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2012

Nutrient Management Trials in Peanut
National Peanut Board Final Report 2012

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Executive Summary

Recent field research on the calcium needs of large-seeded runner peanuts (conducted by this author and funded by the National Peanut Board) resulted in a renewed awareness and interest in better ways to provide calcium to peanut for higher yields, grades and seed quality in terms of calcium levels in the harvested nuts and germination. Peanut growers started asking whether there was a difference in gypsum fertilizers, when was the best time to put out each product, and can product applications be split? In addition, several growers were interested in putting calcium materials through the irrigation pivot. Lastly, there are always questions about the efficacy of new soluble liquid calcium fertilizers that are advertised. This study strives to answer some of the questions. This is year two of a three year study to evaluate the source and timing of calcium fertilizers. Results from this field research (one irrigated and one dryland) will be combined with results from 2011 and next year's results to answer these questions. To date, results indicate that all supplements are effective for irrigated production. Under non-irrigated conditions, there are differences among the gypsum sources in yield, grade, germination, and seed calcium. Lime at planting and Agrical (FGD) gypsum at early bloom at 1120 kg/ha (1000 lb/acre) were the best performing treatments. However, PCS wetbulk was often equivalent to these treatments when applied at half the rate (560 kg/ha) indicating that this treatment may be slightly better than Agrical and USG500 at the same rate. In particular, USG500 tended to be the weakest performer of the three sources evaluated. In the irrigated study, few differences in yield and grade were observed. This is likely due to the adequate moisture and availability of calcium in the pegging zone. Additional studies that evaluated calcium uptake at different maturity classes continue to suggest that calcium is taken up throughout development.

Background

Between 2008 and 2010, calcium research on peanut in Alabama concentrated on rates of gypsum needed for new large-seeded runner varieties. This research resulted in showing that while it is more important to provide adequate amounts of calcium to large-seeded runner varieties, the current recommendations for gypsum rates are the same as for the old small-seeded runner varieties. However, the soil moisture contributes considerably to calcium availability. Thus, non-irrigated peanut production can benefit more from calcium supplementation than irrigated production. As a result of this research, more interest in sources of calcium and timing of calcium applications on peanuts emerged. Therefore, in 2011-2013 the emphasis of calcium research shifted to looking at sources and timing.

Materials & Methods

Field experiment was performed at Wiregrass Research and Extension Center (WREC) at Headland, AL, to evaluate sources of calcium as calcium supplements for peanut. Two of the most popular cultivars grown in the Southeast, Georgia 06G and Georgia Greener, were evaluated in this study. Sources of calcium included three different gypsum treatments (i.e., landplaster or calcium sulfate): 1) USG 500 (naturally mined), 2) PCS Wet Bulk (by-product of phosphorus fertilizer production), 3) AgriCal (flue gas desulfurized gypsum or FGD gypsum, which is a by-product of coal burning power plants), and lime. In the non-irrigated Ca source experiment, AgriCal, USG 500, PCS Wetbulk, lime and a no Ca control treatment were compared (Table 1). In the irrigated study, rates of gypsum were compared with lime (Table 2).

Table 1. Non-irrigated treatments

Treatment	**Treatment description**			
No.	Ca Source	Ca Rate (kg/ha)	Ca Rate (lb/acre)	Timing
1	Control	0	0	---
2	AgriCal (FGD)	560	500	at early bloom
3	AgriCal (FGD)	1120	1000	at early bloom
4	Lime	1120	1000	at planting
5	USG500	560	500	at early bloom
6	PCS Wetbulk	560	500	at early bloom

Table 2. Irrigated treatments

Treatment	**Treatment description**			
No.	Ca Source	Ca Rate (kg/ha)	Ca Rate (lb/acre)	Timing
1	Control	0	0	---
2	AgriCal (FGD)	560	500	at early bloom
3	AgriCal (FGD)	1120	1000	at early bloom
4	Lime	1120	1000	at planting

Results & Discussion

Non-irrigated Peanuts: Yield and Grade

Yield of Georgia-06G peanuts in the non-irrigated trial was highest in the lime (1120 kg/ha or 1000 lb/acre) and Agrical (FGD) gypsum (1120 kg/ha or 1000 lb/acre) treatments (Table 3). Yield increased from 2562 to 3415 kg/ha (710 lb) from the no calcium control to the highest Agrical treatment. Yield of Georgia Greener peanuts in the non-irrigated trial was similar in that the lime and higest rate of Agrical produced the higest yields. However, Georgia Greener yields were not higher than the no calcium control. Additionally, the peanuts receiving USG 500 had a lower yield than lime or PCS wetbulk. Based on yield, it appears that lime, Agrical, and PCS wetbulk are the best sources of gypsum. The USG 500 was generally lower in both varieties, but not always significantly. There was no difference in yield between Georgia-06G and Georgia Greener.

Georgia-06G grade, defined as percentage of sound mature kernels, followed similar trends as yield; however, differences were more pronounced (Table 3). Agrical (1120 kg/ha), lime, PCS wetbulk (560 kg/ha) had the highest grade, followed closely by Agrical (560 kg/ha). Grade of all Georgia-06G peanuts with calcium supplementation were greater than the no calcium control. Grade of Georgia Greener peanuts followed a similar trend as Georgia-06G; however, no treatment had was significantly higher than the no calcium control treatment except the Agrical (1120 kg/ha).

Overall, yield and grade under non-irrigated conditions suggested that PCS wetbulk was potentially a better source of gypsum than Agrical and that USG 500 was potential a poorer source of gypsum than Agrical. Treaments with PCS wetbulk (560 kg/ha) resulted in yield and grades that intermediate between Agrical applied 1120 kg/ha and 560 kg/ha. Results were consistent with both varieties. Yield and grade of USG 500 was consistently lower than other treatments and often did not differ from the control, especially with Georgia Greener.

Table 3. Effect of calcium source and rate on peanut yield and grade. Dissimilar letters within a column for non-irrigated or irrigated studies indicate significant differences at the $\alpha=0.05$ level.

Treatment	Yield (kg/ha)		SMK (%)		TSMK (%)	
	G06G	GG	G06G	GG	G06G	GG
			--------------------Non-irrigated------------------			
1	2562 c	3275 ab	61.3 c	61.0 b	63.8 c	64.0 b
2	3090 b	3117 ab	65.8 b	61.0 b	67.8 b	64.5 b
3	3415 ab	3212 ab	72.3 a	68.5 a	73.3 a	73.0 a
4	3781 a	3388 a	69.8 ab	67.0 ab	72.5 a	71.0 a
5	2873 bc	2832 b	63.3 b	62.8 b	65.8 bc	67.0 b
6	3199 b	3415 a	69.3 ab	67.3 ab	71.5 ab	70.8 ab
			----------------------Irrigated--------------------			
1	6166 a	5868 a	73.3 b	72.4 a	76.6 b	77.0 a
2	6261 a	5231 a	74.1 ab	73.3 a	77.6 ab	77.8 a
3	6302 a	5909 a	74.0 ab	73.8 a	78.0 ab	78.0 a
4	6270 a	4933 a	77.0 a	72.3 a	79.5 a	77.1 a

Irrigated Peanuts: Yield and Grade

Yield of irrigated Georgia-06G peanuts was 6250 kg/ha, which was higher than Georgia Greener (5485 kg/ha) (Table 3). However, there was no effect of calcium treatment for either variety. Grade of Georgia-06G was higher in the lime treatment (77%) compared to the no calcium control 73.3%; however, there was no difference among lime and Agrical treatments. Grade of Georgia Greener did not differ by calcium treatment and averaged 73%.

These results are consistent with previous studies that suggest that the supplemental irrigation helps provide calcium to the peanut. Thus, the calcium that is present in the pegging zone is more available due to the more consistent moisture conditions of the soil.

Non-Irrigated Peanuts: Germination and Seed Calcium Concentration

Under non-irrigated production, Georgia-06G germination (according to both warm and cold germination test) was highest for Agrical (1120 kg/ha) and lime (Table 4). Although the other supplements resulted in higher germination than the no-calcium control treatment, they did not differ from the control. Warm and cold germination test also provided the same conclusions during the Georgia Greener evaluation, and the conclusions were similar to Georgia-06G. The only difference was in the effectiveness of PCS wetbulk. For some reason, the PCS wetbulk was more effective for Georgia Greener than Georgia-06G. This treatment resulted in the highest warm and cold germination.

Calcium in the peanut seed (Table 4) followed almost the exact same trend as the yield (Table 3). Seed Ca in Georgia-06G was highest in the lime and Agrical (1120 kg/ha) treatments, followed by PCS wetbulk, Agrical (560 kg/ha) and USG 500. Only the lime differed significantly from the no calcium control treatment for Georgia-06G. Seed calcium in Georgia Greener also followed a similar trend as yield. There was no difference among the calcium treatments, but Agrical (560 kg/ha), lime, and USG500 treatments were higher than the control.

Typically seed calcium is the best indicator for the availability of calcium in the pegging zone. Results from yield, grade, germination, and seed calcium are highly consistent. Results suggest that PCS wetbulk may be slightly better than Agrical, which is slightly better than USG500 under non-irrigated conditions.

Irrigated Peanuts: Germination and Seed Calcium Concentration

Under irrigated conditions, there were fewer differences among treatments than in the non-irrigated study (Table 4). Using the warm germination test, germination of Georgia-06G was greater than the no-calcium control when any of the calcium supplements was used. There was no difference among any treatments with the cold germination tests for Georgia-06G. Georgia Greener showed higher germination (both warm and cold germination tests) in the lime treatment compared to the control, but the Agrical treatments were intermediate.

Seed calcium was highest in the Agrical (1120 kg/ha) and lime treatments in Georgia-06G with the Agrical (560 kg/ha) intermediate between the no calcium control and the other treatments. Georgia Greener had the highest seed calcium in the Agrical (1120 kg/ha) treatment. The Agrical (560 kg/ha) treatment was intermediate between the higher Agrical rate and lime, and the no calcium control was less than all calcium treatments.

Although there were fewer observed differences in yield and grade in the irrigated trial compared to the non-irrigated trial, the germination and seed calcium data support findings in the non-irrigated trial that show that lime and the higher rate of Agrical (1120 kg/ha) are the most effective at supplying calcium to peanut.

Table 4. Effect of calcium source and rate on peanut seed germination (warm and cold

germination tests) and calcium concentration in the seed. Dissimilar letters within a column for non-irrigated or irrigated studies indicate significant differences at the α=0.05 level.

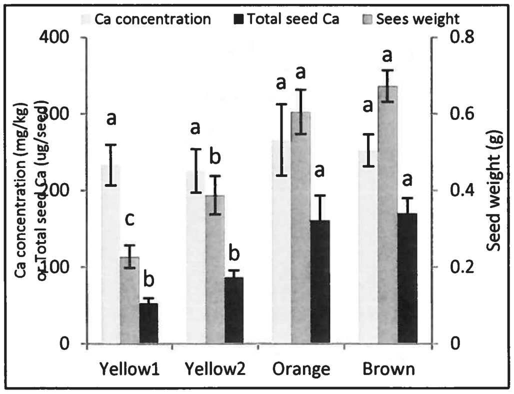
Treatment	**Warm Germination (%)**		**Cold Germination (%)**		**Calcium in nuts (mg/kg)**	
	G06G	GG	G06G	GG	G06G	GG
	--------------------Non-irrigated------------------					
1	13.3 b	19.5 b	20.8 b	20.3 b	254 b	252 b
2	18.5 b	21.8 ab	28.5 b	25.5 ab	280 b	372 a
3	34.3 a	31.3 ab	43.5 a	28.8 ab	343 ab	325 ab
4	36.8 a	34.8 a	49.5 a	36.5 a	375 a	376 a
5	20.5 b	31.0 ab	25.8 b	33.0 ab	285 b	394 a
6	24.3 ab	39.3 a	40.5 ab	36.0 a	327 ab	333 ab
	-----------------------Irrigated--------------------					
1	79.8 b	79.0 b	68.5 a	75.3 b	559 b	567 c
2	87.3 a	86.5 ab	82.3 a	81.5 ab	624 ab	672 ab
3	86.3 a	85.0 ab	81.5 a	82.0 ab	639 a	731 a
4	87.7 a	88.0 a	80.7 a	84.7 a	640 a	648 b

Seed weight and Ca content in different maturity class

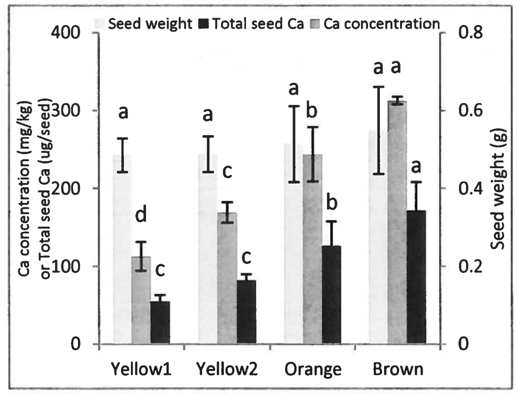
Calcium concentration did not differ as greatly throughout the developmental stages of GG or 06G as the total calcium per seed or total weight of seed (Figure 7). This difference shows the importance examining seed size along with calcium concentration. Total calcium generally increased in both varieties throughout the developmental period. It is likely that as peanut size increases there is more calcium absorbed, thus increasing the total calcium. This may explain why generally smaller stages (White, yellow1, and yellow2) have lower total calcium than the larger stages. The white stage having the least amount of total calcium maybe exclusively due to its seed size as it is much smaller than the other stages (Fig. 7).

These results show the importance of maintaining seed calcium in the pegging zone throughout the development period. High rainfall mid-season may result in leaching and contribute to lower yield, grade, germination, and seed calcium. In 2013, additional treatments will be added to this study to look at late season application of calcium and calcium applications through irrigation applications.

4 weeks before harvest

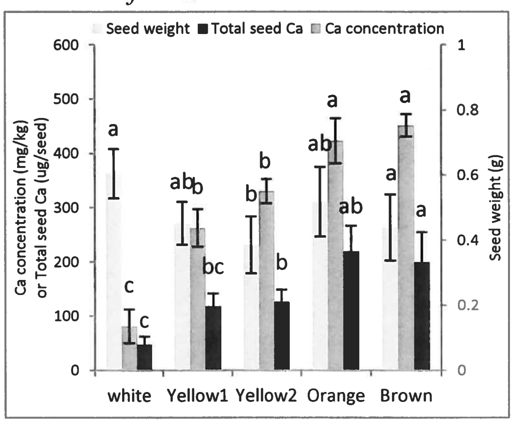


Georgia 06G

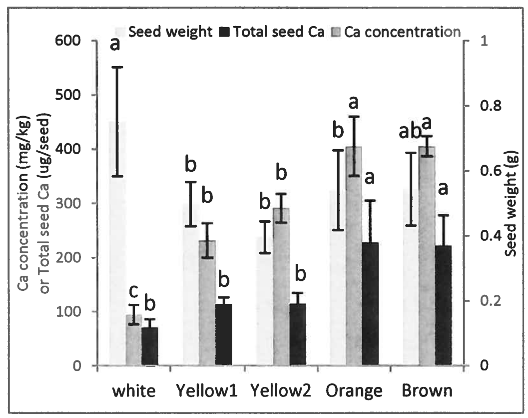


Georgia Greener

2 weeks before harvest

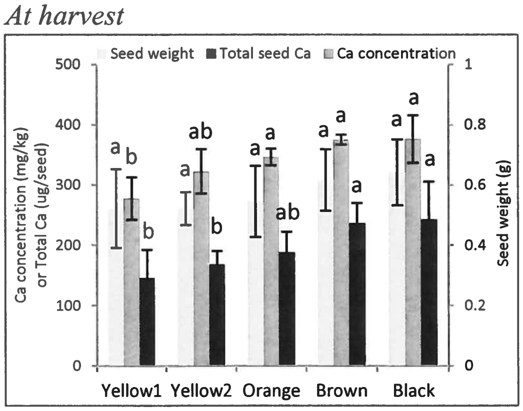


Georgia 06G

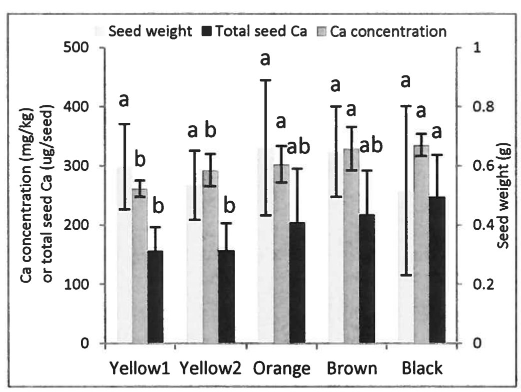


Georgia Greener

At harvest



Georgia 06G



Georgia Greener

Figure 7. Seed calcium concentration, seed weight and total seed calcium as divided into development stages using the hull scrape method