %
The highest seed yield (2086 kg ha\(^{-1}\)) was obtained with 60 kg ha\(^{-1}\) K\(_2\)O, which might be due to better attributed to more number of pods per plant and number of seeds per pod. Similar result was concluded by Samiullah and Khan (2003). While, minimum seed yield (1704 kg ha\(^{-1}\)) was observed with no potash fertilizer. These results are in agreement with those of Ali et al., (2008) and Ganga et al., (2014).

**Effect of sulphur levels on nutrient content, uptake and yield of chickpea**

Fertilization of sulphur significantly increased sulphur content and uptake by seed and stover of chickpea. Maximum content (0.425 & 0.440 %) and uptake (8.79 & 23.37 kg ha\(^{-1}\)) of sulphur by seed and stover of chickpea were recorded with 40 kg S ha\(^{-1}\). Similar result was also concluded by Kaya et al., (2009), Bhatt and Jain (2012) and Poonia et al., (2013). Likewise, application of 40 kg S ha\(^{-1}\) recorded significantly 100-seed weight (23.60 g), which was statistically at par with 60 kg S ha\(^{-1}\). Application of 40 kg S ha\(^{-1}\) recorded significantly the highest seed yield (2060 kg ha\(^{-1}\)), which was remained at par with 20 kg S ha\(^{-1}\) and 60 kg S ha\(^{-1}\). However, application of 60 kg S ha\(^{-1}\) recorded significantly the highest stover yield (5464 kg ha\(^{-1}\)). This result also in conformity with those of Patel et al., (2013) and Bohra (2014).

**Effect of potassium and sulphur levels on after harvest soil fertility of status**

The increasing levels of potassium up to 60 kg K ha\(^{-1}\) significantly increase available potassium in soil after harvest. However it remained at par with 80 kg K ha\(^{-1}\). The application of 40 kg S ha\(^{-1}\) significantly increased available sulphur after harvest in soil over control. This could be due to the fact that ample supply of potassium and sulphur in soil provides a congenial environment in rhizosphere for microbial population and mineralization through its “energy currency’ functions. Besides, on addition of fertilizer to the soil, there might be a sort of triggering action on native soil K, resulting in increased availability. Similar findings were reported by Meena and Ram (2013)) and Patel et al., (2014).

It can be concluded that nutrient content and uptake, quality and yield parameter of chickpea (cv. GJG-3) and after harvest soil fertility status of soil should be increased with potassium 60 kg K\(_2\)O ha\(^{-1}\) or 80 kg K\(_2\)O ha\(^{-1}\) and sulphur 40 kg S ha\(^{-1}\) or 60 kg S ha\(^{-1}\) in medium black calcareous soils of South Saurashtra region of Gujarat.

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