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Studies on The Influence of Phosphorus and Potassium on the Protein, Oil Contents and Quality of Oil in Groundnut*

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A pot experiment was conducted with groundnut POL 2 in the calcareous and non-calcareous red soils of Tamil Nadu, to study the influence of phosphorus and potassium on the quality of groundnut namely protein content, oil content, yield of oil and quality of oil. The calcareous red soil recorded significantly higher value for crude protein content, whereas the non-calcareous red soil recorded significantly higher value for oil content of kernels and yield of oil. Both phosphorus and potassium application increased the crude protein content, oil content and yield of oil. The application of phosphorus decreased the free fatty acid number and iodine number of the oil and increased the saponification number of the oil.

India ranks first among the groundnut growing countries of the world in area and production. But the yield and oil content of kernels obtained in our country are far below the average yield and oil content in other countries. The importance of phosphorus and potassium in the nutrition of groundnut crop has long been recognised. Punnoose and George (1974) recorded increased crude protein and oil contents of groundnut kernels by phosphorus application. However, the data available for the red soils of Tamil Nadu, where groundnut is grown to a large extent are meagre. Hence a detailed study was taken up to find out the effect of phosphorus and potassium on protein content, oil content, yield of oil and quality of oil in groundnut.

MATERIAL AND METHODS

A pot experiment was conducted with groundnut POL. 2 a high yielding bunch variety in the calcareous and non-calcareous red soils collected from groundnut growing areas of Pollachi. Phosphorus was applied as monoammonium phosphate at O (P_0), 40 (P_1) and 60 (P_2) kg P_2O_5/ha and potassium was applied as muriate of potash at O (K_0), 60 (K_1) and 90 (K_2) kg K_2O/ha. The compost and nitrogon as urea were applied at 12.5 t/ha and 20 kg N/ha respectively to all the pots. The experiment was laid out in a randomised block design. The seeds were sown at the rate of 4 seeds/pot and only 3 plants were allowed to grow after germination. The crop was harvested when the pods were fully matured.

Crude protein content of the defatted kernels was obtained by estimating the total nitrogen as described by Humphries (1956) and multiplying the same with the factor 6.25. The oil content of the kernels was estimated

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by extraction with solvent ether, using Soxlet's apparatus, The yield of oil was worked out by multiplying the oil content with the corresponding kernel yield for each treatment. Free fatty acid number, saponification value and iodine value of the oil were determined by adopting the procedures described by Sankaran (1966). Free fatty acid number of the oil was determined by emulisifying the oil with neutral 95 per cent alcohol and titrating with O,1N KOH. The saponification number was estimated after saponifying a weighed quantity of oil with a known excess of 0.5 N alcoholic KOH and back titrating with 0.5 N HCl. The iodine number of the oil was estimated by Wij's method. The data pertaining to crude protein content, oil content, yield of oil free fatty acid number, saponification value and iodine number are furnished in Tables 1 to 6,

RESULTS AND DISCUSSION

i. *Crude protein content*

The calcareous red soil recorded significantly higher value for crude protein content of kernels (46.52 per cent) than the non-calcareousred soil (43.64 per cent). The application of phosphorus significantly increased the crude protein content from 41.36 to 48.21 per cent and this might be attributed to the beneficial role of phosphorus in the protein synthesis. The higher uptake of nitrogen and phosphorus by the crop in the presence of adequate phosphorus also could have increased the crude protein content of the kernels. This conforms to the findings of Punnoose and George (1974) who recorded increased crude protein content of groundnut kernels by phosphorus application.

The application of potassium also increased the crude protein of the kernels from 42.70 to 47.93 per cent. Potassium is an activator of a number of amino acid activating enzymes and markedly enhances the amino acid incorporation and synthesis of protein. Misra (1967) observed a general decrease in the free amino acid content and an increase in the protein content of alfalfa as the rate of potassium fertilization increased. The combined application of 60 kg P_2O_5/ha and 90 kg. K_2O/ha recorded the highest value (52.38 per cent) for the crude protein content of the kernels in the calcareous red soil. Nguyen (1972) observed that a well balanced fertilizer with NPK decreased the free amino acid content of alfalfa and increased the incorporation of these amino acids into protein. Potassium appears to be required for the incorporation of amino acids into Protein and potassium interaction with phosphorus should be taken into consideration to obtain the maximum incorporation of amino acids and protein yield.

ii. *Oil content*

The non-calcareous red soil recorded significantly higher value for the oil content of kernels (46.48 per-cent than the calcareous red soil (44.37 per cent). The application of both phosphorus and potassium increased the oil content from 43.47 to 46.63 per cent and 44.08 to 46.63

percent respectively. Punnoose and George (1974) and Jeyaraman and Sreedaran (1975) reported a significant increase in the oil content of the groundnut kernels by phosphorus application. According to Miller (1938) the formation of lecithin, an important form in which the fat occurs in the absence of phosphorus.

iii. *Yield of oil*

The non-calcareous red soil recorded significantly higher value for the yield of oil (9.27 g/pot) than the calcareous red soil (7.43 g/pot). The application of both phosphorus and potassium significantly increased the oil yield from 6.01 to 10.58 g/pot and 6.85 to 9.70 g/pot respectively and this might be due to the favourable effect of phosphorus and potassium on the yield and oil content of the kernels.

iv. *Quality of oil*

a. *Iodine number*

The calcareous red soil recorded slightly higher value for iodine number of oil (95.27) than the non.calcareous red soil (92.72). The application of phosphorus decreased the iodine number from 97.37 to 89.67.

b. *Saponification number*

The calcareous red soil recorded significantly higher value for the saponification number of the oil (197.77) than the non-calcareous red soil. The application of phosphorus and potassium increased the saponification number from 187.07 to 201.14 and 192.71 to 197.30 respectively.

c. *Acid value*

The calcareous red soil recorded slightly higher acid value of the oil (0.78) than the non-calcareous red soil (0.69). The application of phosphorus decreased the acid value from 0.77 to 0.56.

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Table 1 Effect of Phosphorus and Potassium on the Crude Protein Content of the Kernels

(Mean of three replications in per cent on moisture free basis)

Treatments	Calcareous red soil				Non-calcareous red soil			
	0	60	90	Mean	0	60	90	Mean
0	39.95	41.94	46.31	42.74	35.29	41.56	43.10	39.99
40	45.96	46.67	50.27	47.63	41.62	43.11	46.38	43.70
60	47.44	47.79	52.38	49.20	45.92	46.63	49.13	47.22
Mean	44.45	45.47	49.66	46.52	40.94	43.77	46.20	43.64

Mean values (per cent)

Soils				
S_1	S_2	S. E. of mean	C. D. (P=0.05)	
46.52	43.64	0.72	2.08	
Levels of P				
P_0	P_1	P_2		
41.36	45.67	48.21	0.88	2.53
Levels of K				
K_0	K_1	K_2		
42.70	44.62	47.93	0.88	2.53

Table: 2 Effect of Phosphorus and Potassium on the oil content of Kernels
(Mean of three replications in per cent)

Treatments	Calcareous red soil				Non-calcareous red soil			
K_2O kg/ha P_2O_5 kg/ha	0	60	90	Mean	0	60	90	Mean
0	40.87	42.23	44.10	42.40	43.03	44.83	45.73	44.53
40	43.70	43.47	45.03	44.06	45.67	45.10	46.70	45.82
60	44.37	47.80	47.80	46.66	46.87	49.93	50.43	49.08
Mean	42.98	44.50	45.65	44.37	45.19	46.62	47.62	46.48

Mean values in per cent

Soils	S_1	S_2	S. E. of mean of	C. D. (P=0 05)
	44.37	46.48	0.40	1.14
Levels of P	P_0	P_1	P_2	
	43.47	45.56	46.63	0.48 1.39
Levels of K	K_0	K_1	K_2	
	44.08	45.56	46.63	0.48 1.39

TABLE III. Effect of phosphorus and potassium on the yield of oil
(Mean of three replications in g/pot)

Treatments	Calcareous red soil				Non-calcareous red soil			
K_2O Kg/ha / P_2O_5 kg/ha	0	60	90	Mean	0	60	90	Mean
0	3.18	4.96	5.74	4 63	5.40	8.12	8 66	7.39
40	6,48	7 97	9.57	8.01	8.11	8.80	9.83	8.91
60	8.24	9.79	10.91	9·65	9.67	11.39	13.47	11.51
Mean	5.97	7.57	8.74	7.43	7.73	9.44	10.65	9.27

Mean values in g/pot

1. *Soils*

S_1	S_2	S. E. of mean	C. D. (P=0.05)
7.43	9.27	0.15	0.42

2. *Levels of P*

P_0	P_1	P_2		
6.01	8.46	10.58	0.18	0.51

3. *Levels of K*

K_0	K_1	K_2		
6.85	8.50	9.70	0.18	0.51

TABLE IV. Effect of phosphorus and potassium on Iodine Number of oil (Mean of three replications)

Treatments	Calcareous red soil				Non-calcareous red soil			
K^2O Kg/ha / P_2O_5 kg/ha	0	60	90	Mean	0	60	90	Mean
0	100.27	100.27	100.53	100.46	93.37	94.40	95.10	94.29
40	94.23	97.60	94.87	95.57	96.33	91.80	94.90	94.34
60	87.90	90.63	90.87	89.80	89.80	90.47	88.87	89.53
Mean	94.13	96.27	95.42	95.27	95.27	92.22	92.96	92.72

Mean values

1. *Soils*

S_1	S_2	S. E. of mean	C. D. (P=0.05)
95 27	92.72	0.92	2.66

2. *Levels of P*

P_0	P_1	P_2		
97.37	94.96	89.67	1.13	3.25

3. *Levels of K*

K_0	K_1	K_2	
93 56	94.50	94.19	N. S.

TABLE V. Effect of Phosphorus and Potassium on Saponification Number of oil
(Mean of three replications)

Treatments	Calcareous red soil				Non-calcareous red soil			
K_2O Kg/ha / P_2O_5 kg/ha	0	60	90	Mean	0	60	90	Mean
0	182.30	188.60	192.80	187.90	182.37	186.23	190.13	186.24
40	196.80	201.30	206.63	201.58	192.87	190.83	195.00	192.90
60	205.93	206.53	199.00	203.82	196.03	199.13	200.20	198.46
Mean	195.01	198.81	199.48	197.77	190.42	192.07	195.11	192.53

Mean values

1. *Soils*

S_1	S_2	S. E. of mean	C. D. (P=0.05)
197.77	192.53	1.40	4.05

2. *Levels of P*

P_0	P_1	P_2		
187.07	197.24	201.14	1.73	4.97

3. *Levels of K*

K_0	K_1	K_2	
192.71	195.44	197.30	N. S.

TABLE VI. Effect of Phosphorus and Potassium on Acid value of oil (Mean of three replications)

Treatments	Calcareous red soil				Non-calcareous red soil			
K_2O kg/ha	0	60	90	Mean	0	60	90	Mean
P_2O_5 kg/ha								
0	1.07	0.88	1.09	1.01	0.67	0.90	0.78	0.75
40	0.22	0.65	0.84	0.74	0.80	0.79	0.68	0.76
80	0.48	0.73	0.53	0.58	0.53	0.52	0.60	0.55
Mean	0.76	0.75	0.82	0.78	0.63	0.74	0.69	0.69

Mean values

Soils

S_1	S_2	S. E. of mean	C. D. (P=0.05)
0.78	0.69		N. S.

Levels of P

P_0	P_1	P_2		
0.77	0.75	0.56	0.06	0.17

Levels of K

K_0	K_1	K_2	
0.70	0.75	0.76	N. S.