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Effect of potassium and sulphur on nutrient content, uptake and soil fertility of summer groundnut (*Arachis hypogaea* L.) under middle Gujarat condition

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Abstract
A field experiment was conducted at the college Agronomy farm, Anand Agricultural University, Anand (Gujarat) during summer season of the year 2017 to study the effect of potassium and sulphur levels on nutrient content, uptake and soil fertility of summer groundnut (*Arachis hypogaea* L.) under middle Gujarat conditions. The experiment included four levels of potassium *viz.* 0, 25, 50 and 75 kg K_2O ha^{-1} and three levels of sulphur *viz.* 0, 20 and 40 kg S ha^{-1}. The experiment was laid out in a Randomized Block Design (Factorial) with four replications. Potassium showed significant effect on yield, content, uptake and soil fertility of groundnut. Application of potassium @ 75 kg K_2O ha^{-1} produced the highest pod yield, haulm yield, nutrient content (N, P, K, S) of haulm and pod, nutrient uptake (N, P, K, S) of haulm and pod and soil fertility. Sulphur fertilizer also had significant effect on yield, content, uptake and soil fertility of groundnut. Application of sulphur @ 40 kg S ha^{-1} produced the highest pod yield, haulm yield, nutrient content (N, P, K, S) of haulm and pod, nutrient uptake (N, P, K, S) of haulm and pod and soil fertility. Combined application of potassium @ 75 kg ha^{-1} and sulphur @ 40 kg ha^{-1} resulted the highest pod yield, haulm yield, uptake (P, K, S) by haulm and N uptake by pod of groundnut. On the other hand, in all the cases the lower response was found from the control treatment.

Keywords: Potassium, sulphur, content, uptake, groundnut

Introduction
Groundnut (*Arachis hypogaea* L.) is known to be a unique and important legume cum oilseed crop of India accounting 33% of world's groundnut area and about 27.3% production. It belongs to Leguminoseae family. It is also known as peanut, monkey nut, earthnut, manila nut and goober. It is world's largest source of edible oil and ranks 13th among the food crops as well as 4th most important oilseed crops of the world. India ranks first in the world in respect of area and second in production after China. But the productivity (about 1000 kg ha^{-1}) of groundnut is quite low as compared to world average productivity (1500 kg ha^{-1}). Nutrient management is one of the most important agronomic factors that affect the yield of all the crops. Continuous and imbalance use of selected fertilizer nutrients have resulted in deterioration of soil health, increasing per unit cost of production and decline in rate of growth of productivity. Sulphur is now widely accepted as fourth major plant nutrient along with N, P and K. It involved in the synthesis of essential amino acids and oils in oilseeds, being vital component of co-enzyme involved in oil synthesis. It also involved in various metabolic and enzymatic processes including photosynthesis, respiration and legume-rhizobium symbiotic nitrogen fixation. This role of sulphur in plant make it of fundamental importance in increasing the productivity of crops especially legume oilseeds in India, where more than 50% of soils have been reported to be deficient in sulphur (Tewatia *et al*., 2006) [6].

Potassium is known for its ability to increase yield and improve quality. It is also essential for photosynthesis and pod development in groundnut. Potassium plays a major role in growth and yield as it is involved in assimilation, transport, and storage tissue development (Cakmak, 2005) [2]. Potassium is the second most absorbed nutrient by the peanut crop (Tasso *et al*., 2004) [5]. 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.

Materials and Methods

A field experiment was conducted at the college Agronomy farm, Anand Agricultural University, Anand (Gujarat) during summer season of the year 2017 for studying the role of potassium and sulphur in improving production of summer groundnut (*Arachis hypogaea* L.). The experiment was laid out in a factorial randomized block design with 12 treatment combinations and replicated four times. It consist of four levels of potassium *viz.* 0, 25, 50 and 75 kg K_2O ha^{-1} applied as Muriate of potash and three levels of sulphur *viz.* 0, 20 and 40 kg S ha^{-1} applied as Bentonite sulphur. The soil was loamy sand in texture, having pH (1:2.5) 7.80, EC (1:2.5) 0.18 dS m^{-1}, Organic Carbon 0.23%. It contained 130, 49.31 and 227 kg ha^{-1} available N, P_2O_5 and K_2O, respectively and available sulphur 4.53 mg kg^{-1}. The full dose of nitrogen (25 kg ha^{-1}) and full dose of P_2O_5 (50 kg ha^{-1}) were added through urea and DAP as basal application in each plot. The treatment wise sulphur and potassium were applied through bentonite sulphur and muriate of potash, respectively as basal. The crop was dibbled at 45 cm raw to raw spacing. The crop was raised with standard package of practices. The crop was harvested at maturity and plot wise haulm and pod yield were recorded after sun dry. Soil properties and nutrient content in grain and straw were analyzed using standard analytical procedures (Black, 1965; Jackson, 1962 and Page *et al*., 1982) [1, 3, 4]. The obtained data were statistically analyzed using standard procedure.

Result and Discussion

Pod and Haulm Yield

The pod and haulm yields of groundnut were significantly influenced by graded levels of potassium (Table 1). The significantly higher pod yield (2128 kg ha^{-1}) of groundnut was recorded with application of 75 kg K_2O ha^{-1}, which was at par with 50 kg K_2O ha^{-1}. Beneficial effect of potassium on grain production is related to its known role in plant nutrition, in many physiological and metabolic processes, including photosynthesis, osmoregulation, transport of nutrients, transport and storage of carbohydrates from which fat has formed, nitrogen absorption and synthesis of proteins and starch. Treatment receiving application of potassium @ 75 kg ha^{-1} (K_3) recorded significantly higher haulm yield (4404 kg ha^{-1}) which was at par with treatment K_2 (4219 kg ha^{-1}). Potassium helps in the resistance to crops against pests and diseases, which, in turn, increased the yield.

Application of sulphur produced significant effect on pod and haulm yields of groundnut (Table 1). Significantly the highest pod yield (2083 kg ha^{-1}) was noted with application of 40 kg S ha^{-1} than rest of the treatments. Maximum availability of sulphur helps in stimulating photosynthesis and seed formation as well as synthesis of sulphur containing amino acids, proteins, chlorophyll, and promoting nodulation may be assigned to increase total biomass production which was finally reflected in increment in pod yield of groundnut. Significantly the highest haulm yield (4349 kg ha^{-1}) was noticed in treatment S_2 (40 kg S ha^{-1}). Lowest haulm yield (3704 kg ha^{-1}) was recorded in treatment S_0 (0 kg S ha^{-1}).

Interaction effect of potassium and sulphur was found to be significant in pod yield and haulm yield. Combined application of 75 kg K_2O ha^{-1} and 40 kg S h^{-1} gave significantly higher pod yield and haulm yield than other treatments. This might be due to the synergistic effect of potassium and sulphur application in improving productivity of groundnut.

Table 1: Effect of levels of potassium and sulphur on yield of summer groundnut

Treatments	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
Levels of Potassium		
K_0 = 0 kg K_2O ha^{-1}	1731	3683
K_1 = 25 kg K_2O ha^{-1}	1824	3952
K_2 = 50 kg K_2O ha^{-1}	2030	4219
K_3 = 75 kg K_2O ha^{-1}	2128	4404
SEm ±	44	80
CD at 5 %	126	231
Levels of Sulphur		
S_0 = 0 kg S ha^{-1}	1745	3704
S_1 = 20 kg S ha^{-1}	1956	4141
S_2 = 40 kg S ha^{-1}	2083	4349
SEm ±	38	69
CD at 5 %	109	200
Interaction		
(K×S)	Sig.	Sig.
CV (%)	7.82	6.82

Nutrient content

The nutrient content by different plant parts *viz*. haulm and pod as influenced by application of potassium and sulphur was computed and mean data over presented in table 2.

Effect of potassium on nutrient content

The data on effect of potassium levels on nutrient content in groundnut (Table 2) revealed that the K levels significantly influenced the content of major nutrients in groundnut. Application of potassium @ 75 kg ha^{-1} recorded significantly higher value of nitrogen content (2.01%), phosphorus content (0.31%), potassium content (0.71%) and sulphur content (0.52%) of haulm, which was found to be at par with treatment K_2 (50 kg K_2O ha^{-1}). The lowest nutrient content was recorded under treatment K_0 (control). This increase in nutrient content might be due to favorable effect on availability of nutrients at the higher level of potassium.

Treatment K_3 (75 kg K_2O ha^{-1}) gave significantly higher nitrogen content (4.42%) and potassium content (0.83%) in pod, which was found to be at par with treatment K_2 (50 kg K_2O ha^{-1}). Application of potassium @ 75 kg ha^{-1} recorded significantly the highest phosphorus content (0.37%) in pod than rest of the treatment.

Effect of Sulphur on nutrient content

A perusal of data furnished in Table 2 indicated that different levels of sulphur significantly affect the nutrient content of haulm and pod in groundnut. The treatment S_2 (40 kg S ha^{-1}) recorded significantly higher nitrogen content (1.98%) and potassium content (0.67%) in haulm which was at par with treatment S_1 (20 kg S ha^{-1}). Application of sulphur @ 40 kg ha^{-1} recorded significantly the highest phosphorus content (0.31%) and sulphur content (0.52%) in haulm than rest of the treatments. The lowest nutrient content was recorded under treatment S_0 (control).

Application of sulphur @ 40 kg ha^{-1} recorded significantly higher value of nitrogen content (4.42%), phosphorus content (0.36%) and potassium content (0.80%) which was at par with treatment S_1 (20 kg S ha^{-1}). Treatment S_2 (40 kg S ha^{-1}) recorded significantly the highest sulphur content (0.38%) than rest of the treatments.

Interaction effect of potassium and sulphur was found to be non-significant in nutrient content in case of both haulm and pod of groundnut.

Table 2: Effect of levels of potassium and sulphur on nutrient content (%) in haulm and pod by summer groundnut

Treatment	Haulm				Pod			
	N	P	K	S	N	P	K	S
Levels of potassium (kg ha^{-1})								
K_O	1.89	0.27	0.59	0.47	4.30	0.34	0.73	0.34
K_1	1.92	0.28	0.64	0.49	4.34	0.34	0.78	0.35
K_2	1.98	0.29	0.68	0.50	4.39	0.35	0.79	0.35
K_3	2.01	0.31	0.71	0.52	4.42	0.37	0.83	0.37
SEm ±	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01
CD at 5 %	0.06	0.02	0.03	0.02	0.05	0.01	0.04	NS
Level of sulphur (kg ha^{-1})								
S_0	1.91	0.27	0.64	0.47	4.32	0.34	0.76	0.31
S_1	1.96	0.29	0.66	0.49	4.37	0.35	0.79	0.35
S_2	1.98	0.31	0.67	0.52	4.40	0.36	0.80	0.38
SEm ±	0.02	0.01	0.01	0.01	0.02	0.00	0.01	0.01
CD at 5 %	0.05	0.01	0.02	0.02	0.05	0.01	0.03	0.02
Interaction								
(K×S)	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	3.69	6.87	4.85	4.77	1.47	4.71	5.45	7.82

Nutrient uptake

Effect of potassium on nutrient uptake

The data on effect of potassium and sulphur levels on nutrient uptake in groundnut (Table 3) revealed that the K and S levels significantly influenced the uptake of major nutrients in groundnut. The application of 75 kg K_2O ha^{-1} (K_3) gave significantly higher nitrogen uptake (88.68 kg ha^{-1}) by haulm, but it was remained at par with treatment receiving 50 kg K_2O ha^{-1} (K_2). The increase in uptake of nitrogen by haulm could be attributed to favorable effect of potassium on growth and yield attributes which resulted into higher yield of pod and haulm. Application of 75 kg K_2O ha^{-1} (K_3) recorded significantly the highest phosphorus uptake (13.55 kg ha^{-1}), potassium uptake (31.57 kg ha^{-1}) and sulphur uptake (22.92 kg ha^{-1}) by haulm over rest of the treatments. Further the lowest nutrient uptake was noted with treatment K_0 (control).

The treatment 75 kg K_2O ha^{-1} (K_3) recorded significantly higher nitrogen uptake (94.14 kg ha^{-1}), phosphorus uptake (19.09 kg ha^{-1}) and sulphur uptake (7.87 kg ha^{-1}) by pod than other treatments but it was remained at par with treatment K_2 (50 kg K_2O ha^{-1}). The application of 75 kg K_2O ha^{-1} (K_3) gave significantly the highest potassium uptake (17.63 kg ha^{-1}) by pod than rest of the treatment. The lowest nutrient uptake by pod was observed under no application of potassium (K_0).

Effect of sulphur on nutrient uptake

Data on uptake of nutrient by haulm and pod in groundnut at harvest as influenced by various levels of sulphur are presented in Table 3. Maximum uptake of nitrogen (86.25 kg ha^{-1}), phosphorus (13.31 kg ha^{-1}), potassium (29.46 kg ha^{-1}) and sulphur (22.69 kg ha^{-1}) by haulm in groundnut was obtained with application of 40 kg S ha^{-1} (S_2) which was significantly the highest over treatment S_1 (20 kg S ha^{-1}) and control. This could be attributed to enhanced vigour of crop growth with increased utilization and translocation in to plant resulting in the enhancement of yield.

Table 3: Effect of levels of potassium and sulphur on nutrient uptake (kg ha^{-1}) in haulm and pod by summer groundnut

Treatment	Haulm				Pod			
	N	P	K	S	N	P	K	S
Levels of potassium (kg ha^{-1})								
K_O	69.56	10.07	21.75	17.22	74.41	14.32	12.63	5.82
K_1	75.83	11.04	25.38	19.27	79.05	16.18	14.17	6.37
K_2	83.47	12.33	28.67	21.20	89.10	17.54	16.16	7.13
K_3	88.68	13.55	31.57	22.92	94.14	19.09	17.63	7.87
SEm ±	1.81	0.29	0.68	0.48	1.81	0.59	0.41	0.25
CD at 5 %	5.24	0.85	1.96	1.38	5.23	1.72	1.18	0.74
Level of sulphur (kg ha^{-1})								
S_0	70.69	10.05	23.65	17.28	75.37	14.39	13.26	5.46
S_1	81.20	11.88	27.41	20.49	85.48	17.08	15.43	6.95
S_2	86.25	13.31	29.46	22.69	91.68	18.87	16.75	7.98
SEm ±	1.57	0.25	0.59	0.41	1.57	0.51	0.35	0.22
CD at 5 %	4.54	0.73	1.70	1.20	4.53	1.48	1.02	0.64
Interaction								
(K×S)	NS	Sig.	Sig.	Sig.	Sig.	NS	NS	NS
CV (%)	7.92	8.63	8.77	8.24	7.45	12.26	9.37	12.99

The data presented in Table 3 indicated that varying levels of sulphur significantly influenced the nutrient uptake by pod in groundnut. Application of 40 kg S ha^{-1} (S_2) gave significantly the highest nitrogen uptake (91.68 kg ha^{-1}), phosphorus uptake (18.87 kg ha^{-1}), potassium uptake (16.75 kg ha^{-1}) and sulphur uptake (7.98 kg ha^{-1}) by pod over 20 kg S ha^{-1} (S_2) and control.

Soil Fertility

Effect of potassium and sulphur on soil fertility

The analysis of soil samples after harvest of groundnut crop did not reveal significant changes in EC (dS m^{-1}), pH, OC (%) and available P_2O_5 of soil either due to different levels of potassium or sulphur (Table 4).

Table 4: Effect of levels of potassium and sulphur on soil fertility after harvest of crop

Treatment	EC dS m^{-1} (1:2.5)	pH (1:2.5)	OC (%)	Available nutrient			
				Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium(kg ha^{-1})	Sulphur (ppm)
Levels of Potassium							
K_0 = 0 kg K_2O ha^{-1}	0.16	7.77	0.21	100	53.84	217	5.39
K_1 = 25 kg K_2O ha^{-1}	0.16	7.75	0.22	106	54.85	235	5.88
K_2 = 50 kg K_2O ha^{-1}	0.16	7.71	0.23	111	56.17	285	6.63
K_3 = 75 kg K_2O ha^{-1}	0.17	7.69	0.23	116	57.82	332	7.27
SEm ±	0.00	0.04	0.01	1.86	1.22	6.12	0.12
CD at 5 %	NS	NS	NS	5	NS	17	0.34
Levels of Sulphur							
S_0 = 0 kg S ha^{-1}	0.16	7.76	0.21	102	53.57	248	5.36
S_1 = 20 kg S ha^{-1}	0.16	7.74	0.22	109	56.14	267	6.52
S_2 = 40 kg S ha^{-1}	0.17	7.69	0.23	114	57.29	288	7.01
SEm ±	0.00	0.03	0.01	1.61	1.05	5.30	0.10
CD at 5 %	NS	NS	NS	4	NS	15	0.29
Interaction							
(K×S)	NS	NS	NS	NS	NS	NS	NS
CV (%)	8.12	1.55	11.22	5	7.56	7	6.40

Maximum available nitrogen content (116 kg ha^{-1}) in soil was found with treatment K_3 (75 kg K_2O ha^{-1}) but was remained at par with K_2 (111 kg ha^{-1}). Increased available nitrogen content can be ascribed to synergetic effect of potassium application resulted in increasing nitrogen availability in soil, as it is known that there is a favorable effect of potassium application on available nitrogen status of soil. Application of 75 kg K_2O ha^{-1} gave significantly the highest available potassium (332 kg ha^{-1}) and sulphur (7.27 ppm) than rest of the treatments.

Significantly the highest available nitrogen (114 kg ha^{-1}), potassium (288 kg ha^{-1}) and sulphur (7.01 ppm) status of soil after harvest was recorded under the treatment S_2 (40 kg S ha^{-1}) as compared to other treatment.

Conclusion

It was concluded from foregoing results that application of potassium @ 75 kg K_2O ha^{-1} and sulphur @ 40 kg S ha^{-1} in addition to recommended dose of fertilizer (25: 50 kg NP ha^{-1} through urea and DAP) to summer groundnut was found better for obtaining higher yield, nutrient content and uptake along with sustain soil fertility.

Reference

1. Black CA. Methods of Soil Analysis. Part I and II. American Society Agronomy Inc. Pub., Madison USA, 1965.
2. Cakmak. Effect of N, P and K levels on yield, nutrient content, uptake and quality of summer groundnut grown on Typic Haplustepts! Journal of the Indian Society of Soil Science. 2005; 53(1):125-128.
3. Jackson ML. Soil Chemical Analysis. Constable and Co. Ltd. London, 1962.
4. Page AL, Miller RH, Keeney DR. Methods of Soil analysis Part 2. 2nd Edition. American Society Agronomy, Madison. Wisconsin, USA, 1982.
5. Tasso NM, Chaudhary VN. Schoenite and potassium sulphate: Indigenous potassic fertilizer for rainfed groundnut! Indian Journal of Traditional Knowledge. 2004; 13(1):222-226.
6. Tewatia RK, Choudhary RS, Kalwe SP. TSI-FAI-IFA sulphur project–salient findings. (In) Proceedings of TSIFAI-IFA Symposium-cum–workshop on Sulphur in Balanced Fertilization, held at New Delhi, 2006, 15-25.