© 2010 Plant Management Network.
Accepted for publication 25 November 2009. Published 26 February 2010.

Response of Virginia Market Type Peanut to Interactions of Cultivar, Calcium, and Potassium

David L. Jordan, Professor, **P. Dewayne Johnson,** Research Specialist, **Janet F. Spears,** Professor, and **Brenda Penny,** Research Specialist, Department of Crop Science, Box 7620, North Carolina State University, Raleigh, NC 27695; and **David Hardy,** Section Chief, Agronomic Division, North Carolina Department of Agriculture and Consumer Services, 4300 Reedy Creek Road, Raleigh, NC 27607

Corresponding author: David L. Jordan. David_Jordan@ncsu.edu

Jordan, D. L., Johnson, P. D., Spears, J. F., Penny, B., and Hardy, D. 2010. Response of Virginia market type peanut to interactions of cultivar, calcium, and potassium. Online. Crop Management doi:10.1094/CM-2010-0226-01-RS.

Abstract

Peanut kernel size can influence response to calcium. While runner market type peanut cultivars often do not require supplemental calcium at flowering, application of gypsum ($CaSO_4$) is routinely recommended for large-seeded Virginia market type peanut cultivars. However, kernel size varies considerably for Virginia market type peanut. Research was conducted from 2001-2005 at two locations in North Carolina to determine if the gypsum rate with or without prior potassium application should vary for the Virginia market type peanut cultivars NC-V 11 (625 kernels/lb seed) and Gregory (450 kernels/lb seed). Although the percentage of total sound mature kernels (%TSMK) was not affected by the interaction of cultivar and gypsum rate, pod yield and the percentage of extra large kernels (% ELK) was affected by this interaction. The interaction of location, year, and gypsum rate was significant for pod yield, %TSMK, and %ELK. Potassium had no major effect on pod yield or market grade characteristics. Seed germination and percentages of calcium deficient kernels were not affected by the interaction of cultivar and gypsum rate but was affected by the main effect of these treatment factors. These data suggest that although differences in peanut response to Virginia market type peanut exist, increasing the rate of gypsum above the rate currently recommended is not necessary for large-seeded Virginia market type peanut.

Introduction

The need for adequate calcium in the pegging zone of soil for kernel development is well documented for peanut (2,3,7,8,9,19). A strong relationship between pod yield and soil calcium concentration exists for small-seeded runner market type peanut, but the relationship is relatively poor for large-seeded Virginia market type peanut (7,8). Cooperative Extension recommendations in several states in the United States include soil testing as a tool for determining the need for supplemental gypsum application at flowering for runner market type cultivars (1,6,10,11,13). Because of the poor relationship between soil calcium concentration and pod yield for Virginia market type peanut, supplemental calcium is generally recommended for all large-seeded Virginia market types (1,6,10,11,13). However, Virginia market type peanut vary considerably in size of kernels and pods, and in recent years some growers have applied rates of gypsum higher than the standard recommendation for large-seeded cultivars (13). Research is needed to determine if gypsum rates need to be adjusted for Virginia market type peanut based on kernel and pod size.

The concentration of potassium in soil can influence calcium absorption by developing kernels and pods (7,8), and recommendations on gypsum application to runner market types include determining the ratio of calcium to potassium in the pegging zone (11,13). Elevated concentrations of potassium in the pegging zone could interact with gypsum rate and cultivar kernel size. In a

survey of growers in North Carolina with Virginia market type peanut with pod yields typically higher the state average, approximately 80% of growers applied some form of N-P_2O_5-K_2O in the spring prior to planting (17). In this same group of growers, 98% applied gypsum at flowering (17). The relationship of calcium and potassium fertility has not been evaluated with more recently released Virginia market type peanut cultivars with varying kernel size.

The cultivars Gregory and NC-V 11 offer the widest range of kernel and pod size of Virginia market type peanut grown commercially (13). These cultivars have similar disease reaction, and pod maturity of these cultivars progresses in a similar manner (13,20). Research was conducted to define interactions among the cultivars Gregory and NC-V 11, gypsum rate, and potassium to determine if the gypsum rate needs to be modified based on kernel and pod size of Virginia market type peanut.

Locations, Soil Series, Tillage, and Pest Management

The experiment was conducted in North Carolina from 2001-2005 at the Peanut Belt Research Station located near Lewiston-Woodville and the Upper Coastal Plain Research Station located near Rocky Mount. Soil at Lewiston-Woodville was a Norfolk sandy loam (fine-loamy, siliceous, thermic, Typic Paleudults). Soil at Rocky Mount was a Goldsboro loamy sand (fine-loamy, siliceous, thermic Aquic Paleudults). Peanut was planted in conventionally-prepared raised seedbeds in plots 2 rows wide (36-inch spacing) by 30 ft in length. Production and pest management practices were based on Cooperative Extension recommendations for the region (5,13,14,20).

Cultivar, Gypsum, and Potassium Treatments

Treatments consisted of a factorial arrangement of two levels of cultivar (Gregory and NC-V 11), three levels of gypsum (no gypsum, the recommended use rate of gypsum, and 1.5 times the recommended use rate of gypsum), and two levels of potassium fertilizer applied immediately after planting to the soil surface [no potassium and 250 lbs/acre 0-0-60 (N, P_2O_5-K_2O)]. The seeding rate for Gregory (12) (450 seeds/lb) was 150 lbs/acre (13). The seeding rate for NC-V 11 (22) (625 seeds/lb) was 115 lbs/acre (13). Cultivars were seeded at a rate designed to achieve an in-row plant population of 4 to 5 plants/ft. The broadcast standard rate of gypsum during 2001-2004 was 1250 lbs/acre (USG 500, 70% calcium sulfate) (13). Gypsum at 600 lb/acre (USG Ben Franklin, 85% calcium sulfate) (13) was banded in 2005 (18-inch band on rows spaced 36 inches apart). Rates are based on treated area. Gypsum was applied in late June of each year at early flower production.

Immediately prior to application of gypsum, twelve soil cores to a depth of three inches were collected from no potassium and potassium-treated plots for the cultivar Gregory. Soil pH, soil potassium, and soil calcium levels for these samples are presented in Table 1.

Peanut was dug and vines were inverted in late September or early October based on pod mesocarp color (21). Pods and vines were allowed to air-dry for 4 to 7 days prior to threshing, and final pod yield was adjusted to 8% moisture. Percentage of extra large kernels (%ELK) and total sound mature kernels (% TSMK) were determined from a one pound sample of pods collected at harvest.

One hundred kernels from the sound mature kernel fraction of each sample during 2001, 2004, and 2005 were used to determine the percentage of kernels showing a calcium deficiency and standard germination (4).

Table 1. Soil test results for pH, potassium, and calcium in the pegging zone immediately prior to gypsum application approximately 45 days after planting. Potassium (0-0-60, N-P_2O_5-K_2O) at 250 lbs/acre was applied immediately after planting to the soil surface without incorporation.

Location	Year	Soil fertility characteristic					
		Soil pH		Potassium ($cmol_c$ /kg)		Calcium ($cmol_c$ /kg)	
		$-K_2O$	$+K_2O$	$-K_2O$	$+K_2O$	$-K_2O$	$+K_2O$
Lewiston-Woodville	2001	5.9	6.1	0.19	0.46*	2.73	2.18
Rocky Mount	2001	5.6	5.4	0.34	0.44	3.08	3.00
Lewiston-Woodville	2002	6.1	6.0	0.32	0.42	4.69	4.76
Rocky Mount	2002	6.2	6.3	0.42	0.56	3.46	3.58
Lewiston-Woodville	2003	6.0	5.9	0.26	0.44*	3.19	2.58
Rocky Mount	2003	5.8	5.8	0.24	0.47*	2.57	2.60
Lewiston-Woodville	2004	5.7	5.5	0.19	0.34*	3.96	3.94
Rocky Mount	2004	6.3	6.4	0.47	0.61	4.35	4.54
Lewiston-Woodville	2005	6.0	6.0	0.51	0.81*	3.63	3.79
Rocky Mount	2005	6.4	6.8	0.18	0.42*	1.31	1.30

* Indicates significance at $P \leq 0.05$ for each soil fertility characteristic within a location and year combination.

Experimental Design and Statistical Analyses

The experimental design was a randomized complete block with treatments replicated four times. Data for soil pH, soil potassium, and soil calcium from each location were subjected to analysis of variance comparing the no potassium and potassium fertilizer treatments. Data for pod yield, %ELK, % TSMK, percent seed germination, and the percentage of kernels showing calcium deficiency were subjected to analysis of variance with Proc GLM of SAS software (18). Means of significant main effect and interactions were separated using Fisher's Protected LSD test at $P \leq 0.05$.

Results of Soil Sampling Prior to Gypsum Application

Soil pH did not differ within a site and year combination (referred to as trial) but did range from 5.4 to 6.8 (Table 1). The concentration of potassium in the pegging zone was higher in the potassium-treated than non-treated control plots at the time of gypsum application (approximately 45 days after planting) in 6 of 10 trials (Table 1). Although not significant, soil potassium levels were higher when applied in all other trials. The concentration of calcium in the pegging zone was not affected by previous application of potassium (Table 1).

Results of Statistical Analyses

The main effect of gypsum rate and the interaction of location, year and gypsum rate were significant for pod yield, %ELK, %TSMK, seed germination, and calcium deficient kernels (Table 2). The interaction of location, year and cultivar was significant for pod yield, %ELK, and %TSMK (Table 2). The interaction of cultivar by gypsum rate was significant only for pod yield while the interaction of gypsum rate by potassium rate was significant for %ELK and %TSMK (Table 2). The interaction of location, year, cultivar, and potassium rate was significant for %ELK (Table 2). The interaction location × year × cultivar × gypsum × potassium was not significant for any of the parameters.

Table 2. Probability values from analyses of variance for pod yield, percentage of extra large kernels (%ELK), percentage of total sound mature kernels (%TSMK), percent seed germination (%GER), and percent calcium deficient kernels (%CDK).

Source	Pod yield	%ELK	%TSMK	%GER	%CDK
	P value				
Location × year	0.0001	0.0001	0.0001	0.0001	0.0001
Cultivar (CUL)	0.6965	0.0001	0.0019	0.0146	0.4331
K_2O	0.0815	0.5766	0.9202	0.1308	0.0786
Gypsum	0.0001	0.0001	0.0001	0.0001	0.0001
Location × year × CUL	0.0001	0.0001	0.0066	0.7103	0.7475
Location × year × K_2O	0.4778	0.2465	0.2495	0.5344	0.8144
Location × year × gypsum	0.0001	0.0001	0.0001	0.0001	0.0001
CUL × K_2O	0.7721	0.7645	0.3843	0.1443	0.0510
CUL × gypsum	0.0270	0.3104	0.8280	0.4317	0.5279
K_2O × gypsum	0.3601	0.0064	0.0006	0.5263	0.8253
Location × year × CUL × K_2O	0.7449	0.0505	0.3468	0.2787	0.4779
Location × year × CUL × gypsum	0.7319	0.5123	0.4462	0.9004	0.8332
Location × year × K_2O × gypsum	0.1771	0.0672	0.3343	0.2428	0.6949
CUL × K_2O × gypsum	0.2965	0.2368	0.6391	0.3242	0.3555
Location × year × CUL × K_2O × gypsum	0.9919	0.8310	0.6261	0.3588	0.6337
Coefficient of variation (%)	12.1	10.4	4.5	8.1	78.9
Number of trials	10	10	10	6	6

Pod Yield

Differences in pod yield were found in 8 of 10 trials when comparing cultivars but they had similar pod yield overall (Table 3). Gypsum did not affect pod yield in five trials when pooled over cultivars and potassium rates (Table 3). In two trials (Rocky Mount 2001, and Lewiston-Woodville-2004), an increase in 1.5 times the recommended use rate resulted in a decrease in yield compared with the no-gypsum control while in one trial (Lewiston-Woodville 2005), yield was higher when gypsum was applied at the 1.5 times the recommended use rate compared with the no-gypsum control and the recommended rate of gypsum. In 2005, both rates of gypsum increased yield similarly over the no-gypsum control (Table 3). No clear relationship between soil calcium and potassium concentration and pod yield was found (Tables 1 and 3).

Although a positive response in pod yield does not always occur (15,16), results demonstrating a yield increase were expected. However, lower yield with the higher rate of gypsum in two of the ten trials was not expected. The lower yield with the highest rate of gypsum may have been associated with low pH in the pegging zone. Soil pH at the two locations where yield was lower following application of the highest gypsum rate (Rocky Mount 2001 and Lewiston-Woodville 2004) was 5.4 to 5.7 (Table 1). Although not substantiated in this research, pH in the pegging zone may have decreased even further following application of gypsum, possibly caused by a salt effect. The combination of a relatively low pH already existing in the pegging zone coupled with a further decrease in pH may have negatively affected pod and kernel development. Although fertility throughout the entire soil profile may have influenced peanut growth, development, and yield, soil was sampled only in the pegging zone.

Table 3. Interactions of location, year with cultivar and location, year with gypsum rate for peanut pod yield.*

Location	Year	Cultivar		Relative gypsum rate**		
		Gregory	NC-V 11	0	1.0×	1.5×
		Peanut pod yield (lbs/acre)				
Lewiston-Woodville	2001	4170 a	3660 b	4000 a	3780 a	3670 a
Rocky Mount	2001	4300 a	3620 b	4170 a	3970 ab	3730 b
Lewiston-Woodville	2002	3660 a	3260 b	3420 a	3570 a	3390 a
Rocky Mount	2002	4350 a	4280 a	4320 a	4320 a	4300 a
Lewiston-Woodville	2003	4200 b	4520 a	4130 b	4350 b	4610 a
Rocky Mount	2003	3530 b	3920 a	3780 a	3660 a	3740 a
Lewiston-Woodville	2004	3340 b	3950 a	3820 a	3760 a	3350 b
Rocky Mount	2004	3320 a	3030 b	3150 a	3110 a	3270 a
Lewiston-Woodville	2005	4950 a	4890 a	4530 b	5110 a	5120 a
Rocky Mount	2005	3580 b	4240 a	2540 b	4490 a	4630 a

* Means for cultivar or for relative gypsum rate within each combination of year and location followed by the same letter are not significantly different according to Fisher's Protected LSD Test at $P \leq 0.05$. Data for cultivar are pooled over K_2O and gypsum rates. Data for relative gypsum rate are pooled over K_2O rates of 0 and 250 lbs/acre (0-0-60, N-P_2O_5-K_2O) and cultivar.

** The 1× rate of gypsum corresponds to a broadcast application of 1,250 lbs/acre of USG 500 (70% calcium sulfate) from 2001-2004. In 2005, a banded (18 inch band on 36-inch rows) application of 600 lbs/acre of USG Ben Franklin (85% calcium sulfate) was applied.

Applying gypsum at either rate did not increase pod yield of the cultivar NC-V 11 when data were pooled over locations, years and potassium rate (Table 4). However, application of gypsum increased pod yield over the no-gypsum control for Gregory cultivar (Table 4). Pod yield was similar for both cultivars when gypsum was applied, although pod yield of NC-V 11 exceeded that of Gregory in absence of gypsum (Table 4). The cultivar Gregory is known to produce larger kernels than NC-V 11 and is considered to have a higher calcium requirement than other smaller-seeded cultivars (13). The higher yield of NC-V 11 than Gregory in absence of supplemental calcium may have been associated partially with the ability of the smaller-seeded cultivar NC-V 11 to absorb adequate calcium from soil for pod and kernel development whereas calcium in soil was inadequate for the larger-seeded cultivar Gregory without gypsum sulfate application.

Results from the interaction of cultivar by gypsum rate suggest that applying gypsum at a rate exceeding the current recommended rate is of no value even for the larger-seeded cultivar Gregory. Additionally, results from the interaction of location × year × gypsum rate suggest that applying gypsum at rates higher than the recommended rate can be detrimental in some cases, perhaps when soil pH is relatively low. Other research (16) demonstrated that pod yield of Gregory increased when gypsum at 300 or 600 lbs/acre was applied compared with a no-gypsum control. However, yield response of Virginia market type peanut can vary by location, environmental conditions, and cultivar (7,8,15,16,19).

Table 4. Interactions of cultivar and gypsum rate for peanut pod yield.

Cultivar	Relative gypsum rate**		
	0	1.0×	1.5×
	Peanut pod yield (lbs/acre)		
Gregory	3720 c*	4040 a	4070 a
NC-V 11	3880 b	3970 ab	3950 ab

* Means within a column or row followed by the same letter are not significantly different according to Fisher's Protected LSD Test at $P \leq 0.05$. Data are pooled over locations, years and K_2O rates of 0 and 250 lbs/acre (0-0-60, N-P_2O_5-K_2O).

** The 1× rate of gypsum corresponds to a broadcast application of 1,250 lbs/acre of USG 500 (70% calcium sulfate) from 2001-2004. In 2005, a banded (18 inch band on 36-inch rows) application of 600 lbs/acre of USG Ben Franklin (85% calcium sulfate) was applied.

Market Grade Characteristics

Considerable variation in %ELK and %TSMK were noted when comparing gypsum rates across trials (Table 5). Both rates of supplemental calcium increased %ELK equally over the no-gypsum control in three trials (Lewiston-Woodville 2001, Rocky Mount 2002, and Lewiston-Woodville 2005) while applying the higher rate of gypsum was more effective in increasing the %ELK in two of the trials (Lewiston-Woodville 2003, and Rocky Mount 2005) than the recommended rate (Table 5). In three trials no difference in %ELK was noted among gypsum rates while at Lewiston-Woodville in 2004 the %ELK was lower with the highest rate of gypsum compared with the no-gypsum control (Table 5).

Table 5. Interaction of location, year with gypsum rate for percentage of extra large kernels (%ELK) and percentage of total sound mature kernels (%TSMK).*

Location	Year	Relative gypsum rate**					
		0	1.0×	1.5×	0	1.0×	1.5×
		%ELK			%TSMK		
Lewiston-Woodville	2001	41 b	45 a	45 a	68 b	72 a	71 a
Rocky Mount	2001	37 a	35 a	36 a	73 a	72 ab	71 b
Lewiston-Woodville	2002	44 a	45 a	43 a	69 a	70 a	70 a
Rocky Mount	2002	43 b	46 a	47 a	66 b	68 a	70 a
Lewiston-Woodville	2003	49 c	52 b	55 a	73 b	73 b	75 a
Rocky Mount	2003	48 a	47 a	46 a	70 b	72 a	72 a
Lewiston-Woodville	2004	45 a	44 ab	42 b	72 b	73 a	73 a
Rocky Mount	2004	45 b	47 ab	48 a	71 a	71 a	71 a
Lewiston-Woodville	2005	43 b	52 a	52 a	65 b	69 a	70 a
Rocky Mount	2005	20 c	47 b	50 a	48 b	69 a	70 a

* Means of %ELK or %TSMK within each combination of year and location followed by the same letter are not significantly different according to Fisher's Protected LSD Test at $P \leq 0.05$. Data are pooled over cultivars and K_2O rates of 0 and 250 lbs/acre (0-0-60, N-P_2O_5-K_2O).

** The 1× rate of gypsum corresponds to a broadcast application of 1,250 lbs/acre of USG 500 (70% calcium sulfate) from 2001-2004. In 2005, a banded (18-inch band on 36-inch rows) application of 600 lbs/acre of USG Ben Franklin (85% calcium sulfate) was applied.

In six trials, both rates of supplemental calcium increased the %TSMK equally (Table 5). At Lewiston-Woodville 2002 and Rocky Mount 2004, gypsum rate did not affect %TSMK while at Rocky Mount 2001, the higher rate of gypsum decreased %TSMK above the control (Table 5). In a previous study (16), larger-seeded Virginia market type cultivar Gregory had consistently higher % TSMK than the smaller runner market type cultivars Georgia Green and GK-7 across locations and over years.

Although %ELK and %TSMK sometimes increased when the higher rate of gypsum was applied compared with the recommended rate, a reduction also occurred in some cases. Coupled with results obtained for pod yield, these data suggest that rates higher than those currently recommended for Virginia market type peanut offer no advantage, even for the large-seeded cultivar Gregory.

Interactions potassium × gypsum and location × year × cultivar × potassium influenced %ELK (Tables 6 and 7). During 2001-2004, the %ELK for Gregory was similar regardless of potassium rate and exceeded %ELK for NC-V 11 (Table 6). Potassium rate did not affect %ELK for Gregory or NC-V 11 during 2005 but applying potassium increased %ELK for NC-V 11 at Lewiston-Woodville during 2001 (Table 6).

Results from the interaction of potassium rate and gypsum rate were surprising. Although it was expected that increasing the gypsum rate would increase %ELK, the higher %ELK obtained when potassium was applied at planting prior to applying gypsum at the recommended rate was not expected (Table 7). Growers are often concerned that excessive potassium in the pegging zone can affect calcium absorption and result in pods with only one kernel or even no kernels (19). These results suggest soil potassium levels tested in these trials will most likely have no adverse affect on pod yield or market grade characteristics.

Table 6. Interaction of location, year, cultivar, and potash rate for percentage of extra large kernels (%ELK).*

		Gregory		NC-V 11	
		K_2O rate (lbs/acre)			
		0	250	0	250
Location	**Year**	**%ELK**			
Lewiston-Woodville	2001	50 a	48 a	36 c	41 b
Rocky Mount	2001	48 a	46 a	25 b	25 b
Lewiston-Woodville	2002	51 a	52 a	35 b	38 b
Rocky Mount	2002	50 a	52 a	38 b	40 b
Lewiston-Woodville	2003	55 a	56 a	48 b	48 b
Rocky Mount	2003	55 a	54 a	39 b	40 b
Lewiston-Woodville	2004	50 a	53 a	36 b	35 b
Rocky Mount	2004	50 a	52 a	43 b	41 b
Lewiston-Woodville	2005	52 a	49 ab	48 ab	46 b
Rocky Mount	2005	43 a	41 ab	38 bc	35 c

* Means for percentage of extra large kernels for cultivars within each combination of year and location followed by the same letter are not significantly different according to Fisher's Protected LSD Test at $P \leq 0.05$. K_2O applied as 0-0-60 (N-P_2O_5-K_2O) immediately after planting to the soil surface without incorporation.

Table 7. Interactions of potassium rate and gypsum rate for percentage of extra large kernels.*

K_2O rate** (lbs/acre)	Relative gypsum rate†		
	0	1.0×	1.5×
	% ELK		
0	42 c	45 b	46 ab
250	41 c	47 a	47 a

* Means within a column or row followed by the same letter are not significantly different according to Fisher's Protected LSD Test at $P \leq 0.05$. Data are pooled over locations, years and cultivars.

** K_2O applied as 0-0-60 (N-P_2O_5-K_2O) immediately after planting to the soil surface without incorporation.

† The 1× rate of gypsum corresponds to a broadcast application of 1250 lbs/acre of USG 500 (70% calcium sulfate) from 2001-2004. In 2005, a banded (18 inch band on 36-inch rows) application of 600 lbs/acre of USG Ben Franklin (85% calcium sulfate) was applied.

Seed Quality

Percent germination was slightly higher for the cultivar NC-V 11 (87%) than Gregory (85%) when data were pooled over locations, years, gypsum rates, and potassium rate (data not shown in tables). Higher germination was obtained when gypsum was applied in all six trials where germination was determined from market grade samples collected at harvest (Table 8). In four trials, the highest rate of gypsum increased germination over the recommended rate of gypsum while at one location the higher rate was less effective than the recommend rate (Table 8). However, germination was at least 82% following both rates of supplemental calcium.

Table 8. Interaction of location, year with gypsum rate for percent germination and percent calcium deficient kernels.*

Location	Year	Relative gypsum rate**					
		0	1.0×	1.5×	0	1.0×	1.5×
		% Germination			% Calcium deficient kernels		
Lewiston-Woodville	2001	74 c	82 b	87 a	13 a	5 b	5 b
Rocky Mount	2001	92 c	93 b	95 a	4 a	2 a	2 a
Lewiston-Woodville	2004	87 c	89 b	91 a	6 a	3 a	4 a
Rocky Mount	2004	85 c	90 a	88 b	9 a	6 a	7 a
Lewiston-Woodville	2005	83 b	92 a	92 a	9 a	4 a	3 a
Rocky Mount	2005	54 c	82 b	84 a	31 a	10 b	9 b

* Means of % germination or % calcium deficient kernels within each combination of year and location followed by the same letter are not significantly different according to Fisher's Protected LSD Test at $P \leq 0.05$. Data are pooled over cultivars and K_2O rates of 0 and 250 lbs/acre (0-0-60, N-P_2O_5-K_2O).

** The 1× rate of gypsum corresponds to a broadcast application of 1,250 lbs/acre of USG 500 (70% calcium sulfate) from 2001-2004. In 2005, a banded (18 inch band on 36-inch rows) application of 600 lbs/acre of USG Ben Franklin (85% calcium sulfate) was applied.

The percentage of calcium deficient kernels was lower in two trials when gypsum was applied regardless of rate; no difference was found in the remaining four trials (Table 8). At Lewiston-Woodville 2001 and Rocky Mount 2005, soil calcium levels initially were relatively low and may partially explain the higher percentage of calcium deficient kernels in no-gypsum control and a corresponding reduction of the percentage of calcium deficient kernels when gypsum was applied (Tables 1 and 8).

The percent of calcium deficient kernels was slightly higher when potassium was applied (8%) compared with the no-potassium control (6%) when data were pooled over locations, years and gypsum rates (data not presented in tables). The percentage of calcium deficient kernels was similar for NC-V 11 (7%) regardless of location, year, gypsum, or potassium rate (data not presented in tables).

Summary

Collectively, results from these trials indicate that gypsum rates higher than currently recommended for Virginia market type peanut are not needed even for large-seeded cultivars like Gregory. The importance of supplemental calcium for the large-seeded cultivar Gregory was demonstrated in these trials as was the lower calcium requirement for smaller-seeded cultivars like NC-V 11. Potassium, at the rate applied in these trials combined with native soil levels in these fields, did not negatively affect pod yield, market grade characteristics, or seed quality. Therefore, growers should not avoid applying potassium at planting if soil test recommend potassium or if relatively low levels of potassium are applied.

Acknowledgments

The North Carolina Peanut Growers Association, Inc. and the National Peanut Board provided partial funding for this research. Carl Murphey and staff at the Peanut Belt Research Station, Upper Coastal Plain Research Station, and the North Carolina Department of Agriculture and Consumer Services provided technical support.

Literature Cited

1. Baughman, T., Dotray, P., Grichar, J., Black, M., Woodward, J., Trostle, C., Russell, S., Crumley, C., Porter, P., New, L., Baumann, P., and McFarland, M. 2007. Texas peanut production guide. Online. Coop. Ext. Serv., Texas A&M Univ., College Station, TX.
2. Adams, J. F., and Hartzog, D. L. 1991. Seed quality of runner peanuts as affected by gypsum and soil calcium. J. Plant Nutr. 14:841-851.
3. Adams, J. F., Hartzog, D. L., and Nelson, D. B. 1993. Supplemental calcium application on yield, grade, and seed quality of runner peanut. Agron. J. 85:86-93.
4. Association of Official Seed Analysts. 1999. Rules for testing seeds. J. Seed Technol. 6:1-113.
5. Brandenburg, R. L. 2009. Peanut insect management. Online. Pages 77-94 in: 2009 Peanut Information. Coop. Ext. Serv. Publ. AG-331. North Carolina State Univ., Raleigh, NC.
6. Chapin, J. W., Prostko, E. P., and Thomas, J. S. 2007. Peanut money-maker production guide, 2007. Online. Coop. Ext. Serv. Circ. 588, Clemson Univ., Clemson, SC.
7. Cox, F. R., and Sholar, J. R. 1995. Site selection, land preparation, and management of soil fertility. Pages 7-10 in: Peanut Health Management. H. A. Melouk and F. M. Shokes, eds. American Phytopathological Society, St. Paul, MN.
8. Gascho, G. J., and Davis, J. G. 1995. Soil fertility and plant nutrition. Pages 383-418 in: Advances in Peanut Science. H. E. Pattee and T. H. Stalker, eds. Am. Peanut Res. and Educ. Soc., Stillwater, OK.
9. Gascho, G. J., and Parker, M. B. 2001. Long-term liming effects on Coastal Plain soils and crops. Agron. J. 93:1305-1315.
10. Godsey, C., Damicone, P., Medlin, C., Kizer, M., Noyes, R., and Zhang, H. 2007. Peanut production guide. Online. Coop. Ext. Serv. Circ., E-806. Oklahoma State Univ., Stillwater, OK.
11. Hardy, D. H., Tucker, M. R., and Stokes, C. E. 2008. Crop fertilization based on North Carolina soil tests. Circ. No. 1. Agronomic Div., North Carolina Dept. of Agric. and Consumer Serv., Raleigh, NC.
12. Isleib, T. G., Rice, P. W., Mozingo, R. W., Mozingo, R. W., II, and Pattee, H. E. 1999. Registration of "Gregory" peanut. Crop Sci. 39:1526.
13. Jordan, D. L. 2009. Peanut production practices. Online. Pages 21-49 in: 2009 Peanut Information. Coop. Ext. Serv. Publ. AG-331. North Carolina State Univ., Raleigh, NC.

14. Jordan, D. L. 2009. Peanut weed management. Online. Pages 50-76 in: 2009 Peanut Information. Coop. Ext. Serv. Publ. AG-331. North Carolina State Univ., Raleigh, NC.
15. Jordan, D. L., Barnes, J. S., Bogle, C. R., Naderman, G. C., Roberson, G. T., and Johnson, P. D. 2001. Peanut response to tillage and fertilization. Agron. J. 93:1125-1130.
16. Jordan, D. L., Swann, C. W., Spears, J. F., Brandenburg, R. L., and Bailey, J. E. 2000. Comparison of virginia and runner market type peanut (*Arachis hypogaea* L.) grown in the Virginia-Carolina area. Peanut Sci. 27:71-77.
17. Rhodes, R., Smith, L., Williams, M., Smith, P., Winslow, F., Cochran, A., Simonds, B., Whitehead, Jr., A., Ellison, C., Pearce, J., Tyson, C., Uzzell, S., Harrelson, R., Fountain, C., Shaw, M., Bridgers, M., Jordan, D. L., Brandenburg, R. L., and Shew, B. B. 2008. Summary of production and pest management practices by top growers in North Carolina. Proc. Am. Peanut Res. and Ed. Soc. 40:78-79.
18. SAS Institute. 1999. SAS user's guide. SAS Inst., Cary, NC.
19. Sholar, R. E., Mozingo, R. W., and Beasley, J. P., Jr. 1995. Peanut cultural practices. Pages 354-382 in: Advances in Peanut Science. H. E. Pattee and T. H. Stalker, eds. Am. Peanut Res. and Educ. Soc., Stillwater, OK.
20. Shew, B. B. 2009. Peanut disease management. Online. Pages 95-120 in: 2009 Peanut Information. Coop. Ext. Serv. Publ. AG-331. North Carolina State Univ., Raleigh, NC.
21. Williams, E. J., and Drexler, J. S. 1981. A non-destructive method for determining peanut pod maturity. Peanut Sci. 8:134-141.
22. Wynne, J. C., Coffelt, T. A., Mozingo, R. W., and Anderson, W. F. 1991. Registration of "NC-V 11" peanut. Crop Sci. 31:484-485.