Asian Journal of Chemistry Vol. 8, No. 1 (1996), 110–114

Chemical Composition of Groundnut Plant: Its Critical Growth Stages as Influenced by the use of Phosphatic and Potassic Chemical Fertilizers

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A field experiment was conducted in sandy loam typic chromustert soil with increasing doses of phosphorus with potassium applied to groundnut as a test crop. Groundunt crop responded remarkably to the application of phosphorus @ 30 and 60 kg P_2O_5 ha^{-1} applied through single superphosphate significantly increased the dry matter yield at 50 DAS and flowering stages over control. Similarly, artificial supplementation of potassium @ 10 and 20 kg K 20 ha^{-1} in the form of muriate potash significantly and linearly affected the dry matter yield at 50 DAS and flowering stages over no treatment. Progressive doses of phosphorus application significantly enhanced the N, P, K, Ca, Mg uptake at 50 DAS and flowering stages. Similarly, increasing trends in uptake of above plant nutrients were observed with the addition of increasing weights of potassium. Higher levels of application contributed additional increment in promoting the uptake as compared to lower levels and control in both the growth stages. Interaction between P and K was found to be positively affected in increasing dry matter yield and N, Ca and S uptake in both the stages.

INTRODUCTION

A major problem of heavy and medium black soils is low availability of both native reserve and applied phosphate. Response of phosphorus depends upon the nature and phosphorus-fixing capacity of soil and method of application. The high cost of phosphatic fertilizers has made the scientist pay attention to increasing the fertilizer use efficiency. Among all the sixteen essential elements, phosphorus occupies a pre-eminent position. For groundnut, it is useful in the formation and filling of pods. Phosphorus, besides being root growth promoters also helps in the absorption of different nutrients. Similarly potassium is essential for the formation of oil. Farmers generally avoid the use of potassic fertilizers. The available literature shows that groundnut crops respond to both phosphatic and potassic fertilizer application[1] in heavy or medium texture black soil, but very scant information is available on light texture sandy soil. This resulted in our effort to assess the effects of application of phosphatic and potassic fertilizers on dry matter yield and major nutrients uptake in different critical growth stages of groundnut in sandy loam soil.

MATERIALS AND METHODS

A field experiment was carried out in the kharif season with groundnut (*Arachis hypogea* L.) var. 'Joyti' as a test crop. The soil used in the experiment was hypothermic sandy chromustert which was low in available N (90 kg ha^{-1}), available P (5.6 kg ha^{-1}) and available K (117 kg ha^{-1}) and slightly acidic in nature (pH 5.6) and whose electrical conductivity was 0.63 dsm^{-1}. The net size of experimental plot was 2.2 m in length and 1.20 m in width. The experiment consisted of three levels of each phosphorus and potassium *i.e.* 0 (P_0), 30 (P_{30}) and 60 (P_{60}) kg P_2O_5 ha^{-1} applied through single superphosphate and 0 (K_0) 10 (K_{10}) and 20 (K_{20}) K_2O ha^{-1} applied through mueriate of potash, respectively. All the experimental plots received a common starter dose of 20 kg nitrogen given in the form of urea. Treatments were replicated three times in RBD with factorial concept. Seeds of groundnut were inoculated with Rhizobium culture and sown at the rate of 100 kg ha^{-1} in lines 40 cm away with plant to plant distance of 15 cm. The first plant sampling was done 50 days after sowing (DAS) of crop. Second sampling was done at the flowering stage of the crop. Plant samples were dried in an oven at 60°C till constant weight was obtained. Dry matter yield was recorded and the plant sample was ground to powder form for further chemical analysis.

Plant samples were digested in di-acid mixture of nitro-perchloric acid in the ratio of 5:2. These plant samples were analysed for nitrogen[2], phosphorus[3] and potassium flame photometrically[4], for calcium and magnesium by versenate titration method[4] and for sulphur[5] by usual analytical procedures. Soil samples were analysed for pH, EL[6], available nitrogen[7], available-phosphorus[8] and available potassium by flame photometrically.

RESULT AND DISCUSSION

Dry matter yield of groundnut

The data presented in Table-1 indicate that dry matter production per plant ranged from 4.01 to 7.20% of plant at 50 DAS and 20.17 to 61.28 g $plant^{1}$ at flowering. Application of 0, 30 and 60 kg P_2O_5 ha^{-1} through single superphosphate along with 0, 10 and 20 kg K_2O ha^{-1} resulted in a significant rise in the dry matter yield in both the growth stages. The per cent response was in the order of 10.7%, 45.1% and 45.3%, 83.6% due to application of phosphorus and 18.8%, 25.9%, 48.4% and 76.1% due to application of potassium in 50 DAS and flowering growth stages of groundnut respectively. The highest dry matter yield *i.e.* 7.28 and 61.28 g $plant^{-1}$ was obtained in the treatment combination of P_3K_{20} and $P_{60}K_{20}$ in both the growth stages of crop respectively. The higher dose of P (60 kg P_2O_5 ha^{-1}) and K (20 kg K_2O ha^{-1}) gave significantly more dry matter yield over lower levels (P_{30} and K_{10}) and control (P_0K_0). This response of P and K in enhancing the dry matter yield may be due to the fact that the experimental soil was low in available P (5.60 kg ha^{-1}) and K (117 kg ha^{-1}).[9, 10] Interaction between P and K was found to be significantly increasing dry matter yield.

TABLE-1
DRY MATTER YIELDS AND UPTAKE OF NUTRIENTS EFFECTED BY THE TREATMENTS

Potassium levels	Phosphorus levels: 50 Days after sowing P_0	P_{30}	P_{60}	Mean	Flowering stage P_0	P_{30}	P_{60}	Mean
1	2	3	4	5	6	7	8	9
Dry Matter Yield (g $plant^{-1}$)								
K 0	4.01	5.87	6.19	5.36	20.17	26.42	40.19	28.93
K 10	4.80	7.07	7.24	6.37	32.48	40.13	56.21	42.94
K 20	5.82	7.28	7.16	6.75	33.22	58.26	61.28	50.92
Mean	4.90	6.74	6.86	—	28.62	41.60	52.56	—
CD 5%	P – 0.29, K – 0.29, P × K – 0.50				P – 2.1, K – 2.1, P × K – 4.8			
Nitrogen uptake (mg $plant^{-1}$)								
K 0	10.6	19.3	20.3	16.8	342.40	559.30	588.60	469.77
K 10	23.4	24.0	24.2	23.8	526.20	713.70	784.80	674.90
K 20	22.5	24.9	4.7	31.0	717.30	851.80	920.30	829.80
Mean	18.8	22.8	29.7	—	528.63	708.27	764.57	—
CD 5%	P – 0.2, K – 0.2, P × K – 0.35				P – 12.2, K – 12.2, P × K – 22.4			
Phosphorus uptake (mg $plant^{-1}$)								
K 0	1.92	2.81	2.81	2.51	46.28	70.35	90.12	68.92
K 10	2.00	2.72	2.63	2.45	60.65	89.72	112.40	87.59
K 20	1.96	2.84	2.75	2.51	75.94	102.10	121.50	99.85
Mean	1.97	2.79	2.79	—	60.96	87.39	108.01	—
CD 5%	P – 0.11, K – NS, P × K – NS				P – 9.4, K – 9.4, P × K – 16.8			

1	2	3	4	5	6	7	8	9
Potassium uptake (mg plant^{-1})								
K 0	2.19	2.42	2.53	2.38	198.8	265.8	283.1	249.23
K 10	3.31	3.70	5.04	4.04	285.3	568.4	693.4	515.7
K 20	4.18	4.89	5.52	4.86	361.0	664.1	832.1	619.33
Mean	3.23	3.72	4.39	—	281.97	499.43	602.87	—
CD 5%	P – 0.16, K – 0.16, P × K – 0.25				P – 14.2, K – 14.2, P × K – 25.6			
Calcium uptake (mg plant^{-1})								
K 0	9.91	12.0	12.8	11.57	126.80	179.50	279.2	195.17
K 10	6.70	10.4	12.6	9.90	252.00	374.20	549.4	391.87
K 20	6.72	6.65	14.8	9.39	287.10	407.70	665.7	453.50
Mean	7.71	9.53	13.4	—	221.97	320.47	498.1	—
CD 5%	P – 0.28, K – 0.28, P × K – 0.48				P – 18.6, K – 18.6, P × K – 30.2			
Magnesium uptake (mg plant^{-1})								
K 0	3.97	3.76	3.87	3.87	64.68	82.07	102.80	83.18
K 10	2.80	3.99	3.94	3.58	153.10	158.10	167.70	159.63
K 20	2.55	4.61	5.57	4.24	156.80	187.90	208.40	185.37
Mean	3.11	4.12	4.46	—	125.86	142.69	159.63	—
CD 5%	P – 0.41, K – 0.41, P × K – 0.72				P – 15.2, K – 15.2, P × K – 31.2			
Sulphur uptake (mg plant^{-1})								
K 0	0.414	0.676	0.884	0.66	63.25	76.0	80.84	73.36
K 10	0.632	0.961	0.972	0.86	95.10	100.8	106.10	100.67
K 20	0.914	1.022	1.118	1.02	80.34	120.2	122.50	107.68
Mean	0.651	0.891	0.992	—	79.56	99.0	103.15	—
CD 5%	P – 0.08, K – 0.08, P × K – 0.11				P – 14.9, K – 14.9, P × K – 27.3			

Nutrients uptake

Application of phosphorus from P_0 to P_{60} significantly and linearly increases the N, P, K, Ca, Mg and S uptake by groundnut crop at 50 DAS and flowering stages over control. Similarly, application of potassium from K_0 to K_{20} successfully influenced the uptake of nitrogen, phosphorus, potassium, calcium, magnesium and sulphur except P uptake at 50 DAS and Mg uptake in flowering stage. Higher levels of P and K gave an additive effect over lower levels and control. Flowering stage showed more uptake of nutrients as compared to 50 DAS. This may be due to the fact that the rate of growth of plant increases with the passage of time and simultaneously increases the requirement of nutrients for growth and development. Sawarker[1] in the pot experiment found that nutrients absorbed at and after 50 days growth contributed towards the yield of groundnut pods, and phosphorus application increased the P and K uptake at both the growth stages. The reason behind this is that upon ionisation the phosphatic ions increase with time resulting in higher P release from fertilizer and soil.

Interaction between P and K was found to be significant in increasing the uptake of nitrogen, calcium and sulphur in both the growth stages. This shows the positive influence of phosphorus and potassium application over nitrogen, calcium and sulphur[10]

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(*Received:* 10 May 1995; *Accepted:* 25 July 1995) AJC-1000