Does Prohexadione Calcium Increase Peanut Yields?

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Introduction

Peanut (*Arachis hypogaea* L.) has a spreading growth habit with lateral branches completely covering the ground at harvest. The current Virginia-type cultivars Bailey II, Emery, Sullivan, N.C. 20, and Walton have shown abundant vine growth under Virginia climate. While this is a positive thing, e.g. more biomass production can support higher yields, growers that do not use RTK guidance may be unable to see the rows for efficient vine digging and inversion. In short, under pressure from inverter set off the rows, pods can shed from the vines and yield can be lost (Samenko, 2021). Excessive vine growth can also be conducive to more disease pressure as more moisture is trapped within the canopy and fungicide penetration impeded (Can Growth Regulators Boost Peanut Yields? | Panhandle Agriculture).

To suppress excessive vine growth and increase row visibility, growers in Virginia spray prohexadione calcium (PRO-CA) as Apogee® (BASF Corp., 27.5% PRO-CA), once or twice during vegetation. The first application is recommended at 50% touching of vines from adjacent rows, and the second application can follow the first after 2 weeks. Figure 1 shows the optimum vine growth for beginning PRO-CA applications and when it is too late (vines have grown too much). PRO-CA is a growth regulator used in peanuts and other crops. It inhibits production of gibberellins, a group of hormones responsible for cell growth and, therefore, vine and leaf growth. Application of PRO-CA results in leaf greening and plant height & width reduction.

In 2022, a survey across Virginia, North Carolina, and South Carolina (the Virginia-Carolina region), showed that 60% of growers applied PRO-CA once and 32% twice (Jordan, Anco et al, 2024). Although it seems simple and straightforward, PRO-CA applications are a relatively expensive input cost for growers. Jordan, Auman et al. (2024) estimated that the cost of a single PRO-CA application is $30/acre. To be affordable, PRO-CA will need to increase yields either directly, i.e. adjusting the vine growth so that plant reserves are used by pods and seed rather than leaves, or indirectly, i.e. reduce pod loss at digging. However, yield benefits from PRO-CA applications have been inconsistent in research trials. Jordan, Johnson et al. (2024) found a yield response to PRO-CA application when research plots were large, but not when small. This agrees with other researchers reporting that yield increase was rare when PRO-CA was applied on small plots (Monfort et al., 2021; Studstill et al., 2020). Similarly, historic cultivars responded positively to PRO-CA in small plots, but not newer cultivars (Beam et al., 2002; Faircloth et al., 2005; Jordan et al., 2001, 2008, 2024). So, what is going on?

Figure 1. Past optimum (upper picture) and optimum (below picture) vine growth for the first application of prohexadione calcium.

What Our Research Reveals

Methods

In 2022, 2023, and 2024, replicated experiments were carried out at the Tidewater AREC in Suffolk VA, using four Virginia-type cultivars, 'Bailey II', 'Emery', 'N.C. 20', and 'Walton'. Cultivar 'Sullivan' was tested only in 2023 and 2024. Each year, two applications of Apogee® at 7.25 oz/acre with 16 oz UAN and crop oil were applied at 50% vine touching (Jul 23 - Aug 10) and 14 days after the first application. General management of the fields followed recommendations of the Virginia Production Guide (Balota, 2023). At the physiological maturity, yield and yield components were recorded.

In 2022 and 2023, mechanized spray applications were performed on 5 to 8-row strips randomly selected to receive or not receive PRO-CA within two-acre large fields, each field planted with an individual cultivar. In each field, 4 strips or replications, the length of the entire field (over 100 feet long), received and 4 did not receive the growth regulator. Yield was taken from 420 ft^2 areas within each PRO-CA treatment and replication in 2022, and from an average of 2,500 ft^2 in 2023. Figure 2 shows the large plots design used in 2022 and 2023.

Figure 2. Strips of peanut rows that received or not prohexadione calcium in 2022 and 2023.

In 2022, expected changes in leaf color and plant heigh between plants receiving or not PRO-CA were not evident on the aerial images (Fig. 2). Our visual observations noted a slight change in leaf color within a week after the first PRO-CA application, but no differences in color or height were noted later. In 2023, there were more obvious differences, with darker green color for the plants that received PRO-CA.

In 2024, small plots (10 ft by 3 ft) were designed to accommodate randomized complete block trials of PRO-CA and non-PRO-CA treatments in open-air and under rainout shelter, replicated twice under each treatment and environment. In this test, backpack spraying of PRO-CA was performed on July 23. Then, the rain shelters were moved over the plots designated to a severe heat stress and drought environment, and a second PRO-CA was applied on Aug 6.

In 2024, the change to darker green color of the plants receiving PRO-CA was obvious and lasted long. Plant height was also one foot shorter for plants that received PRO-CA. What happened then and what was the difference between years to trigger these responses?

Figure 3. Picture showing the effect of prohexadione calcium (PRO-CA) on peanut leaf color in 2024. Peanuts on the left side of the rainout shelter are darker green because of PRO-CA in comparison with the right side.

Figure 4. Picture showing the effect of prohexadione calcium (PRO-CA) effect on peanut height in 2024. Peanuts on the left side of the rainout shelter are one inch shorter because of PRO-CA in comparison with the right side.

Yield and yield components in 2022

In 2022, pod yield was not significantly affected by the PRO-CA applied as Apogee® for any of the cultivars and ranged from 4,263 pounds per acre to 5,933 pounds per acre across cultivars and PRO-CA treatments (Fig. 5). Across all cultivars, the 100-seed weight slightly decreased when Apogee® was applied from 104 grams to 102 grams, but this was not statistically significant.

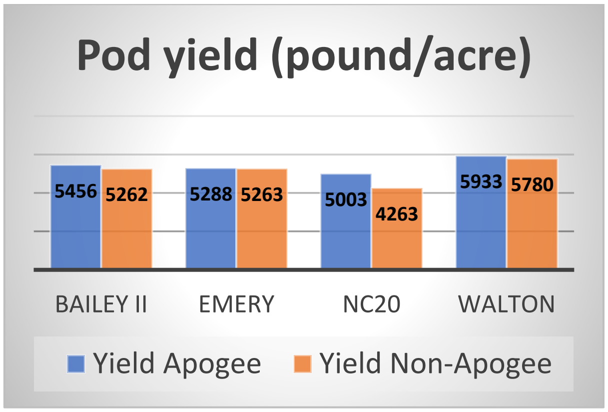


Figure 5. The yield of four peanut cultivars was not affected by prohexadione calcium (Apogee®) applied at 50% vine touching in 2022.

Yield and yield components in 2023

In 2023, overall pod yield increased when Apogee® was applied, but each cultivar responded differently. Figure 6 shows that for Bailey II, NC20 and Sullivan, yield was higher with than without Apogee®; for Emery there was no change; and for Walton yield decreased when Apogee® was applied.

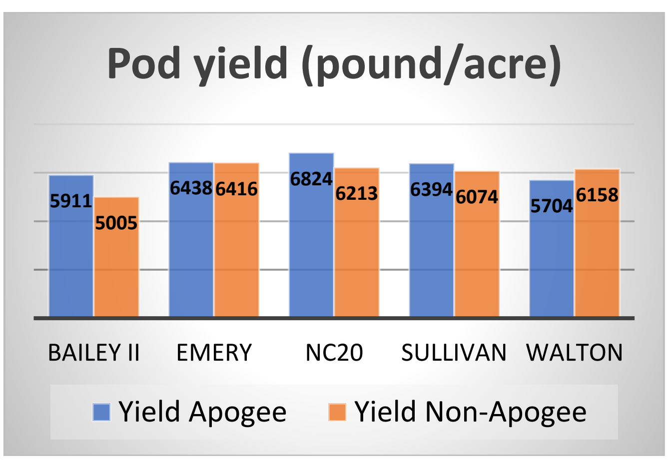


Figure 6. The yield of five peanut cultivars was overall increased by prohexadione calcium (Apogee®) applied at 50% vine touching in 2023.

In 2023, 100-seed weight was not affected by Apogee®, but the number of pods per plant was significantly greater for Apogee® treated versus untreated plants and, overall, increased from 29 to 35 pods per plant.

Yield and yield components in 2024

In 2024, pod yield increased significantly for all cultivars when Apogee® was applied, regardless of the plots being in open-air or under the shelter after the first application. Figure 7 shows that the average yield of all five peanut cultivars (Bailey II, Emery, NC20, Sullivan, and Walton) was 6,296 pounds per acre in open-air and 4,760 pounds under the shelter when Apogee® was applied. When Apogee® was not applied, the yield was 4,972 pounds per acre in open-air and 2,732 pounds under the shelter.

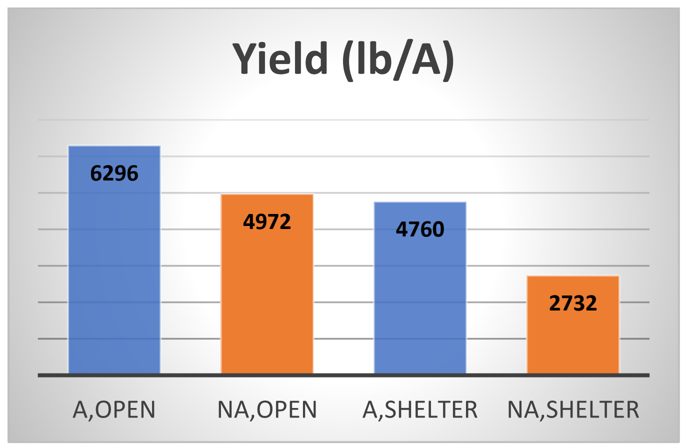
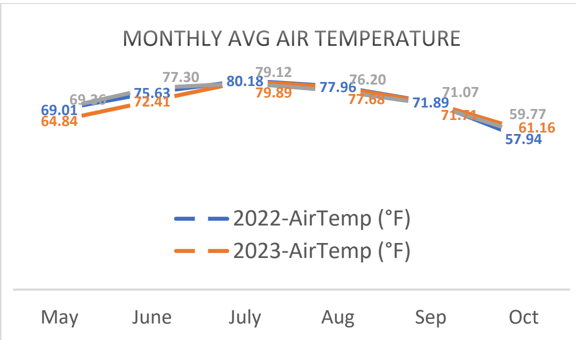


Figure 7. The average yield of five peanut cultivars was increased by prohexadione calcium (Apogee®) applied at 50% vine touching, in open-air and rain-out shelter plots, in 2024.

Not every year PRO-CA application increased yield, for which it has been hypothesized that large rather than small plots could demonstrate its positive benefit. In our experience, the small plots rather than large plots showed a yield benefit from PRO-CA applications. Could there be another reason for PRO-CA affecting yielding differently in some years versus the others?

To explain this, we looked at the temperature and precipitation in 2022, 2023, and 2024 growing seasons. In Virginia' s climate, 50% vine touching usually occurs during the last week of July to the first week of Aug. Because of morning dew and genetics, vine touching and canopy closure can happen even in dry years, like in 2022, when total rainfall in July was half that observed in 2023 and three times less than in 2024. In this year, Bailey II, Emery, NC20, and Walton were, in appearance, ready to receive the first PRO-CA application. Only Sullivan had vines that did not touch in 2022, and this is why this cultivar is missing from comparisons in 2022. Higher temperatures in May and June could have also contributed to an apparently ready canopy to receive PRO-CA in 2022 for the four cultivars.



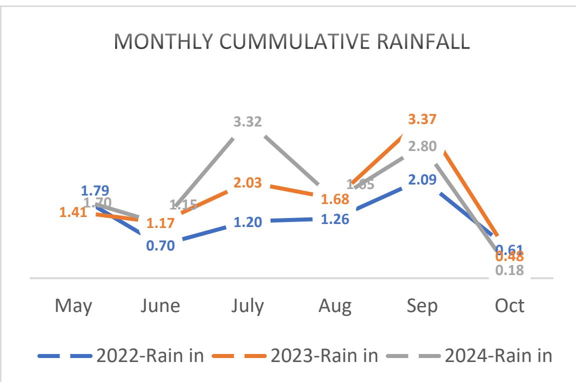


Figure 8. There were no differences among years for average temperature when prohexadione calcium is typically applied (end of July and beginning Aug), but monthly cumulative precipitation in July was different: 1.2 inches were received by the crop in 2022, 2.03 inches in 2023, and 3.32 inches in 2024.

Precipitation distribution was also different among years. For example, in 2022, 80% of the rainfall from July 1 to Aug 10 was received in three rain events, on July 10, July 31, and Aug 10, with almost no rain in between. In 2023 and 2024, rainfall was distributed weekly or bi-weekly in reasonable to substantial amounts. This may likely have caused subtle differences between canopies from one year to another, which is difficult to visually observe without measuring total biomass. Temperature wise, 2023 was a little cooler than 2022 and 2024 in May and June with no major differences during the remaining growing season.

What we think

Based on this data, we suggest that to obtain a yield benefit from PRO-CA applications, a grower should consider monitoring weather conditions with care. For example, total precipitation of 2 inches or more in July, uniformly distributed, coupled with higher-than-normal temperatures in May and June seem to warrant a yield increase when PRO-CA is applied and regardless of the weather following its first application, e.g. from Aug on the season becomes drier. Alternatively, if rainfall in July alone is less than 2 inches and sporadically distributed, and May and June are cooler, then PRO-CA does not need to be applied, even in the fields where visually the vines are abundant. Many growers that use PRO-CA in peanut production can supply water through irrigation. However, based on our data, it seems that the use of irrigation must be proactive rather than when absolutely needed, e.g. water availability in July needs to be constant from the beginning of the month, which may be difficult to achieve unless an accurate long-term prediction model is available. Under these conditions, maybe PRO-CA should not be used even in irrigated fields. Finally, heterogenicity may be one cause for observing PRO-CA positive effects on yield consistently only in large size plots as explained by Jordan, Johnson et al. (2024), however, the growing environment has been historically the major cause for yield inconsistencies in field research trials and grower fields. We shall not disregard any of these potential causes on advising growers on the use of PRO-CA in peanut production.

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References

Balota, M. (2023). 2023 Virginia Production Guide _ Agronomy. VCE. Retrieved from https://www.pubs.ext.vt.edu/SPES/SPES-367/SPES-367.html

Beam, J. B., Jordan, D. L., York, A. C., Isleib, T. G., Bailey, J. E., McKemie, T. E., Spears, J. F., & Johnson, P. D. (2002). Influence of prohexadione calcium on pod yield and pod loss of peanut. Agronomy Journal, 94, 331–336. https://doi.org/10.2134/agronj2002.3310

Faircloth, J. C., Coker, D. L., Swann, C. W., Mozingo, R. W., Phipps, P. M., & Jordan, D. L. (2005).

Response of four Virginia-type peanut cultivars to prohexadione calcium as affected by cultivar and planting pattern. Peanut Science, 32, 42–47. https://doi.org/10.3146/0095-3679(2005)32[42:ROFVPRO-CA]2.0.CO;2

Jordan, D. L., Anco, D., Balota, M., & Brandenburg, R. L. (2024). Farmer insights on harvesting peanut: A survey from the Virginia-Carolina region of the United States. Crop, Forage & Turfgrass Management, 10, e20262. https://doi.org/10.1002/cft2.20262

Jordan, D. L., Auman, D., Brandenburg, R. L., Buol, G., Collins, A., Dorfman, J., Dunne, J., Foote, E., Gorny, A., Lux, L., Reisig, D., Roberson, G. T., Royals, B., Shew, B., & Washburn, D. (2024). 2024 Peanut information (Publication no. AG-331). North Carolina Cooperative Extension Service.

Jordan, D. L., Johnson, P. D., Hare, A., Foote, E., Wells, R., Balota, M., Barrow, B., Grimes, L., Ellison, C., King, D., Parker, Z., Brake, M., Deal, S., Stevens, B., Corbett, T., Lanier, I., & Ransom, L. (2024). Peanut response to single and sequential applications of prohexadione calcium. Crop, Forage & Turfgrass Management, 10, e20309. https://doi.org/10.1002/cft2.20309

Jordan, D. L., Nuti, R. C., Beam, J. B., Lancaster, S. H., Lanier, J. E., Lassiter, B. R., & Johnson, P. D. (2008). Peanut (Arachis hypogaea L.) cultivar response to prohexadione calcium. Peanut Science, 35, 101–107. https://doi.org/10.3146/PS07-112.1

Jordan, D. L., Beam, J. B., Johnson, P. D., & Spears, J. F. (2001). Peanut response to prohexadione calcium in three seeding rate-row pattern planting systems. Agronomy Journal, 93, 232–236. https://doi.org/10.2134/agronj2001.931232x

Monfort, W. S., Tubbs, R. S., Creswell, B. L., Jordan, E. L., Smith, N. B., & Luo, X. (2021). Yield and economic response of peanut (Arachis hypogaea L.) cultivars to prohexadione calcium in large- plot trials in Georgia. Peanut Science, 48(1), 15–21. https://doi.org/ 10.3146/PS20-29.1

Samenko, L. (2021). Sources of peanut digging losses and strategies to reduce losses during inversion (No. 3685) [Master’s thesis, Clemson University]. Tiger Prints. https://tigerprints.clemson.edu/all_theses/3685

Studstill, S. P., Monfort, W. S., Tubbs, R. S., Jordan, D. L., Hare, A. T., Anco, D. J., Sarver, J. M., Ferguson, J. C., Faske, T. R., Creswell, B. L., & Tyson, W. G. (2020). Influence of prohexadione calcium rate on growth and yield of peanut (Arachis hypogaea). Peanut Science, 47(3), 163–172. https://doi.org/10.3146/PS20-11.1

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