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Potassium fertilization to *kharif* groundnut in medium black calcareous soils of Saurashtra region of Gujarat

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Abstract
A field experiment was conducted during four *kharif* season (2010 to 2013) at main oilseeds Research Station, Junagadh Agricultural University, Junagadh, to study the effect of potassium fertilization on yield, quality and nutrients uptake by groundnut. The experiment was laid out in randomized block design with seven treatments comprising of three levels of potassium *viz;* 25, 50 and 75 kg ha^{-1} each as basal and in two split (1/2 at sowing and 1/2 at 30 days after sowing) along with control (No potassium). The results revealed that the average pod as well as haulm yield of groundnut was significantly influenced by different potassium treatments. The average higher pod (1485 kg ha^{-1}) and haulm (3747 kg ha^{-1}) yield were recorded with application of 50 kg K_2O ha^{-1} in two split. Increase in groundnut pod yield to the tune of 34 percent over control. The shelling percentage and oil content in kernel was significantly affected by different potassium treatments. The maximum shelling percentage and oil content was recorded with potassium application of 50 kg K_2O ha^{-1} as basal and in two split, respectively. Significantly higher N, P, K and S uptake by pod and haulm were recorded with treatment application of 75 kg K_2O ha^{-1} as basal and in two split, respectively.

Keywords: Potassium levels, yields, nutrients uptake, *Kharif* groundnut

Introduction

The groundnut (*Arachis hypogaea* L.) is one of the important food legume crop of tropical and subtropical parts of the world. China and India are the largest producers of groundnut sharing 42 and 20 per cent of the world groundnut production, respectively. India is one of the largest producers of oilseeds in the world and oilseeds occupy an important position in the Indian agricultural economy. However, because of its high energy, protein and mineral contents at a comparatively low price, the demand of groundnut, as food crop, is increasing worldwide. In India, groundnut is being grown to an area of 4.56 million ha, production of 6.77 million tones, with an average productivity of 1486 kg ha^{-1}(Anonymous, 2016) [1]. The South West monsoon decides the fate of groundnut in India, because around 75% of groundnut crop grown under rain fed conditions during *Kharif* season (June - September). The groundnut crop is mainly grown in the states of Gujarat, Tamil Nadu, Andhra Pradesh, Karnataka and Maharashtra, which accounts for 89% of area and production in India. In Gujarat is leading in area (1.76 million ha.) and its production and productivity is 2.94 million tones and 1673 kg ha^{-1}, respectively.

Potassium is involved in large number of physiological processes like osmoregulation, cation-anion balance, protein synthesis and activation of enzymes. Being a major inorganic solute, it plays a key role in the water balance of plants. It also reduces lodging, imparts disease resistance and improves the quality and shelf life of crop produce. Considering its role in crop production, potassium is regarded as major element. In Gujarat, Saurashtra region is the pocket of groundnut. In general, many other factors specific to different area, balance fertilization necessary for raising the groundnut yield and maintaining the quality of crop and productivity of soil. The soil with free lime content on exchange complex predominantly occupied with calcium may need high dose of potassium for better crop response. Potassium is also required in large amount by oil seed crop (Singh, 2004) [12]. Very few experiments were conducted to study the potassium requirement of groundnut in calcareous soil. Keeping this in view, the experiment was taken to study the effect of potassium to *kharif* groundnut.

Materials and methods

A field experiments were conducted in four consecutive *kharif* seasons of 2010, 2011, 2012 and 2013at main Oilseeds Research Station, Junagadh Agricultural University, Junagadh. The experiment was laid out in randomized block design with four replications. The characteristics of the experimental soils was *Vartic Haplustepts*, clayey and calcareous in nature had organic carbon 4.8 g kg^{-1}, available nitrogen 187 kg ha^{-1}, available phosphorus 36 kg ha^{-1}, available potassium 186 kg ha^{-1} and sulphur 16 mg kg^{-1} with pH 7.8. The experiment comprising seven treatments were three levels of potassium 25, 50 and 75 kg ha^{-1} as basal and in two split (1/2 at sowing and 1/2 at 30 days after sowing) along with control (No potassium). Groundnut kernels (var. GG 20) at the rate of 120 kg ha^{-1} were sown in row with spacing of 60 cm x 10 cm and all the recommended package of practices were followed. The recommended dose of fertilizers (12.5:25; N : P_2O_5) were applied commonly in all the plots. The crop was harvested as its full maturity stage and pod and haulm samples were collected from each plot, oven dry at 60 ºC to constant weight and ground to pass through a 0.5 mm sieve for chemical analysis. The nitrogen from plant samples were estimated separately by micro Kjeldahl's method as described by A.O.A.C (1965) [2]. The phosphorus determined by Vanadomolybdo phosphoric yellow colour method (Jackson 1974) [6], potassium by Flame Photometer (Jackson 1974) [6] and sulphur as described by Williams and Steinbergs (1959), after wet digestion of plant tissues with HNO_3 : $HClO_4$ (3:1) di-acid (Johnson and Ulrich, 1969).

Results and discussion

Yield and quality parameter

The data presented in Table-1 indicated that the pod and haulm yield of *kharif* groundnut was significantly influenced by different potassium treatments in pooled results. The average higher pod (1485 kg ha^{-1}) and haulm (3747 kg ha^{-1}) yield were recorded with application of 50 kg K_2O ha^{-1} two split, followed by treatment 50 K_2O ha^{-1} an basal. The application of potassium 50 kg ha^{-1} (in two split) increase the groundnut pod yield by 34 percent over control. The significant increase in yield could be attributed to better growth and development attained by the crop due to application of potassium, known to be potassium involved in photosynthesis, protein metabolism and energy transfer reactions. Increased in yield may also be due to potassium have important role in carbohydrate metabolism, synthesis of proteins and activation of oxidation process and enzymes. Similar results were also observed by Singh (2007) [13], Hadwani and Gundalia (2005) [5], Borah *et al.* (2017) and Meena *et al.* (2018) [7] in groundnut. As far as quality parameters concern, the application of potassium significantly influenced the quality parameters of groundnut (Table-3).The significantly higher shelling percentage (71.25) and oil content (50.58 %) were recorded with application of 50 kg K_2O ha^{-1} as basal, follow by treatment 50 kg K_2O ha^{-1} in two split. The lower (65.75) and higher (69.40) HPS count was recorded with application of 75 kg K_2O ha^{-1} and in control (no potassium) treatment, respectively. It could be due to potassium play important role in carbohydrate metabolism, synthesis of proteins and oil. Similar results were also reported by Borah *et al.* (2017) and Sanadi, *et al.* (2018) [10].

Nutrients content and uptake

The data presented in Table-4 revealed that N, P, K and S content and uptake by pod and haulm of groundnut was significantly influenced by different potassium treatments, except N content in pod and haulm. Significantly higher P, K and S content in pod (0.263, 0.645 and 0.157 %) and in haulm (0.121, 0.986 and 0.250 %) were recorded with application of 75 kg K_2O ha^{-1} as basal. While, the significantly higher uptake of N and S (48.24 and 2.44 kg ha^{-1}) by pod were recorded with application of 50 kg K_2O ha^{-1} in two split, respectively and higher P and K uptake (9.22 and 3.69 kg ha^{-1}) by pod was found with application of 75 kg K_2O ha^{-1} as basal (Table-5). Significantly higher uptake of N, P, K and S (61.0, 3.84, 32.45 and 7.95 kg ha^{-1}) by haulm were recorded with application of 50 kg K_2O ha^{-1} in two split. This means that the potassium fertilizer may enhance plant utilization of nutrients and water which was reflected in a good growth and biological yield. These results are akin to those reported by Shahid Umar *et al.* (2002) [11], Sakarvadia *et al.* (2010) [8] and Salve *et al.* (2010) [9] in groundnut crop.

Conclusion

Based on the four years study it can be concluded that the application of 50 kg K_2O ha^{-1} either basal or in two split @ 50 kg ha^{-1} beneficial for enhancement of pod and haulm yield as well as quality of *kharif* groundnut.

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Table 1: Effect of potassium on pod yield of *kharif* groundnut

Treatments	Pod yield of groundnut (kg ha^{-1})				
	2010	2011	2012	2013	Pooled
T_1 - Control	785	924	1617	1097	1106
T_2 - K_{25} Basal	971	1169	1932	1185	1314
T_3 - K_{50} Basal	1028	1276	1966	1420	1422
T_4 - K_{75} Basal	997	1196	2047	1354	1399
T_5 - K_{25} (Two split)	990	1245	1966	1333	1384
T_6 - K_{50} (Two split)	1141	1267	2107	1423	1485
T_7 - K_{75} (Two split)	1008	1219	1995	1461	1421
S.Em.±	48	58	92	76	35
C.D.(P=0.05)	144	172	275	227	100

Table 2: Effect of potassium on haulm yield of *kharif* groundnut

Treatments	Haulm yield of groundnut (kg ha^{-1})				
	2010	2011	2012	2013	Pooled
T_1 - Control	2344	2292	3802	4167	3151
T_2 - K_{25} Basal	2552	2813	4219	4689	3568
T_3 - K_{50} Basal	2722	2839	4271	4766	3649
T_4 - K_{75} Basal	2578	2813	4037	4922	3587
T_5 - K_{25} (Two split)	2849	2656	4167	4479	3538
T_6 - K_{50} (Two split)	2880	2786	4505	4818	3747
T_7 - K_{75} (Two split)	2735	2813	4115	4740	3600
S.Em.±	113	154	268	279	108
C.D.(P=0.05)	33	NS	NS	NS	304

Table 3: Effect of potassium on quality parameters of kharif groundnut

Treatments	Quality parameters		
	Shelling (%)	Oil content (%)	HPS Count
T_1 - Control	69.3	48.20	69.40
T_2 - K_{25} Basal	69.9	50.19	66.47
T_3 - K_{50} Basal	71.2	50.58	66.30
T_4 - K_{75} Basal	70.3	50.20	66.82
T_5 - K_{25} (Two split)	70.3	50.09	66.57
T_6 - K_{50} (Two split)	71.0	50.38	64.91
T_7 - K_{75} (Two split)	70.9	50.34	65.75
S.Em.±	0.44	0.27	0.59
C.D.(P=0.05)	1.24	0.79	1.69

Table 4: Effect of potassium on nutrients content in pod and haulm of groundnut

Treatments	Nutrients content in groundnut (%)							
	Pod				Haulm			
	N	P	K	S	N	P	K	S
T_1 - Control	3.18	0.168	0.432	0.135	1.80	0.101	0.856	0.214
T_2 - K_{25} Basal	3.15	0.232	0.577	0.143	1.82	0.115	0.921	0.228
T_3 - K_{50} Basal	3.20	0.242	0.602	0.150	1.84	0.117	0.945	0.239
T_4 - K_{75} Basal	3.29	0.263	0.45	0.157	1.83	0.121	0.986	0.250
T_5 - K_{25} (Two split)	3.20	0.239	0.560	0.152	1.80	0.106	0.910	0.222
T_6 - K_{50} (Two split)	3.25	0.237	0.594	0.157	1.75	0.115	0.957	0.226
T_7 - K_{75} (Two split)	3.35	0.177	0.640	0.146	1.80	0.111	0.986	0.237
S.Em.±	0.071	0.019	0.031	0.005	0.06	0.004	0.013	0.006
C.D.(P=0.05)	NS	0.058	0.082	0.014	NS	0.012	0.034	0.017

Table 5: Effect of potassium on nutrients uptake by groundnut

Treatments	Nutrients uptake by groundnut (kg ha^{-1})							
	Pod				Haulm			
	N	P	K	S	N	P	K	S
T_1 - Control	35.06	1.69	4.63	1.47	50.60	2.88	24.59	6.08
T_2 - K_{25} Basal	42.28	3.03	7.90	1.92	58.25	3.60	29.44	7.29
T_3 - K_{50} Basal	44.88	3.39	8.62	2.15	60.79	3.78	30.66	7.82
T_4 - K_{75} Basal	46.00	3.69	9.22	2.39	57.61	3.75	30.80	7.90
T_5 - K_{25} (Two split)	44.83	3.25	7.89	2.11	59.09	3.35	29.49	7.18
T_6 - K_{50} (Two split)	48.24	3.53	9.02	2.44	61.00	3.84	32.45	7.95
T_7 - K_{75} (Two split)	46.70	2.28	8.61	2.02	59.29	3.50	31.23	7.61
S.Em.±	1.655	0.31	0.60	0.11	2.50	0.19	1.08	0.26
C.D.(P=0.05)	4.696	0.95	1.86	0.31	7.20	0.61	3.06	0.76

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