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CATIONIC CONTENT OF GROUNDNUT SHELL AS INFLUENCED BY CALCIUM-SODIUM INTERACTION

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A field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore to study the cationic content of shell in groundnut (TMV 7) with four levels of calcium viz., 0, 40 80 and 160 kg/ha and five levels of sodium viz., 0, 5, 10, 20 and 40 kg/ha. Sodium reduced the absorption of calcium by the developing peg. High amount of calcium alters potassium status which in turn in combination with varying sodium levels produce both synergistic and antagonistic results. The 'Thief Watchman Antagonsim (TWA)' mechanism between sodium and potassium is discussed and a balanced ionic environment in the fruiting medium is stressed for increased pod yield in groundnut.

In India groundnut is the most important oil seed crop. The attempts made so far on intensive cultivation of this 'unpredictable legume' has not greatly increased the per hectare production. Since the cultivable area has already been exploited, the extension of this crop into the problem soils such as saline and alkaline areas is inevitable, inspite of their limitations. Heimann and Ratner (1965) reported that sodium reduced the yield of groundnut and cowpea. Pel and Laloraya (1967) suggested that the presence of sodium in the culture medium inhibited the uptake of calcium by the peg in groundnut. The poor transport of calcium inside the plant is common knowledge. In regard to groundnut nutrition it has been established by tracer technique that hardly more than one percent of calcium supplied to the root reached the developing pod (Burkhort and Collins, 1942). As such the direct uptake of calcium through the peg assumes importance, Chahal and Virmani, 1973). The present study reports the influence of sodium on the uptake of calcium by the developing pod. Hence the data on shell content alone is discussed. A field experiment was conducted with calcium and sodium in order to study their interaction on cation content and productivity of groundnut crop.

MATERIALS AND METHODS

The field experiment was conducted with groundnut variety TMV 7 during September, 1975 at the Tamil Nadu Agricultural University, Coimbatore. The soil type was of a sandy loam texture and the intial soil analysis indicated the following:

Electrical conductivity (1 : 2) : 0.2 mmhos/cm

PH (1 : 2. 5) : 7 3

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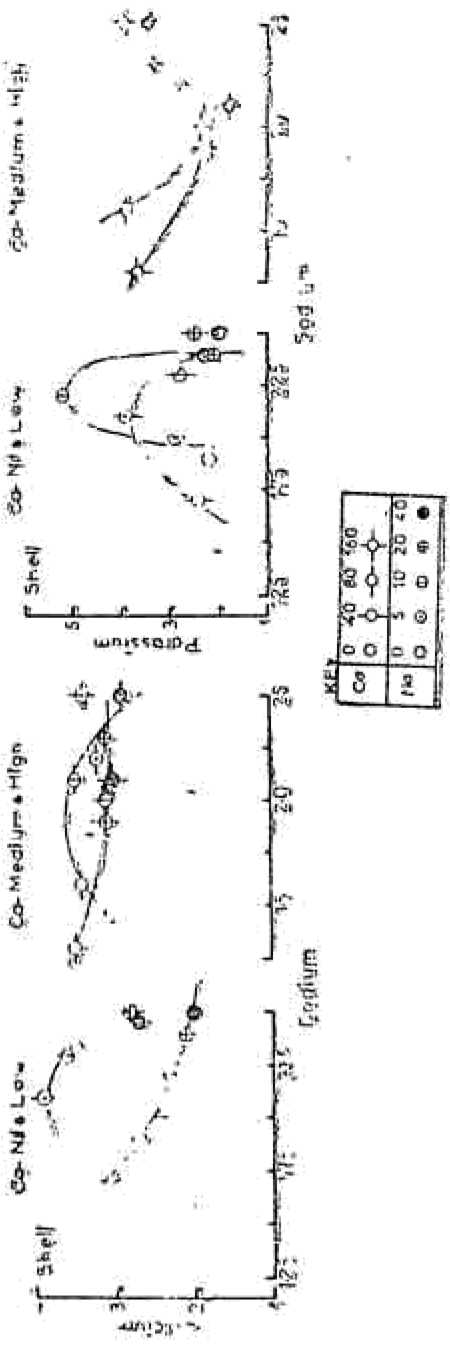
Exchangeable sodium : 1.20 meq/100 g ofsoil
Exchangeable potassium : 0.44 ,,
Exchangeable calcium : 4 00 ,,
Exchangeable magnesium : 3.00 ,,
CEC : 11.60 ,,

There were four levels of calcium viz., 0, 40, 80 and 160kg/ha and five levelsof sodium viz . 0, 5, 10, 20 and 40 kg ha on elemental basis. Calcium and sodium were supplied as gypsum and sodium chloride respectively. The salts were applied basally and thoroughly mixed with the soil in the respective plots before sowing the seeds. The experiment was laid out in a randomised block design with three replications. The plot size was 4.5 x 3.0 m. The crop received uniform basal application of 17, 35 and 52 kg of N, P_2O_5 and K_2O per hectare. The crop was grown under irrigation At harvest, ten plants were pulled out at random in each plot, pods were air-dried and then oven-dried at 100° C and dry weights recorded The replicated samples were pooled and the cationic content of shell were estimated photometrically.

RESULTS AND DISCUSSION

The cationic content of shell are presented in Table 1. The trend presents a complexity. From the data in Table 1 it is observed that the total cation/Na+ ratio is highest at 5 kg of sodium plus 40 kg of calcium, followed by 5kg of sodium plus 160 kg of calcium and 10 kg of sodium plus 80 kg of calcium. However, the ratio of total cation to Na+ is higher in all calcium levels (alone) over calcium plus sodium applied treatments. The K+ content is higher under 40 kg ha calcium along with 5kg hg sodium application. In 80kg/ha calcium application it is higher at 40 kg/ha. Under 160 kg/ha calcium application the 5 kg sodium combination registered the maximam K+. The data indicate the existence of antagonistic and synergistic effect between sodium and potassium (Fig 1). With 'nil' calcium, sodium acts synergistically in the increased potassium (5.2 mg) of shell at 10 kg/ha of sodium level, while at 'high' calcium supplement of 160 kg/ha sodium acts antagonistically with potassium reducing the latter (2.4 mg). As far as relative potassium status of shell is concerned. synersigm at 'nil' and 'low' calcium (40 kg/ha) and antagonism with 'medium' (80 kg/ha) and 'high' (160 kg/ha) calcium are observed. It has also become clear that both synergistic and antagonisic relationship between Na+ and K+ ions can develop when potassium status attains slightly deficient level by superimposing with high amounts of calcium. While sodium sensitive crop shows little tendency to synergism, sodium tolerant crops show appreciable degree of synergism and sodium liking crops very much higher (Liqman *et al.*. 1926). Groundnut being a sodium sensitive crop (Heiman and Ratner, 1965) synergism is observed only at low levels of sodium. Similar observations were made by

Yoshida and Castaneda (1969) in IR 8 paddy and by Prevot and ollagnier (1957) in coconut. However such a



clear information on groundnut is not met with by the author. The Na+ content of the shell is lowest at 5 kg/ha of sodium in combination with 40 kg /ha of calcium. When 80 kg/ha of calcium is supplied, the lowest Na+ content is recorded under 10 kg / ha of sodium application. Again at 160 kg of calcium/ha application, the Na+ content is lowest for 20 kg/ha sodium application. In the data presented on the content of Ca^{2+} (mg/g) and Na^{+} (mg/g) it will be observed that these two factors viz., a higher Ca^{2+} and a lower Na+ contant go together (Fig. 1). At 40 kg/ha calcium in combination with 5 kg/ha of sodium, a higher Ca^{2+} content is recorded with simultaneous lower Na+ content At 80 kg/ha calcium level the higher Ca^{2+} content is noted at the combination of 10 kg/ha of sodium application. Again at 160 kg/ha calcium level application, higher Ca2 and lower Na+ are recorded at 20 kg/ha sodium application. The data on Ca^{2+}/Na^{+} ratio makes this behaviour more clear. It is interesting to note that in all the treatments of calcium-sodium combinations tested, a ratio of 8 : 1 calcium and sodium application registered the favourable trend. These events affecting the ion uptake to varying degrees is thus well focussed.

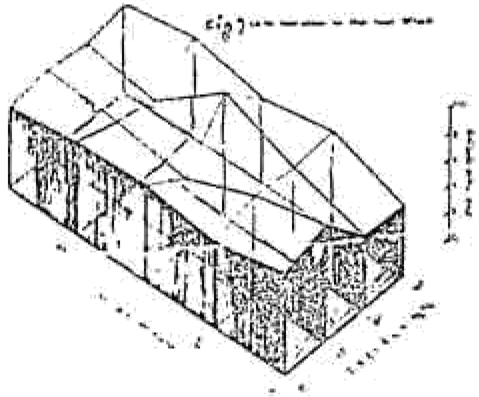
Similar trend is maintainad in the yield per plant (Fig. 2). It will be seen from the table that in the plots with salts, the higher plant yield is recorded in the treatments 80 Kg calcium plus 10 kg sodium (9.3 g) followed by 160 kg calcium plus 20 kg sodium (7.63 g) and 40kg calcium plus 5kg sodium (7.516). But among

Table 1 Cation content of shell (mg/g of dry weight) at harvest (110 days after sowing) and pod yield (g/plant)

Calcium kg/ha	Sodium kg/ha	Ca^{2+}	Na^{+}	K^{+}	mg^{2+}	Total	Total / Na^{+}	Ca^{2+} / Na^{+}	Pod yield (g/plant)	
	Nil	2.7	1.9	2.2	3.3	10.1	5.32	1.4	7.68	
	5	2.4	2.0	2.9	4.1	11.4	5.70	1.2	6.47	
Nil.	10	2.3	2.2	5.2	3.1	12.8	5.82	1.1	7.24	
	20	2.1	2.4	2.1	2.7	9.3	3.88	0.9	7.07	
	40	2.0	2.5	2.0	2.6	9.1	3.64	0.8	6.30	
	Nil	3.1	1.7	2.4	3.2	10.4	6.12	1.4	8.83	
	5	3.9	2.1	3.9	2.9	12.8	6.10	1.9	7.51	SE=0.728
40	10	3.6	2.3	2.8	3.1	11.8	5.13	1.6	5.35	CD=2.068 (g)
	20	2.8	2.5	2.5	3.0	10.8	4.32	1.1	6.10	Interaction :
	40	2.7	2.4	2.1	2.8	10.0	4.17	1.1	6.58	Significant at 1%
	Nil	3.4	1.0	3.9	3.1	11.4	11.40	2.1	5.55	
	5	3.2	2.2	2.8	3.4	11.6	5.18	1.5	7.16	
80	10	3.5	2.1	2.2	3.3	11.1	5.29	1.7	9.30	
	20	3.1	2.3	3.4	3.3	12.1	5.26	1.4	5.22	
	40	2.9	2.5	3.5	3.6	12.5	5.00	1.2	6.11	
	Nil	3.5	1.3	3.7	3.8	12.3	8.46	2.4	5.32	
	5	3.4	2.5	4.0	3.9	13.8	5.52	1.4	7.42	
160	10	3.1	2.0	2.4	3.5	11.0	5.50	1.6	6.35	
	20	3.1	1.9	2.2	3.0	10.2	5.37	1.6	7.63	
	40	3.0	2.1	1.8	3.2	10.1	4.81	1.4	6.67	

the treatments with 40 kg calcium/ha, yield is higher at O kg Na/ha (8.83g) than the all other sodium treatments. As such a beneficial interaction is perceptible in the calcium - sodium combination at the ratio 8 : 1. It has been clearly established that the pod growth is governed by the nutrients absorbed by the shell and the plant growth is influenced by its nutrition through roots (Pal and Laloraya, 1967).

Thus the present study has provided evidence on the operation of "Thief - Watchman - Antagonism-TWA" (Heimann. 1959) From an environment rich in sodium this ion cannot completely be prevented from in vading the plant tissues. The delicate balance between sodium and potassium being endan_



gered, the plants react by simultaneous uptake of additional amounts of potassium and so, sodium-potassium balance is redressed. In the present study, the high amount of calcium is responsible for altering potassium status which in turn in combination with varying sodium levels produce both synergistic and antagenistic results. Tissue content above a level in potassium shows an antagonistic trend of sodium. Also potassium-sodium antagonism has been confirmed sodium appreciably decreases the absorption of potassium (Killian, 1956) Based on this hypothesist he complex interaction of calcium and sodium is understandable with regard to yield The permeability of the membrane of the pod on the one hand and "TWA" mechanism on the other have helped in the evaluation of a desirable calcium-sodium ratio for soil application namely 80-10 in the matter of increased pod yield.

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