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Effect of potassium & sulphur on total uptake and availability of nutrient under summer groundnut

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Abstract
An present field experimental trial was conducted to assess the Effect of potassium and sulphur on total uptake and availability of nutrient under summer groundnut during summer season of 2018 at the RCSM College of Agriculture, Kolhapur (M.S.), India. The field trial was laid out in FRBD with three replications and twelve treatment combinations. The soil of experimental field was sandy loam in texture, low in available nitrogen (238.84 kg ha^{-1}), moderately high in available phosphorus (23.65 kg ha^{-1}) and moderately high in available potassium (249.10 kg ha^{-1}). The soil was slightly alkaline in reaction (pH 7.7). The mean N, P, K, S uptake of groundnut and available soil N, P, K, S were recorded maximum with application of 45 kg K_2O ha^{-1} followed by 30 kg K_2O ha^{-1} in case of potassium and 40 kg S ha^{-1} which is comparable with 20 kg S ha^{-1} in case of sulphur.

Keywords: *Groundnut, potassium, sulphur, uptake, nutrient*

1. 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) [1]. 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) [3].
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.

2. Material 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 dsm^{-1}, organic carbon 0.18%, available N, P2O5, K2O 238.84, 23.65 and 249.10 kg ha^{-1}, respectively. The treatments comprising of twelve treatment combinations of three 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 K2O 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).

Application of organic manure through farmyard manure was done well before 15 days of dibbling. The Phule Chaitanya (KDG-160) variety was used for sowing. The groundnut crop was fertilized with 25 kg N and 50 kg P_2O_5 ha^{-1}. The application of N through urea, P_2O_5 through Diammonium phosphate, K_2O through Muriate of Potash and S through Gypsum was done as per the treatments. The quantity of Sulphur and Potassium were applied as per treatment to each plot at the time of sowing. The plant samples were analyzed to estimate the NPKS content in the plant for estimation of total uptake. The soil samples were analyzed to estimate the NPKS content in soil. The available N by Alkaline KMnO4 method (Subbiah and Asija, 1956) [11], P determination by Olsen method (Olsen, 1954) [6] and K content by flame photometer method (Jackson, 1973) [2] in kg ha^{-1} by adopting the standard procedures. The data obtained from various characters under study were analyzed by the method of analysis of variance as described by Panse, V.G. and Sukhamate, P.V. 1967 [7]. 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.

3. Result and Discussion

Effect on nutrient uptake

The data of nutrient uptake were presented in Table 1.

Effect of Potassium Levels

The mean N (208.51 kg ha^{-1}), P (24.27 kg ha^{-1}), K (58.87 kg ha^{-1}) and S (21.13 kg ha^{-1}) 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, however lowest nutrient uptake under potassium level found with 0 kg potassium level (K_0). Increased potassium level resulted in higher uptake of nutrient. Similar results were reported by Musa *et al.,* (2017) [5], Singh *et al.,* (1997) [10] and Mishra *et al.,* (1990) [4] in case of N, P, K, S.

Effect of Sulphur Levels

The mean N (205.93 kg ha^{-1}), P (24.07 kg ha^{-1}), K (57.61 kg ha^{-1}) and S (20.24 kg ha^{-1}) 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}, however lowest nutrient uptake under sulphur level found with 10 kg potassium level (S_1). Increased sulphur level resulted in higher uptake of nutrient. Similar results were reported by Singh and Chaudhari (1996) [9] and Mishra *et al.,* (1990) [4].

Effect of Interaction

The interaction effect of potassium and sulphur levels for total nutrient uptake failed to reach the level of significance.

Effect on available soil nutrient

The data of available soil nutrient were presented in Table 2.

Effect of Potassium Levels

The mean N (250.55 kg ha^{-1}), P (22.25 kg ha^{-1}), K (254.47 kg ha^{-1}) and S (10.98 kg ha^{-1}) available soil nutrient 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, however lowest available soil nutrient under potassium level found with 0 kg potassium level (K_0). Increased potassium level resulted in higher available of nutrient.

Effect of Sulphur Levels:

The mean N (248.53 kg ha^{-1}), P (21.77 kg ha^{-1}), K (251.35 kg ha^{-1}) and S (10.16 kg ha^{-1}) available soil nutrient 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}, however lowest available soil nutrient under sulphur level found with 10 kg potassium level (S_1). Increased sulphur level resulted in higher available of nutrient. Similar results were reported by Reddy *et al.,* (1992) [8] and Singh and Chaudhari (1996) [9].

Effect of Interaction

The interaction effect of potassium and sulphur levels for available soil nutrient failed to reach the level of significance.

Table 1: Mean uptake of nutrients (N, P_2O_5, K_2O and S) by groundnut as influenced by different treatments

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 2: Mean available nitrogen, phosphorus, potassium and sulphur in soil of groundnut after harvest as influenced by different treatments

Treatments	Available nitrogen (kg ha^{-1})	Available phosphorous (kg ha^{-1})	Available potassium (kg ha^{-1})	Available sulphur (kg ha^{-1})
Potassium levels				
K_0- 00 (kg K_2O ha^{-1})	245.31	20.75	236.69	5.52
K_1- 15 (kg K_2O ha^{-1})	246.69	20.95	241.51	7.65
K_2- 30 (kg K_2O ha^{-1})	249.29	21.63	248.70	8.64
K_3- 45 (kg K_2O ha^{-1})	250.55	22.25	254.47	10.98
S. Em±	0.48	0.57	5.30	0.80
C. D. at 5%	1.43	1.70	15.31	2.37
Sulphur levels				
S_1 - 10 (kg S ha^{-1})	246.50	21.04	239.10	5.73
S_2 - 20 (kg S ha^{-1})	247.86	21.38	246.61	7.26
S_3 - 40 (kg S ha^{-1})	248.53	21.77	251.35	10.16
S. Em±	0.32	0.38	4.05	1.04
C. D. at 5%	1.22	1.48	13.95	3.10
Interactions (K × S)				
S. E m±	0.76	0.76	8.10	2.08
C. D. at 5%	NS	NS	NS	NS
General mean	247.86	21.39	245.19	7.99
Initial status of soil	238.84	23.65	249.10	7.05

4. Conclusions

Among the different potassium and sulphur levels, nutrient uptake and available soil nutrient maximum with 30 kg K_2O ha^{-1} and 20 kg S ha^{-1}.

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