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FINAL REPORT FOR WORK
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INSTITUTION: University of Georgia

PROJECT TITLE: Calibration of soil test calcium with modern cultivar yield, grade, and germination.

RES. AGR. NO.: 25-21-RF328-683, PROJECT LEADER: Gary Gascho

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REPORT:

Over three seasons nine (9) field experiments were conducted at four sites (Headland, AL, Quincy, Fl, Attapulgus, Ga, and Tifton, GA) in this project to determine the calcium requirements of modern varieties of runner-type peanut. These studies were necessary as few calcium studies had taken place since Florunner was the predominant runner-type variety. Based on those earlier studies with Florunner, bloom gypsum application is recommended when Mehlich-1 soil Ca is less than 200 mg/kg in AL and less than 250 mg/kg in FL and GA. Bloom gypsum is always recommended for the larger seeded Virginia-type peanut and for all peanuts grown for seed. The objective of the research was to determine if modern runner-type varieties, having varying seed size, have calcium requirements different from those of Florunner and if they differ from each other. Four varieties were planted in replicated plots at each location. Due to ever-changing variety recommendations, selection of varieties for the experiments were not consistent over locations and years. The varietal plots were split at first bloom so that ½ received gypsum (according to the rates recommended in the given State) and the other ½ did not. Plant and soil samples were collected according to plan and analyzed in the lab at the Coastal Plain Experiment Station at Tifton. We determined pod yield and grade for all experiments and in most of the experiments we also determined the calcium concentration and germination of the seed produced. Germination of the seed produced was determined by the Georgia Department of Agriculture Seed Laboratory at Tifton, GA. Experiments were statistically analyzed as split-plots and the main effect means were separated by the LSD test at P=0.05. Interaction data are presented only where the interaction between variety and gypsum was significant at P=0.05. Results of individual trials are presented followed by a summary of the nine experiments.

In the Headland experiment in 2001 (Table 1) DP_1 yielded more than the other varieties and Georgia Green yielded less than the other varieties. Grade was significantly less for DP_1 than for the other varieties. There was no response to bloom gypsum application and no interaction between variety and gypsum application. Soil test Ca was 372 mg/kg (744 lb/acre) in the check plots, a content great enough that no response would have been expected for Florunner in previous studies.

Table 1. Headland AL, 2001
Soil tests in the pegging zone where no gypsum was applied.
Soil pH = 6.6, P, K, Ca, and Mg = 34, 39, 372, and 42 mg/kg, respectively.

variety	pod yield	TSMK
	lb/acre	%
AT_201	2588 b	73 a
DP_1	3182 a	68 b
GA Green	1832 c	73 a
Norden	2288 b	72 a

Gypsum	pod yield	TSMK
	lb/acre	%
bloom gypsum	2422 a	72 a
no gypsum	2523 a	72 a

Values in a data set and column followed by a common letter are not different by LSD (0.05)
There were no significant interactions of variety and gypsum by F test (P=0.05)

In the Headland experiment in 2002 (Table 2) there was an interaction between variety and gypsum application for pod yield and seed Ca content. Bloom gypsum application increased yield for AT_201, but mysterious decreased yield of GA_Green and Norden, while the yield of C_99R was not affected by gypsum. Seed Ca content was increased by bloom gypsum for all varieties, but the magnitude of the increase was less for C_99R than for the other varieties.
Grade (percent total sound mature kernels, TSMK) was greatest for AT_201 and least for Norden. Seed produced from the Norden plots had a greater germination percent than that produced in the AT_201 and C_99R plots. Over all varieties, germination of seed produced was increased by bloom gypsum application. Soil test Ca in the no gypsum plots averaged 354 mg/kg, a value at which no response in pod yield or grade was obtained from gypsum application in

earlier studies with Florunner. The germination results from seed produced in this experiment clearly indicate that gypsum application was beneficial for seed production for all four varieties in the experiment.

Table 2. Headland AL, 2002
Soil tests in the pegging zone where no gypsum was applied.
Soil pH = 6.6, P, K, Ca, and Mg = 25, 48, 354, and 46 mg/kg, respectively.

variety	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
AT_201	3996 a	79 a	478 b	79 b
C_99R	3854 a	75 ab	460 b	78 b
GA Green	3900 a	74 b	490 b	82 ab
Norden	3793 a	73 c	548 a	84 a

Gypsum	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
bloom gypsum	3742 a	74 a	608 a	84 a
no gypsum	4029 a	75 a	380 b	77 b

Values in a data set and column followed by a common letter are not different by LSD (0.05)

Significant interactions of variety and gypsum by F test (P=0.05)

Variety	Gypsum	Pod Yield	Seed Ca
		lb/acre	mg/kg
AT_201	bloom gypsum	4134*	577*
AT_201	no gypsum	3858	378
C_99R	bloom gypsum	3942	512*
C_99R	no gypsum	3766	409
GA_Green	bloom gypsum	3546	627*
GA_Green	no gypsum	4254*	354

Norden	bloom gypsum	3346	716*
Norden	no gypsum	4240*	380

*significantly greater value due to gypsum treatment for a given variety

The third experiment at Headland in 2003 did not record any interactions between varieties and gypsum (Table 3). Yield for Carver was greater than yield for DP_1 or GA_02C. Yield of Norden was greater than yield of GA_02C. Grade for Carver and DP_1 was superior to grade for Norden. Seed produced in this experiment had very high Ca contents and germinations. However, seed Ca was lower for DP_1 than for other varieties and germination was greatest for Norden and least for GA_02C and DP_1. Soil Ca values for the no gypsum plots were greater than where any response for yield or grade would be expected due to gypsum application, as for the experiments conducted in 2001 and 2002 at Headland. No responses were recorded due to gypsum application.

Table 3. Headland AL, 2003
Soil pH = 6.3, P, K, Ca, and Mg = 22, 45, 337, and 40 mg/kg, respectively.

variety	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
GA_O2C	2963 c	69 ab	841 a	91 c
Carver	3535 a	70 a	893 a	94 b
Norden	3420 ab	68 b	928 a	97 a
DP_1	3120 bc	70 a	622 b	90 c

Gypsum	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
bloom gypsum	3277 a	69 a	839 a	93 a
no gypsum	3194 a	69 a	803 a	93 a

Values in a data set and column followed by a common letter are not different by LSD (0.05)

At the Quincy, FL location in 2002 (Table 4) pod yield was greatest for DP_1 and least for GA_Green, however grade was inferior for the DP_1 variety. Calcium content and germination of seed produced was less for DP_1 than for the other varieties. Both seed Ca and germination of the seed produced was less in this experiment than in the experiments conducted at Headland. None of the treatments had germinations acceptable for sale as seed. Over all varieties, bloom gypsum application increased seed Ca concentration and germination of the seed produced, but had no effect on yield or grade. A significant interaction between variety and gypsum application was recorded for germination of the seed produced, indicating that germination responded to

bloom gypsum applications for AT_201 and DP_1, but not for GA_Green or Norden. With a beginning soil Ca of 332 mg/kg, no yield or grade responses were found, consistent with earlier work with Florunner. However, greater soil concentrations of Ca appear necessary for production of high quality seed.

Table 4. Quincy, FL 2002
Soil tests in the pegging zone prior to application of gypsum treatments:
Soil pH = 6.0, K, Ca, and Mg = 151, 332, and 67 mg/kg, respectively.

variety	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
AT_201	2588 b	73 a	550 a	71 a
DP_1	3182 a	68 b	402 b	63 b
GA Green	1832 c	73 a	510 a	66 ab
Norden	2289 b	72 a	535 a	72 a

Gypsum	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
bloom gypsum	2422 a	72 a	517 a	70 a
no gypsum	2523 a	72 a	480 b	67 a

Values in a data set and column followed by a common letter are not different by LSD (0.05)

Significant interaction of variety and gypsum by F test (P=0.05)

Variety	Gypsum	Germination
		%
AT_201	bloom gypsum	73*
AT_201	no gypsum	69
DP_1	bloom gypsum	68*
DP_1	no gypsum	59
GA_Green	bloom gypsum	66
GA_Green	no gypsum	66
Norden	bloom gypsum	72

Norden	no gypsum	72

*significant greater value due to gypsum treatment for a given variety.

At the Quincy, Fl location in 2003 (Table 5) soil Ca was 282 mg/kg and pH was less than in the experiments presented previously. However, soil Ca was above the soil Ca threshold in Ga (values below 250 mg/kg have a recommendation for bloom gypsum). Pod yield was low due to wet conditions that delayed and interfered with harvest. There were no interactions between variety and gypsum for any of the variables measured. Yield of Carver was inferior to the other varieties. DP_1 resulted in the lowest grade, seed Ca and germination of seed produced. Bloom gypsum application did not increase pod yield, but increased grade, seed Ca and germination. of all four varieties.

Table 5. Quincy, FL 2003

Soil tests in the pegging zone prior to application of gypsum treatments:
Soil pH = 5.6, K, Ca, and Mg = 72, 282, and 36 mg/kg, respectively.

variety	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
DP_1	1397 a	68.9 c	502 b	74 b
GA_Green	1268 a	72.4 a	635 ab	81 ab
Carver	878 b	72.0 ab	637 ab	84 a
Norden	1371 a	70.4 bc	676 a	79 ab

Gypsum	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
bloom gypsum	1252 a	72 a	639 a	82 a
no gypsum	1205 a	70 b	585 b	77 b

Values in a data set and column followed by a common letter are not different by LSD (0.05)

The experiment at Attipulgus, Ga in 2002 was devastated by CBR, resulting in low yields and low grades (Table 6). The soil Ca was below the GA 250 mg/kg threshold where response could be expected for Florunner from previous studies. due partially to disease, variability was great in the plots and no differences were recorded for pod yield or seed Ca due to variety. DP_1 yielded less and had lower grade than the other three varieties. Over all four varieties, bloom gypsum increased grade and seed Ca and germination of the seed produced.

Table 6. Attapulgus, GA 2002

Soil tests in the pegging zone prior to application of gypsum treatments:
Soil pH = 6.0, K, Ca, and Mg = 48, 162, and 22 mg/kg, respectively.

variety	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
AT_201	1184 a	65 a	653 a	70 a
DP_1	1060 a	56 b	594 a	63 b
GA Green	1321 a	64 a	709 a	75 a
Norden	1183 a	60 a	661 a	76 a

Gypsum	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
bloom gypsum	1191 a	62 a	703 a	76 a
no gypsum	1184 a	60 a	606 b	67 b

Values in a data set and column followed by a common letter are not different by LSD (0.05).
There were no significant interactions of variety and gypsum by F test (P=0.05).

At the Attapulgus site in 2003 the beginning soil Ca was adequate to high at 360 mg/kg (Table 7). No responses in yield or grade would be anticipated due to additions of gypsum for Florunner. GA_02C had high yield, grade, seed Ca and germination . Yield for DP_1 was equal to that of GA_02C, but seed Ca was lower. Over the four varieties, only the seed Ca was affected by gypsum additions.

Table 7. Attapulgus, GA 2003
Soil tests in the pegging zone prior to application of gypsum treatments:
Soil pH = 6.2, K, Ca, and Mg = 55, 360, and 51 mg/kg, respectively.

variety	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
Ga_02C	4872 a	73 a	843 a	93 ab
DP_1	4587 ab	68 b	575 b	90 ab
Carver	4209 bc	70 b	836 a	94 a
Norden	3749 c	69 b	881 a	90 b

Gypsum	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
bloom gypsum	4267 a	70 a	939 a	93 a
no gypsum	4441 a	69 a	628 b	91 a

Values in a data set and column followed by a common letter are not different by LSD (0.05)
There were no significant interactions of variety and gypsum by F test (P=0.05)

Soil Ca at the Tifton site in 2002 was near the Ga threshold level established with Florunner (Table 8). Yields were decreased and there was great variability in the plots due to a high incidence of Tomato Spotted Wilt Virus infections. Planting DP_1 resulted in greatest yield and numerically the lowest grade among the four varieties. Yield of Norden was greater than yield of GA_Green. There were no other significant responses due to variety or gypsum in the experiment.

In an experiment at Tifton in 2003 where the initial soil Ca was 332 mg/kg, GA_02C produced the highest yield and grade of four varieties and seed Ca and germinations of seed produced equal to Carver and Norden (Table 9). Bloom gypsum did not affect yield or grade, but significantly increased the concentration of Ca in the seed and percent germination, regardless of variety.

A summary of the nine experiments (location-years) is provided in Table 10. Only the Attapulgus 2002 experiment had a soil Ca test of less than the threshold concentration where gypsum would have been recommended. Over both gypsum treatments, yield, grade and germination were low for that experiment, but the high infection with CBR contributed to the poor crop at that location. Even though the total data set indicates a wide range in values due to location and year, the above threshold Ca concentrations indicate the difficulty in finding cultivated soils with Mehlich-1 soil Ca

less than 250 mg/kg, where response of yield and grade to bloom gypsum may be anticipated.

Table 8. Tifton, GA 2002
Soil tests in the pegging zone prior to application of gypsum treatments:
Soil pH = 5.7, K, Ca, and Mg = 78, 261, and 25 mg/kg, respectively.

variety	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
AT_201	2268 bc	65 a	743 a	77 a
DP_1	3014 a	64 a	760 a	76 a
GA Green	1970 c	73 a	870 a	80 a
Norden	2576 b	70 a	739 a	82 a

Gypsum	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
bloom gypsum	2522 a	71 a	760 a	83 a
no gypsum	2393 a	65 a	796 a	73 b

Values in a data set and column followed by a common letter are not different by LSD (0.05)
There were no significant interactions of variety and gypsum by F test (P=0.05).

When the nine experiments were combined, it is cleared that grade, seed Ca and germination of the seed was increased by bloom gypsum application (Table 11). Significant responses due to gypsum application was determined for at least one of these measurements in seven out of the nine experiments (Table 12). Some response to gypsum was determined at each experiment in FL and GA, but in only one of the three experiments in AL. The lack of any response to gypsum in two experiments in Al was likely due to the high soil test Ca at that location.

SUMMARY

Although we tried to obtain experiments where soil Ca was less than 250 mg/kg, where some response in yield and grade could often be obtained with Florunner. most of our experiments with modern varieties were conducted in fields with higher soil Ca. Most commercial peanut fields have soil Ca tests where Florunner yield and grade are not significantly increased by additions of gypsum at bloom. The results in this study with several modern varieties, indicate the same results for those varieties. There was a general lack of interaction between variety and bloom gypsum application in this study, indicating that there is no evidence for recommending separate gypsum

applications among these varieties. Data collected for seed Ca and germination of the seeds produced in these experiments indicate that bloom gypsum should continue to be recommended for all peanuts grown for seed production, regardless of variety.

Table 9. Tifton, GA 2003

Soil tests in the pegging zone prior to application of gypsum treatments:
Soil pH = 5.8, K, Ca, and Mg = 56, 332, and 24 mg/kg, respectively.

variety	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
Ga_O2C	4825 a	74 a	872 a	93 a
DP_1	4386 b	71 b	636 b	84 b
Carver	4214 b	70 b	865 a	95 a
Norden	4304 b	70 b	918 a	92 a

Gypsum	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
bloom gypsum	4452 a	71 a	973 a	93 a
no gypsum	4412 a	71 a	672 b	89 b

Values in a data set and column followed by a common letter are not different by LSD (0.05)
There were no significant interactions of variety and gypsum by F test (P=0.05)

Table 10. Summary for 9 location-years.

Location Year	Soil Ca	pod yield	TSMK	Seed Ca	germination
	mg/kg	lb/acre	%	mg/kg	%
Headland 01	372 a	3689 b	69.5 cd	no data	no data
Headland 02	354 ab	3886 b	74.6 a	497 d	81 b
Headland 03	no data	3237 c	69.4 cd	821 b	93 a
Quincy 02	332 b	2472 d	71.6 b	510 d	68 c
Quincy 03	282 c	1228 e	70.9 bc	612 c	80 b
Attapulgus 02	162 d	1187 e	71.2 e	872 b	71 c
Attapulgus 03	360 ab	4354 a	69.8 bcd	784 b	92 a
Tifton 02	261 c	2457 d	68.2 d	1179 a	79 b

Tifton 03	332 b	4432 a	71.3 b	823 b	91 a

Values for pod yield, TSMK, seed Ca and germination are an average of gypsum and no gypsum.
Values in a data set and column followed by a common letter are not different by LSD (P=0.05).

Table 11. Effect of bloom gypsum application for all experiments combined.

Gypsum	pod yield	TSMK	seed Ca	germination
	lb/acre	%	mg/kg	%
bloom gypsum	2962 a	70.2 a	801 a	84 a
no gypsum	2995 a	69.3 b	691 b	79 b

Values in a data set and column followed by a common letter are not different by LSD (0.05)

Table 12. Significant interactions of location-year with gypsum applications (by F test at P= 0.05)

Location-year	Soil Ca[1]	Gypsum	TSMK	Seed Ca	Germination
	mg/kg		%	mg/kg	%
Headland01	372	bloom	69.2	no data	no data
		no gypsum	69.7	no data	no data
Headland02	354	bloom	74.2	603*	84.3*
		no gypsum	74.9	390	77.2
Headland03	no data	bloom	69.4	839	92.6
		no gypsum	69.3	803	93.1
Quincy02	332	bloom	71.6	519*	69.6
		no gypsum	71.6	501	66.6
Quincy03	282	bloom	71.8*	639*	81.8*
		no gypsum	70.0	585	77.2
Attapulgus02	162	bloom	62.0	926*	75.5*
		no gypsum	60.4	817	66.8
Attapulgus03	360	bloom	70.5	939	92.8
		no gypsum	69.2	628*	90.8
Tifton02	261	bloom	71.0	1111	83.2*
		no gypsum	65.3	1242	73.4
Tifton03	332	bloom	71.4	973*	92.8*
		no gypsum	71.3	672	89.4

[1]Soil Ca after planting where no gypsum had been applied.
*value for bloom gypsum application for a given location-year is significantly greater than where no bloom gypsum was applied by the F test (P=0.05).