Influence of Prohexadione Calcium Rate on Growth and Yield of Peanut (*Arachis hypogaea*)

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ABSTRACT

Prohexadione calcium, a plant growth regulator, is commonly used on virginia market type peanut (*Arachis hypogaea* L.) cultivars to manage excessive vine growth and improve digging efficiency. However, use of prohexadione calcium on runner market type cultivars has been minimal. The objective of this research was to evaluate prohexadione calcium on virginia and runner market type peanut cultivars at multiple rates in small-plot (17 site years) and on-farm (5 site years) experiments. Applications of prohexadione calcium were at the manufacturer's recommended use rate of 140 g a.i./ha (1x), 105 g a.i /ha (0.75x), and 70 g a.i /ha (0.5x) rates. A non-treated control was also included in all experiments. Cultivar and treatment responses were evaluated based on mainstem height, yield, total sound mature kernels, and return on investment. Plants treated with prohexadione calcium had greater row definition based on a 1-10 row visibility rating scale. Plant main stem heights were often shortened when prohexadione calcium was applied compared to the control, although response varied by location and by year. Average mainstem heights were 26 cm for non-treated plots and 23 cm for prohexadione calcium treated plots across all virginia market type small plot experiments. Prohexadione calcium did not significantly increase yield at any rate in any small plot experiments regardless of rate. Reduced rates of prohexadione calcium significantly increased yield in all the large on-farm experiments compared to the control. Yield increases ranged from 453 to 731 kg/ha for all prohexadione calcium treatments compared to the control across all large plot on-farm experiments. The greatest return on investment was the 0.75x rate resulting in an increase in revenue of \$210 ha^{-1}. With an increase in yield and return on investment in all large plot on-farm experiments and not in small plot experiments no matter the market type, it is assumed that the growth and yield response to prohexadione calcium may be more pronounced where soil variability is greater, affecting growth, digging, and yield potential. Prohexadione calcium can be beneficial in virginia market type and runner market type peanut cultivars to decrease vine growth and increase yield.

Key Words: Plant growth regulator, height, runner market type peanut, virginia market type peanut

Plant growth regulators have been evaluated and utilized intermittently for more than 40 years to manage vegetative growth on fast growing cultivars of virginia and runner market type peanut (*Arachis hypogaea* L.). There are several key reasons for managing vine growth in peanut. Research has shown that peanut plants produce more vegetative growth than needed to achieve maximum pod yield (Mitchem *et al.*, 1996), excessive vines can be problematic for managing diseases (Henning *et al.*, 1982; Maloy, 1993), and excessive vines can decrease digging and harvesting efficiency (Beam *et al.*, 2002). Excessive vines can also become damaged by tractor tires during mid- and late season pesticide applications potentially causing an increase in disease and yield losses (Wu and Santelman, 1977). Daminozole was an effective plant growth regulator used throughout the 1970's and the 1980's. However, daminozole's registration was discontinued by EPA in 1989 due to safety concerns in food products (Smith, 1989). With growers still in need of managing excessive vine growth to minimize disease issues and harvest difficulties, the chemical industry continues to evaluate potential growth regulators with lower health risks while suppressing vegetative growth similar to daminozole. In the early 1980's, prohexadione calcium [calcium salt of 3,5-dioxo-4 propionylcyclohexanecarboxylic acid] (Apogee 27.5

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WDG, BASF Corp., 26 David Dr., Research Triangle Park, NC 27709 or Kudos 27.5 WDG, Fine-Americas, 1850 Mt. Diablo Blvd., Walnut Creek, CA 94596), a novel plant growth regulator, was discovered (Motojima, *et al*., 1984). In April of 2000, prohexadione calcium was developed and registered by BASF Corporation for use in the United States (Giles-Parker, 2000).

Prohexadione calcium, is a plant growth regulator used in apple (*Malus xdomestica* Borkh.), grain sorghum [*Sorghum bicolor* (L.) Moench], oilseed rape (*Brassica napus* L.), peanut, rice (*Oryza sativa* L.), tomato (*Solanum lycopersicum* L.), and wheat (*Triticum aestivum* L.) to slow vegetative growth (Yamaji *et al*., 1991, Nakayama *et al*., 1992; Grossman *et al*., 1994, Mitchem *et al*.1996, Lee *et al*., 1998; Byers and Yoder, 1999). Prohexadione calcium works by inhibiting the biosynthesis of gibberellin, a natural plant hormone that regulates cell elongation by blocking kaurene oxidase. It also increases the level of abscisic acid and cytokines (Grossman *et al*., 1994).

Initial research of prohexadione calcium (Mitchem *et al*., 1996), showed a reduction in main branch length and cotyledon branch length of 32% and 30%, respectively over the non-treated peanut. This reduction in vegetative growth was similar to reductions by daminozole. It was also reported that prohexadione calcium increased pod yield by 8% and increased the percentage of extra-large kernels by 3% but had no effect on the percentage of fancy pods and total sound mature kernels.

Since that time, many studies have been conducted on virginia market type peanut cultivars to learn more about the effect of prohexadione calcium on peanut. Culpepper *et al*. (1997) showed that yield response was cultivar dependent with yield increases varying among six virginia market type peanut cultivars. Prohexadione calcium increased the yield of cultivar NC 9 by 7% while decreasing the yield of cultivar VA-C 92R by 8%. The plant growth regulator also had no yield response on cultivars NC 10C (Wynne et al., 1991), NC 12C (Isleib et al., 1997), or NC-V 11 (Wynne et al., 1991). In a similar experiment comparing the effect of prohexadione on four virginia market type peanut cultivars, yield response to prohexadione calcium was shown to be greatest in twin rows, as opposed to single rows, regardless of cultivar (Faircloth *et al*., 2005). Applying prohexadione calcium with urea ammonia nitrate, either alone or with crop oil concentrate, increased the effect more than when prohexadione calcium was applied without the urea ammonium nitrate (Jordan *et al*., 2000). Beam *et al*., (2002) reported that applying prohexadione calcium reduced digging losses by as much as 4% regardless of digging date and lifting treatment compared with nontreated peanuts. During the initial time period when prohexadione calcium was registered and sold commercially, runner market type cultivars changed from having an excessive vine growth habit to a moderate growth habit. Research during that time also reported that a tractor guidance system with a Global Positioning systems with Real-Time Kinematics (GPS RTK) was more effective at optimizing yield than prohexadione calcium (Roberson and Jordan, 2014). This reduced growth habit, along with GPS RTK guidance, reduced the cost effectiveness of the growth regulator on runner-type peanut cultivars. Even though the benefits of prohexadione calcium have been established in the literature on virginia market type peanut cultivars, the price (estimated at $148/ha for 2 applications at 140 g/ha – excluding cost of application) of prohexadione calcium can be cost prohibitive to growers (Bullen *et al*., 2019). However, Jordan *et al*. (2019) reported that over 50% of growers in North Carolina and Virginia apply prohexadione calcium at least once, demonstrating perceived value at the farm level.

The use of prohexadione calcium at the labeled rate (140 g/ha) on runner market type peanuts has not been recommended over the last 20 years due to the limited vine growth of cultivars like Georgia Green (Branch, 1996) and Georgia-06G (Branch, 2007). This is unlike recent virginia market type peanut cultivars such as NC-V 11, NC 12C, Perry (Isleib et al., 2003), Gregory (Isleib et al., 1999), and Bailey (Isleib et al. 2011), which exhibit a robust growth habit. However, the resurgence since 2012 of runner market type cultivars with excessive vegetative growth, like Georgia-12Y (Branch, 2013), has increased the interest for the growth regulator to manage vine growth in order to allow better inverting and harvesting operations. Therefore, research was conducted to quantify the growth response and economics of using prohexadione calcium on currently available runner and virginia market type peanut cultivars in the Southeast and Carolinas. Since vine growth is different among runner and virginia market type peanut cultivars, research was also conducted to determine the efficacy of the growth regulator at reduced rates on both peanut types.

Materials and Methods

All experiments were conducted in 2017 and 2018 under irrigation in Arkansas, Georgia, Mississippi, North Carolina, and South Carolina to

Table 1. Location, state, year, market type, planting date, prohexadione calcium applications timing, digging dates, and harvest dates used in small plot runner and virginia market type experiments.

						DAP[a]			
						Prohexadione calcium appl.			
Exp.	Location	State	Year	Type	Planting Date	First	Second	Digging Date	Harvest Date
1	Lewiston-Woodville	NC	2017	Virg.	18 May	67	84	126	138
2	Rocky Mount	NC	2017	Virg.	11 May	74	91	138	154
3	Whiteville	NC	2017	Virg.	16 May	64	79	121	128
4	Blackville	SC	2017	Virg.	2 June	66	80	146	159
5	Lewiston-Woodville 1	NC	2018	Virg.	15 May	69	88	134	143
6	Lewiston-Woodville 2	NC	2018	Virg.	15 May	69	88	134	143
7	Rocky Mount	NC	2018	Virg.	5 June	65	80	133	141
8	Whiteville	NC	2018	Virg.	8 May	70	84	124	139
9	Blackville	SC	2018	Virg.	1 June	69	84	139	150
10	Newport	AR	2017	Run.	9 June	60	74	139	144
11	Attapulgus	GA	2017	Run.	3 May	85	99	161	168
12	Tifton RDC	GA	2017	Run.	19 May	60	74	140	153
13	Blackville	SC	2017	Run.	2 June	66	80	146	159
14	Newport	AR	2018	Run.	2 May	62	83	169	175
15	Tifton Ponder	GA	2018	Run.	30 April	72	86	142	148
16	Tifton Ponder	GA	2018	Run.	15 May	65	86	153	160
17	Blackville	SC	2018	Run.	1 June	65	79	139	150

[a]DAP = d after planting

evaluate growth and yield response of peanut based upon prohexadione calcium application rate. Prohexadione calcium treatments evaluated were 1) the manufacturer's recommended use rate of 140 g a.i / ha (1.0x); 2) 105 g a.i /ha (0.75x); and 3) 70 g a.i /ha (0.5x). A non-treated control was included in all experiments. As per label directions, crop oil concentrate, (Agri-Dex, 83% paraffin based petroleum oil and 17% surfactant, Helena Chemical Co., 5100 Poplar Ave., Memphis, TN) was applied at 2.3 L/ha and 28% urea ammonium nitrate or 21% ammonium sulfate was applied at 1.2 L/ha with prohexadione calcium applications. Prohexadione calcium was applied in 233 L/ha water using a CO_2 -pressurized backpack sprayer equipped with 8002 regular flat fan nozzles (Teejet nozzles, Spraying Systems Co., Wheaton, IL) in all small plot experiments and 140 L/ha of water using commercial large-scale crop sprayers for the large plot on-farm experiments. All treatments were applied independently of any other pesticide applications. Commercial large-scale crop sprayers (type and size) varied by location. In all experiments, prohexadione calcium treatments were initiated when at least 50% lateral vines from adjacent rows were touching. A second application of each treatment was applied 14 d after the first application. Peanut market type, cultivar, and planting date varied by location and are described in more detail in Table 1. Seed was planted at rates to achieve a final in-row plant population of 13.1 to 16.4 plants/m in a single row planting pattern (91.4 cm). Small plot dimensions were 1.8 m wide and 7.6 m to 9.1 m long with two untreated rows between each plot. Large plot trial dimensions ranged from 5.5 m to 11 m wide and 152.4 m to 457.2 m long. All experiments were randomized complete block design with four replicates. Peanut production management decisions were made based on individual state University Cooperative Extension Service recommendations. Main stem height (cm) was measured 2 weeks after the second application of prohexadione calcium was applied to determine plant growth response to the growth regulator. This measurement was taken by measuring the height of the main stem in cm at three random locations in the plot. Peanut plants in each plot were dug and inverted based on maturity profile method (pod mesocarp color) (Williams and Drexler, 1981). Plants were dried for 5 to 7 d depending on weather and harvested mechanically using commercial peanut combines. Pod yield was assessed at harvest and final pod weight was adjusted to 7% moisture. Return on investment for each treatment was calculated based on the gross yield*base loan value – cost of prohexadione calcium. The base loan value for peanut in the United States is $355/farmer stock ton.

Analysis of variance was conducted using the PROC MIXED function within SAS version 9.4 (SAS Institute, Cary, NC). Location, market type (virginia or runner), and plot size (small plot or

Table 2. Location, state, year, planting date, prohexadione calcium applications timings, digging dates, and harvest dates used in large plot on-farm, runner market type experiments.

					DAP[a]			
					Prohexadione calcium appl.			
Exp.	Location	State	Year	Planting Date	First	Second	Digging Date	Harvest Date
18	Bulloch Co.	GA	2017	25 April	73	87	140	146
19	Coahoma Co.	MS	2017	4 May	64	76	138	144
20	Holmes Co.	MS	2017	10 May	56	72	148	154
21	Forrest Co.	MS	2017	9 May	58	72	151	157
22	Early Co.	GA	2018	8 May	63	76	147	153

[a]DAP = days after planting

large plot on-farm) were analyzed separately because of variation in field types and plant growth habit to minimize variability among experiments. Appropriate means were separated with Fisher's protected least significant difference (LSD) test at $P = 0.05$.

Virginia market type small plot experiments. Nine small plot experiments were conducted using virginia market type peanut cultivars on university research stations at Lewiston-Woodville, Rocky Mount, and Whiteville in North Carolina and at Blackville, SC (Table 1). Planting date varied by location ranging from early May to early June (Table 1). All experiments in North Carolina were planted with the cultivar Bailey, while Bailey, Wynne (Isleib et al, 2015), and Sullivan (Isleib et al., 2015) were used in South Carolina. Since cultivars varied among states, data were combined across cultivars for the multi-location analysis. Plant architecture was assessed visually 2 to 4 weeks after final prohexadione calcium application in North Carolina using a 1 to 10 row visibility rating scale developed by Mitchem *et al*. (1996) where 1 = a flat peanut canopy with an indistinguishable main stem where row definition is unclear and 10 = a peanut canopy with triangular-shaped plants (apex at central mainstem).

Runner market type small plot experiments. Seven small plot experiments were conducted on university research stations with runner market type peanuts in Arkansas, Georgia, and South Carolina (Table 1). Peanut planting date varied by location and ranged from early May to early June. Runner market type cultivars varied by state; thus, data were combined across cultivars in the multi-location analysis. Runner market type cultivars included Georgia-06G, Georgia-09B (Branch, 2010), Georgia-12Y, and TUFRunner 511 (Tillman and Gorbet, 2017).

Large plot on-farm experiments. In 2017, a large plot on-farm experiment was conducted in Georgia (Bulloch County) and three in Mississippi (Coahoma, Holmes, and Forrest Counties), and, in 2018, one large plot on-farm experiment was conducted in Georgia (Early County) (Table 2). Peanut planting date varied by location and ranged from early to mid-May. Runner market type cultivars varied by state; thus, data were combined across cultivars in the multi-location analysis. Runner market type cultivars included Georgia-06G, Georgia-12Y, TUFRunner-297 (Tillman, 2017), TUFRunner-511.

Results

Virginia market type small plot experiments. The location by treatment interaction was not significant for mainstem height or pod yield in the virginia market type small plot experiments (Table 3), thus experiments were additionally combined across locations for analysis. Location and prohexadione calcium rate was significant for mainstem height and row visibility at $P < 0.0001$ and $= 0.0045$; and $P < 0.0001$ and < 0.0001, respectively. Location was significant for pod yield ($P < 0.0001$).

Main stem heights ranged from 36 to 56 cm across locations and treatments (Table 4). Mainstem heights varied among locations which could be due to variations in environmental conditions and their effects on crop growth. Experiments 3 and 4 had the tallest main stem heights, while Experiments 1, 5, and 7 had the shortest average main stem heights. Microclimate conditions including temperature and moisture likely contributed to the variations in canopy growth across locations. In examining the treatment effects of prohexadione calcium, the non-treated plots had the tallest main stem heights of all treatments for all experiments (Table 4). Reduced rates (0.5x and 0.75x) provided similar growth inhibition as the full labeled rate of the growth regulator (Table 4). These results were similar to the runner market type experiments and results from Mitchem *et al.*

Table 3. Analysis of variance for peanut crop growth and yield for virginia market type in small plot experiments, runner market type in small plot experiments, and large plot on-farm experiments for Location (Virginia, South Carolina, North Carolina, Georgia, Arkansas, and Mississippi in 2017 and 2018) and prohexadione calcium rates.

	Mainstem height (cm)		Row Visibility (1-10)[a]		Yield (kg/ha)	
Treatment	F	P value	F	P value	F	P value
Virginia Market Type (Small Plot)						
Location	287.50	<0.0001	27.20	<0.0001	14.79	<0.0001
Prohexadione calcium	4.54	0.0045	274.30	<0.0001	0.85	0.4697
Location x prohexadione calcium	0.59	0.9186	6.67	<0.0001	0.80	0.7306
Runner Market Type (Small Plot)						
Location	118.30	<0.0001	—	—	14.69	<0.0001
Prohexadione calcium	4.90	0.0035	—	—	0.66	0.5783
Location x prohexadione calcium	2.10	0.0636	—	—	0.72	0.8071
Runner Market Type (Large Plot On-Farm)						
Location	17.04	0.0044	—	—	14.56	0.0001
Prohexadione calcium	51.23	<0.0001	—	—	25.81	<0.0001
Location x prohexadione calcium	4.03	0.0068	—	—	2.27	0.0302

[a]Row visibility is a 1 to 10 visual rating developed by Mitchem *et al*. (1996) where 1 = a flat peanut canopy with an indistinguishable main stem where row definition is unclear and 10 = a peanut canopy with triangular-shaped plants.

(1996) testing the effect of prohexadione calcium on the virginia market type peanut cultivar NC 9.

Row visibility for each location was analyzed separately due to a location by prohexadione calcium interaction. Based on this data row visibility was least for the non-treated control in all experiments, indicating the non-treated control had a flat canopy shape (Table 4). Although the full labeled rate (1.0x) had the greatest row visibility, all prohexadione calcium treatments had significantly better row visibility than the non-treated control at each location. Similar observations were made by Mitchem *et al*. (1996). Mitchem also noted that increased row visibility can lead to greater disease and insect management due to the condensed canopy. Pod yield for the virginia market type small plot experiments varied across locations and pod yield ranged from 4600 kg/ha to 6900 kg/ha with experiments 2, 5, 6, 7, and 8 having the greatest pod yield (Table 4). When combined across experiments, the yield response from utilizing prohexadione calcium to manage canopy growth was not different from the non-treated control at the P = 0.05 level.

Runner market type small plot experiments. The location by treatment interaction was not significant for mainstem height or pod yield in the runner market type small plot experiments (Table 3). Location was significant for both mainstem height and pod yield with the treatment effect of prohexadione calcium only being significant for mainstem height (Table 3). Height measurements were taken for only experiments 11, 13, and 17. Experiment 17 had the tallest plant main stem height compared to experiment 11 and 13 (Table 5). When the data were averaged across all three locations, prohexadione calcium applications at the 0.75x and the 1.0x were the only rates that significantly reduced mainstem height compared to the non-treated control (Table 5). Pod yield for the runner market type small plot experiments varied across locations and treatments with pod yield ranging from 4900 kg/ha to 6800 kg/ha with experiments 11, 12, 13, 15, and 16 having the greatest pod yield at P = 0.05 (Table 5). In all runner market type small plot experiments, the use of prohexadione calcium to manage canopy growth did not affect pod yield over that of the non-treated control. When combined across experiments, pod yield is not different when using prohexadione calcium from the non-treated control at the P = 0.05 level.

Large plot on-farm experiments. The interaction of location by treatment and the corresponding main effects were significant for mainstem height and pod yield in the large plot on-farm runner type experiments (Table 3). Mainstem height was significantly greater for the non-treated control compared to all prohexadione calcium treatments at all locations (Table 6). When examining the individual experiments, the 0.75x and 1.0x rates provided significant reductions in main stem heights compared to the non-treated control across all locations (Table 6).

Pod yield was significantly greater for 0.75x rates of prohexadione calcium compared to the non-treated control for all of the large plot on-farm experiments. The 0.75x treatment was similar in yield response to the 0.5x and 1.0x rate in experiments 18, 19, and 20 and similar to the 1.0x

Table 4. Influence of prohexadione calcium rate on canopy growth and peanut pod yield from virginia market type peanut cultivar in small plot experiments.

Treatment[a]	Exp. 1 Lewiston-Woodville NC 2017	Exp. 2 Rocky Mount NC 2017	Exp. 3 Whiteville NC 2017	Exp. 4 Blackville SC 2017	Exp. 5 Lewiston-Woodville 1 NC 2018	Exp. 6 Lewiston-Woodville 2 NC 2018	Exp. 7 Rocky Mount NC 2018	Exp. 8 Whiteville NC 2018	Exp. 9 Blackville SC 2018	Across Experiments
Main Stem Height (cm)										
Non-treated	46.0	50.4	62.0	57.7	41.9	—	39.1	57.4	52.7	51 A[bc]
0.5X	37.9	47.7	55.0	57.8	31.8	—	38.7	49.3	48.1	46 B
0.75X	37.7	41.9	55.9	52.6	35.6	—	36.8	48.5	44.3	44 B
1.0X	37.2	40.2	51.7	55.8	33.7	—	38.1	46.6	45.4	44 B
Across Treatments	40 D	45 C	56 A	56 A	36 D		38 D	50 B	48 BC	
Row Visibility (1-10 Scale)[e]										
Non-treated	6.0 b[d]	1.8 c	1.5 d	—	3.8 b	1.8 d	3.5 b	4.3 d	—	—
0.5x	9.0 a	4.4 b	3.0 c	—	6.8 a	4.4 c	7.1 a	6.0 c	—	—
0.75x	9.3 a	7.9 a	4.9 b	—	7.1 a	6.6 b	7.6 a	7.4 b	—	—
1.0x	9.6 a	8.6 a	6.5 a	—	7.6 a	8.4 a	7.5 a	8.4 a	—	—
Yield (kg/ha)										
Non-treated	5330	6690	4906	4264	5836	6112	6117	6552	4642	5610
0.5x	5291	6630	5479	4899	5970	6399	6006	6519	4710	5770
0.75x	5333	6972	5321	4896	5954	5908	5989	6773	4549	5740
1.0x	5052	7135	4753	4733	5859	6234	6245	5891	4674	5620
Across Treatments	5250 C	6860 A	5120 CD	4700 CD	5900 B	6160 B	6090 B	6430 AB	4640 D	

[a]Prohexadione calcium treatments evaluated were 1) the manufacturer's recommended use rate of 140 g/ha (1.0x), 2) 105 g/ha (0.75x), 3) 70 g/ha (0.5x) and 4) a non-treated control.

[b]Means followed by the same letter are not significantly different according to Fisher's Protected LSD test a $p \leq 0.05$.

[c]Upper case significane letters denote significance across experiments and treatments.

[d]Lower case significance letters denote significane within experiment.

[e]Row visibility is a 1 to 10 visual rating developed by Mitchem et al. (1996) where 1 = a flat peanut canopy with an indistinguishable main stem where row definition is unclear and 10 = a peanut canopy with triangular-shaped plants.

Table 5. Influence of prohexadione calcium rate on canopy growth and peanut pod yield from runner market type peanut in small plot experiments.

Treatment[a]	Exp. 10 Newport AR 2017	Exp. 11 Attapulgus GA 2017	Exp. 12 Tifton RDC GA 2017	Exp. 13 Blackville SC 2017	Exp. 14 Newport AR 2018	Exp. 15 Tifton Ponder GA 2018	Exp. 16 Tifton Ponder GA 2018	Exp. 17 Blackville SC 2018	Across Experiments
Main Stem Height (cm)									
Non-treated	—	29.0	—	48.5	—	—	—	45.5	41 A[b]
0.5x	—	30.4	—	45.7	—	—	—	41.6	39 AB
0.75x	—	31.0	—	44.1	—	—	—	38.6	38 B
1.0x	—	30.1	—	43.8	—	—	—	38.2	37 B
Across Treatments	—	30 C	—	41 B	—	—	—	46 A	
Yield (kg/ha)									
Non-treated	4777	6762	5939	6058	5342	6295	6281	6141	—
0.5x	4688	6804	6572	6444	5108	6284	6520	5855	—
0.75x	5412	6888	6433	6412	5318	6414	6354	5823	—
1.0x	4558	6815	6449	6118	5758	6645	6604	5790	—
Across Treatments	4860 E	6820 A	6350 AB	6260 B	5380 D	6410 AB	6440 AB	5900 C	

[a]Prohexadione calcium treatments evaluated were 1) the manufacturer's recommended use rate of 140 g/ha (1.0x), 2) 105 g/ha (0.75x), 3) 70 g/ha (0.5x) and 4) a non-treated control.

[b]Means followed by the same letter are not significantly different according to Fisher's Protected LSD test a $p \leq 0.05$.

Table 6. Influence of prohexadione calcium rate on canopy growth and peanut pod yield from runner market type peanut in large plot on-farm experiments.

Treatment[a]	Exp. 18 Bulloch Co. (GA)	Exp. 19 Coahoma Co. (MS)	Exp. 20 Holmes Co. (MS)	Exp. 21 Forrest Co. (MS)	Exp. 22 Early Co. (GA)
Main Stem Height (cm)					
Non-treated	—	45.5 a[b]	55.6 a	58.4 a	—
0.5x	—	39.8 b	46.2 b	45.4 b	—
0.75x	—	38.1 b	46.7 b	41.8 c	—
1.0x	—	37.7 b	46.3 b	40.8 c	—
Yield (kg/ha)					
Non-treated	6792 b	6316 b	6565 b	7623 c	8121 b
0.5x	7207 a	6950 a	7147 a	8046 b	8330 b
0.75x	7504 a	6763 a	7393 a	8574 a	8700 a
1.0x	7217 a	6602 ab	7529 a	8493 a	8121 b

[a]Prohexadione calcium treatments evaluated were 1) the manufacturer's recommended use rate of 140 g/ha (1.0x), 2) 105 g/ha (0.75x), 3) 70 g/ha (0.5x) and 4) a non-treated control.

[b]Means followed by the same letter are not significantly different according to Fisher's Protected LSD test a $p \leq 0.05$.

rate in experiment 21. The 0.75x treatment was significantly better than the 1x treatment in experiment 22 (Table 6). Return on investment for each treatment was calculated based on the gross yield*base loan value – cost of prohexadione calcium. Therefore, net dollar value for prohexadione calcium treatments for the on-farm experiments across all locations were $3,242/ha (b), $3,327/ha (a), and $3,181/ha (bc) for the 0.5x, 0.75x, and 1.0x prohexadione calcium rates, respectively, compared to the non-treated control at $3,117/ha (c) at $P = 0.05$. The return on investment for the large plot on-farm experiments was greater for the 0.5x and 0.75x prohexadione calcium treatments compared to the non-treated control. Based on these results, growers could increase their revenues $62 (0.5x) to $146 (0.75x)/ha by using a reduced rate of prohexadione calcium compared to the manufacturer's recommended use rate (1.0x rate) for managing their canopy growth.

Discussion and Summary

The goal of this multistate project was to evaluate the efficacy and economics of prohexadione calcium at reduced and labeled rates on runner and virginia market type peanut cultivars. Results of these experiments supported previous research showing prohexadione calcium is effective at reducing canopy growth at the labeled rate on both runner and virginia market type peanut cultivars (Mitchem *et al.*, 1996). Further, these data showed that reduced rates of prohexadione calcium can be used to reduce mainstem height and increase row visibility similar to the 1.0x rate in both runner and virginia market type peanut cultivars no matter the plot size. This research does support previous findings that at the labeled rate (1.0x) of prohexadione calcium did not provide a consistent increase in yield nor an increase in return on investment (Faircloth *et al.*, 2005). However, reduced rates performing similarly to the labeled rate could potentially save growers an average of $49.40 (0.75x) to $74.10 (0.5x)/ha in growth regulator costs making it more cost effective to manage vine growth in extreme cases.

The evaluation of prohexadione calcium was conducted in both small plot and large on-farm experiments for runner market type peanut in Georgia and Mississippi. The results of the large plot on-farm experiments supported the small plot experiments in which significant reductions in canopy growth were achieved for all rates of the growth regulator. The intriguing part of this research project was the significant yield responses observed as a result of applying the growth regulator in the large on-farm experiments. In every experiment, there was at least one prohexadione calcium treatment that had greater yield than the non-treated control, and the 0.75x rate consistently provided improved yield compared to the non-treated control in all experiments. The labeled rate (1.0x) and the 0.5x rate were inconsistent in providing a yield enhancement compared to the 0.75x rate.

Based on these experiments, it is evident that prohexadione calcium manages canopy growth consistently in both small plot and large plot on-farm experiments at labeled and reduced rates. The differences in pod yield responses in small plot experiments and large plot on-farm experiments needs to be examined further in relationship to prohexadione calcium. There are many factors that cannot be accounted for which could have an impact on pod yield in the large plot on-farm experiments that might not be observed in small plot experiments. For instance, the large plot on-farm experiments may have had larger variation in excessive vine growth due to environmental/soil factors which made the effect of prohexadione calcium greater. Some of these environmental/soil factors may include variations in soil types, soil water holding capacity, fertility and pH differences, as well as elevation. These types of differences tend to be greatly reduced in small plot experiments. Based on previous research, it is also possible that the increased row visibility from prohexadione calcium contributes to the yield increase through increasing digging efficiency and reducing the loss of pods through the digging and inversion process (Jordan, 2008). This could explain some of the differences in small plot versus large on-farm experiments in which the digger losses might be minimized due to the short distance of the plot and reduced speed of the tractor compared to large-scale equipment (Kendal Kirk, personal communication). These types of differences might be a reason to evaluate products like growth regulators under a more grower-oriented environment. Overall, this multistate research project confirms that prohexadione calcium provided consistent management of canopy growth at reduced rates of 70 (0.5x) to 105 (0.75x) g/ha on both runner and virginia market type peanut cultivars, while the reduced rate of 105 g a.i /ha provided a significant yield improvement over the non-treated control. This reduction in rate and the increase in yield provided a return of investment of $210/ha over the cost of the non-treated control.

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