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ARTICLE

Prohexadione Calcium Effect on Peanut Maturity, Pod Yield, and 100 SMK Weight in a Unique Site-Cultivar Scenario in Virginia

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ABSTRACT

In Virginia, prohexadione calcium (PC) has been used for decades in peanut (*Arachis hypogaea* L.) production to reduce vine growth for visually guided digging. Along with growth suppression, PC has been reported to improve yield and physiological stress responses of numerous field crops, vegetables, and ornamental crops. However, in peanut, PC's effect on plant physiological and agronomic characteristics is inconclusive. This could be attributed to several factors including variable genotypic responses and potential PC effect on maturity. In 2022 and 2023, replicated trials were established at the Tidewater Agricultural Research and Extension Center in Suffolk, VA (USDA Zone 7b), to evaluate the effect of PC on yield, seed characteristics, and pod maturity on commercially available peanut cultivars in Virginia, using a unique site-cultivar scenario. PC was applied at the recommended rate of 140 g ai/ha, at 50% and 100% canopy closure. Maturity was determined by pod mesocarp color several times during the growing season(s) starting at 100 d after planting until digging and expressed as pod maturity index, i.e. the ratio of orange, brown, and black pods from all pods within a sample of approximately 200 pods. Data indicate PC did not affect peanut maturity and 100 SMK weight in 2022 or 2023 but influenced pod number per plant in 2023. Pod yield was improved by PC applications in 2023, a year with twice as much precipitation as 2022; and site-cultivar and PC interaction was significant in 2023. In 2023, yield was increased by PC for the site planted with Bailey II and NC 20 and remained non-significant for Emery, Sullivan, and Walton. Results suggest that the PC effect on peanut yield was weather and site-cultivar dependent.

INTRODUCTION

Prohexadione calcium (PC) is a growth regulator primarily used to reduce vegetative growth in field crops, vegetables, and ornamentals (Duong et al., 2024; Evans et al., 1997; Husiny et al., 2023; Ozbay et al., 2020) via inhibition of gibberellin and ethylene biosynthesis. Photosynthetic assimilates after application of PC become more available to fruits rather than shoots, increasing fruit set and yield (Rademacher et al., 2006; Yu et al., 2019). For example, PC increased rice (*Oryza sativa* L.) yield and decreased lodging risk by 6.7% and 14%, respectively, and increased fruit development and fruit set in mango (*Mangifera indica* L.) (Liao et al., 2023; Pérez-Barraza et al., 2025; Ping et al., 2023). PC had a positive effect on photosynthesis, antioxidant metabolism, and source-sink relationship with increased yield in rice under salt stress and wheat (*Triticum aestivum* L.) under drought stress (Deng et al., 2025; Mei et al., 2025; Zhang, 2024). PC also had positive effects on bacterial, fungal, and insect incidence. For example, PC is considered an alternative to antibiotics for the control of secondary fire blight *(Erwinia amylovora*) in apples and pears, against scab (*Venturia inaequalis*) in apples and grey mold (*Botrytis cinerea*) in grape (*Vitis* spp.) (Bazzi et al., 2003).

In peanut (*Arachis hypogaea* L.) production, and in absence of GPS and/or RTK guidance, growers use PC to supress vine growth, increase row visibility, and avoid yield loss from excessive pod shedding during digging operations (Samenko, 2021). Prohexadione calcium is widely used in either one or two standard applications of 140 g ai/ha; first at 50% canopy closure (CC) followed by the second application 2-3 weeks later. Here, 50% CC is defined as the stage when 50% of lateral vines have touched in the middle row. A recent survey by Jordan et al. (2024a) showed that 60% of growers applied PC once and 32% twice at the recommended rate in the Virginia-Carolinas (VC) region. The decision on number of PC applications is generally dictated by the relatively high cost of a single application and uncertainty of cost recovery through improved yield. Jordan et al. (2024b) estimated a cost of $74 per ha/application, while yield benefits from the PC applications have been inconsistent in research trials to support return on investment. Inconsistencies were attributed to research factors including size of the plots (larger plots consistently showed yield increases from PC in comparison with small plots) and genotypic response among cultivars (Beam et al., 2002; Faircloth et al., 2005; Gaudin et al., 2023; Jordan et al., 2001, Jordan et al., 2008, Jordan et al., 2024a, Jordan et al., 2024b, Jordan et al., 2024c; Monfort et al., 2021; Singh et al., 2023; Studstill et al., 2020).

Current virginia market-type cultivars grown in the VC region have significant yield increase over historic cultivars, yet all cultivars historically have abundant biomass production to support yield. This has resulted in a general production "standard" among 90% or more of growers in Virginia to employ PC to control vine growth for increased row visibility during digging (Jordan et al., 2024a). Jordan and co-authors (2024 a, b, c) have recently researched the effect of PC on peanut yield in the VC region. These authors included the cultivar Bailey, that is no longer produced (Isleib et al., 2011), or Bailey II (that is currently produced) virginia-type cultivars in their research, leaving aside the most recent cultivars Emery, Sullivan, Walton (Balota et al., 2021) and NC 20. More information about these new cultivars, e.g. year of release, authors, characteristics and genetics can be found on the Virginia Crop Improvement Association' s website (http://www.virginiacrop.org/index.html). Newer cultivars have improved yield and more importantly, early maturity. For example, under optimal growth conditions, new cultivars may require 1800 C growth degree days (GDD) to reach harvest maturity in comparison with old cultivars needing a minimum of 2500 C GDD (Balota and Phipps, 2013). Early maturity is very important for peanut growers in the VC region, Virginia and northern North Carolina in particular, as this region is the northernmost peanut growing region of the U.S. peanut belt.

In Virginia, average farm size is 76 ha (USDA NASS, 2024) divided in multiple fields separated by woodland and within several miles distance from each other. Yearly, growers plant a small fraction of their land in peanut to achieve a 5-year rotation that has been adopted for the past few decades in this state. As most growers grow peanut to produce certified seed, they plant annually several cultivars, the mostly grown and highest yielding in the region. To satisfy seed certification requirements, peanut varieties are planted in separate fields with different soil properties, which seems to suit the farmland structure in this state. Depending on the weather and total farm acreage, planting and digging time is usually extended to 2-3 weeks within a farm to accommodate different genetics and farm logistics. Most of these growers use PC to increase row visibility and maximize yield with expectations of positive PC effect on yield regardless of the site-cultivar combination. With this in mind, this study evaluated the effect of standard PC applications on maturity, pod yield, and 100 SMK weight of all currently (2022-23) grown virginia type cultivars; Bailey II, Emery, Sullivan, Walton and NC 20, in a site-cultivar situation similar with certified seed producers in Virginia.

MATERIALS AND METHODS

Location, Cultivars, and Experimental Design

Research was conducted in 2022 and 2023 at TAREC in Suffolk, VA, USA (36°39′ N, 76°44′ W). Cultivars Bailey II, Emery, NC 20, Sullivan (developed by the North Carolina State University) and Walton (developed by Virginia Tech/University of Florida; Balota et al., 2021) were planted in multiple sites (fields) for production of certified seed for the Virginia Crop Improvement Association. At the same time, these sites allowed for the design of large plots to obtain measurable yield benefits from PC application under this research, as suggested by previous research, and allow multiple samplings for maturity determination (Jordan et al., 2024c; Studstill et al., 2020). Each cultivar was planted in a different site; therefore "cultivar" comparisons should be understood as "site-cultivar" comparisons meant to show PC effect on site-cultivar performance rather than cultivar performance *per se*. This design was implemented to accommodate large plots and mimic a certified seed producing farm situation in the VC region. At the same time, it allowed us to create a diversity of unique situations within only two years to better understand PC effect on the peanut traits analysed in this study. All sites were within 2-mile radius from each other and represented the entire spectrum of soil types used for peanut production in the VC region, e.g. fine-loamy siliceous, coarse-loamy siliceous, loamy siliceous, and clayey mixed. Cultivars were randomly assigned to each site and planted in plots ranging from 0.5 to 1.5 acres in a completely randomized design (CRD) with four replications receiving and four not receiving PC. In 2022, Bailey II site only had room for three replications (Figure 1). All plots were planted within 18 d window, with a peanut planter with 91 cm row spacing, at a density of 14 seeds/m^2. In 2022, planting was from 15 May through 1 June and in 2023 from 7-15 May. Because land was available in 2023, an additional four replications with and four without PC were added to allow for an early and late digging dates, for a total of eight replications with and eight without PC. Depending on the total number of rows available in each field, plots varied from five to eight peanut rows in length of the entire field. In 2022, digging was from 11 October to 2 November and in 2023 from 3 to 16 October. In both years, all fields were rainfed and cultural practices followed agronomic recommendations of the Virginia

Peanut Production Guide (Balota, 2023). Each year, two applications of PC at 140 g ai/ha as Apogee® (27.5% PC) (BASF Corp.), with ammonium sulphate (1120 g/ha) and 0.5% crop oil concentrate (volume basis) (Helena Agri-Enterprises, Collierville, Tennessee, USA) were sprayed on the plots at 50% CC (23 July to 10 August) and 14 days after the first application, i.e. 100% CC. The only exception was Sullivan in 2022. This cultivar was planted on June 1 and had insufficient biomass to justify a PC application. Each year, weather was monitored daily within 2 miles radius from the experimental fields.

Figure 1. Aerial image showing the designation of plots and biomass coverage in NDVI units right before the first prohexadione calcium application. This is an example from the field planted with Bailey II in 2022.

Table 1. Analysis of variance for the effect of site-cultivar, prohexadione calcium, and sampling time on peanut harvest maturity. In 2022, peanuts were dug 155 days after planting (DAP). In 2023, digging was 150 DAP for early digging and 160 DAP for late digging. In 2023, all plots of cultivar 'NC 20' were dug at 150 DAP, therefore, the second digging date only included 4 cultivars, and this sampling time was excluded from the three-way ANOVA.

	Year 2022				Year 2023							
	155 DAP				150 DAP (Dig 1)				160 DAP (Dig 2)			
Source	DF	Sum Squares	F Ratio	Prob > F	DF	Sum Squares	F Ratio	Prob > F	DF	Sum Squares	F Ratio	Prob > F
Site-Cultivar (Site-C)	3	0.2944	11.179	<.0001	4	0.3082	6.282	0.0002	3	0.5668	14.874	<.0001
Prohexadione calcium (PC)	1	0.0197	2.240	0.1406	1	0.0012	0.101	0.7516	1	0.0222	1.750	0.1913
Site-C × PC	3	0.0206	0.782	0.5091	4	0.1011	2.060	0.0955	3	0.0365	0.957	0.4196
Site-C	3	0.5201	14.516	<.0001	4	1.1560	17.886	<.0001				
Sampling (S)	3	8.8051	245.747	<.0001	3	1.1560	17.886	<.0001				
Site-C × S	9	1.0443	9.715	<.0001	12	0.3997	2.061	0.0196				
PC	1	0.0003	0.023	0.8787	1	0.0647	4.007	0.0463				
Site-C × PC	3	0.0335	0.934	0.4252	4	0.1251	1.935	0.1048				
S × PC	3	0.0354	0.987	0.3997	3	0.0743	1.534	0.2060				
Site-C × S × PC	9	0.0626	0.582	0.8109	12	0.2931	1.512	0.1192				

Data Collection

Pod Maturity Assessment

Two samples of approximately 200 pods were collected from each strip/replication in each cultivar-field in both years. In 2022, samples were taken at 100, 115, 130, and 155 days after planting (DAP). In 2023, samples were collected at approximately 120, 127, 134, 140, 150, and 160 DAP. However, not all cultivars were sampled at 120 and 160 DAP in year 2, and these dates were not used in ANOVA (Table 1). The samples were taken randomly from two locations within the strip by removing 2 to 4 plants per location. Plants were then taken to the laboratory; pods were removed from the vines and pod exocarp removed with a pressure washer at 1300-1600 psi to expose mesocarp color (Williams and Drexler, 1981). Then, pods were sorted into five color-groups defined as white and yellow (immature pods) and orange, brown and black (fully mature); and counted. Maturity was determined by the Pod

Maturity Index (PMI) calculated as the ratio of orange, brown and black pods from the total pods in each sample. Peanut profile boards were used to visually determine the days until digging (Williams and Drexler, 1981) based upon pod mesocarp color.

Yield And Seed Assessment

Peanuts were dug with a KMC two-row digger at approximately 155 DAP in 2022, and 150 DAP for early digging and 160 DAP for late digging in 2023. After adequate windrow drying time to allow seed moisture to drop to 12%, pods were combined with a Hobbs peanut combine (Model 325A). Pod yield was calculated for each strip/replication from a plot area of 40 m^2 in 2022 and 232 m^2 in 2023 based on pod weight adjusted to 7% seed moisture. Pod samples from each replication were shelled and 100 sound mature kernel (SMK) weight recorded. SMK is defined as kernels not passing a 25.4 by 5.9 mm (15/64-inch) screen. In 2023, pod number from each pod maturity sampling was divided by the number of plants the pods were collected from to determine pods per plant.

Statistical Analysis

Data was analysed and graphs were built in JMP® Pro software version 18 (JMP Statistical Discovery LLC, Cary, NC, USA). GLM was used for factorial ANOVA with factors PC, site-cultivar, and digging date (only in 2023) treated as fixed effects and replication as random effects. Fisher's least significant difference (LSD) was used for ANOVA Post Hoc Test.

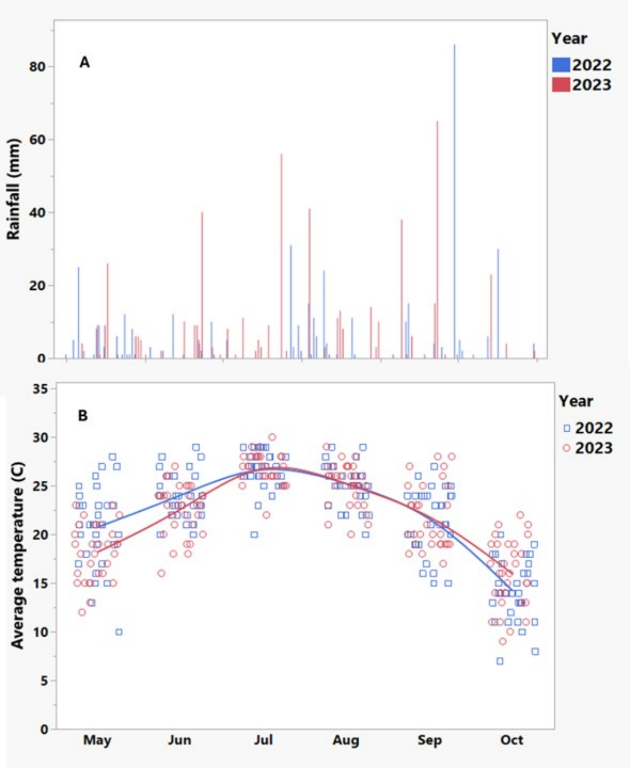

Figure 2. Daily average temperature (A) and precipitation (B) during the peanut growing season in 2022 and 2023. Lines on each graph are smooth curves through the data for easy visualization of the differences between years.

RESULTS AND DISCUSSION

Weather Conditions

Environmental conditions between 2022 and 2023 were different regarding temperature and precipitation (Figure 2). Crop year 2022 initiated with temperatures consistently above 20 C during May and most of June. This was up to 10 C above temperatures observed in 2023 during the same time frame. The 2022 growing season ended in October with cooler weather than 2023 by 2-3 C. There were no substantial temperature differences among years from end of June to end of September. In early May 2022, precipitation totals of 40 mm delayed peanut planting to the second week of May, and adequate soil moisture provided normal crop stand by mid-June. From mid-June to early August 2022, however, rainfall was deficient, with drought ongoing from mid-August to mid-September (NOAA drought monitor https://www.cpc.ncep.noaa.gov/products/Drought/). This caused the 2022 growing season to be one of the driest seasons of the last decade in the Mid-Atlantic. Conversely, year 2023 provided the crop 505 mm precipitation from 1 May to 30 October, almost 100 mm over precipitation totals in 2022 over the same timeframe, uniformly distributed each month (Figure 2). However, cooler temperatures at, and two weeks after planting in May 2023 in comparison with May 2022 delayed emergence and stands established slower than in the previous year. Under these conditions, peanut grew and matured differently each year.

PC Effect on Peanut Maturity

In 2022, at 100 and 115 DAP (15 August and 1 September), overall PMI was 0.4 (40% of the pods were orange, brown and black) with wide ranges of individual samples from less than 15% to 60% PMI (Figure 3). The Texas Production guide (Lemon et al., 2001), an online publication by the Texas Agricultural Extension Service, advises growers to dig virginia-type peanut cultivars at 60-70 percent maturity. Assuming the guide refers to the percent of orange, brown, and black pods from total pods sampled (the guide refers to sorting the pod maturity by the pod mesocarp color), this is 0.6-0.7 PMI (or 60-70% maturity) as computed in this paper. This is in line with the Virginia Peanut Guide recommending optimum digging for virginia type peanuts at 70% pod colours of orange, brown and black combined (Balota, 2023). In this case, by 1 September 2022, peanuts were not mature enough for digging. By 25 September at 130 DAP, however, PMI reached and exceeded 60% PMI for all cultivars, apart from Walton that was slower to mature in comparison with the other cultivars in both years (Figure 3). At 155 DAP, around 20 October, all cultivars had PMIs over 70% maturity. It has been recognized that humidity and soil moisture can expedite peanut maturity (de Almeida et al., 2023, Rowland et al., 2006). Even though in 2023 precipitation was greater and more evenly distributed than in 2022, overall PMI was under 0.6 at all sampling times until 150 DAP (3 October), when average PMI was at or close to 0.6 for all cultivars, excepting Walton (Figure 3). Notably, the relationship between DAP and PMI was also different between years. In 2022 a polynomial regression provided better fit than linear regression between DAP and MPI (with Adj. r^2 0.5499 vs 0.5198 and RMSE 0.154 vs. 0.159). In 2023, the opposite was observed (linear – Adj. r^2 0.2828 and RMSE 0.146; polynomial Adj. r^2 0.2807 and RMSE 0.146) and the correlation between MPI and DAP was weaker in 2023 than in 2022. Growing degree days (GDD) accumulated by the crop at each DAP when maturity was determined and shown on Figure 3 were similar in both years and cannot explain the difference in maturity progression between years. The only difference between years for heat accumulation was from planting to 14 DAP. GDD at 14 DAP in 2022 was in average132 C, almost double the GDD at 14 DAP in 2023 (avg. 81 C) and this had visible effects on crop establishment whereby observation indicated less vigorous seedlings and longer emergence duration in 2023 compared to 2022. If emergence rate and early vigor can predict the maturation progression for the rest of the season for a peanut crop, this requires further research.

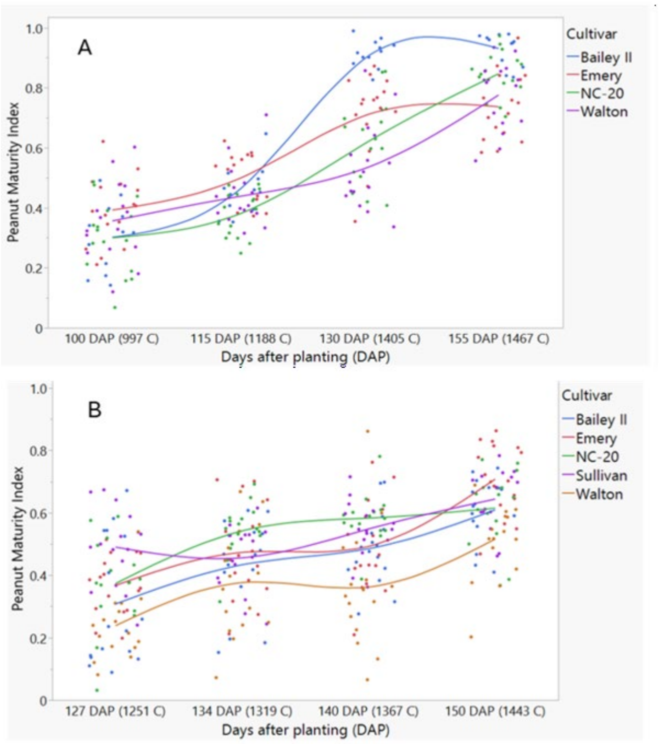

Figure 3. Progression of maturity for five virginia-type peanut cultivars planted between May 15 and June 1 in 2022 (A), and May 7 to 15 in 2023 (B), at the Tidewater Agricultural Research and Extension Center in Suffolk, VA, USA. Maturity is shown as Peanut Maturity Index, the ratio of orange, brown, and black pods from the total pods on a sample of approximately 200 pods. Optimum maturity and digging are recommended at PMI of 0.6 – 0.7 for Virginia-type peanut. In parentheses on the X axes the growth degree days from planting to each corresponding DAP are shown.

In two years with different maturity scenarios (temperature profiles), cultivar had a significant effect on harvest maturity, regardless the planting site. As an example, Walton required a longer period to reach full maturity than the other cultivars. Yet the PC application by site-cultivar interaction was not significant (Table 1). The 3-way ANOVA with site-cultivar, sampling date, and PC treatment as factors showed no significant PC effect in 2022 but a significant PC effect (P=0.0463) was observed in 2023 when rainfall was both greater in volume and temporal frequency, i.e. PMI was 0.5 for PC untreated and 0.47 for PC treated peanuts in 2023. This was caused by significant PC effect on maturity at 140 DAP in 2023, showing that PC untreated were more mature than PC treated peanuts, i.e. 0.52 vs. 0.46 (data not shown). Because this happened at one out of 10 sampling dates (counting both years) but not at the digging time in either year, a conclusion that PC has no effect on peanut maturity on the new cultivars is plausible. This result confirms findings of Mitchem et al. (1996) that PC application affected peanut maturity only in one out of two years of the study and, in the year when maturity was enhanced by PC, the effect depended on location and application timing, i.e. PC enhanced maturity only at Lewiston but not at Rocky Mount, NC, and only when applied at row closure vs. pegging. The cv. used in these authors' study is NC 9, an obsolete peanut cultivar, released by Wynne, Mozingo & Emery (1986).

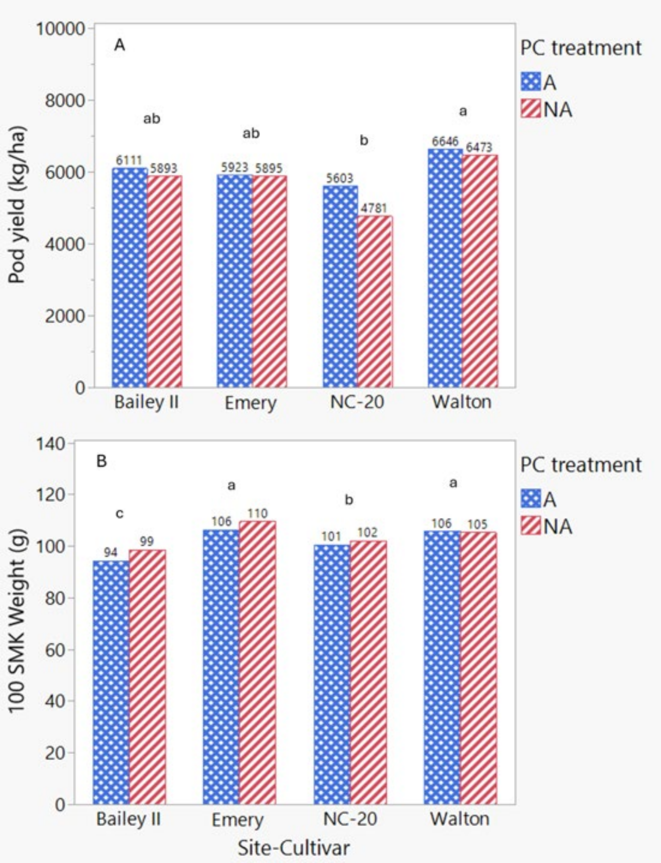

Figure 4. Pod yield (A) and 100 SMK weight (B) (means shown at the top of each bar) as affected by site-cultivar and prohexadione calcium (PC) applied (A) or not applied (NA) as Apogee® growth regulator in 2022. The letters show means separation for the site-cultivar main effect (PC treatments combined), i.e. similar letters show no significant differences based on Fisher LSD (P≤0.05). PC and site-cultivar × PC interaction were not significant at P≤0.05; separate bars for the PC treatment are shown for data visualization only.

PC Effect on Pod Yield and 100 SMK weight

In 2022, PC did not significantly affect the pod yield and 100 SMK weight, and the site-cultivar × PC interaction was insignificant at 0.05 probability (Table 2). Higher yield in PC treated vs. PC untreated peanuts for all cultivars trended, but this was insignificant (P=0.343) (Figure 4A), and the 100 SMK weight trended lower in PC treated vs. untreated peanuts (P=0.078) (Table 2, Figure 4B). This apparent decrease in seed weight after PC application requires further investigation as, if true, it may affect other seed properties, e.g. germination and seedling vigor that could be disastrous for commercial peanut seed production (Balota & Chandel, 2024). In the dry year (2022) average yield ranged from 4781 to 6646 kg/ha, with limited (P=0.038) site-cultivar differences (Figure 4A). For example, in average of PC treatments, the site planted with Walton produced higher (P=0.0136) yield than the site planted with NC 20, i.e. 6560 vs. 5192 kg/ha. This difference could have been due to the field properties rather than the cultivar, but the fact that Walton was released for its improved yield under drought compared to other cultivars also needs consideration (Balota et al., 2021). The 100 SMK weight ranged from 94 to 110 g with significant (P<0.0001) differences among site-cultivars. For example, Emery is generally recognized as the largest seeded virginia type cultivar currently grown in the VC region. In line with this description, Emery had higher test weight (P<0.0001) seeds than Bailey II and NC 20, but like Walton regardless of the PC treatment in 2022 (Figure 4).

Table 2. Analysis of variance for the effect of site-cultivar, prohexadione calcium, year, and digging date on peanut yield and 100 SMK weight. Digging date was a factor only in 2023.

Source		Pod yield			100 SMK weight		
	DF	Sum Squares	F Ratio	Prob > F	Sum Squares	F Ratio	Prob > F
				2022			
Site-Cultivar (Site-C)	3	6018653.9	3.33	0.038	516.93	17.26	<.0001
Prohexadione calcium (PC)	1	566098.5	0.94	0.343	34.00	3.41	0.078
Site-C × PC	3	586255.2	0.32	0.808	24.29	0.81	0.501
				2023			
Site-C	4	11829575.0	8.28	<.0001	581.07	5.93	<0.000
PC	1	1576835.0	4.42	0.040	0.07	0.00	0.957
Site-C × PC	4	4430031.0	3.10	0.022	173.04	1.77	0.148
Digging date (D)	1	5843113.0	16.37	<0.000	1117.51	45.61	<.0001
Site-C × D	4	2547528.0	1.78	0.144	95.56	0.98	0.428
PC × D	1	287941.0	0.81	0.373	45.60	1.86	0.178
Site-C × PC × D	4	840457.0	0.59	0.672	159.98	1.63	0.178
Year (Y)	1	19173470.0	24.16	<.0001	784.80	18.89	<.0001
PC	1	2728141.0	3.43	0.066	6.93	0.17	0.684
Y × PC	1	17.0	0	0.996	23.15	0.56	0.457

In 2023, significantly (P<0.0001) higher yields compared to 2022 were obtained regardless of the PC treatment, i.e. 6847 in 2023 vs. 5916 kg/ha in 2022 across the PC treatments (Table 2). This is a 14% yield increase from the (dry) 2022 year and confirms earlier research indicating that a minimum of 500 mm of precipitation during the growing season is required to achieve high yields in peanut, i.e. 505 mm were received in 2023 vs. 412 mm in 2022 (Balota, 2020; Balota et al., 2012, 2024; Puppala et al., 2023; Rowland et al., 2012). Not only yield, but PC efficacy seems to depend upon adequate precipitation, which is suggested by the lack of PC effect on either yield or 100 SMK weight in 2022. In contrast to 2022, in 2023, PC had a significant (P=0.040) effect on pod yield, i.e. 7004 kg/ha with vs. 6690 kg/ha without PC among site-cultivars; and the site-cultivar × PC interaction was significant (P=0.022) (Table 2). This denotes that cultivars in interaction with the soil type responded differently to PC applications, as suggested by other authors (Beam et al., 2002; Faircloth et al., 2005; Jordan, 2024; Jordan et al., 2001, 2008). Similarly, sites planted with Bailey II and NC 20 had significant yield increase when PC was applied, whereas for sites planted with Emery, Sullivan and Walton yield was similar (Figure 5). Consistent with 2022 results, PC did not affect 100 SMK weight, yet site-cultivar effect was significant (P<0.0001) (Figure 5). In line with 2022, in 2023, Emery had the highest and Bailey II the least 100 SMK weight. Consistent across cultivars and PC treatments, 100 SMK weight was significantly (P<0.0001) less in 2023 than in 2022 (Table 2), clearly indicating that 2023 yield increase was not determined by seed weight (Figures 4 & 5).

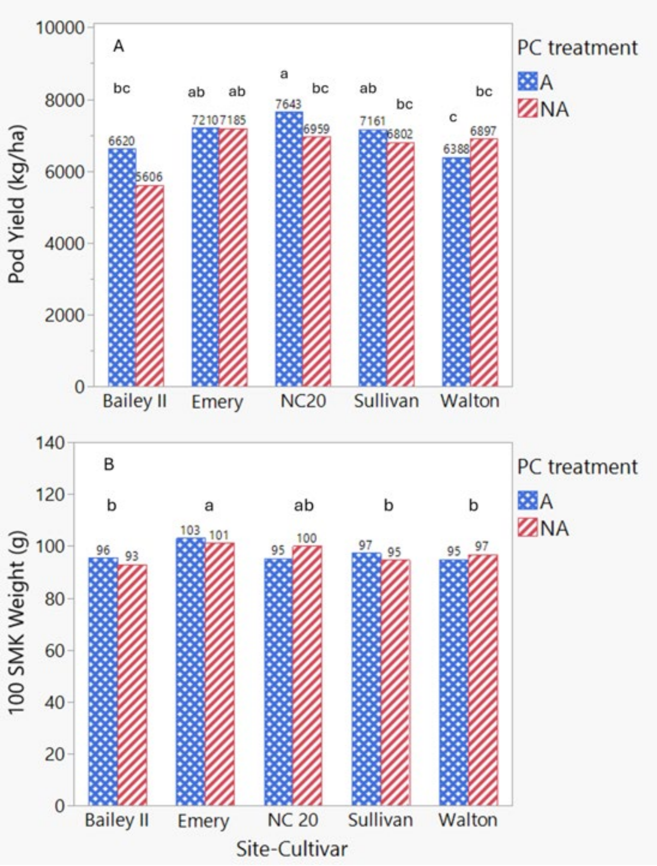

Figure 5. Pod yield (A) and 100 SMK weight (B) (means shown at the top of each bar) as affected by site-cultivar and prohexadione calcium (PC) applied (A) or not applied (NA) as Apogee® growth regulator in 2023. The letters show means separation for site-cultivar × PC interaction (Fig. 5A) and site-cultivar main effect (PC treatments combined) (Fig. 5B), i.e. similar letters show no significant differences based on Fisher LSD (P≤0.05). PC, site-cultivar, and their interaction were significant at P≤0.05 for yield. PC and site-cultivar × PC interaction were not significant for 100 SMK weight; separate bars for the PC treatment are shown for data visualization only.

In 2023, seed weight was less than in 2022, yet pods were less mature at harvest. For example, in 2022 at 155 DAP when peanut was dug, 1476 C GDD were accumulated and the average PMI across site-cultivars and PC treatments was 0.82. In 2023, at 150 DAP when plants were dug early, 1443 C GDD were accumulated, but average PMI was only 0.62.

Allowing 10 additional days to the late dig (at 160 DAP) resulted in PMI increase to 0.64 after additional 43 C GGD recorded from 3 October through 16 October. This may explain the reduced seed weight in 2023 compared to 2022, but it does not align with the pod yield, and 100 SMK weight increase from early to late dig in 2023 (Figure 6). Overall, yield increased from 5843 to 6384 kg/ha (P=0.0002), and 100 SMK weight from 93 to 101 g (P<0.0001) when dug later at 160 DAP vs. 150 DAP (Figure 6). Higher yield of the later dig compared with early dig could have been caused by higher SMK weight gain during 10 additional days in the ground. However, maturity progression from 150 to 160 DAP by the mesocarp color method seemed to not accurately reflect the pod filling progression reflected by increased yield and 100 SMK weight. This underscores the need for development of an improved method for determining peanut maturity, e.g. canopy reflectance changes as canopy matures via aerial imaging.

In 2023, at each date of maturity sampling, the number of harvestable pods per plant were calculated. Among cultivars, plants receiving PC had significantly (P=0.0001) more pods than untreated plants, with assessments between Bailey II and NC 20 showing the greatest PC effect (Figure 7). In Florida, Singh et al. (2024) determined that application of 140 g. a.i. PC/ha increased significantly peanut peg strength. These authors hypothesized that PC could increase harvest efficiency, and therefore yield, via increased peg strength. This could, in part, explain our results. However, in this study, PC treated plants had significantly more harvestable pods at all six sampling dates, not just at harvest. In this study, PC reduced vine mass redistributing the assimilates to fruits rather than shoots is attributed to increasing fruit set and yield, as shown in other crops (Rademacher, Spinelli, Costa, 2006).

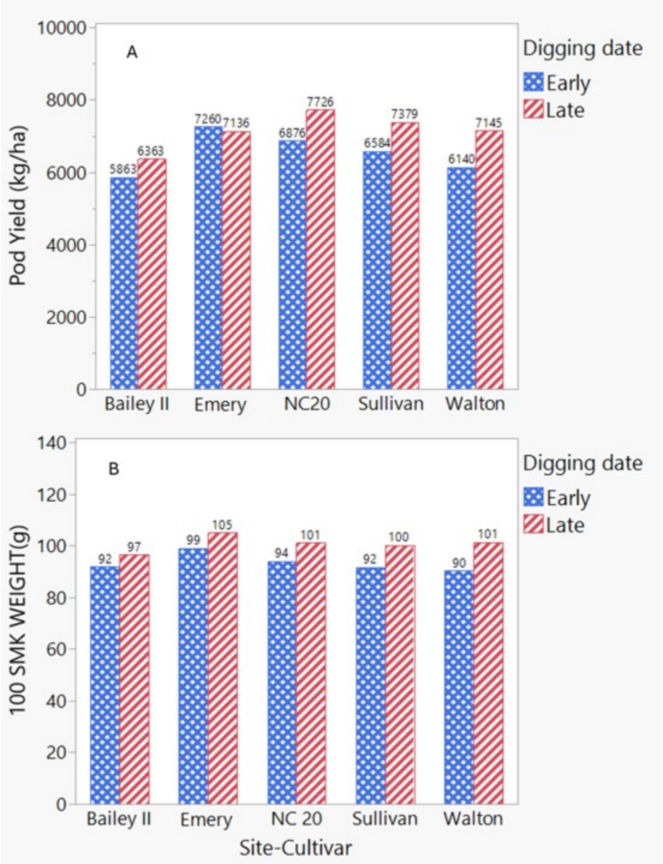

Figure 6. Pod yield (A) and 100 SMK weight (B) (means shown at the top of each bar) as affected by site-cultivar and digging date in 2023. Digging date had significant (P≤0.0001) effects based on Fisher LSD (P≤0.05) on both yield and 100 SMK weight, with no significant digging date × site-cultivar interaction.

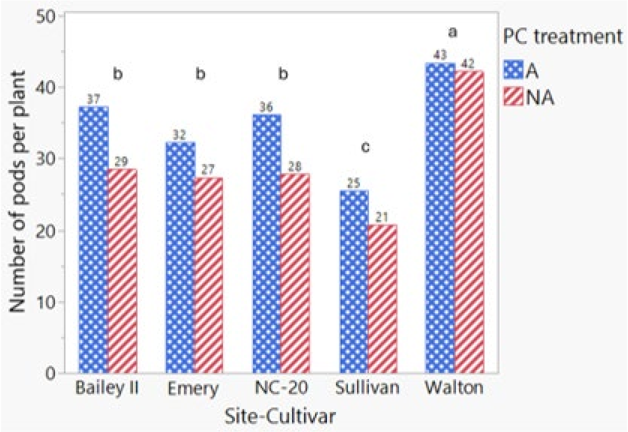

Figure 7. Number of pods per plant (means shown at the top of each bar) as affected by site-cultivar and prohexadione calcium (PC) applied (A) or not applied (NA) as Apogee® growth regulator in 2023. Means were calculated from approximately 350 plants per site-cultivar, sampled at six pod developmental stages starting with 120 days after planting (DAP) to 160 DAP. The letters on the figure indicate if the site-cultivar means are significantly different based on Fisher LSD (P≤0.05), i.e. same letters indicate no statistical differences comparing site-cultivars. Under significantly different site-cultivar scenarios, PC had a significant (P≤0.0001) effect on pods per plant with insignificant site-cultivar × PC interaction.

SUMMARY AND CONCLUSIONS

Data from this study including multiple combinations of diverse weather conditions (dry and wet years), growth stages (from 100 to 160 DAP or R5 through R8), and site-cultivars combinations, indicated that PC did not affect peanut maturity. However, this study raised concerns that later in the season, when heat accumulation drops, SMK weight gain may not pair well with the mesocarp pod color. This suggests that alternative methods for determining peanut maturity should be developed in the future. The differences in pod maturity between years in this study could have been driven by differences in heat accumulation early in the season rather than during seed filling. Similarly, PC did not affect peanut 100 SMK weight, rather the dry weather was paramount in this observation. This would suggest that lack of yield differences between PC treated and untreated plots in 2022 could have been more related to rainfall deficit effect on yield rather than plot size. In 2023, yield of PC treated plots was higher than for PC untreated, possibly as the result of improved assimilate partitioning, allowing an increased number of pods per plant in PC treated plots. The effect, however, was site-cultivar dependent. Our results agree with earlier research showing no effect of PC on pod maturity and inconsistent yield responses. Even if our plots were relatively large, PC effect on yield was weather and site-cultivar dependent, for which growers should use precaution when deciding to make one or two PC applications and prioritize the fields to receive or not PC each year, if minimizing costs is a priority.

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