Economic impact of prohexadione calcium for managing vine growth in runner market-type peanut

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Photo by Bruce Dupree/Alabama Extension.

In recent years, there have been several new peanut varieties developed that perform exceptionally well across many environments and have improved disease resistance packages. However, growers have been slow to adopt some new varieties due to their excessive vine growth. One potential solution is to use a plant growth regulator to manage the excessive vine growth.

Sustainability of a peanut crop depends largely on the consistency of a variety to produce across many different microclimates throughout the growing region. In recent years, there have been several new varieties developed that perform exceptionally well across many environments and have improved disease resistance packages. However, growers have been slow to adopt some new varieties due to their excessive vine growth. Excessive vine growth has caused issues with pesticide coverage and movement to target areas on the plant. It also contributes to inaccurate digging when GPS guidance is not used and slowing harvest due to the increase in biomass being processed through the combine. One potential solution is to use a plant growth regulator to manage the excessive vine growth.

Utilization of plant growth regulators in peanut to manage vegetative growth in the United States is not a new approach. Growth regulators have been evaluated and utilized for more than 40 years with prohexadione calcium being the most recent

(Beasley et al., 2004; Jordan et al., 2008, 2000; Mitchem et al., 1996; Smith, 1989; Wu & Santelmann, 1977). Prohexadione calcium is sold commercially as Apogee 27.5 WDG (BASF Corp., Research Triangle Park, NC) or Kudos 27.5 WDG (Fine-Americas, Walnut Creek, CA). Since its commercialization in 2000, there have been numerous research experiments on Virginia market-type peanut that have shown the effectiveness of prohexadione calcium (two applications of 7.25 oz/ac) in managing vegetative growth by reducing internode elongation through inhibiting gibberellin biosynthesis (Culpepper et al., 1997; Faircloth et al., 2005; Jordan et al., 2000). During the time period when prohexadione calcium was registered commercially on peanut, it was not marketed for use on runner market-type cultivars due to their less vigorous vine growth habit along with the adaptation of GPS guidance on tractors (Roberson & Jordan, 2014). However in the last 10 years, there has been a resurgence of faster-growing runner market-type cultivars, which resulted in growers mowing the top third of the canopy out of the crop in an effort to increase row visibility and further reduce digging losses, even in the presence of GPS guidance.

Initial observations of prohexadione calcium at the labeled product rate of 7.25/ac showed a significant reduction in vine growth in runner market-type peanut but did not show consistent yield or economical gains for managing the excessive vines compared with the non-treated check (Beasley, unpublished data; Monfort, unpublished data). Evaluating efficacy of reduced rates of prohexadione calcium as a way to reduce the cost of the application while still managing the vine growth became more relevant. Therefore, research was conducted to quantify the growth response and economics of reduced rates compared with the labeled rate of prohexadione calcium on currently available runner-type peanut cultivars.

Materials and Methods

Large on-farm plot experiments were conducted from 2017 to 2018 under irrigation in Georgia to evaluate cultivar response (growth and yield) and economic return to prohexadione calcium application rate in peanut. Two large on-farm rate trials were conducted comparing the labeled rate of 7.25 oz/ac and a non-treated check in Bulloch and Early counties. Five additional on-farm trials were conducted to examine reduced rates of prohexadione calcium compared with a non-treated check in Baker and Early counties. Peanut planting date varied by location and ranged from early to mid-May.

Prohexadione calcium treatments evaluated were (1) the manufacturer's recommended use rate of 7.25 oz/ac (1 ×, Apogee or Kudos); (2) 5.44 oz/ac (0.75 ×, Apogee or Kudos); and/or (3) 3.63 oz/ac (0.5 ×, Apogee or Kudos). Each treatment was applied twice. A non-treated control was included in all experiments. Prohexadione calcium was applied in 15 gal/ac of water using commercial large-scale crop sprayers for the large-plot experiments. For all experiments, prohexadione calcium treatments were initiated when at least 50% of lateral vines from adjacent rows were touching. The second application of each treatment was applied 14 days after the first application.

Seed was planted at rates to achieve a final in-row plant population of 4 to 5 plants/ft in a single-row planting pattern (36-inch row spacing). The label requires a crop oil concentrate at 1 qt/ac (Agri-Dex, 83% paraffin-based petroleum oil and 17% surfactant, Helena Chemical Co., Memphis, TN) and 28% urea ammonium nitrate or 21% ammonium sulfate nitrogen source at 1 pt/ac to be applied with the prohexadione calcium to increase absorption and efficacy in the peanut plant. Plot dimensions ranged from 18 to 36 ft wide and 500 to 1,500 ft long. All experiments were in a randomized complete block design with four replicates. Main stem height (inches) was measured two weeks after the second application of prohexadione calcium to determine plant growth response to the growth regulator. This measurement was taken by measuring the height of the main stem 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 & Drexler, 1981). Plants were air-dried for 5 to 7 days 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. The estimated product cost for prohexadione calcium is $6.92/oz.

Analysis of variance was conducted using the PROC MIXED function within SAS version 9.4 (SAS Institute, Cary, NC). Appropriate means were separated with Fisher's protected least significant difference (LSD) test at $p = .05$.

Results

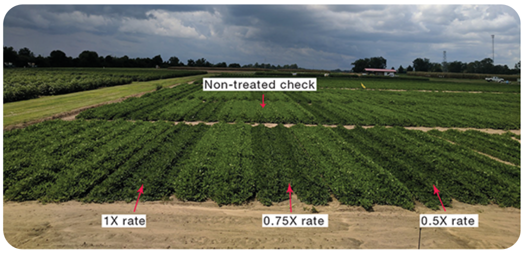

Figure 1, *Response of peanut canopy growth to prohexadione calcium application rates seven days after a second application in Tifton, GA.*

Like with previous growth regulator research on peanut, two applications of prohexadione calcium reduced vine growth in all trials compared with the non-treated control (Figures 1 and 2). The more notable discovery in these experiments was that the reduced rates of 3.63 and 5.44 oz/ac reduced vine growth similarly to the 7.25 oz/ac labeled rate. Although prohexadione calcium did not affect pod yield over that of the non-treated control in previous small-plot research

(Studstill et al., 2020), the reduced rate of 5.44 oz/ac significantly increased pod yield compared with the nontreated check and the full labeled rate of 7.25 oz/ac in the Early County, GA location and the non-treated check in Bulloch County, GA (Figure 3). Furthermore, pod yield was also greater for the five large-plot trials where prohexadione calcium at 5.44 oz/ac (two applications) was compared individually to the non-treated control. The average yield was 7,253 lb/ac for the 5.44 oz/ac rate of prohexadione calcium and 6,682 lb/ac for the non-treated control averaged over the five trials.

In evaluating the return on investment for each treatment, the 3.63 oz/ac and 5.44 oz/ac prohexadione calcium treatments significantly increased revenues from $50/ac (0.5 ×) to $85/ac (0.75 ×), respectively, when compared with the non-treated control in the two on-farm application rate trials (Figure 4). When the return on investment was evaluated for the five large-plot trials, the two applications of 5.44 oz/ac increased revenues by $69.35/ac compared with the non-treated control.

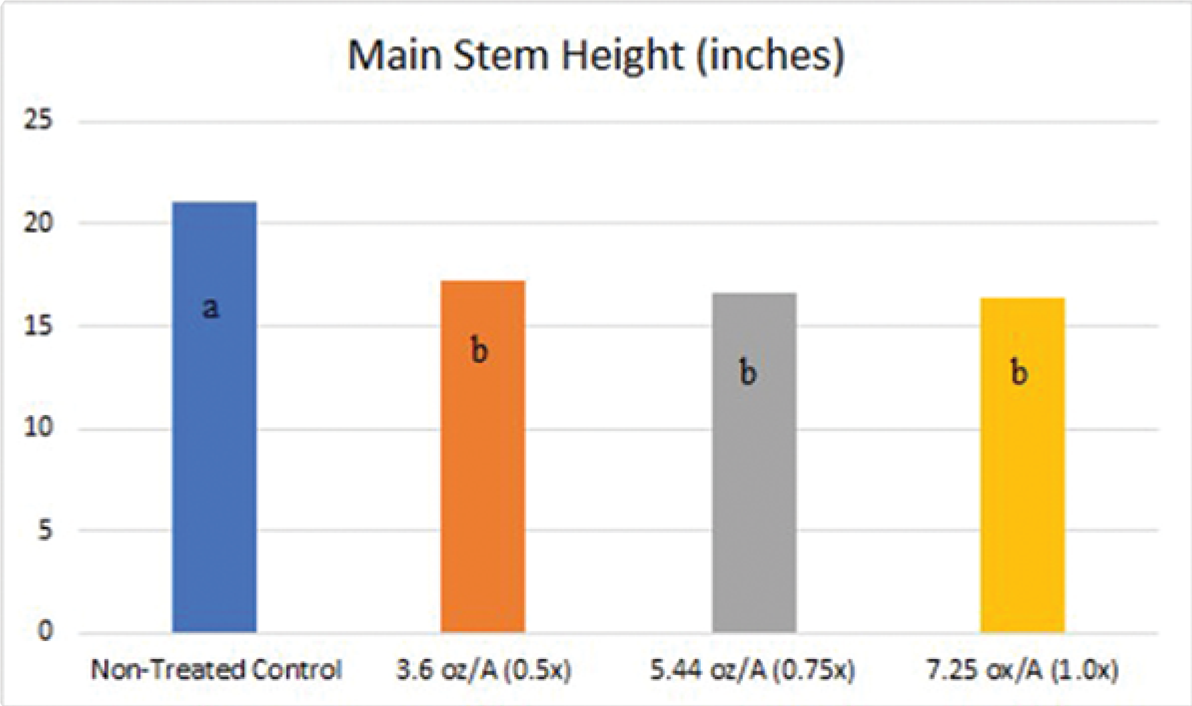

Figure 2, *Response of peanut canopy growth (inches) to prohexadione calcium application rates. Canopy height data were pooled across locations and cultivars.*

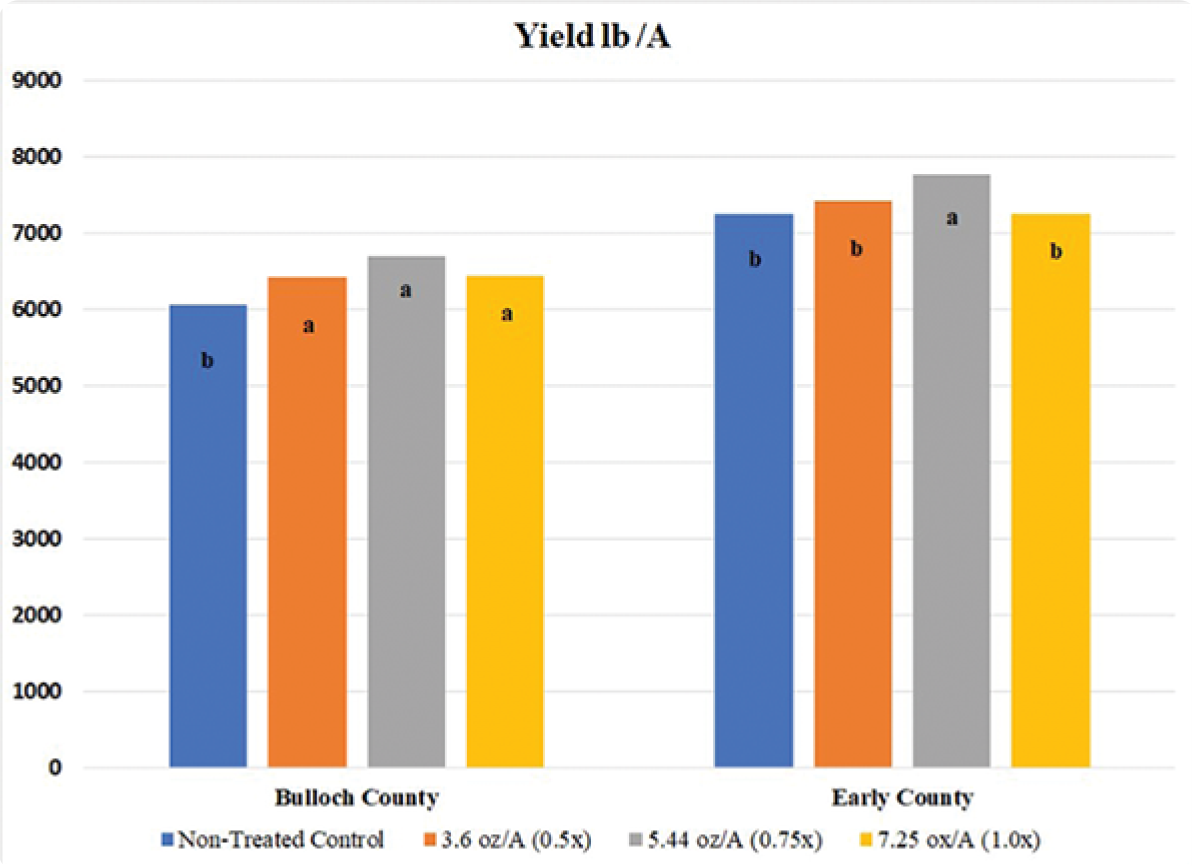

__Figure 3,__ Response of peanut yield (lb/ac) to prohexadione calcium application rate in large on-farm trials in Bulloch and Early counties in Georgia. Yield data were pooled across cultivars.

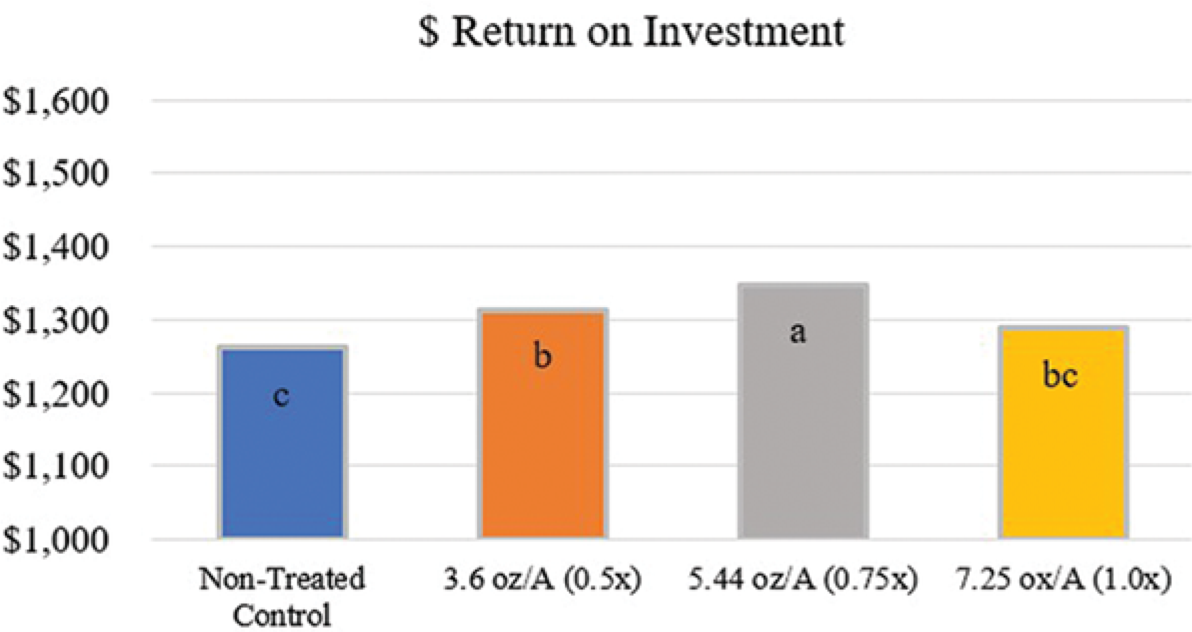

Figure 4, *Net dollar returns to prohexadione calcium application rates in large on-farm trials in Bulloch and Early counties in Georgia. Net dollar return data were pooled across location and cultivars.*

Discussion and Summary

The goal of this project was to evaluate the efficacy and economics of prohexadione calcium applied at reduced and labeled rates on runner market-type peanut cultivars. The results showed that reduced rates of prohexadione calcium at 3.63 oz/ac and 5.44 oz/ac can be used to reduce mainstem height similar to the 7.25 oz/ac rate. This research supports previous findings that the labeled rate (1.0x) of prohexadione calcium did not provide a consistent increase in yield nor an increase in return on investment compared with no application (Faircloth et al., **2005**). However, reduced rates performing similarly to the labeled rate could potentially save growers an average of $14.00/ac (0.75 ×) to $30.00/ac (0.5 ×) in growth regulator costs, making it more cost effective to manage vine growth while providing a yield boost and return on investment, especially at the reduced rate of 5.44 oz/ac. This reduction in rate and the increase in yield provided a return of investment of up to $85/ac over the economic return of the non-treated control in all on-farm trials. Based on these trials, the University of Georgia recommends that growers use reduced rates of 3.63 to 5.44 oz/ac to economically manage excessive vine growth in peanuts in irrigated fields.

A note of caution from working with this growth regulator: the use of the growth regulator on peanut is only recommended for:

- Peanut cultivars with excessive vine growth in irrigated fields.
- Irrigated fields with a history of excessive vines growth for all cultivars.

The use of a growth regulator in non-irrigated or in irrigated fields without excessive vine growth is not recommended as growers could experience growth issues and/or loss of yield when peanut is under stress due to lack of moisture, disease pressure, fertility, or other stress conditions.

Dig deeper

This article was adapted from the following two articles published in the journal *Peanut Science*:

Studstill, S.P., Monfort, W.S., Tubbs, R.S., Jordan, D.L., Hare, A.T., Anco, D.J., ... & 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

Monfort, W.S., Tubbs, R.S., Cresswell, 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

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