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Response of Early Bunch Peanuts to Calcium and Potassium Fertilization[1]

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ABSTRACT

There is an immediate need for fertilization data concerning any newly released cultivar of peanuts (*Arachis hypogaea* L.). Field studies were conducted on three soil types to determine the effect of various rates of Ca and K on yield, quality and certain peanut diseases of the new peanut cultivar, Early Bunch. Calcium was applied at rates of 0, 123, 246 and 369 kg/ha and K was applied at levels of 0, 112 and 224 kg/ha. Fertilizer treatments were arranged in randomized block design with four replications. Yields, sound mature kernels (SMK), extra large kernels (ELK), and *Pythium* population and *Sclerotium rolfsii* (disease loci) incidence were determined. The yield, SMK, and ELK of Early Bunch peanuts were increased by Ca fertilization on Fuquay and Tifton loamy sand, but not on the Greenville sandy loam. The application of high levels of K reduced the yield of Early Bunch peanuts on Fuquay soil but had no effect on Tifton or Greenville soils.

Increased Ca fertilization increased soil Ca on Greenville and Tifton soils but not on Fuquay soil. Potassium fertilization increased soil K on the Greenville soil but not on the Fuquay and Tifton soils. Some evidence was obtained that Ca fertilization reduced average *Pythium* (total) population in the Tifton and Fuquay soils and increased average incidence of *Sclerotium rolfsii*.

Key Words: Peanut yield, peanut seed size, *Pythium*, *Sclerotium rolfsii*, Fuquay ls, Tifton ls and Greenville sl, nematicides.

Peanuts (*Arachis hypogaea* L.) are unique in that soil applied Ca not only stimulates vegetative growth above the ground but contributes directly to its fruit development below the soil surface. Numerous reports (3,18,21,22 and 23) have shown that a readily available source of Ca is needed in the fruiting zone for good fruit development. The response to Ca fertilization usually is limited to large-seeded "Virginia market type" peanuts (1, 4, 12, 13), except in cases where small seeded peanuts are grown on Ca deficient soils. Large-seeded peanuts do not always respond to additions of Ca fertilizer (3, 10, 11) if soil levels are adequate. Most soils in the Coastal Plain area of Georgia have low cation exchange capacity (16) and, therefore may not retain adequate Ca levels without Ca fertilization annually. A few soils in the peanut growing area of Georgia retain a fairly high Ca level due to their higher cation exchange capacity. Soils that contain high levels of K relative to Ca can reduce the yield and quality of peanuts (2, 17, 20, 23). This condition usually can be corrected by the addition of available Ca. High levels of K relative to Ca may stimulate the activity of certain soil borne organisms (*Pythium*) which tend to attack the peanut fruit causing it to rot prior to harvest (8). Less rot reportedly has occured when high rates of gypsum (5, 6) were applied. Other researchers (14) have reported no relation between the Ca applied and the amount of pod breakdown by soil fungi (*Pythium and Rhizoctonia*).

There are pathogens which attack the aboveground portion of the peanut plant, such as the fungus *Sclerotium rolfsii* which causes "white mold" or "Southern Stem Blight". There have been reports that high levels of Ca may control this pathogen or that such added Ca may only increase resistance or productivity of the host plant (7, 24). Other research (9) conducted at several sites has shown that the addition of gypsum to PCNB treatments increased the *Sclerotium rolfsii* severity.

Peanut breeding research for crop improvement and product uniformity produced 21 new peanut cultivars that have been released over the past 44 years. It is important to the peanut breeder and farmer to know how new peanut cultivars will respond to fertilization and other soil factors. The objectives of this experiment were twofold: To determine the effect of varying rates of Ca and K on yield and quality of Early Bunch peanuts, and to determine if these soil treatments affect the incidence of certain peanut diseases.

Materials and Methods

Experiments were conducted for three years (1974-76) at Tifton, Georgia, on a Fuquay loamy sand (Arenic Plinthic Paleudult; loamy siliceous, thermic) and a Tifton loamy sand (Plinthic Paleudult; fine, loamy siliceous, thermic), and at Plains, Georgia on a Greenville sandy loam (Rhodic Paleudult; clayey, kaolinitic, thermic). Soil test values at the initiation of the experiment at Tifton and Plains, Georgia are shown in Table 1.

The experimental design was a split-plot with four replications. Whole plots (26.6 m by 13.3 m) were nematicide and no-nematicide and sub-plots (6.6 m by 5.3 m) consisted of K and Ca treatments.

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Table 1. Initial Soil pH Values and P, K, Ca and Mg Content of Experimental Plots at Tifton and Plains, Georgia - 1974.

Location	Soil Type	pH[1]	P	K	Ca	Mg
			------ kg/ha ------			
Tifton, Georgia	Fuquay Loamy Sand	5.8	112	41	561	310
Tifton, Georgia	Tifton Loamy Sand	6.1	115	51	850	240
Plains, Georgia	Greenville Sandy Loam	5.8	112	182	641	305

[1]Soil pH was determined with a 1:1 water:soil and P, K, Ca and Mg were extracted with double acid (0.05 $\underline{N}$ HCl + 0.025 $\underline{N}$ H_2SO_4) solution.

The nematicide was applied at planting with an injector system using Fumazone 86 E (1, 2-dibromo-3-chloropropane and related halogented C_3 aliphates) at 3.78 liters/ha.

Annual K treatments consisted of 0, 112 and 224 kg/ha of K (KCl, 60% K_2O) which was mixed with 73 kg/ha of P ($CaH_4(PO_4)_2$, 46% P_2O_5) and broadcast on individual plots and incorporated.

The peanut cultivar UF 70115, since named Early Bunch (15) was planted at the rate of 117 kg/ha. Calcium was applied as gypsum ($CaSO_4 \bullet 2H_2O$, approximately 72% $CaSO_4$, 20.2% Ca) in a 30 cm band centered over the drill at early bloom at rates of 9, 123, 246 and 369 kg/ha.

Recommended cultural, insect and disease practices were followed, except for continuous peanuts. Peanuts were dug with a mechanical digger-shaker, allowed to dry in a field windrow, and harvested with a field combine. Harvested peanuts were dried to 8% moisture. A 454 g sample of harvested peanuts was used for grade determination according to Federal-State Inspection Service guidelines for determining % sound mature kernels (SMK) and extra large kernels (ELK).

Soil samples were taken in the spring after planting and in the fall prior to harvest for chemical analysis (pH, P, K, Ca and Mg), nematodes and certain soil fungi counts. No soil fungi counts were made on the Greenville soil due to the large number of samples. Prior to harvest, each plot was checked for diseased plants (*Sclerotium rolfsii*) and findings are reported according to methods previously described (19).

Results and Discussion

The three-year average yield of Early Bunch peanuts as affected by Ca fertilization in three soil types is shown in Figure 1. The first increment of Ca applied to the Fuquay and Tifton Soils increased yields 1582 and 650 kg/ha, respectively. Early Bunch peanuts tended to respond to additional increments of Ca on the Fuquay soil, and up to 246 kg/ha of added Ca on the Tifton soil. On the Greenville soil, there was no increase in yield from the application of Ca.

The application of high levels of K on the Fuquay soil greatly reduced the yield of Early Bunch peanuts (Figure 2) while on the Tifton soil their was no change. Slightly lower yields occured on the Greenville soil at the highest K level. Depressive yield effect from high levels of K fertilizer on the Tifton and Greenville soils may have been offset by the slightly higher level of soil Ca.

On the Fuquay and Tifton soils, the peanut SMK obtained from Early Bunch peanuts increased

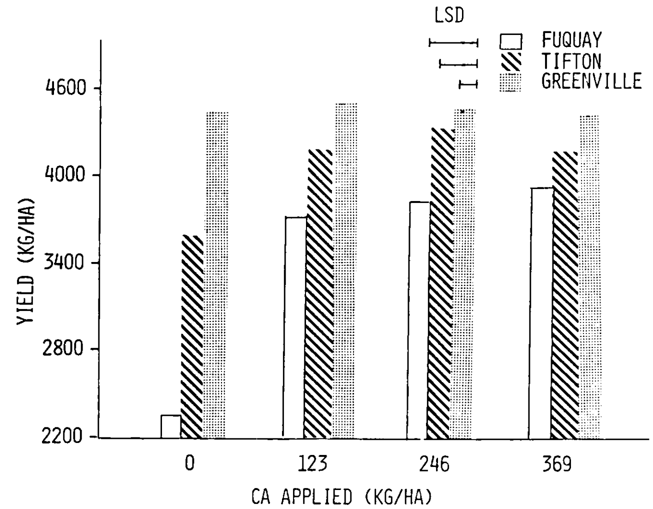

Fig. 1. Response of early bunch peanuts to Ca Fertilization on three soil types, 1974-76.

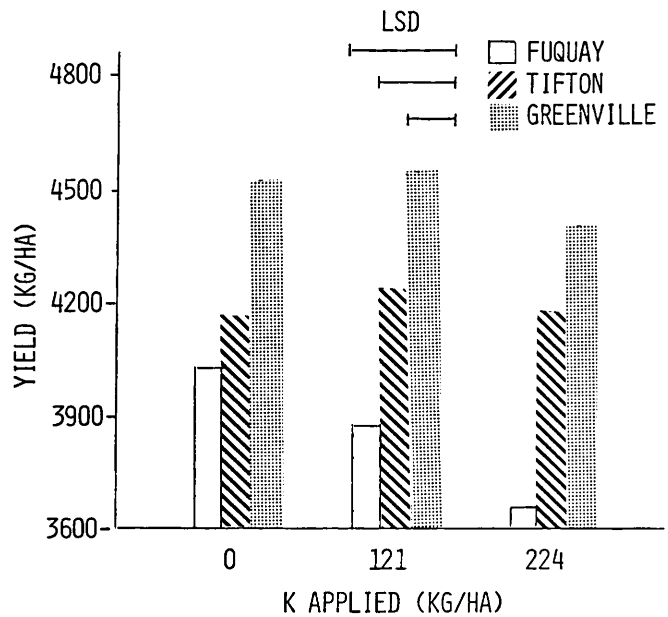

Fig. 2. Response of early bunch peanuts to K Fertilization on three soil types, 1974-76.

with each increment of Ca, with the greatest response coming from the initial application of Ca (Figure 3). There was no increase in the percent of SMK's on the Greenville soil from additional Ca.

The percentage ELK produced on the Tifton and Fuquay soils followed the same trends as those of the SMK with the greatest percentage increase coming from the 123 kg/ha rate of Ca (Figure 4). No reason can be given as to why the percent ELK was consistently less regardless of Ca treatment of Greenville soil.

The average double acid extractable Ca content of the Greenville, Tifton and Fuquay soils as influenced by Ca application is shown in Figure 5. The Greenville and Tifton soil contained a higher

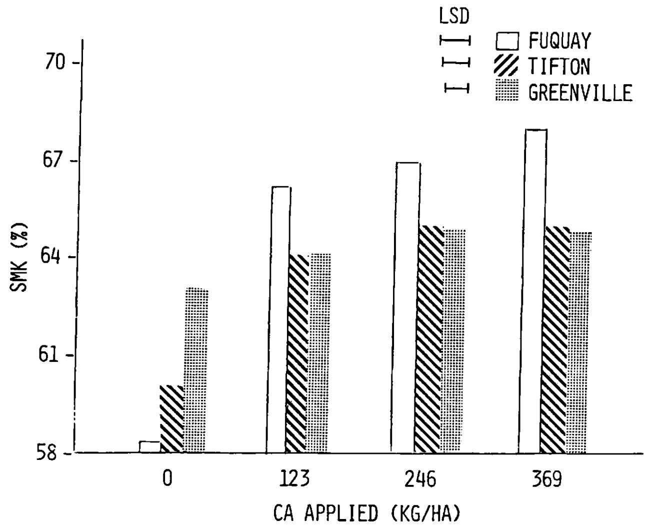

Fig. 3. Influence of Ca Fertilization on percent SMK of early bunch peanuts on three soil type, 1974-76.

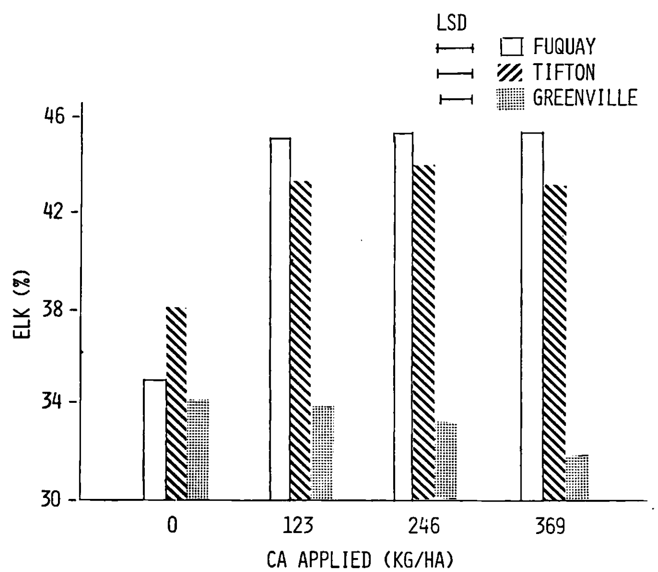

Fig. 4. Influence of Ca Fertilization on percent ELK of early bunch peanuts on three soil types, 1974-76.

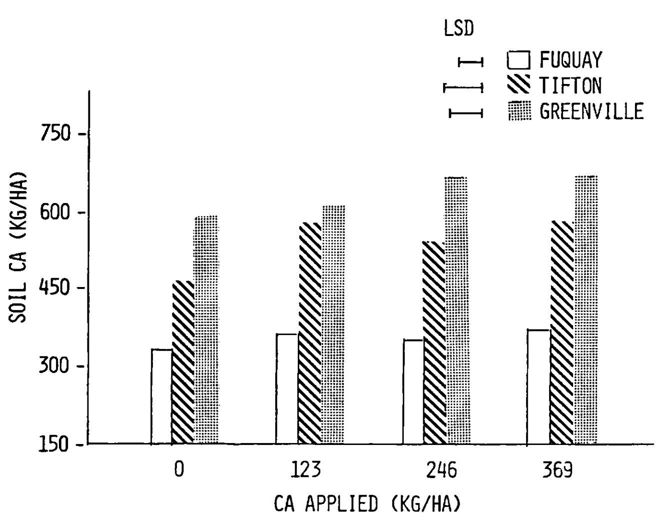

Fig. 5. Influence of Ca Application and soil Ca Level on three Coastal Plain Soils, 1974-76.

level of soil Ca than Fuquay soil. The Fuquay soil retained only a very small amount of the Ca applied to Early Bunch peanuts in mid-June. These data and yield data show the need for high rates of Ca when Early Bunch peanuts are grown on Fuquay or similar soil when the soil Ca level is 250 kg/ha or less.

Potassium fertilizer applied to Greenville soil increased soil K as rates were increased (Figure 6). The Tifton and Fuquay soils showed no evidence of enough K retention from fertilizer application to be of practical importance.

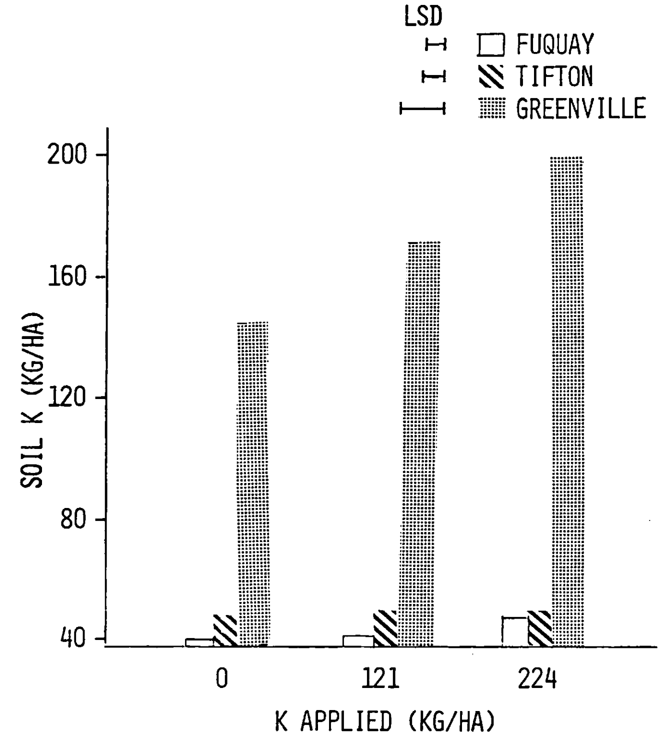

Fig. 6. Influence of K Application and soil K Level on three Coastal Plain Soils, 1974-76.

Nematode data were taken on all soils in the spring and late summer but nematode populations were erratic and no yield response was obtained from the use of nematicides. The nematodes present were primarily ring (*Criconemodes* spp.) and lesion (*Pralylenchus* spp.) which are not usually considered a threat to peanut production.

The application of K had no measurable effect on soil fungi (*Pythium*) populations on the Fuquay and Tifton soils. These data were variable without trends and are omitted. Calcium had no significant effect on the *Pythium* populations but there were some interesting trends. The average total *Pythium* populations tended to decrease on the Fuquay and Tifton soils, as Ca rates were increased (Table 2). Previous research (5) was successful in reducing peanut pod rot with high levels of Ca. Also, there was some evidence that Ca effects "white mold" caused by *Sclerotium rolfsii* (Table 3). Frequently,

Table 2. Effect of Applied Ca on Soil Pythium Population in Fuquay and Tifton Soils During Two Years.

Applied Ca	Pythium[1]			
	Fuquay		Tifton	
	1975	1976	1975	1976
(kg/ha)				
0	269	102	275	49
123	222	39	169	18
246	175	24	317	26
369	155	28	105	11
	N.S[2]	N.S	N.S	N.S

[1]Total Pythium Counts - Propagules/g dry soil.

[2]No Significant Difference (P = 0.05).

Table 3. The Effect of Ca on the Number of Disease Loci Caused by Sclerotium Rolfsii in Early Bunch Peanuts on Two Soils During Two Years.

Applied Ca	Fuquay		Tifton	
	1975	1976	1975	1976
(kg/ha)	(Loci/33 m row)			
0	1.09	4.1	5.4	7.0
123	0.93	6.6	5.4	10.8
246	2.34	6.9	6.6	8.3
369	1.56	7.2	12.5	8.3
	N.S[1]	N.S	N.S	N.S

[1]No significant difference (P = 0.05).

as Ca rates were increased, the incidence of disease tended to be increased slightly. These data support previous results (9) which showed an increase in *Sclerotium rolfsii* (disease loci) with the addition of gypsum.

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Literature Cited

1. Bailey, Wallace K. 1951. Virginia type peanuts in Georgia. Georgia Experiment Station Bull. 267.
2. Brady, N. C., J. F. Reid, and W. E. Colwell. 1948. The effect of certain mineral elements on peanut fruit filling. Agron. J. 40:155-167.
3. Colwell, W. E. and N. C Brady. 1945. The effect of calcium on yield and quality of large seeded type peanuts. Agron. J. 37:413-428.
4. Futral, J. G. 1952. Peanut fertilizer and amendments for Georgia. Georgia Exp. Sta. Bull. 275.
5. Garren, K. H. 1964. Landplaster and soil rot of peanut pods in Virginia. Plant Disease Repts. 48:349-352.
6. Garren, K. H. 1964. Recent development in research on peanut pod rot. Proc. 3rd Nat'l Peanut Research Conf. pp. 20-27, Auburn, AL.
7. Garren, K. H. and C. Jackson. 1973. Peanut diseases. *In* Peanut Culture and Uses, 429-494. Amer. Peanut Res. and Educ. Assn. Inc., Stillwater, OK.
8. Hallock, D. L. and K. H. Garren. 1968. Pod breakdown, yield and grade of Virginia type peanuts as affected by Ca, Mg and K sulfates. Agron. J. 60:253-257.
9. Harrison, A. L. 1961. Control of *Sclerotium rolfsii* with chemicals. Phytopathology, 51:124-128.
10. Hartzog, D. and F. Adams. 1973. Fertilizer, gypsum, and lime experiments with peanuts in Alabama. Ala. Exp. Sta. Bull. 448, Auburn, Ala.
11. Herndon, P. M. 1965. The effect of gypsum on yield and quality of four varieties. M. S. Thesis, University of Georgia, Athens, Georgia.
12. McGill, F. and R. J. Henning. 1973. Growning peanuts in Georgia. Cooperative Extension Service, University of Georgia, Bull. 640.
13. Middleton, G. K., W. E. Colwell, N. C. Brady and E. F. Schultz, Jr. 1945. The behavior of four varieties of peanuts as affected by calcium and potassium variables. Agron. J. 37:443-457.
14. Moore, Lawrence D. and W. H. Willis. 1974. The influence of calcium on the susceptibility of peanut pods to *Pythium myriotylum* and *Rhizoctonia solani*. Peanut Sci. 1:18-20.
15. Norden, A. J., R. O. Hammons and D. W. Gorbet. 1978. Registration of Early Bunch peanuts. Crop. Sci., 18:913-914.
16. Perkins, H. F., C. B. England and J. A. Gibbs. 1962. Some morphological, physical, chemical and clay mineral characteristics of several agriculturally important Georgia soils. Ga. Ag. Exp. Sta. University of Georgia. Tech. Bull. N.C. 26.
17. Robertson, W.K., C. E. Hutton and W. D. Hanson. 1956. Crop response to different soil fertility levels in a 5 by 5 by 2 factorial experiment. Soil Sci. Soc. Amer. J. 20: 537-543.
18. Robertson, W. K., H. W. Lundy and L. G. Thompson. 1965. Peanut response to calcium sources and micronutrients. Soils and Crop Sci. Soc. of Fla. Proc. 25:335-343.

19. Rodriguez-Kabana, R., P. A. Backman and J. C. Williams. 1975. Determination of yield losses to *Sclerotium rolfsii* in peanut fields. Plant Disease Reptr. V. 59:855-858.

20. Rogers, H. T. 1948. Liming for peanuts in relation to exchangeable soil calcium and effect on yield, quality and uptake of calcium and potassium. Agron. J. 40:15-31.

21. Slack, T. E. 1970. Studies on calcium nutrition of Spanish peauts. Ph. D., Oklahoma State University, Stillwater, OK.

22. Slack, T. E. and L. G. Morrill. 1972. A comparison of a large seeded (NC 2) and a small seeded (Starr) peanut (*Arachis hypogaea* L.) cultivars as affected by levels of calcium added to the fruit zone. Soil Sci. Soc. Amer. J. 36:87-90.

23. Sullivan, G. A., G. L. Jones and R. P. Moore. 1974. Effect of dolomitic limestone, gypsum and potassium on yield and seed quality of peanuts. Peanut Sci. 1:73-77.

24. Watkins, G. M. 1961. Physiology of *Sclerotium rolfsii* with emphasis on parasitism. Phytopathology 51:110-113.

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