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Effect of Calcium Application of the Uptake of Nutrients by Groundnut Kernel and Shell

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A pot experiment was conducted in two red soils collected from Tindivanam and Pollachi with groundunt (*Arachis hypogaea* L.) with three levels of calcium namely 0, 75 and 150 kg Ca/ha applied in two forms viz., calcium carbonate and sulphate in combinations with two levels of each of phosphorus, potassium and magnesium and constant dosages of nitrogen and boron. After the harvest of the crop groundnut kernel and shell were analysed for nitrogen, phosphorus, potassium and magnesium. Nitrogen uptake by kernel was markedly increased by calcium application. In both soils addition of calcium has increased the absorption of phosphorus and potassium in kernel. Magnesium uptake by kernel was favoured by calcium application especially at the higher level viz., 150 kg Ca/ha.

Groundnut being a rich source of protein and lipid, ranks first in importance among oilseeds in the Indian economy. Divergent views have been expressed by different workers about the effect of calcium upon the uptake of other nutrient elements in groundnut. Therefore an attempt was made to study the effect of calcium on the uptake of various nutrient elements by groundnut kernel and shell.

MATERIALS AND METHODS

An experiment was conducted in pots with groundnut (*Arachis hypogaea* L.) in two red soils collected from Tindivanam and Pollachi which represent two vast groundnut growing tracts in Tamil Nadu. These two original soils were examined for the various chemical characteristics (Table I). Calcium was applied at three levels namely 0, 75 and 150 kg Ca/ha in two forms like calcium carbonate and sulphate in combination with two levels of each of phosphorus, potassium and magnesium chloride respectively. Constant doses of nitrogen and boron at the rates of 20 kg N and 4 kg boron as ammonium nitrate and borax respectively, were also applied (Table II).

To eight kilogram of soil taken in each pot, calculated quantities of the above mentioned fertilizers and calcium compounds were applied and thoroughly mixed with the soil. The experiment was replicated thrice. TMV 7 groundnut seeds (bunch type)

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TABLE I. Basic analytical data for soils of pot experiment study

Soil properties	Soil	
	TVM	POL
A Mechanical composition (Percentage)		
Clay	10.6	13.8
Silt	9.7	4.7
Fine sand	26.2	30.5
Coarse sand	51.6	48.4
Loss on solution	1.9	2.6
B Physical properties		
Apparent density	1.47	1.46
Absolute specific gravity	2.23	2.52
Pore space (per cent)	43.10	44.30
Water holding capacity (per cent)	31.74	34.65
Volume expansion on wetting (per cent)	14.34	17.32
Sticky point (per cent)	14.10	13.20
Hygroscopic coefficient	1.60	1.11
C. Chemical analysis (Percentage)		
Moisture	3.16	1.84
Loss on ignition	2.35	2.84
Acid insoluble	91.37	89.13
Iron oxide (Fe_2O_3)	3.76	4.46
Alumina (Al_2O_4)	2.11	2.87
Soluble silica (SiO_2)	3.50	2.00
Total calcium (Ca)	0.24	0.26
Total magesium (Mg)	0.23	0.55
Total potassium (K)	0.11	0.35
Total sodium (Na)	0.03	0.04
Total nitrogen	0.03	0.06
Total phosphorus (p)	0.02	0.03
Organic matter	0.41	0.52
D. Available nutrients (kg/ha)		
Available nitrogen	236	324
Available phosphorus	12	8
Available potassium	254	306
Available calcium	334	195
E. Cation exchange properties (me/100g)		
Cation exchange capacity	8.20	9.70
Exchangeable calcium	4.25	4.31
Exchangeable magnesium	2.70	2.20
Exchangeable potassium	1.00	2.40
Exchangeable sodium	0.20	0.10
F. Water soluble nutrients (ppm)		
Water soluble calcium	56	40
Water soluble magnesium	19	28
Water soluble potassium	10	36
Water soluble sodium	15	17
g Other properties		
pH	6.8	6.6
Electrical conductivity (m mhos/cm)	0.39	0.47

were sown at the rate of five seeds per pot and thinned to three plants per pot after germination. The crop was harvested on 110th day after sowing. The kernel and shell of pods were seperated and analysed for various nutrient elements. Nitrogen was estimated by microkjedahl digestion and distillation method. Phosphorus, potassium and magnesium were determined in the triple acid extract of the plant material following colorimetry, flame photometry and versenate titration methods respectively (Jockson, 1967).

RESULTS AND DISCUSSION

Uptake of nutrients by groundnut kernel

(a) **Nitrogen**: Application of calcium has distinctly increased the nitrogen content of kernel compared to the control. However, the various forms of calcium did not show much difference (Table III).

(b) **Phosphorus**: Phosphorus uptake by groundnut kernel was significantly more in plants raised on Tindivanam soil than Pollachi soil (Table III)

TABLE II. Details regarding the fertilizer treatments

Treatment No.	Treatment	Treatment No.	Treatment
1.	$Ca_0P_0K_0Mg_0$	21.	$CaC_2P_1K_0Mg_0$
2.	$Ca_0P_0K_0Mg_1$	22.	$CaC_2P_1K_0Mg_1$
3.	$Ca_0P_0K_1Mg_0$	23.	$CaC_2P_1K_1Mg_0$
4.	$Ca_0P_0K_1Mg_1$	24.	$CaC_2P_1K_1Mg_1$
5.	$Ca_0P_1K_0Mg_0$	25.	$CaS_1P_0K_0Mg_0$
6.	$Ca_0P_1K_0Mg_1$	26.	$CaS_1P_0K_0Mg_1$
7.	$Ca_0P_1K_1Mg_0$	27.	$CaS_1P_0K_1Mg_0$
8.	$Ca_0P_1K_1Mg_1$	28.	$CaS_1P_0K_1Mg_1$
9.	$CaC_1P_0K_0Mg_0$	29.	$CaS_1P_1K_0Mg_0$
10.	$CaC_1P_0K_0Mg_1$	30.	$CaS_1P_1K_0Mg_1$
11.	$CaC_1P_0K_1Mg_0$	31.	$CaS_1P_1K_1Mg_0$
12.	$CaC_1P_0K_1Mg_1$	32.	$CaS_1P_1K_1Mg_1$
13.	$CaC_1P_1K_0Mg_0$	33.	$CaS_2P_0K_0Mg_0$
14.	$CaC_1P_1K_0Mg_1$	34.	$CaS_2P_0K_0Mg_1$
15.	$CaC_1P_1K_1Mg_0$	35.	$CaS_2P_0K_1Mg_0$
16.	$CaC_1P_1K_1Mg_1$	36.	$CaS_2P_0K_1Mg_1$
17.	$CaO_2P_0K_0Mg_0$	37.	$CaS_2P_1K_0Mg_0$
18.	$CaC_2P_0K_0Mg_1$	38.	$CaS_2P_1K_0Mg_1$
19.	$CaC_2P_0K_1Mg_0$	39.	$CaS_2P_1K_1Mg_0$
20.	$CaC_2P_0K_1Mg_1$	40.	$CaS_2P_1K_1Mg_1$

Ca_0=Calcium not applied (Control)
CaC_1=Calcium carbonate, 75 kg Ca/ha
CaC_2=Calcium Larbonate, 150 kg Ca/ha
CaS_1=Calcium sulphate, 75 kg Ca/ha
CaS_2=Calcium sulphate, 150 kg Ca/ha

Levels of Phosphorus
P_0—No phosphorus
P_1—40kg P_2O_5/ha
Levels of potassium
K_0—No potassium
K_1—60 kg K_2O/ha
Levels of Magnesium
Mg_0—No magnesium
Mg_1—50 kg/ha

But highly divergent views have been reported in literature about the effect of calcium upon the uptake of phosphorus by legumes. Key *et al.* (1962) observed that phosphorus uptake in soybean, was not affected appreciably by calcium. Tewari and Mandal (1972) were of the opinion that calcium application reduced phosphorus absorption by soybean. Nevertheless, the finding of the present study is in agreement with that of Rai *et al.* (1963).

(c) **Potassium**: Potassium uptake by groundnut kernel was significantly increased due to application of calcium. This finding is contrary to the observation made by Klingebiel and and Brown (1937) who stated that addition of lime to soils resulted in decreased absorption of potash by groundnut.

(d) **Magnesium**: Uptake of magnesium by groundnut kernel was significantly higher in plants raised on Tindivanam soil than Pollachi soil. High exchangeable magnesium status of Tindivanam soil at the initial stage may account for this observed result. Application of calcium has distinctly increased the magnesium uptake by kernel than no calcium treatment. Magnesium uptake was enhanced due to addition of 150kg than 75kg Ca/ha.

Uptake of nutrients by groundnut shell

(a) **Nitrogen**: Uptake of nitrogen by groundnut shell was found to be higher in plants grown on Tindivanam soil than Pollachi soil. Calcium sulphate treatment increased the uptake of nitrogen compared to calcium carbonate treatment. Application of 150 kg Ca/ha registered higher uptake of nitrogen than 75kg calcium application (Table IV)

(b) **Phosphorus**: Phosphorus uptake by shell was strikingly higher in Tindivanam soil than Pollachi soil. This might be due to higher available

TABLE III. Uptake of nutrients by groundnut kernel (mg/pot)

Treatment	Nitrogen		Phosphorus		Potassium		Magnesium	
	TVM	POL	TVM	POL	TVM	POL	TVM	POL
1	87	281	8	19	17	43	6	16
2	293	318	10	20	20	50	10	20
3	209	318	25	35	53	78	15	25
4	235	253	27	35	64	60	25	30
5	165	493	15	36	25	85	10	33
6	607	484	53	30	111	74	32	34
7	373	192	37	17	65	36	27	16
8	387	429	40	20	60	46	30	17
9	548	378	46	24	84	58	35	18
10	465	441	42	32	70	81	29	24
11	560	287	45	20	80	55	32	15
12	457	461	43	20	100	56	33	14
13	337	325	36	20	68	53	27	14
14	219	236	22	20	42	50	20	11
15	494	173	48	14	98	24	38	7
16	383	125	42	9	75	20	33	8
17	315	283	27	20	55	60	23	27
18	460	396	45	27	80	75	32	27
19	524	302	51	27	106	52	43	10
20	544	314	55	25	80	60	30	18
21	252	566	28	39	56	80	25	25
22	345	505	38	40	72	87	31	43
23	533	587	47	39	82	73	29	24
24	316	420	45	40	69	78	67	31
25	411	233	43	31	82	69	34	21
26	496	494	44	30	91	70	36	23
27	508	423	44	29	99	76	33	26
28	426	298	37	26	74	61	33	16
29	176	959	21	41	42	103	16	22
30	300	442	30	34	70	79	20	37
31	472	429	43	40	89	90	30	32
32	328	315	36	40	70	100	25	32
33	559	537	51	44	97	105	44	33
34	474	397	42	32	71	73	30	33
35	318	400	41	9	67	20	20	11
36	539	369	40	27	77	52	23	27
37	356	435	42	27	80	63	30	20
38	400	345	47	26	91	62	37	22
39	490	430	52	27	100	53	35	16
40	544	315	54	27	80	60	30	28

TVM=Tindivanam soil
POL=Pollachi soil

TABLE. IV. Uptake of nutrients by groundnut shell (mg/pot)

Treatment	Nitrogen		Phosphorus		Potassium		Magnesium	
	TVM	POL	TVM	POL	TVM	POL	TVM	POL
1	11	24	2	2	12	34	5	10
2	43	31	3	2	35	35	11	16
3	32	43	3	4	29	37	11	19
4	52	21	5	2	41	24	23	6
5	15	26	2	2	13	35	4	13
6	43	52	4	4	39	46	20	20
7	58	34	8	3	55	35	22	8
8	33	42	2	3	69	39	11	14
9	36	28	2	2	66	31	12	10
10	40	33	6	2	63	34	11	12
11	37	28	3	3	30	28	12	13
12	29	27	3	2	30	23	11	12
13	37	18	5	1	30	27	20	10
14	19	16	3	1	21	18	12	7
15	41	22	5	2	34	15	17	6
16	98	33	10	3	68	28	25	9
17	34	34	3	2	25	26	8	8
18	08	26	10	2	44	23	38	11
19	34	21	4	2	29	28	18	12
20	37	18	4	2	35	20	19	7
21	34	29	4	2	19	25	12	16
22	41	27	6	2	23	27	20	11
23	38	37	5	3	26	25	18	18
24	37	26	4	3	34	20	14	15
25	34	27	4	2	28	34	19	12
26	25	38	3	2	22	46	13	17
27	30	21	4	2	33	30	16	10
28	38	25	5	2	29	26	19	9
29	62	37	9	3	53	58	19	19
30	50	36	7	2	40	40	15	13
31	39	45	4	4	35	51	11	17
32	44	48	4	4	30	48	15	26
33	35	45	3	2	36	40	19	27
34	84	29	8	3	43	31	22	15
35	60	32	7	2	47	28	27	12
36	48	18	4	1	37	22	17	9
37	56	52	6	4	33	31	14	18
38	45	27	6	2	39	29	21	12
39	53	36	6	3	51	34	27	20
40	41	42	6	4	40	38	16	17

phosphorus status of Tindivanam soil at initial stage. In Tindivanam soil application of calcium has increased the phosphorus uptake than control. But in Pollachi soil, application and non-application of calcium were on a par. Robertson *et al.* (1954) obtained increased recovery of phosphorus in oat and corn due to calcium treatment.

(c) Potassium: Uptake of potassium by groundnut shell was significantly increased by calcium sulphate than calcium carbonate. This observation held good for Pollachi soil but in Tindivanam soil, both forms of calcium were on a par.

(d) Magnesium: The uptake of magnesium by groundnut shell was spectacularly higher in plants raised on Tindivanam soil than Pollachi soil. Application of calcium sulphate has appreciably increased the uptake of magnesium by shell compared to calcium carbonate.

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