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Effect of potassium and sulphur on nutrient content, uptake, quality and yield of summer groundnut (*Arachis hypogaea* L.)

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Abstract
Effect of potassium and sulphur on nutrient content, uptake, quality and yield of summer groundnut (*Arachis hypogaea* L.) was studied at the PG Research Farm, Agronomy Section, RCSM College of Agriculture, Kolhapur during summer, 2018. The experiment was laid out in factorial randomized block design (FRBD) with three replications and twelve treatment combinations of four potassium levels (K_0- 00 kg K_2O ha^{-1}, K_1- 15 kg K_2O ha^{-1}, K_2- 30 kg K_2O ha^{-1}, K_3- 45 kg K_2O ha^{-1}) and three sulphur levels (S_1- 10 kg S ha^{-1}, S_2- 20 kg S ha^{-1}, S_3- 40 kg S ha^{-1}). Mean N, P, K and S content in kernel and haulm was not influenced significantly by different potassium levels as well as sulphur levels. The mean N, P, K and S uptake, oil yield and protein yield of groundnut were maximum with application of 45 kg K_2O ha^{-1} which was at par with 30 kg K_2O ha^{-1}, but significantly superior over rest of treatments and also it was maximum in application of sulphure @ 40 kg/ha, while in case of sulphure application they are maximum in application of 40 kg sulphure /ha. over rest of treatment. The dry pod yield (32.49 q ha^{-1}) and dry haulm yield (44.86 q ha^{-1}) were recorded maximum with application of 45 kg K_2O ha^{-1} which was at par with 30 kg K_2O ha^{-1}, but significantly superior over rest of treatments. The dry pod yield (32.92 q ha^{-1}), dry haulm yield (45.27 q ha^{-1}) were recorded more with application of 40 kg S ha^{-1} which was at par with 20 kg S ha^{-1}, but significantly superior over 10 kg S ha^{-1}.

Keywords: Groundnut, potassium, sulphur, nutrient content, uptake, quality and yield

Introduction
Groundnut (*Arachis hypogaea* L.) is one of the most important oilseed crop in India. It belongs to family Leguminoseae. Groundnut appeared to have originated in South America i.e., North-West of Brazil and the secondary centre of its cultivation is in Africa and then spread to other parts of the world. The crop has its own importance due to high edible oil and nutritional value of kernel as human food and haulm as rich fodder for cattle. It is a valuable cash crop planted by millions of small farmers because of its economic and nutritional value. Its kernels are rich source of edible oil (48-52%) and protein (25-28%). The groundnut kernel contains about 50 per cent edible oil. The remaining 50 per cent of the seed has higher quality protein (21.4-26.45%), carbohydrates (6- 24.9%) and minerals and vitamins (Das, 1997) [2]. The groundnut oil is generally used in the preparation of vanspati tup, soap, cosmetics and cold creams besides as cooking medium. This contains 20 per cent saturated and 80 per cent unsaturated fatty acid. Poly saturated fatty acid has two types i.e. oleic (40-50%) and linoleic (24-35%) (Mathur and Khan, 1997) [5].

The potassium is also one of the major plant nutrients, which is important for growth and development of plants. Potassium application is not regularly practiced, it plays equally important role as nitrogen and phosphorus in plants metabolic activities. It helps the plants in using the water economically.

Sulphur is a now recognized, as the fourth major plant nutrient, along with Nitrogen, Phosphorous and Potassium, therefore sulphur is now very much a part of balanced fertilization and nutrition for oilseed crops in general and for groundnut crop in particular. It is one of the important pre-requisites for enhance productivity and quality of groundnut. Sulphur as plant nutrients is becoming increasingly important in dry land agriculture as it is master nutrient of all oilseed crops. Among the field crops, oilseeds and pulses are more responsive to sulphur.

Materials and Methods

The field experiment was conducted at Post Graduate Research Farm, R.C.S.M. College of Agriculture, Kolhapur during summer, 2018. The topography of experimental field was fairly uniform and leveled. The soil was vertisol (medium black) in nature and about one meter deep with good drainage. The soil of experimental field has pH 7.7, EC 0.31 d Sm^{-1}, low in organic carbon 0.18%, available N, P_2O_5, K_2O 238.84, 23.65 and 249.10 kg ha^{-1}, respectively. The treatments comprising of twelve treatment combinations of four potassium levels (K_0- 00 kg K_2O ha^{-1}, K_1- 15 kg K_2O ha^{-1}, K_2- 30 kg K_2O ha^{-1}, K_3- 45 kg K_2O ha^{-1}) and three sulphur levels (S_1- 10 kg S ha^{-1}, S_2- 20 kg S ha^{-1}, S_3- 40 kg S ha^{-1}) and these treatments were replicated three times in factorial randomized block design (FRBD). The gross and net plot size were 5.4 m x 4.8 m and 4.8 m x 3.6 m, respectively. All growth observations are recorded as per the standard procedure.

Groundnut variety 'Phule Chaitanya (KDG-160)' was grown in the experimental field with recommended package of practices. Fertilizers were applied uniformly at the rate of 25 kg N and 50 kg P_2O_5 ha^{-1} and K_2O-as per treatments.

Result and Discussion

I) Effect on nutrient content

Effect of Potassium Levels: The nutrient content of summer groundnut at harvest as influenced by different treatment were presented in Table No 1. The nutrient content viz., N, P, K and S content in kernel and haulm was not influenced significantly by different potassium levels.

Effect of Sulphur Levels: The mean N, P, K and S content in kernel and haulm was not influenced significantly by different sulphur levels.

II) Effect on nutrient uptake

Effect of Potassium Levels: The mean N, P, K and S uptake of groundnut were maximum with application of 45 kg K_2O ha^{-1} which was at par with 30 kg K_2O ha^{-1}, but significantly superior over rest of treatments.

Effect of Sulphur Levels: The mean N, P, K and S uptake of groundnut were maximum with application of 40 kg S ha^{-1} recorded which was significantly superior over rest of the treatments, however comparable with 20 kg S ha^{-1}.

III) Effect on oil yield and protein yield

Effect of Potassium Levels: The oil content in kernel, oil yield, protein content in kernel and protein yield as influenced by different treatment were presented in Table No 3. The significantly highest values of oil yield, protein content in kernel and protein yield at harvest were recorded highest with application of 45 kg K_2O ha^{-1}, which was significantly superior over rest of the treatments, however comparable with 30 kg K_2O ha^{-1}. The scientist Sahid *et al.*, (1999) [7] and Patra *et al.*, (1995) [6] reported similar results.

Effect of Sulphur Levels: The significantly highest values of oil content in kernel, oil yield, protein content in kernel and protein yield at harvest were recorded highest with application of 40 kg S ha^{-1} recorded which was significantly superior over rest of the treatments, however comparable with 20 kg S ha^{-1}. Moreover, the positive influence of these treatments through immediate supply of suphur at the early stage of the crop, which might have improved adequate biomass production and improvement in yield parameters resulting in higher pod yield. Sulphur application increased the oil yield in groundnut was also reported by Shivraj and Gowda, (1993) [9] and Mjumdar (2002) [4].

IV) Effect on dry pod, dry haulm yields and harvest index

Effect of Potassium Levels: The dry pod, dry haulm yields and harvest index as influenced by different treatment were presented in Table No 4. The significantly highest values of dry pod, dry haulm yields and harvest index at harvest were recorded with application of 45 kg K_2O ha^{-1}, which was significantly superior over rest of the treatments, however comparable with 30 kg K_2O ha^{-1}.

Higher pod and haulm yield could be attributed to favorable changes in physical and chemical characteristics of the soil which might have enabled better pod formation. Moreover, 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. The result reported by Gashti *et al.*, (2012) [3], Veeramani and Subrahmaniyan (2015) [10] and Singh (2007) [8] were at par with this result.

Effect of Sulphur Levels: The significantly highest values of dry pod, dry haulm yields and harvest index at harvest were recorded highest with application of 40 kg S ha^{-1} recorded which was significantly superior over rest of the treatments, however comparable with 20 kg S ha^{-1}. Similar result were also reported by Banu *et al.*, (2017) [1] at Anand Agricultural University, Anand,

Table 1: Effect of potassium and sulphur levels on nutrient content of summer groundnut at harvest

Treatments	Nitrogen (%)		Phosphorous (%)		Potassium (%)		Sulphur (%)	
	Kernel	Haulm	Kernel	Haulm	Kernel	Haulm	Kernel	Haulm
Potassium levels:								
K_0- 00 (kg K_2O ha^{-1})	3.07	1.27	0.31	0.23	0.76	0.59	0.26	0.19
K_1- 15 (kg K_2O ha^{-1})	3.25	1.35	0.33	0.24	0.78	0.60	0.27	0.19
K_2- 30 (kg K_2O ha^{-1})	3.43	1.47	0.34	0.24	0.81	0.63	0.28	0.24
K_3- 45 (kg K_2O ha^{-1})	3.59	1.54	0.36	0.25	0.83	0.68	0.29	0.26
S. Em±	0.04	0.02	0.003	0.002	0.004	0.008	0.002	0.003
C. D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
Sulphur levels:								
S_1 - 10 (kg S ha^{-1})	3.16	1.32	0.32	0.23	0.78	0.58	0.25	0.20
S_2 - 20 (kg S ha^{-1})	3.36	1.43	0.33	0.24	0.79	0.63	0.27	0.22
S_3 - 40 (kg S ha^{-1})	3.51	1.47	0.35	0.25	0.81	0.66	0.29	0.24
S. Em±	0.04	0.01	0.004	0.003	0.004	0.005	0.004	0.003
C. D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
Interactions (K × S):								

S. E m±	0.08	0.02	0.008	0.006	0.008	0.010	0.008	0.006
C. D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
General mean	3.33	1.40	0.33	0.24	0.79	0.62	0.27	0.21

Table 2: Effect of potassium and sulphur levels on nutrient uptake of summer groundnut at harvest

Treatments	Nutrient uptake (kg ha^{-1})			
	Nitrogen	Phosphorous	Potassium	Sulphur
Potassium levels:				
K_0- 00 (kg K_2O ha^{-1})	157.56	18.63	46.39	15.55
K_1- 15 (kg K_2O ha^{-1})	177.81	21.05	50.70	17.03
K_2- 30 (kg K_2O ha^{-1})	197.52	23.04	55.21	19.66
K_3- 45 (kg K_2O ha^{-1})	208.51	24.27	58.87	21.13
S. Em±	3.75	0.42	1.24	0.53
C. D. at 5%	11.23	1.26	3.71	1.56
Sulphur levels:				
S_1 - 10 (kg S ha^{-1})	156.50	18.35	45.20	14.87
S_2 - 20 (kg S ha^{-1})	186.65	22.08	52.80	18.18
S_3 - 40 (kg S ha^{-1})	205.93	24.07	57.61	20.24
S. Em±	6.46	0.69	1.63	0.71
C. D. at 5%	19.36	2.05	4.86	2.14
Interactions (K × S):				
S. E m±	12.92	1.38	3.26	1.42
C. D. at 5%	NS	NS	NS	NS
General mean	184.35	21.64	52.40	18.09

Table 3: Effect of potassium and sulphur levels on oil content in kernel, oil yield, protein content in kernel and protein yield of summer groundnut at harvest

Treatments	Oil content in kernel (%)	Oil yield(kg ha^{-1})	Protein content in kernel (%)	Protein yield (kg ha^{-1})
Potassium levels:				
K_0- 00 (kg K_2O ha^{-1})	47.62	1277.16	18.42	516.91
K_1- 15 (kg K_2O ha^{-1})	48.00	1397.28	19.98	591.61
K_2- 30 (kg K_2O ha^{-1})	49.05	1504.36	21.67	671.41
K_3- 45 (kg K_2O ha^{-1})	49.96	1623.20	22.92	720.77
S. Em±	0.21	54.28	0.45	23.99
C. D. at 5%	NS	159.22	1.32	70.38
Sulphur levels:				
S_1 - 10 (kg S ha^{-1})	47.83	1245.49	19.97	579.92
S_2 - 20 (kg S ha^{-1})	48.36	1468.21	20.88	639.77
S_3 - 40 (kg S ha^{-1})	49.46	1628.22	21.40	717.83
S. Em±	0.42	59.65	0.39	27.59
C. D. at 5%	1.25	177.89	1.14	81.95
Interactions (K × S):				
S. E m±	0.85	119.30	0.78	55.18
C. D. at 5%	NS	NS	NS	NS
General mean	48.19	1447.30	20.75	625.17

Table 4: Effect of potassium and sulphur levels on dry pod, dry haulm yields and harvest index of summer groundnut at harvest

Treatments	Dry pod yield (q ha^{-1})	Dry haulm yield (q ha^{-1})	Harvest index (%)
Potassium levels:			
K_0- 00 (kg K_2O ha^{-1})	26.82	40.23	40.15
K_1- 15 (kg K_2O ha^{-1})	29.11	42.62	40.58
K_2- 30 (kg K_2O ha^{-1})	30.67	43.93	41.70
K_3- 45 (kg K_2O ha^{-1})	32.49	44.86	42.15
S. Em±	1.09	0.74	0.15
C. D. at 5%	3.01	2.20	0.46
Sulphur levels:			
S_1 - 10 (kg S ha^{-1})	26.04	38.65	40.25
S_2 - 20 (kg S ha^{-1})	30.36	42.63	41.65
S_3 - 40 (kg S ha^{-1})	32.92	45.27	42.10
S. Em±	0.89	0.96	0.17
C. D. at 5%	2.61	2.87	0.49
Interactions (K × S):			
S. E m±	1.78	1.92	0.34
C. D. at 5%	NS	NS	NS
General mean	29.77	42.59	41.22

Conclusions

Based on the present investigation of one year data the following conclusions could be drawn:

1. Application of 30 kg K_2O ha^{-1} found beneficial in increasing nutrient content, uptake, quality and yield of summer groundnut.
2. Among the sulphur levels application of 20 kg S ha^{-1} recorded the higher nutrient content, uptake, quality and yield of summer groundnut.

By and large, recommended that an application of 30 kg K_2O ha^{-1}, 20 kg S ha^{-1} resulted in higher nutrient content, uptake, quality and yield of groundnut.

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