PEANUT (ARACHIS HYPOGAEA) RESPONSE TO PROHEXADIONE CALCIUM

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ABSTRACT
Managing vines to ensure adequate row visibility is important in peanut production systems where efficient and precise digging is needed to optimize yield. Prohexadione calcium is registered for use in peanut to reduce excessive vegetative growth in order to improve row visibility. Research has been conducted in North Carolina since 1994 to determine factors influencing peanut response to prohexadione calcium. A wide range of cultural practices and application variables influence efficacy of prohexadione calcium and often explain response to this plant growth regulator. This article summarizes results from research in North Carolina with Virginia market type cultivars that is currently being used in developing recommendations on prohexadione calcium use in peanut.

INTRODUCTION
Excessive growth of peanut vines can decrease row visibility and subsequently reduce efficiency of digging peanut pods and inverting vines. Daminozide (succinic acid-2,2-dimethylhydrazide) was effective in minimizing late season growth of peanut and enhancing row visibility (Brown and Etheridge, 1974; Gorbet and Rhoads, 1975; Hsi and Davidson, 1980). However, registration of daminzide was cancelled in late 1980s. More recently, prohexadione calcium (calcium salt of 3,5-dioxo-4 propionylcyclohexanecarboxylic acid) received registration for peanut and several other crops as replacement for daminozide (Mitchem et al., 1996; Culpepper et al., 1997) and is currently marketed as (Apogee®) in the United States. Prohexadione calcium inhibits internode elongation in responsive plants by blocking kaurene oxidase and subsequent gibberellin biosynthesis (Grossman et al., 1994; Nakayama et al., 1992). Research has been conducted in North Carolina since 1994 to determine the suitability of prohexadione calcium in peanut and to define interactions with cultural and pest management practices that influence consistency of performance. The purpose of this article is to summarize results from research evaluating peanut response to prohexadione calcium in North Carolina.

MATERIALS AND METHODS
The majority of experiments were conducted on research stations or on-farm locations using small-plot research techniques. Unless otherwise noted, prohexadione calcium, either as Baseline® or Apogee®, was applied sequentially at 140 g ai/ha when 50% of vines from adjacent rows are touching followed by a second application at the same rate 2 to 3 weeks later. Prohexadione calcium was generally applied in 145 L aqueous solution/ha with crop oil concentrate and urea ammonium nitrate solution each at 2.4 L/ha using regular flat fan nozzles.
Visual estimates of row visibility using a scale of 0 to 10 were recorded within three weeks prior to digging and vine inversion to compare canopy architecture and row visibility where 0 = a flat canopy with no distinguishable rows and 10 = peanut rows with a distinct triangular shape (Mitchem et al., 1996). In many experiments main stem height was also recorded prior to digging. Pod yield and market grade characteristics including percentages of extra large kernels, total sound mature kernels, and fancy pods were determined in most experiments (USDA-FSA, 2003).

Data for row visibility, main stem height, pod yield, and appropriate market grade characteristics were subjected to analyses of variance appropriate for the factorial treatment arrangement in each experiment. Means of significant main effects and interactions were separated using Fisher’s Protected LSD test at p < 0.05.

RESULTS AND DISCUSSION
Mitchem et al. (1996) and Culpepper et al. (1997) reported that in many instances prohexadione calcium improved row visibility, increased pod yield, and increased market grade characteristics. Research demonstrated that peanut response to prohexadione calcium was dependant in part on cultivar selection, application rate, and timing of application. Research also indicated that a higher percentage of pods with a brown and black mesocarp color were noted when prohexadione calcium was applied compared with non-treated peanut when samples were collected on the same day. A darker mesocarp color is indicative of more advanced pod maturity (Williams and Drexler, 1981), and a higher percentage of mature pods could be a reflection of more advanced pod maturation or greater pod retention due to prohexadione calcium. Previous research (Hodges and Perry, 1970) suggested that daminozide increased pod retention. Although Culpepper et al. (1997) did not define the mechanism of having a higher percentage of mature pods, either enhanced pod maturation allowing earlier digging or greater pod retention would minimize digging loss would be positive from a peanut management standpoint. Beam et al. (2002) reported that prohexadione calcium reduced pod loss compared with non-treated peanut explaining partially yield increases observed in the field.

In addition to results by Mitchem et al. (1996) and Culpepper et al. (1997), Jordan et al. (2009) reported that applications past 50% row closure increased row visibility less effectively than earlier applications. Applications made within 3 weeks prior to harvest increased row visibility slightly but did not affect pod yield.

Cultivars evaluated by Mitchem et al. (1996) and Culpepper et al. (1997) are no longer grown on significant ha in the United States. Research by Beam et al. (2002), Faircloth et al. (2004), and Jordan et al. (2008) reported response of peanut to prohexadione calcium with more recently released cultivars. Although no clear relationship between prohexadione calcium and pod yield could be established, row visibility was improved regardless of cultivar. Some cultivars inherently have greater row visibility regardless of prohexadione calcium treatment. Establishing interactions of prohexadione calcium and cultivars with respect to row visibility and pod yield will continue to be important as new cultivars are released by breeding programs and become accepted by growers.
Prohexadione calcium has a very short half life and rapid absorption into plant tissue is critical for optimum performance (Beam, 2004). Research suggested that nitrogen solution is critical for optimum performance and that in some cases the combination of nitrogen solution and crop oil concentrate are more effective than crop oil concentrate or nitrogen solution alone (Jordan et al., 1999). Crop oil concentrate alone was the least effective adjuvant.

A wide range of pesticides and other crop management materials are available for use in peanut, and timing of application of many of these agrichemicals often coincide. Because growers attempt to minimize trips across fields, co-application of prohexadione calcium with other agrichemicals is a possibility. Research by Beam et al. (2002) and Jordan et al. (2009) suggests that the majority of agrichemicals applied to peanut do not adversely interact with prohexadione calcium. Weed and disease control and row visibility were not compromised when prohexadione calcium and other agrichemicals were co-applied (Beam et al., 2002; Jordan et al., 2009). The requirement for crop oil concentrate and nitrogen solution to optimize prohexadione calcium efficacy is a concern when considering efficacy of agrichemicals other than prohexadione calcium.

Prohexadione calcium is relatively expensive for peanut due to patent issues and peanut marketing arrangements. Research was conducted to determine if row visibility is adequate when prohexadione calcium was applied as a band (spraying 45 cm of 91-cm rows) or by alternating spray nozzles to deliver less solution when nozzles were spaced 45 cm apart on 91-cm rows using a broadcast application (Jordan et al., 2009). Research indicated that applying prohexadione between rows on lateral branches was more effective than applying prohexadione calcium over main stems in terms of improving row visibility. However, benefits of prohexadione calcium in improving pod retention may not be realized when lower rates of prohexadione calcium are applied to portions of the peanut canopy, especially the central portion of the canopy associated with the main stems.

Research is currently underway to compare benefits of prohexadione calcium compared with precision digging of peanut using satellite imagery. In these experiments peanut is planted in straight rows that ensures accurate digging in absence of prohexadione calcium and in rows that are randomly planted in a winding pattern. While precision digging eliminates or minimizes the value of enhanced row visibility by prohexadione calcium, benefits of pod retention and possible effects on disease development are important factors when considering the value of prohexadione calcium.

Prohexadione calcium continues to show promise as a management tool in peanut. Research will continue in order to define interactions with a range of cultural and pest management practices. Efforts will also be made to more clearly predict when a positive yield response to prohexadione calcium can be expected.

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LITERATURE CITED


