Response of New Cultivars to Early Postemergence Chlorimuron Applications[1]

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ABSTRACT

Field studies were conducted in Alabama and Georgia in 2002 and 2003 to determine whether the peanut cultivar that replaced the cultivar Florunner can tolerate earlier applications of the herbicide chlorimuron than what is registered. The application timing restriction of chlorimuron on peanut had been established in the late 1980s with Florunner. In a factorial treatment arrangement, the cultivars AT201, Georgia Green, Viragard, C99R, and Florunner were treated with chlorimuron at 8.75 g ai/ha at 5, 7, 9, or 11 wk after planting. Only the later two application timings are covered by the current registration. Across all 4 yr-location replications, yield was influenced by the main effect of peanut cultivar. C99R was consistently the highest yielding cultivar. Chlorimuron had no effect on yield, regardless of application timing when compared to the nontreated entries in three of the four repetitions (i.e. Plains 2002, Plains 2003, and Headland 2002). Cultivar-based chlorimuron tolerance differences were detected only at Headland in 2003. For this location, chlorimuron applied at 5 wk after planting reduced yield across all cultivars, while application at 7, 9, and 11 WAP had no effect on yield. Results indicate that chlorimuron possesses a yield-reducing risk only when the crop has been stressed by other factors. Assuming that the crop has been stressed, the potential of yield reduction can be avoided only by observing the currently registered application timing. No clear indication was obtained that one cultivar was more tolerant to chlorimuron than another cultivar.

Key Words: Herbicide injury.

Chlorimuron {2-[[[[(4-chloro-6-methoxy-2-pyrimidinyl)amino] carbonyl]amino]sulfonyl] benzoic acid} is a sulfonylurea herbicide that was registered in 1989 for postemergence control of Florida beggarweed [*Desmodium tortuosum* (Sw.) DC.] in runner type peanut. Use of chlorimuron in peanut is unique in that application is restricted to a limited period within the middle of the production season (Patterson *et al.*, 1989). Current product label states that chlorimuron (Classic®) (E.I. du Pont, Inc. Crop Protection Division, Wilmington, DE) "can be applied from 60 d after crop emergence to 45 d before harvest." The typical peanut production period (seeding to harvest) is approximately 140 d. Seeding to emergence is approximately 7 d, leaving 133 d between emergence and harvest. This leaves approximately a 1-mo period in which chlorimuron may be applied, generally beginning at 7 wk after planting. Due to this timing restriction, chlorimuron applications are generally viewed as the final option to control Florida beggarweed that escaped earlier control efforts.

The application timing restriction for chlorimuron was based upon field research conducted in the late 1980s (Patterson *et al.*, 1989). The absorption and metabolism

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of chlorimuron was evaluated in 3-, 7-, and 10-wk-old peanut plants (Wilcut *et al.*, 1989), and tolerance to chlorimuron was plant age-dependent. The increased tolerance was attributed to combined effects of reduced absorption and translocation, and more extensive metabolism by the older plants. This research was conducted with Florunner, which was the dominant peanut cultivar grown at the time.

Chlorimuron use has been considered to have some risk with respect to peanut crop safety. Peanut injury can occur even when correct application timing is practiced. In a multi-state research project across the peanut-production region, chlorimuron was implicated in yield suppression in only four of the 15 trials (Brown *et al.*, 1993). However, it was concluded that the risk of yield loss from Florida beggarweed competition was greater than that from chlorimuron-induced crop injury. The Classic® product label does note that peanut cultivar differences may be observed. In particular, it is stated that the cultivar Southern Runner "has shown moderate tolerance" to chlorimuron. However, the label does not exclude any cultivar from use. Additional research has demonstrated that chlorimuron can result in increased occurrence of the tomato spotted wilt virus (TSWV) disease. This increased occurrence has not been linked to a specific application timing (Brown *et al.*, 2003).

Florunner has been totally replaced in the Southeast by other peanut cultivars since chlorimuron was first registered. Increased tolerance to one or more of the endemic diseases of peanut, particularly TSWV, is the most prevalent features of the newer cultivars. It has been questioned whether the chlorimuron application timings that were established on Florunner are appropriate for the newer cultivar. Specifically, there have been unsubstantiated reports from growers that earlier (off label) applications do not suppress yield. Earlier application timings are often more effective since they target smaller and less mature Florida beggarweed. Therefore, the objective of this study was to determine if the peanut cultivars currently planted in the Southeast can tolerate earlier chlorimuron applications than are allowed by the current registration.

Materials and Methods

Field experiments were conducted during 2002 and 2003 at the Wiregrass Substation of Auburn Univ. located at Headland, AL, and the Univ. of Georgia Agric. Exp. Sta. located at Plains, GA. Soil at Headland was a Dothan loamy sand (fine-loamy, siliceous, thermic plinthic paleudults) with 1.3% organic matter and a pH of 6.5. Soil at Plains was a Faceville sandy loam (clayey, kaolinitic, thermic, Typic Kandiudults) with 1.1% organic matter and pH of 6.1. Separate areas of the same field at both locations were used each year. Selected sites had minimal weed infestation.

Experimental areas were moldboard plowed in the spring and a seedbed was prepared by disking. Annual grasses and small-seeded broadleaf weeds were controlled with a broadcast, preplant incorporated application of ethalfluralin [*N*-ethyl-*N*-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl) benzenamine] at 0.6 kg ai/ha. All other pest management decisions and cultural practices were in accordance with recommendations of the Alabama and Georgia Coop. Ext. Serv. for the Alabama and Georgia locations, respectively. Test sites were maintained weed-free via weekly hand weeding. Test sites were treated with chlorothalanil (tetrachloroisophthalonitrile) at 1.26 kg ai/ha for control of the diseases early and late leafspot. Chlorothalanil treatments began 1 mo after planting and were continued on a 10- to 14-d schedule (depending upon the weather) for the duration of the growing season. This schedule resulted in six to eight applications. Planting dates were 21 May 2002 and 16 May 2003 at Headland, and 10 June 2002 and 27 May 2003 at Plains.

Five peanut cultivars were included in this research: AT201, C99R, Georgia Green, Viragard, and Florunner. Detailed descriptions of these cultivars have been previously published (Whitty *et al.*, 2003) and are summarized here. AT201 was released in 2000 by AgraTech Seeds (AgraTech Seeds, Inc., Ashburn, GA). It is noted for having high oleic acid oil content. AT201 has some resistance to TSWV but not to other peanut diseases; it typically matures in 130 to 140 d. C99R was released by the Univ. of Florida in 1999. C99R is considered to have the highest resistance to TSWV of the currently available cultivars, has a long growing season, and typically matures in 150 d. Georgia Green was released in 1995 by the Univ. of Georgia (Branch, 1996). Georgia Green has good resistance to TSWV and typically matures in 130 to 140 d. Georgia Green was planted on 90% of the peanut acreage in Georgia in 2002 (Culbreath *et al.*, 2003). Viragard was released in 1997 by AgraTech Seeds. It is an early season cultivar and matures in 130 to 135 d. Florunner was released by the Univ. of Florida in 1969 (Norden *et al.*, 1969) and was an extremely popular cultivar for many years, but it is very susceptible to TSWV and many other diseases. It was included as a reference because it was the peanut cultivar for which the chlorimuron registration was originally established.

Chlorimuron was applied at 8.75 g ai/ha to 5-, 7-, 9-, or 11-wk after planting (WAP) peanut and a nontreated control was included for each cultivar. Induce® nonionic surfactant, which is a 90%-active mixture of alkyl aryl poloxykane ethers, free fatty acids, and dimethyl polysiloxane (Helena Chemical Comp., Colliersville, TN), was included at 0.25% v/v. All treatments were applied using either a tractor-mounted compressed-air sprayer, or a CO_2-pressurized backpack sprayer. Both sprayers were equipped with flat fan nozzles and were calibrated to deliver 140 L/ha. The tractor was used for the earlier application timings and the backpack was used at the later timings when the tractor boom could not be raised above the above the crop canopy at Headland. For Plains, all treatments were applied with a backpack sprayer as previously described. Test areas were maintained weed-free (including volunteer peanuts) through routine hand weeding. The elimination of possible hosts for TSWV and/or thrips vectors through complete weed control has been suggested as an additional management factor of possible merit (Culbreath *et al.*, 2003).

A split plot design with four replications was used. Peanut cultivar was assigned to the main plots and the chlorimuron treatments were assigned to the sub-plots. Individual plots were four rows wide (0.9 m spacing) × 6 m long at Headland, and two rows wide (0.9 m spacing) × 10 m long at Plains. On the day on which a chlorimuron application was scheduled, peanut canopy diameter, number of blooms, and number of pegs per meter of row were determined. Additionally, peanut canopy diameter was measured at 2-wk intervals at Plains beginning with the 5 WAP application and continuing until harvest. Yield data were taken at all 4 yr-locations of the experiment. Peanuts were harvested (inverted) using conventional harvesting equipment, but on a staggered scheduled to compensate for the different maturing requirements of cultivars. Maturity determination was based upon mesocarp pod color (Williams and Dexter, 1981). Harvested peanuts were cleaned of debris, weighed, and the weight was adjusted to 11% moisture. All data were subjected to ANOVA using the general linear models procedures of SAS® (SAS, 2000). Canopy width measurements were plotted with SigmaPlot® graphing software (SPSS Inc., Chicago, IL).

Results and Discussion

The number of suspected TSWV infection sites was low (data not shown), and were deemed not to have affected overall peanut performance. An individual TSWV infection site is typically defined as a 0.3-m portion of a common row that contains severely stunted, chlorotic, wilted, or dead plants (Culbreath *et al.*, 1997). The hand removal of all weeds and volunteer peanuts may have attributed to the minimal occurrence of TSWV. Yield data from each of the four location-year experiment repetitions were subjected to ANOVA, which reflected the factorial treatment arrangement. In three of the four repetitions (i.e., Plains 2002, Plains 2003, and Headland 2002), yield was influenced only by the main effects of peanut cultivar, with C99R the highest yielding (Table 1).

In Headland 2003, a significant peanut cultivar by chlorimuron application timing interaction was detected. Consequently, Headland 2003 yield data are presented on an individual treatment basis, and the appropriate LSD value was computed to allow comparing of individual application timing means within a common cultivar (Table 2). Chlorimuron applications had no statistically detectable effect on yield of either AT201 or Georgia Green. For C99R, Viragard, and Florunner, chlorimuron at 5 WAP resulted in a significant yield reduction. Conversely, the 9- and 11-WAP application timings were generally equivalent to the nontreated check. For C99R, the 5- and 7-WAP treatments yielded less than the later two application timings and the nontreated check. With respect to product label, the 5-WAP application timing is clearly considered off label, 7 WAP is slightly off label, and the later two timings are in accordance with label directions. The Headland 2003 data are in general agreement with the previous research that established the relative safety of the later applications and the potential risk of early applications (Patterson *et al.*, 1989; Johnson *et al.*, 1992a,b).

Table 1. Peanut yield as influenced by cultivar.[a]

Cultivar	Plains		Headland	
	2002	2003	2002	2003
	kg/ha			
AT201	4034 b[b]	4916 b	3826 b	2106
C99R	6339 a	6064 a	4032 a	2795
Georgia Green	4219 b	5758 c	3090 c	2236
Virugard	3100 c	4060 c	4601 a	1398
Florunner	3661 bc	4342 bc	2257 d	1269
Mean	4271	5028	3561	1961

[a]Data have been pooled over all chlorimuron application timings. For comparison purposes, the average yield for the state of Georgia was 2910 and 3580 kg/ha for 2002 and 2003, respectively. Comparable yield for Alabama was 2300 and 2910 kg/ha, respectively.

[b]Means in the same column with the same letter are not significantly different according to Fisher's protected LSD comparison at the P = 0.05 level.

Across all cultivars, the number of blooms was relatively small at 5 WAP, peaked at 7 WAP, and dropped at 9 and 11 WAP. Conversely, the number of pegs increased in stepwise manner over 7, 9, and 11 WAP (data not shown). The relatively greater number of blooms and fewer number of pegs having entered into the soil at 5 WAP and 7 WAP probably contributes to the greater sensitivity of this period to chlorimuron-based injury. It has been previously reported that during flowering and pegging, peanut has minimal tolerance to the herbicides chloramben (Wehtje and Reed, 1985) and 2,4-DB (Ketchersid *et al.*, 1978). Peanut yield reduction due to chlorimuron applications at 5 WAP has been previously reported (Sims *et al.*, 1987).

Canopy diameter (row width) measurements from Plains, which were pooled over years since no year × treatment interactions were detected, reflected the injurious potential of early chlorimuron applications (Fig. 1).

Canopy diameter of C99R, Georgia Green, Viragard, and Florunner were reduced to less than 40 cm following the 5 WAP chlorimuron treatment. In contrast, diameters of the nontreated plots were between 55 and 65 cm. Diameter of AT201 was also reduced by the 5 WAP applications, but not to the extent of the other cultivars. Diameter was also reduced following the 7 WAP chlorimuron application for all cultivars except AT201. No canopy diameter differences were detected regardless of cultivar following the 9- and the 11-WAP applications.

In the 3 yr-location repetitions in which no cultivar differences were detected, the overall yield within the experiment exceeded the corresponding state average yield by at least 40%. Cultivar differences with respect to chlorimuron tolerance were detected only at Headland during 2003. Of the 4 yr-location repetitions, Headland 2003 also had the lowest overall yield, i.e., 33% less than the state average for that year (Table 1). This low yield could be attributed in part to excessive and unfavorably distributed rainfall where approximately 17 cm of rain

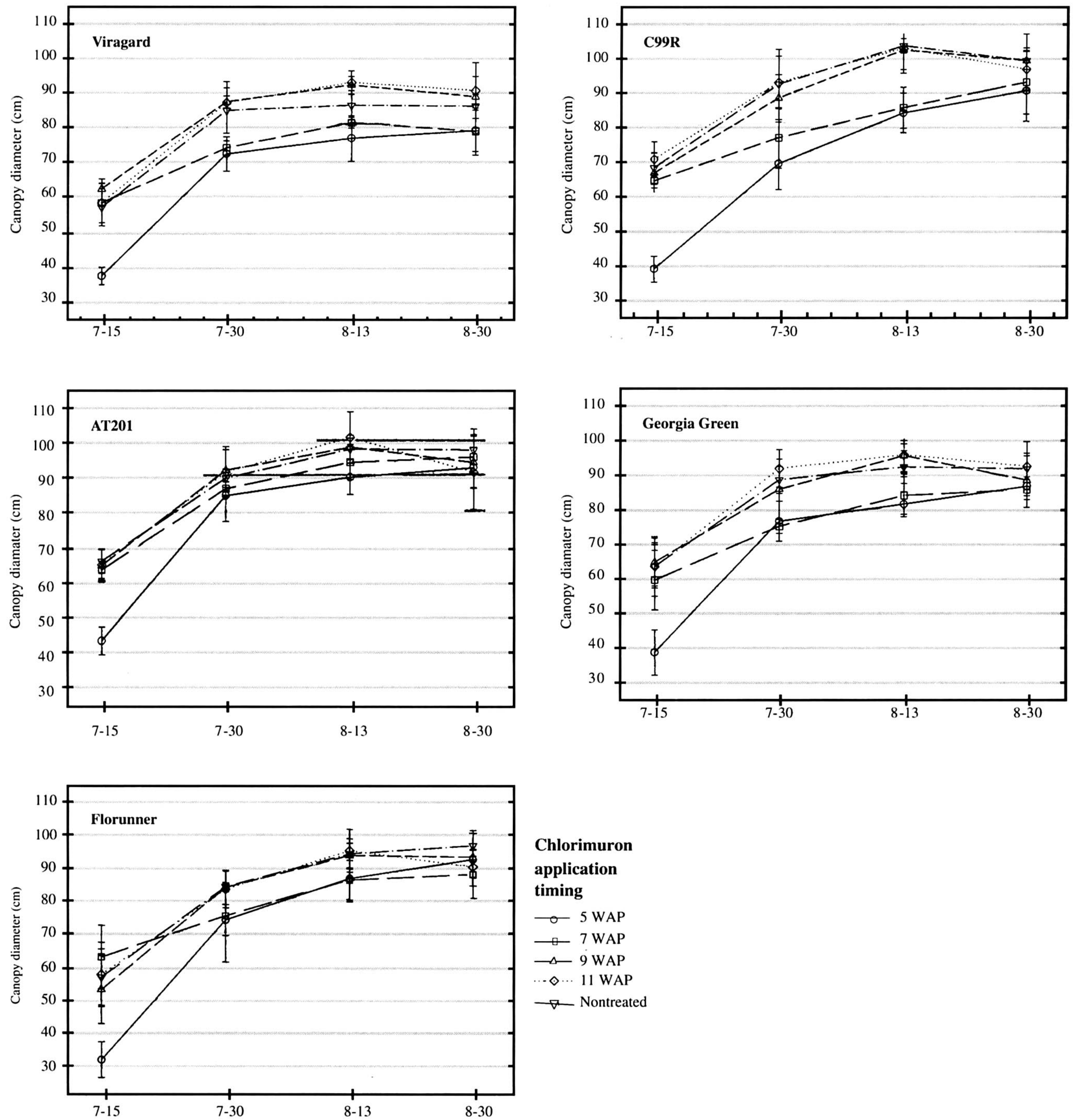

Fig. 1. Peanut canopy diameter (row width) over time for five peanut cultivars as influenced by the timing of a chlorimuron application. The 5-, 7-, 9-, and 11-WAP applications were applied approximately on 6-30, 7-15, 7-30, and 8-13, respectively.

Table 2. Peanut yield as influenced by cultivar and chlorimuron application timing, Headland 2003.[a,b]

	Chlorimuron application timing				
Cultivar	None	5 WAP	7 WAP	9 WAP	11 WAP
	kg/ha				
AT201	2132 a	1811 a (-15)	2159 a (+1)	2117 a (-1)	2312 a (+8)
C99R	3412 ab	2034 b (-40)	2062 b (-40)	2786 ab (-18)	3677 a (+8)
Georgia Green	2703 a	2089 a (-23)	1742 a (-36)	2117 a (-22)	2522 a (-7)
Virugard	1602 a	1002 b (-37)	1532 ab (-4)	1365 ab (-15)	1504 a (-6)
Florunner	1337 ab	1072 b (-20)	1212 ab (-9)	1657 ab (+24)	1812 a (+36)

[a]Means within a row that are followed by the same letter are not significantly different according to Fisher's protected LSD comparison at the $P = 0.05$ level.

[b]Values in parentheses are the percentage difference in yield relative to the no-chlorimuron control for the respective cultivar.

was received during 13 rainfall events between 7 and 20 June.

In summary, chlorimuron had no effect on yield regardless of the application timing provided the peanut crop was healthy and not under any discernable stress. However, if the crop was stressed and the yield potential was compromised, early chlorimuron applications (i.e., either 5 or 7 WAP) can become a significant additional yield-reducing factor. In this study there was no clear indication that one cultivar was more tolerant to chlorimuron or more sensitive to chlorimuron relative to the others. Differential disease tolerance among cultivars is an inescapable confounding factor that makes assessing differences in chlorimuron tolerance difficult. As previously mentioned, the application timing requirements for the use of chlorimuron in peanut was first established with Florunner, a cultivar which has been largely dropped in the Southeast due to is high susceptibility to TSWV. The yield loss of Florunner due to chlorimuron when it is applied early in the growing season (i.e., prior to 9 WAP) may actually reflect the additive stresses of chlorimuron application and disease occurrence. Conversely, the perceived tolerance of the newer cultivars to early chlorimuron applications may be the result of greater disease (e.g., TSWV) resistance rather than unique tolerance to chlorimuron.

Literature Cited

Branch, W.D. 1996. Registration of 'Georgia Green' peanut. Crop Sci. 36:806.

Brown, S.M., B.J. Brecke, D.L. Colvin, J.W. Everest, D.T.Gooden, W.J. Grichar, W.C. Johnson, III, C.W. Swann, G.R. Wehtje, J.W. Wilcut, and A.C. York. 1993. Peanut yield response to Classic® (chlorimuron): Results from a beltwide evaluation. Proc. South. Weed Sci. Soc. 46:41 (abstr.).

Brown, S., A. Culbreath, J. Baldwin, J. Beasley, B. Kemerait, and E. Prostko. 2003. Minimizing spotted wilt of peanut. Univ. of Georgia, College of Agric. and Environ. Sci. Available online at http://www.cpes.peachnet.edu.

Culbreath, A.K., J.W. Todd, and S.L. Brown. 2003. Epidemiology and management of tomato spotted wilt in peanut. Ann. Rev. of Phytopathol. 41:53-75.

Culbreath, A.K., J.W. Todd, D.W. Gorbet, F.M. Stokes, and H.R. Pappu. 1997. Field performance of advanced runner- and virginia-type peanut breeding lines during epidemics of TSWV. Peanut Sci. 24:123-128.

Johnson, W.C., III, C.C. Holbrook, B.G. Mullinix, Jr., and J. Cardina. 1992a. Response of eight genetically diverse peanut genotypes to chlorimuron. Peanut Sci. 19:111-115.

Johnson, W.C., III, B.G. Mullinix, Jr., and S. M. Brown. 1992b. Phytotoxicity of chlorimuron and tank mixtures on peanut. Weed Technol. 6:404-408.

Ketchersid, M.L., T.E. Boswell, and M.G. Merkle. 1978. Effects of 2,4-DB on yield and pod development in peanut. Peanut Sci. 5:35-39.

Norden, A.J., R.W. Lipscomb, and W.A. Carver. 1969. Registration of 'Florunner' peanuts. Crop Sci. 9:850.

Patterson, K.A., G.G. Hammes, and R.E. Seay. 1989. Timing of chlorimuron for Florida beggarweed control in peanuts. Proc. South. Weed Sci. Soc. 42:30 (abstr.).

SAS Institute. 2000. SAS User's Guide: Statistics. Ver. 8.1. Cary, NC.

Sims, G.R., G. Wehtje, J.A. McGuire, and T.V. Hicks. 1987. Weed control and response of peanuts to chlorimuron. Peanut Sci. 14:42-45.

Wehtje, G., and R.B. Reed. 1985. Control of Florida beggarweed in peanut with chlorimuron. Peanut Sci. 12:73-77.

Whitty, E.B., D.W. Gorbet, and T.A. Kuchareka. 2003. Peanut varieties for 2003. Published by Univ. of Florida Coop. Ext. Serv. Available online at http//www.edis.ifas.ufl.edu.

Wilcut, J.W., G.R. Wehtje, M.G. Patterson, T.A. Cole, and T.V. Hicks. 1989. Absorption, translocation and metabolism of foliar-applied chlorimuron in soybeans, peanuts and selected weeds. Weed Sci. 37:175-180.

Williams, E.J., and J.S. Drexler. 1981. A nondestructive method of determining peanut maturity. Peanut Sci. 8:134-141.