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Effect on the primary nutrient uptake and soil chemical properties of groundnut (*Arachis hypogaea* L.) influenced by different levels of potassium in entisols

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Abstract
A experiment was conducted at Post Graduate Research Farm, College of Agriculture, Kolhapur during *kharif* season of 2017 to study the effect of levels and time of potassium application on different chemical properties and nutrient status of soil after harvest of *kharif* groundnut (*Arachis hypogaea* L.) in Entisol. The experiment was laid out in Factorial Randomized Block Design with two replications comprising of four levels (0, 20, 30,40 kg K_2O ha^{-1}) and five time of application (Sowing, flowering, pegging) of potassium. The results revealed that successive increase in levels of potassium showed significant effect on uptake of primary nutrients i.e. N, P, K recorded with 40 kg K_2O/ha and chemical properties and their intractions (L X T) were non significant on soil chemical properties i.e pH, EC, Organic carbon and per cent calcium carbonate equivalent and available N, P, K, S and exchangeable Ca, Mg of soil after harvest of groundnut.

Keywords: potassium, levels, nutrients uptake

Introduction
Groundnut is a heavy feeder of potassium and an adequate supply of this nutrient is indispensable to harvest a good crop of groundnut. As regards the nutritional value of groundnut Its seed contains about 40-50 per cent oil, 20-30 per cent protein and 10-20 per cent carbohydrates (Okello *et al.* 2010) [5].

Potassium is one of the 3 main pillers of balanced fertilizer use, along with nitrogen (N) and phosphorus (P). The major functions are enzymes involved in photosynthesis, stomatal activity (water use), transport of sugars, water and nutrient synthesis of protein, translocation of carbohydrate. Also improve the crop quality, kernel size of groundnut, test weight and shelling percentage (Bhosle *et al*. 2011; Rathore *et al*. 2014) [2, 6]. Out of large percentage of area in India, very little or no potassium (K) fertilizers are being applied and therefore it mainly comes from potassium reserves of the soil. Potassium fertilizers are one commodity for which country depends solely on import. Application of required quantity of nutrients at right time by adopting proper method enhances the groundnut pod yield and quality. Since the growth of groundnut is intensive from 30 DAS to 70 DAS, appropriate time of fertilizer application in required quantity is extremely critical to match the nutrient supply with demand prevailing the critical stages of groundnut. Most research data showed that basal and split application of potassium is equally good, but some recent studies conducted on oilseed crop showed beneficial effects of splits doses of potassium over basal doses, due to fixation and leaching loses in intensively cropped area. Therefore, Keeping this in view of the effect of varying levels and time of potassium application on Chemical Properties and Nutrient status of soil of groundnut were studied in present investigation.

Material and Methods
The field experiment was conducted during the *kharif* season of 2017-18 at Post Graduate Research Farm, College of Agriculture, Kolhapur ($16^0$42' N latitude, $74^0$14' E longitude and 548 m AMSL) in sandy clay loam soil (52.92 % sand, 15.26 % silt and 31.82 % clay) containing available N (158.36 kg ha^{-1}), moderately high P (22.17 kg ha^{-1}) and K (246.40 kg ha^{-1}). The status of organic carbon content (0.44 %) was moderate and moderately calcareous with 4.5 per cent $CaCO_3$ equivalent.

The pH, EC values were 7.6 and 0.26 dS m^{-1}, respectively. The weekly mean maximum and minimum temperature during crop growth period ranged between 25^0C to 34^0C and 16^0C to 23^0C, respectively. The weekly mean relative humidity during the morning and evening ranged between 86 to 92 per cent and 53 to 81 per cent, respectively. The weekly mean rainfall received during the experimental period ranged between 0.3 mm to 25mm. The weekly mean evapotranspiration (mm hr^{-1}) ranged between 0.8 mm hr^{-1} to 9.7 mm hr^{-1}. The experiment was laid out in the factorial randomized block design. The treatments consisted of four levels of potassium *viz*.0, 20, 30 and 40 kg ha^{-1} which were supplied through five different time of potassium application *viz* Sowing, flowering, pegging. Groundnut was sown on 28.06.2016 with a spacing 30 cm x 15 cm. All the recommended agronomic practices were adopted. Recommended dose of N and P_2O_5 (25:50 kg ha^{-1}) was applied to all treatments through Urea and Single super phosphate and potassium through MOP as per treatments. Oil content was determined by Soxhlet Ether Extract method (A.O.A.C. 2016) [1].

Results and Discussion

Table 1: Effect of potassium levels and time of application on total uptake of primary nutrients by groundnut

Treatments	Total N uptake (kg ha^{-1})	Total P uptake (kg ha^{-1})	Total K uptake (kg ha^{-1})
Levels of potassium (kg ha^{-1})			
L_1 (0)	120.74	10.20	54.93
L_2 (20)	130.89	12.02	64.15
L_3 (30)	150.38	13.89	68.71
L_4 (40)	160.11	14.54	70.01
S.E.±	3.48	0.51	0.63
CD at 5%	10.31	1.51	1.90
Time of potassium application			
T_1	142.17	14.03	65.61
T_2	141.43	13.30	64.72
T_3	139.61	12.16	64.68
T_4	140.05	11.93	63.75
T_5	139.38	11.89	63.48
S.E.±	3.89	0.57	0.71
CD at 5%	NS	NS	NS
Interaction (L x T)			
S.E.±	10.31	1.51	1.90
CD at 5%	NS	NS	NS

Total nitrogen uptake

The data presented in Table 1 revealed that, the total uptake of nitrogen was significantly affected by different levels. Significantly highest total N uptake was recorded by application of 40 kg ha^{-1} K_2O (L_4) i.e. 160.11 kg ha^{-1} which was at par with 30 kg ha^{-1} K_2O (L_3) i.e. 150 kg ha^{-1} and superior over all other levels of potassium. While in case of time of potassium application showed slightly increased yield at T_1 (full dose at sowing) i.e. 142.17 but variation were found non significant, this may be due to increased availability of nutrients by basal application. And interaction effects were found non-significant.

The added nutrients and various microbial activities resulting in higher nitrogen fixation, profuse plant and root growth which ultimately increased total uptake of nitrogen. The results are in close agreement with the findings reported by Musa *et al.* (2017) [4] and Rathore *et al.* (2014) [6].

Total phosphorus uptake

The data presented in table 1 revealed that, the total uptake of phosphorus by groundnut was significantly affected by different levels of potassium. The significantly highest total P uptake (14.54 kg ha^{-1}) was found with application of 40 kg K_2O ha^{-1} and at par with 30 kg K_2O ha^{-1} (13.89 kg ha^{-1}) may be due to increase in availability of P in soil as increase in levels of K_2O through fertilizer in soil. While there was no significant difference among K_2O time of application. Interaction effects of different potassium levels and time of application were found non-significant in relation to total P uptake.

The increased root and plant growth might have increased higher total uptake of P. The results are in close conformity with the findings reported by Musa *et al.* (2017) [4].

Total potassium uptake

From the data presented in table 1, it was found that significantly highest total K uptake was with the application of 40 kg K_2O ha^{-1} (70.01 kg ha^{-1}) and at par with 30 kg K_2O ha^{-1} (68.71 kg ha^{-1}), while in case of time of potassium application slight increase potassium uptake in T_1 (full dose at sowing) this may be due to basal application of nutrients, the water soluble K from the fertilizers benefited for the groundnut during the crop growth period and Interaction effects of different potassium levels and time of application were found non-significant in relation to total K uptake.

Similar finding were reported by Dutta *et al.* (2003) [3] and Musa *et al.* (2017) [4].

Effect on chemical properties and nutrient status of soil after harvest of groundnut

The data in respect of effect of potassium levels and time of application different chemical properties and nutrient status of soil after harvest of groundnut crop is presented in Table 2.

From the data it was revealed that effect of different potassium levels and time of application and their interactions were non-significant on soil chemical properties i.e. pH, EC, OC, per cent $CaCO_3$ equivalent of soil at harvest. The data given (Table 4.20) showed that, the available (P, K, S) and exchangeable (Ca, Mg) nutrients in soil after harvest of groundnut were not much more influenced by the different potassium levels and time of application and were found non-significant. While in case of soil available N after harvest of groundnut, significantly highest N (176.27 kg k_2o ha^{-1}) with application of 40 kg k_2o ha^{-1}, than rest of K_2O levels.

This might be due to the nitrogen use efficiency (NUE) increase with increase in potash level. Hence the residual soil nitrogen content is high in treatment of high level of Potash.

Table 2: Effect of potassium levels and time of application on chemical properties and nutrient status of soil at harvest of groundnut

Treatments	pH (1:25)	EC (dS m^{-1})	OC (%)	$CaCO_3$ equivalent (%)	Available nutrients				Exchangeable cations [cmol (p+) kg^{-1}]	
					N	P	K	S	Ca	Mg
Levels of potassium (kg ha^{-1})										
L_1	7.63	0.23	0.43	4.43	163.53	24.85	235.17	4.22	23.20	7.89
L_2	7.69	0.24	0.43	4.52	166.07	23.99	247.36	4.69	23.35	8.14
L_3	7.71	0.24	0.44	4.50	168.04	24.87	254.24	4.75	24.52	8.07
L_4	7.71	0.27	0.45	4.80	176.27	26.35	271.37	5.02	24.73	8.13
S.E.±	0.01	0.005	0.01	0.10	2.06	1.16	9.32	0.17	0.54	0.17
CD at 5%	NS	NS	NS	NS	6.09	NS	NS	NS	NS	NS
Time of application										
T_1	7.70	0.24	0.43	4.69	167.05	24.22	237.98	4.70	23.75	8.08
T_2	7.67	0.24	0.45	4.33	169.61	24.22	256.60	4.71	23.77	7.97
T_3	7.67	0.25	0.44	4.68	167.87	25.22	254.80	4.53	24.05	8.20
T_4	7.72	0.25	0.43	4.72	168.82	25.20	260.43	4.77	23.86	8.04
T_5	7.68	0.26	0.44	4.39	169.52	26.21	250.37	4.81	24.34	8.00
S.E.±	0.01	0.006	0.01	0.11	2.30	1.30	10.42	0.19	0.60	0.19
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction (L x T)										
S.E.±	0.03	0.01	0.02	0.23	4.60	2.61	20.85	0.38	1.21	0.38
-CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

The result from the present investigation revealed, Application of potassium significantly increased the uptake of N, P, K. The highest uptake of these nutrient (160.11, 14.54, 70.01 kg ha^{-1} respectively) were recorded with application of 40 kg K_2O ha^{-1} and time of application showed non significant effect. And in case of chemical properties and nutrient status of soil the soil available N was significantly affected by different levels but pH, EC, Organic carbon, per cent calcium carbonate equivalent and available P, K, S and exchangeable Ca, Mg in soil were non-significantly affected by different levels and time of application after harvest of groundnut.

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