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Studies on the Effect of Magnesium on the Progressive Changes of Nutrients on Groundnut (POL 1) in Two Red Soils of Tamil Nadu

By

R. M. SUBRAMANIAN[1], T. S. MANICKAM[2] and K. K. KRISHNAMOORTHY[3]

ABSTRACT

The results indicated that magnesium application increased availability of nitrogen from pre-sowing to post-harvest stage, while phosphorus and magnesium availability decreased from pre-sowing to reproductive and post-harvest stages respectively. Potassium and calcium availability increased from sowing to vegetative and reproductive stage respectively. Magnesium application had superb effects on the uptake of nitrogen and phosphorus by the groundnut crop.

INTRODUCTION

Magnesium, the fifth major nutrient element, is involved in many vital biochemical processes of the plant, *viz.*, photosynthesis, respiration, glycolysis etc. Moreover, Mg is indispensable for chlorophyll formation, since it is the one and only mineral constituent of chlorophyll molecule. But many of the cultivated soils are found to be deficient in exchangeable and available Mg and in many cases crop growth is found to be limited by Mg deficiency. Hence there is the absolute necessity of using fertilizer magnesium for meeting the demand of the growing crops.

Further, legumes are said to consume more Mg than other crops and hence a favourable response can be expected for Mg application. Groundnut is a major oilseed crop. But the data available for Tamil Nadu soils and groundnut grown in these soils on the above mentioned aspects are very meagre. Hence with the object of providing information with reference to influence of Mg application on the availability of soil nutrients, an experiment was conducted with POL 1 groundnut as a test crop, grown in calcareous red and non-calcareous red soils.

MATERIALS AND METHODS

A pot culture experiment was carried out with two red soils (calcareous and non-calcareous) with POL 1 groundnut as the test crop. The treatment details were as follows:

Soils: Two, non-calcareous red (NC) and calcareous red (C).

Replications: Two

Treatments: 12. Magnesium: 6 levels, 0, 5, 10, 15, 20 and 25 kg $MgSO_4$ per hectare (Mg_0 to Mg_5)

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1. Probationery Officer, Bank of India, Baroda. 2. Assistant Professor and 3. Professor of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore - 641 003.

Rhizobium : 2 levels, non-inoculaded (NR) and inoculated (R).

Non-calcareous	Calcareous	
NC NR Mg_0	C NR Mg_0	Replicated two times
NC NR Mg_1	C NR Mg_1	
NC NR Mg_2	C NR Mg_2	
NC NR Mg_3	C NR Mg_3	
NC NR Mg_4	C NR Mg_4	
NC R Mg_0	C R Mg_0	
NC R Mg_1	C R Mg_1	
NC R Mg_2	C R Mg_2	
NC R Mg_3	C R Mg_3	
NC R Mg_4	C R Mg_4	
NC R Mg_5	C R Mg_5	

Nitrogen at 25 kg, 50 kg phosphoric acid (P_2O_5) and 75 kg potash (K_2O) per hectare were applied in the form of ammonium sulphate, mono-ammonium phosphate and potassium chloride respectively. Plant samples were collected and analysed for N, P, K, Ca and Mg, organic-C and total N using Subbiah and Asija's method, Olsen's method, Flame Photometric method, Versenate Titration method, Walkely-Black method and Macro-Kjeldahl's method, respectively.

RESULTS AND DISCUSSION

None of the Mg levels had significant effect on nitrogen availability which corroborates the findings elsewhere. Similar trend has been reported by Nair *et al.* (1970) for groundnut. Availability was maximum in calcareous soil than in non-calcareous soil, mean values being 92.83 and 78.59 ppm, respectively (Fig. 1)

Nitrogen availability in two red soils (in ppm) :

Soils	Non-calcareous (NC)	Calcareous (C)	SED	C. D. (P=0.01)
	78.59	92.83	3.1	9.03

Conclusion : C NC

Availability of P was maximum at pre-sowing stage, and it gradually decreased towards the final stage and reached the minimum at reproductive stage. This may be due to more amount of P consumed by groundnut for the formation of pods. Magnesium at the rate of 20 kg/acre has helped in the availability of phosphorus to the maximum extent.

Effect of magnesium on phosphorus availability (in ppm) :

Mg_0	Mg_1	Mg_2	Mg_3	Mg_4	Mg_5	SED	C. D. (P=0.05)
1.62	1.84	2.04	1.91	2.20	0.22		0.44

Conclusion :

Mg_4 Mg_5 Mg_2 Mg_3 Mg_1 Mg_0

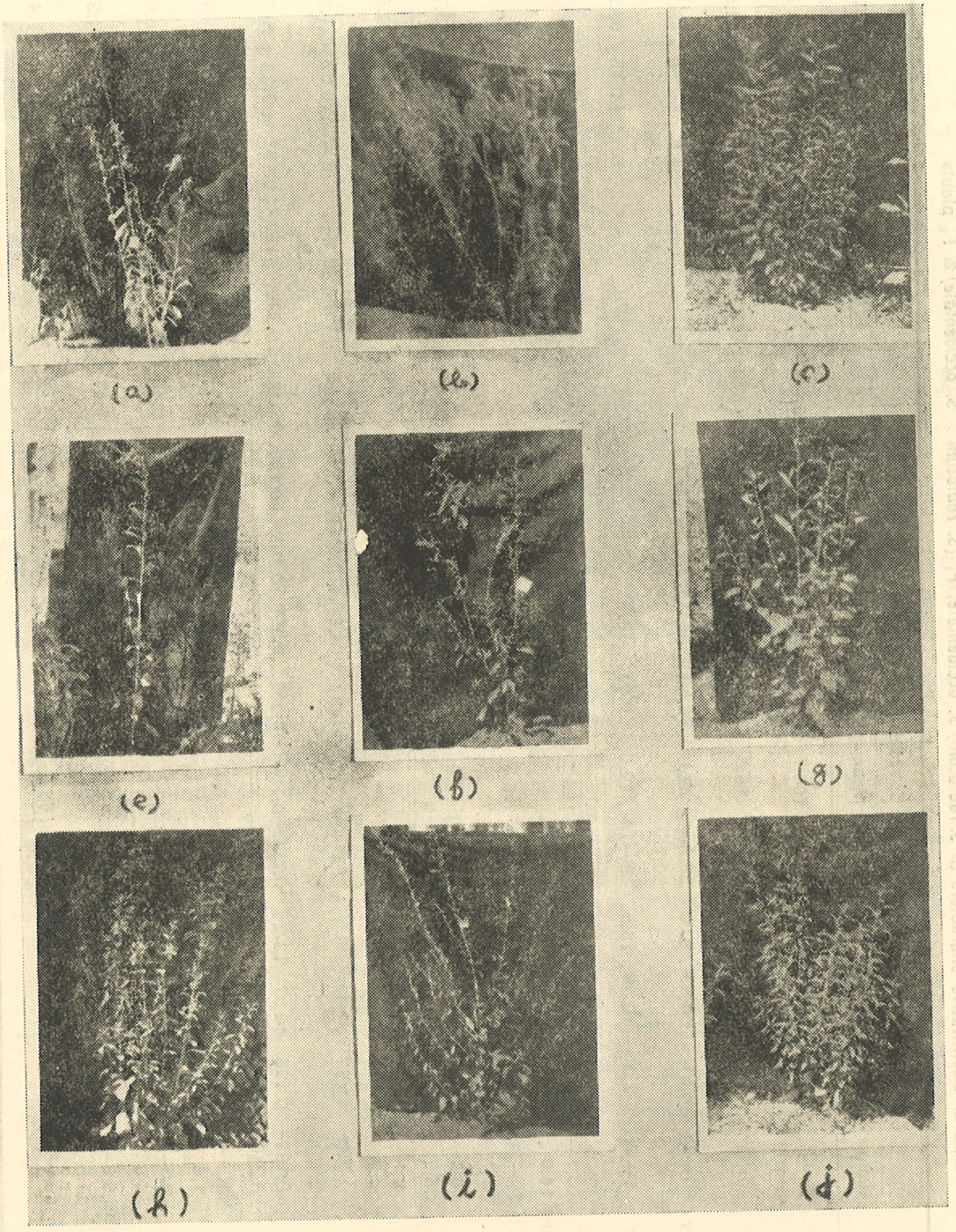


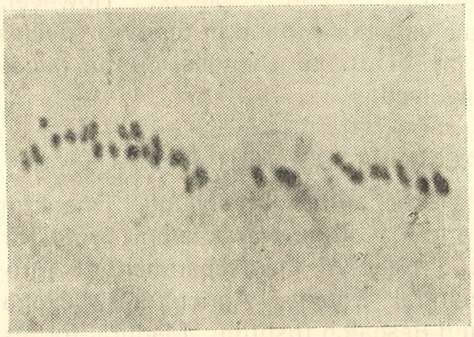
PLATE 1. (a) *Sesamum radiatum* (b) F_1 hybrid (c) *Sesamnm occidentale* (e) to (i) F_2 Segregants

TABLE 2. Quantitative characters of *S. radiatum*, *S. occidentale*, F_1 (*S. radiatum* × *S. occidentale*) & F_2 plants

Characters	*S. radiatum*				*S. occidentale*				F_1				F_2			
	Range	Mean	SE±	CV	Range	Mean	SE±	CV	Range	Mean	SE±	CV	Range	Mean	SE±	CV
Height of the main stem (cm)	84—109	95.6	±3.9	4.7	71—135	104.7	±1.52	5.4	148—172	165.0	±0.09	2.0	30—150	75.8	±1.75	36.6
No. of primary branches	3—6	4.3	±0.9	7.0	12—18	15.6	±2.44	15.6	14.6—23.2	19.5	±0.82	15.3	0—21	6.5	±0.10	61.9
Length of primary branches (cm)	30—61	43.1	±0.23	10.6	32.8—50.7	48.6	±2.00	34.0	42.7—62.7	53.1	±0.22	12.9	0—79.6	35.9	±2.86	69.2
No. of secondary branches	1—4	2.8	±0.46	18.8	9—14	12.0	±0.61	18.3	22.1—36.2	30.1	±1.73	16.1	0—45	6.5	±0.75	66.2
Length of secondary branches (cm)	10.7—14.0	12.2	±0.39	7.7	17.6—23.7	20.7	±1.36	23.6	28.6—43.0	35.8	±1.75	13.6	2.0—49.3	15.9	±0.98	5.4
No. of capsules/ Main stem	20—26	25.4	±1.2	13.1	9—13	10.8	±0.38	7.7	36—46	39.5	±1.41	9.4	5—38	16.9	±0.56	44.1
No. of capsules/ primary branch	16.9—25.2	20.3	±0.89	12.7	8.9—15.3	9.9	±0.69	25.1	20—32	26.2	±0.32	10.4	6—28	12.8	±0.62	36.7
Capsule size (Length/breadth)	3.1—4.3	3.5	±0.13	9.5	4.2—4.9	4.5	±0.71	15.7	3.2—5.0	3.8	±0.10	9.5	3.2—6.6	4.1	±0.98	10.5
Flower size (Length/breadth)	2.2—2.6	2.4	±0.05	6.3	2.1—2.4	2.2	±0.27	3.8	2.3—2.8	2.5	±0.04	7.0	2.1—2.9	2.4	±0.07	1.3
100 seed weight	0.191–0.216	0.196	±0.37	13.2	0.156–0.168	0.164	±0.003	6.5	0.188–0.207	0.198	±0.002	0.330	0.152–0.238	0.191	±0.23	16.7
Bottom leaves (Length/breadth	1.3—1.6	1.4	±0.10	6.7	1.3—1.5	1.4	±0.02	4.0	1.5—1.6	1.6	±0.14	8.6	1.2—4.9	2.2	±0.61	27.1
Middle leaves (Length/breadth)	3.3—4.8	3.9	±0.43	10.5	2.7—3.5	3.1	±0.10	10.5	2.1—4.2	3.4	±0.45	2.6	1.7—7.9	3.9	±0.42	46.5
Top leaves (Length/breadth	5.8—7.5	6.0	±0.18	4.7	3.8—4.6	4.1	±0.29	11.9	3.4—4.0	3.7	±0.41	7.9	2.7—10.0	5.4	±0.21	54.3
No. of seeds/ capsule	60—82	72.0	±0.42	6.8	74—82	68.0	±0.24	12.1	60—89	77.7	±2.52	11.7	40—83	11.5	±2.20	17.4

The continuous array of variations observed in F_2 segregants evidently brings out the interplay of large number of genes and the extent of genetic diversity between these two species. Kedharnath (1954) who obtained fertile hybrids between *S. occidentale* and *S. radiatum* has reported that the morphological differentiation between these two species progressed sufficiently and the development of genetic barrier has been slow. Omidiji (1975) has stated that production of fertile F_1 hybrids and easy exchange of genetic materials in F_2 and back crosses clearly brings out that the species involved are taxonamically related. The results obtained in the crosses between *S. radiatum* and *S. occidentale* simulated that two species are taxonomically similar and the crosses between them may be intra specific rather than interspecific.

The fact was further confirmed by the chromosomal behaviour. Meiosis in the parents, *S. radiatum* and *S. occidentale* has found to be remarkably regular. Thirty two bivalents were usually formed. The anaphase separation was highly regular and distribution of 32/32 chromosomes was seen in telophase I of all the cells studied. Meiosis II was also normal and tetrads were regularly formed. Cytological studies in F_1 showed regular pairing of chromosomes of two species; thirty two bivalents (plate 2) were regularly



formed. Most of the bivalents were O shaped and rods were few in a cell regular disjunction and distribution of 32/32 chromosomes occurred in Telophase I. For the chiasma frequency per cell or per bivalent, there was no appreciable variation between the parents and hybrids (Table 3). None of the cells showed irregularities like laggard or bridges in to F_1 hybrid, indicating the high closeness and affinities between the two genomes of

TABLE 3. Chromosome association, chiasma frequency and pollen fertility of *S. radiatum* ($2n = 64$), *S. occidentale* ($2n = 64$) and the F_1 hybrid ($2n = 64$)

Parents and Hybrids	Chromosome number	Chromosome association II		Chiasma per cell		Chiasma per bivalent	No. of cells studied	Pollen fertility in percentage
		Range	Mean	Mean	SE±			
S. radiatum	64	...	32	39.68	±0.07	1.24	25	96.2
S. occidentale	64	...	32	39.75	±0.06	1.24	25	96.2
F_1 hybrid	64	...	32	39.81	±0.09	1.32	30	95.6

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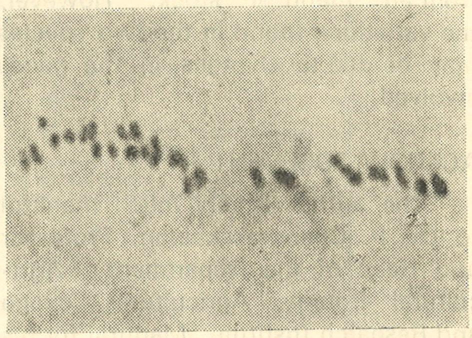

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S. radiatum and *S. occidentale*. The F_2 and back cross F_1 plants also showed normal chromosomal pairing and behaviour at later stages of meiosis. Hence the results obtained revealed that *S. radiatum* and *S. occidentale* are closely related and have originated from an identical stock. However, the variations found in the two species may be due to changes in the genes involved.

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