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Response of Five Peanut Cultivars to Gypsum Fertilization On Soils Varying in Calcium Content[1]

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ABSTRACT

Experiments were conducted to characterize the response to Ca of two recently released peanut (*Arachis hypogaea* L.) cultivars, 'Tifrun' and 'Early Bunch' and to compare their response to that obtained from 'Florunner', 'Florigiant', and 'NC-Fla 14'.

Gypsum ($CaSO_4 \bullet 2H_20$, approximately 72% $CaSO_4$) was applied at rates of 0 and 1,121 kg/ha in a split plot design using the above cultivars. The experiment was conducted on Fuquay loamy sand low in Ca content and on Greenville sandy loam relatively high in Ca content. Yield, percent sound mature Kernels (% SMK), percent extra large kernels (% ELK), and percent oil in the seed were measured.

The peanut cultivars differed in their response to soil Ca level and to Ca fertilizaton. Gypsum applications did not increase % SMK and yield of Florunner significantly when soil Ca content was low and pH adequate, whereas the other four cultivars produced large increases in these factors. Gypsum applications to the low Ca soil with high pH increased the percent oil 4.0% for all varieties every year. The response of Tifrun and Early Bunch to gypsum fertilization was similar to Florigiant and NC.FLA 14 Tifrun quality factors and yields were comparable to Florunner on the Greenville soil without supplementary Ca, whereas Ca fertilization of the Fuquay soil was necessary. Early Bunch was similar to Florigiant and NC-Fla 14 in both yield and quality factors.

Keywords: Ca, Yields, Percent Oil, Sound Mature Kernels, Extra Large Kernels, Groundnuts, Seed Quality.

Four cultivars accounted for 90% of the production in 1974 (6), although peanuts (*Arachis hypogaea* L.) rank ninth in area among the major crops in the United States. One cultivar, 'Florunner' accounted for over 60% of the United States production and its growth internationally recently has increased. From 1930 to 1974, only 17 peanut cultivars have been released due to demands for crop and product uniformity (6, 7). Because of the possibility of genetic vulnerability to some as yet unknown disease or other factor, the widespread growth of one cultivar increases the chance of heavy economic losses. If this should occur, the change to new cultivars would be rapid and production problems could be avoided if information on cultural requirements was available prior to their large scale production.

Many soils used for peanut production in the Southeastern United States are light textured and low in residual Ca content while having a soil pH too high to recommend lime. On these soils, peanut yield and quality have been increased by gypsum applications (1, 2, 3, 4, 5, 9, 10, 11, 12, 13, 14). However, recent research with Florunner indicates pod yields and percent sound mature kernels (% SMK) were relatively insensitive to soil Ca level (13). The soil Ca requirements for efficient production of two new cultivars have not been investigated adequately. This study was undertaken to measure the influence of Ca fertilization on some quality factors and yield of two recently released cultivars and establish how their response compares to currently grown Ca sensitive and relatively insensitive cultivars.

Materials and Methods

Field experiments were conducted for three years (1974, 75, 76) at Tifton, Georgia, on a Fuquay loamy sand (Plinthic Paleudult; loamy, siliceous, thermic, arenic) and at Plains, Georgia, on a Greenville sandy loam (Rhodic Paleudult; clayey, kaolinitic, thermic). Beginning soil test values at Tifton and Plains are shown in Table 1. Phosphorus, K. Ca and Mg were extracted with double acid (0.05 N HCL + 0.025 N H_2SO_4) solution and pH was determined with a 1:1 water to soil ratio. Fertilizer applications consisting of 34, 29, 84, 56, and 96 kg/ha of N, P, K, Mg and S, respectively, were applied to the experimental area each year. The source of N, P and K was a commercial grade of 5-10-15 fertilizer and Mg was supplied as magnesium sulfate. One foliar application of B at the rate of 0.56 kg/ha in 112 1/ha of water was applied each year. Vernolate (S-propyl dipropylthiocarbamate) and benefin (N-butyl-N-ethyl-a,a,a-trifluoro-2,6-dinitro-p-toluidine) at 2.24 and 1.68 kg/ha, respectively, were incorporated to 7.6 cm for weed control. Gypsum treatments were applied each year to the same experimental area in a split plot experimental design with six replications. The whole plots (16 m by 6 m) received 0 or 1,121 kg/ha of gypsum material (72% $CaSO_4$) broadcast at early bloom. The currently recommended high gypsum rate only was used in this research since the objective was to establish whether or not the cultivars investigated responsed similarily to gypsum application. Subplots were 'Florunner', 'Tifrun', 'Florigiant', 'NC-Fla 14', and 'Early Bunch' each planted at the rate of 121,000 plants/ha in four rows (3.2 m by 6.0 m). Planting and harvest dates are given in Table 2.

Recommended cultural, insect, and disease control practices were followed except for the variables being studied. Each peanut cultivar was dug at maturity (as determined by recommended procedures) with a mechanical digger-shaker-windrower, allowed to dry in a field windrow, and harvested with a field combine. Harvested peanuts were dried to 8% moisture for yield determination.

A 454-g sample of harvested peanuts was used for determning percentage of sound mature kernels (% SMK) and of extra large kernels (% ELK) according to the Federal-State Inpection Service guidelines. The SMK were ground in a blender and a 5-g sample of ground seed was used to determine percent oil (8). Data were taken in 1974 and 1975 for % SMK and oil and 1975 and 1976 for % ELK. Samples were discarded in 1974 before % ELK was determined.

Statistically significant variance among means is identified only at the 1% level of probability.

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Table 1. Average pH values and P, K, Ca, and Mg contents of soils in experimental plots at Tifton and Plains, Georgia at the beginning of the experiment.

Location	Soil Type	pH	P	K	Ca	Mg
			kg/ha			
Plains, Georgia	Greenville sandy loam	5.8	67	303	818	-
Tifton, Georgia	Fuquay loamy sand	5.9	49	53	215	54

Table 2. Peanut planting and harvesting dates at Plains and Tifton, Georgia.

	Plains		Tifton	
	Planting	Harvest	Planting	Harvest
1974				
Early Bunch	May 9	Sept. 13	May 7	Sept. 12
Tifrun	May 9	Sept. 20	May 7	Sept. 20
Florunner	May 9	Sept. 20	May 7	Sept. 20
NC-Fla 14	May 9	Sept. 20	May 7	Sept. 20
Florigiant	May 9	Sept. 20	May 7	Sept. 20
1975				
Early Bunch	May 20	Sept. 19	May 19	Sept. 11
Tifrun	May 20	Sept. 27	May 19	Sept. 27
Florunner	May 20	Sept. 27	May 19	Sept. 27
NC-Fla 14	May 20	Sept. 27	May 19	Sept. 27
Florigiant	May 20	Sept. 27	May 19	Sept. 27
1976				
Early Bunch	April 29	Sept. 16	May 3	Sept. 13
Tifrun	April 29	Oct. 5	May 3	Sept. 23
Florunner	April 29	Oct. 5	May 3	Sept. 23
NC-Fla 14	April 29	Oct. 5	May 3	Sept. 23
Florigiant	April 29	Oct. 5	May 3	Sept. 23

Results

Florunner is compared with Tifrun since these are "Runner" market types and Early Bunch is compared to Florigiant and NC-Fla 14 which are "Virginia" market types in presenting the results. No yield response to gypsum fertilization was found at the Plains location. Yields were consistent during the 1974 and 1975 growing seasons. Yield results for 1976 were not included since a severe drought affected these data adversely. Tifrun and Florunner yields were similar and the yields of Early Bunch and Florigiant were similar but higher than NC-Fla 14 (Table 3).

Responses obtained at Tifton on the Fuquay soil, which was low in residual soil Ca, were more complex. Yield responses to gypsum application differed among cultivars (Fig. 1). Cultivar response

Table 3. Yield, % SMK, and percent oil for 1974 and 1975 and % ELK for 1975 and 1976 for peanut cultivars grown at Plains, Georgia.[1]

Cultivars	Yield	SMK	ELK	Oil
	kg/ha	%		
Florunner	4684	76	-	47.4
Tifrun	4836	70	-	47.3
Florigiant	4351	63	38	48.2
NC-Fla 14	4020	63	44	48.3
Early Bunch	4337	61	37	47.2
$LSD_{0.01}$	308	2	2	1.8

[1]All data is averaged over the years during which they were collected since no interaction was found for years. Similarily, data were averaged over gypsum application rates since no interaction or main effect for gypsum was found.

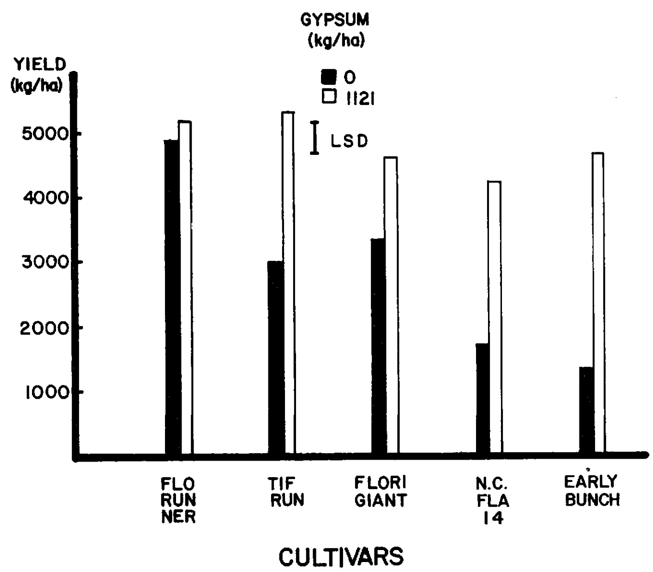

Fig. 1. Yield responses to gypsum of five peanut cultivars grown on Fuquay loamy sand at the Tifton location.

to gypsum fertilization was consistent from one year to the next. The results shown in Fig. 1 are an average of 2 years. Florunner was relatively insensitive to gypsum fertilization even when residual soil Ca was low. Tifrun yielded as much as Florunner only with gypsum fertilization. Early

Bunch, Florigiant, and NC-Fla 14 yields were similar with gypsum fertilization but without gypsum fertilization, Early Bunch and NC-Fla 14 yields were much lower than Florigiant yields.

The % SMK varied among years, gypsum application, and cultivars at the Tifton location (Fig. 2). Gypsum applications on the Fuquay soil increased the % SMK on all cultivars each year. Average increase in % SMK was about 4 for Florunner compared with 9 or more for any of the other varieties. The yearly increases in % SMK, due to gypsum were consistent for Florunner and Tifrun at 4 and 12 respectively, but varied from 5 to 16, 12 to 22, and 14 to 27 for Florigiant, Early Bunch and NC-Fla 14, respectively. Cultivar differences at the Plains location occurred only in % SMK obtained (Table 3). Tifrun produced less % SMK by 5.4 than Florunner. The % SMK in Early Bunch was similar to that in the other "Virginia" market types.

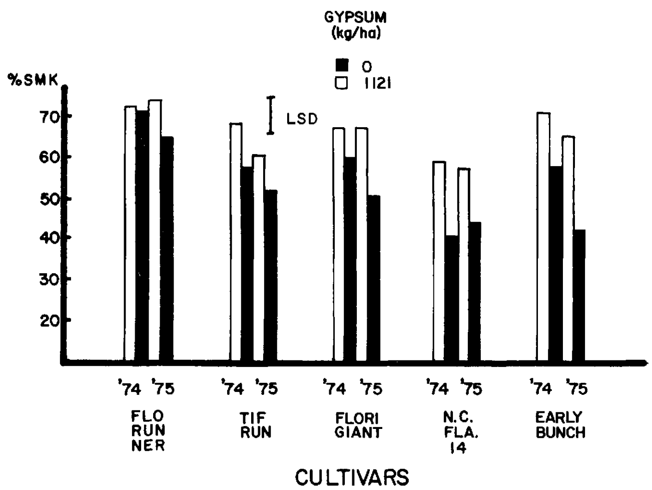

Fig. 2. Effects of gypsum and year on % SMK in fruits of five cultivars grown on Fuquay loamy sand at the Tifton location.

The influence of gypsum fertilization on % ELK and percent oil varied among soils. Early Bunch and Florigiant fruit contained similar % ELK but both were less than that in NC-Fla 14 at the Plains location (Table 3). No other factor measured influenced % ELK at Plains. At Tifton, the only factor studied that influenced % ELK was gypsum fertilization which increased % ELK by 17 (Table 4). The percent oil in seed of all cultivars at Plains was similar regardless of gypsum applications but on the Fuquay soil at Tifton gypsum increased percent oil 4.0% consistently regardless of growing season or cultivar (Table 4). The average oil content of cultivars increased from 45.2% to 50.2% (LSD = 1.3%) from 1974 to 1975 on Fuquay soil.

Discussion

Our results (Table 1) confirm that in many cases gypsum applications increase peanut yields on Fuquay soil low in residual Ca content having an adequate pH level (14) but not on a Greenville soil which had a high soil Ca content. Furthermore, the gypsum applications influenced % SMK, % ELK, and percent oil where residual soil Ca was low and soil pH adequate. Applying gypsum to the low Ca soil increased the percent oil and % ELK of all varieties every year. Gypsum application did not affect these characteristics when the residual soil Ca was high. Tifrun, Early Bunch, Florigiant and NC-Fla 14 responded similarly to gypsum fertilizer. However, note especially that without gypsum Florunner produced yields equivalent to or higher than those of four other cultivars which required gypsum fertilization for maximum yields on a soil with low residual Ca and a pH too high to recommend liming.

Table 4. The influence of gypsum fertilization on % ELK for 1975 and 1976 and percent oil for 1974 and 1975 of peanuts grown at Tifton, Georgia.[1]

Gypsum Rate	ELK	Oil
kg/ha	%	
0	27	45.8
1121	45	49.8
LSD	8	1.8

[1]Since no interaction was found between years or cultivars and gypsum applications, results presented are averaged over years and cultivars.

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