

# Control of Peanut (*Arachis hypogaea* L.) With Cotton (*Gossypium hirsutum* L.) Herbicides

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## ABSTRACT

The use of a cotton-peanut crop rotation system has been beneficial in that it reduces disease incidence which can improve crop yield. However, peanut remaining in the soil after harvest may become problematic if they germinate the following year when fields are rotated to cotton. Field studies were conducted in south and west Texas to evaluate postemergence (POST) cotton herbicides for control of peanut. In west Texas using Spanish peanut, glyphosate at 1.26 kg ae/ha applied early POST or mid-POST controlled peanut at least 91% in one of two years; however, glyphosate applied at 0.84 kg ae/ha at the same application timings controlled peanut 80% or less in both years. Glufosinate at 0.73 kg ai/ha, and MSMA at 2.24 kg ai/ha controlled Spanish peanut 63 to 75%. In south Texas on six runner peanut cultivars, diuron plus MSMA, glyphosate at 1.26 kg ae/ha, glyphosate at 0.84 kg/ha applied twice, glyphosate at 0.84 kg/ha plus flumioxazin at 0.04 kg ai/ha, glufosinate at 0.47 and 0.58 kg ai/ha, or trifloxysulfuron at 0.005 kg ai/ha controlled peanut greater than 95%. Bromoxynil at 0.6 and 0.84 kg ai/ha and fluometuron at 1.12 kg ai/ha failed to control peanut. No cultivar response to any herbicide was noted.

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Key Words: Crop rotation, postemergence herbicides.

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Rotating peanut with non-host crops such as cotton is a key component of a management system for nematodes and diseases for both crops (Rodriguez-Kabana and Ivey, 1986; Rodriguez-Kabana *et al.*, 1987; 1991). In addition to agronomic and weed management benefits (York *et al.*, 1994), crop rotation assists in disease management by reducing the initial inoculums (Sobers and Littrell, 1974). Volunteer peanut can emerge in crops planted in preceding season. Volunteer peanut harbor diseases that likely reduce the effectiveness of crop rotation and can interfere with cotton growth and production (York *et al.*, 1994). The severity of infestation will depend on peanut lost at harvest, autumn or winter tillage programs, consumption by birds and other

wildlife, winter moisture to help germinate and/or rot seed, and time of seedbed preparation for the rotational crop (York *et al.*, 1994).

Preemergence (PRE) cotton herbicides are partially effective on planted peanut and the lack of volunteer peanut control with root and shoot-absorbed herbicides is probably due to their emergence from below the herbicide treated zone (York *et al.*, 1994). Cotton herbicide registrations for bromoxynil, flumioxazin, glyphosate, glufosinate, and trifloxysulfuron (Askew *et al.*, 2002; Blair *et al.*, 2000; Culpepper and York, 1998; Reddy, 2001; Shaw and Arnold, 2002; Porterfield *et al.*, 2002; Burke and Wilcut, 2004) have occurred since the work of York *et al.* (1994). However, evaluations of these herbicides for peanut response have not been conducted. Porterfield and Wilcut (2003) reported that trifloxysulfuron-sodium at 4 and 7 g ai/ha reduced peanut pod yield 73 and 98%, respectively, as compared with the nontreated check. In other work, pyriithiobac applied POST reduced peanut pod yield 8 to 22% (Jordan *et al.*, 1993), whereas chlorimuron reduced peanut yield 18 to 27% (Sims *et al.*, 1987). Also, new runner peanut cultivars have been released since 1992 and have been evaluated for response to peanut herbicides (Main *et al.* 2002, 2003; Richburg *et al.* 1995) but not cotton herbicides. Research to evaluate the response of Spanish peanut to cotton herbicides has not been conducted.

The objective of this study was to evaluate runner and Spanish peanut control with POST cotton herbicides, which may be used to control volunteer peanut in a peanut-cotton rotation. In order to evaluate cotton herbicides for volunteer peanut control, this study simulated volunteer peanut response using planted peanut.

## Materials and Methods

Field studies were conducted from 2003 to 2005 at the Texas Agricultural Experiment Station research site near Yoakum in south-central Texas and at the Western Peanut Growers Research Farm (WPGRF) near Denver City. Soil type at Yoakum was a Hallettsville fine loamy sand (fine, montmorillonitic, thermic Udertic Paleustolls) with 1% organic matter and pH 7.0 and at WPGRF, the soil was a Brownfield fine sand (loamy, mixed,

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superactive, thermic Arenic Aridic Paleustalfs) with 0.1% organic matter, and pH 7.8. The experiments were conducted in conventionally planted peanut fields without cotton.

Spanish peanut was planted at the WPGRF location while runner type peanut was planted at the south Texas location (Yoakum). At the Yoakum location, runner peanut cultivars 'Carver', 'OL01', 'Hull', 'Tamrun 96', 'Georgia 02C', and 'Georgia 01R' were planted. At the WPGRF location, Spanish cultivar 'Tamspar 90' was planted. Peanut was planted at a rate of 100 kg/ha at each location. Spanish peanuts were planted April 29, 2003 and April 27, 2004 while at the Yoakum location, runner peanuts were planted June 22, 2004 and June 7, 2005.

Experimental design at Yoakum was a randomized complete block with treatments replicated three times. There was a factorial arrangement of cotton herbicides with six peanut cultivars. Plot size was two rows spaced 97 cm apart and 4 m long. Pendimethalin EC at 1.12 kg ai/ha was applied preplant incorporated to control annual grasses and broadleaf weed species.

Treatments included bromoxynil at 0.6 and 0.84 kg ai/ha, diuron at 1.12 kg ai/ha, diuron at 1.12 kg ai/ha plus MSMA at 1.26 kg ai/ha, fluometuron at 1.12 kg ai/ha, fluometuron at 1.12 kg ai/ha plus MSMA at 1.26 kg ai/ha, glyphosate at 0.42, 0.84, and 1.26 kg ae/ha, glyphosate applied at 0.84 kg ae/ha followed by 0.84 kg/ha applied 2 wks later, glyphosate at 0.84 kg ae/ha plus flumioxazin at 0.04 kg ai/ha, glufosinate at 0.47 and 0.58 kg ai/ha, linuron at 1.12 kg ai/ha, MSMA at 1.26 kg ai/ha, prometryn at 0.47 kg ai/ha, and trifloxysulfuron at 5 and 8 g ai/ha, trifloxysulfuron at 8 g ai/ha plus prometryn at 1.11 kg ai/ha, and trifloxysulfuron at 12 g ai/ha plus prometryn at 1.33 kg ai/ha. A nontreated check was included for comparison. Glyphosate and glufosinate treatments did not include a surfactant, and trifloxysulfuron alone was applied with a nonionic surfactant (Induce, Helena Chemical Co., 6075 Poplar Ave., Memphis, TN 38137) at 0.25% v/v. All other herbicide treatments included a crop oil concentrate (Agridex, Helena Chemical Co.) at 2.3 L/ha.

Initial herbicide application in south Texas was to peanuts approximately 8 to 10 cm tall with the sequential glyphosate application approximately 2 wks later. Herbicides were applied with a compressed-air backpack sprayer equipped with Teejet 11002 DG flat fan spray tips (Spraying Systems Co., P.O. Box 7900, Wheaton, IL 60189) which delivered a spray volume of 187 L/ha at 180 kPa. In 2004, 122 mm of rainfall was received between peanut planting and herbicide application while in

2005 no rainfall was received between peanut planting and herbicide application. No supplemental irrigation was applied in either year.

At the WPGRF location, the experimental design was a randomized complete block with three replications. Herbicides included glyphosate at 0.84 and 1.26 kg ae/ha applied early post-emergence (early POST) and mid postemergence (mid POST), glufosinate at 0.73 kg ai/ha applied early POST, and MSMA at 2.24 kg ai/ha applied early POST. No surfactants were added to any glyphosate treatments while a crop oil concentrate (Agridex) was added to glufosinate at the rate of 2.3 L/ha. Ammonium sulfate at 3.8 kg/ha was also added to glufosinate. Plot size consisted of two rows spaced 97 cm apart and 7.6 m long. The initial applications (early POST) in 2003 and 2004 were to 4 cm and 8 cm tall peanuts, respectively, with subsequent applications (mid POST) when peanuts were 8 to 13 cm tall. Herbicides were applied with a compressed-air backpack sprayer equipped with Teejet 80015 Turbo Tee (TT) flat fan spray tips in a spray volume of 94 L/ha at 180 to 270 kPa depending on herbicide timing.

Peanut was not harvested for yield at either location. Visual estimates of peanut control (chlorosis, necrosis, stunting) were recorded approximately 4 and 8 wks after the initial herbicide application using a scale of 0 (no control) to 100% (complete control). Data were transformed to the arcsine square root before ANOVA by PROC GLM in SAS (2004); however, transformed data did not change the analysis and nontransformed means are presented. Data from the WPGRF location were subjected to analysis of variance and means were separated by Fisher's protected LSD at  $P \leq 0.05$ . Data from the Yoakum location was subjected to ANOVA with partitioning appropriate for a twenty (cotton herbicide) by six (peanut cultivar) factorial arrangement. Means were separated with Fisher's Protected LSD test at the 0.05 level of probability. Analysis of peanut control did include the nontreated check.

## Results and Discussion

It was assumed that the response of planted peanut to POST herbicides would be similar to the response of volunteer peanut (York *et al.* 1994), although emergence is more uniform in planted peanut. Since there was no peanut variety by cotton herbicide interaction for the south Texas location, all cultivar treatments were combined over herbicide treatments; however, years are presented separately due to a treatment by year interaction.

**Table 1. Response of runner peanut cultivars to cotton herbicides applied POST when rated four weeks after initial treatment near Yoakum in south Texas.<sup>a,b</sup>**

Herbicides	Herbicide rate kg ai/ha	Control	
		2004	2005
		%	
Check	-	0 g	0 l
Bromoxynil <sup>c</sup>	0.60	43 f	27 k
Bromoxynil <sup>c</sup>	0.84	46 f	38 j
Diuron <sup>c</sup>	1.12	100 a	89 def
Diuron plus MSMA <sup>c</sup>	1.12 + 1.26	99 a	97 ab
Fluometuron <sup>c</sup>	1.12	45 f	39 j
Fluometuron plus MSMA <sup>c</sup>	1.12 + 1.26	80 d	88 efg
Glyphosate	0.42	70 e	91 de
Glyphosate	0.84	87 cd	98 ab
Glyphosate	1.26	100 a	95 bc
Glyphosate <sup>c</sup>	0.84 / 0.84	98 ab	98 ab
Glyphosate plus flumioxazin	0.84 + 0.04	94 abc	92 cd
Glufosinate	0.47	98 ab	98 ab
Glufosinate	0.58	99 a	99 a
Linuron <sup>c</sup>	1.12	89 bcd	89 def
MSMA <sup>c</sup>	1.26	98 b	74 h
Prometryn <sup>c</sup>	0.47	89 bcd	66 j
Trifloxysulfuron <sup>d</sup>	0.005	99 a	96 ab
Trifloxysulfuron <sup>d</sup>	0.008	100 a	97 ab
Trifloxysulfuron + prometryn <sup>c</sup>	0.008 + 1.11	100 a	87 ef
Trifloxysulfuron + prometryn <sup>c</sup>	0.012 + 1.33	99 a	85 f

<sup>a</sup>Cultivars evaluated included: Carver, OLO1, Hull, Tamrun 96, Georgia 02C, and Georgia 01R. Analysis of data indicated no significant difference between cultivars; therefore, data were combined across cultivars for presentation.

<sup>b</sup>Means within a column followed by the same letter are not significantly different according to Fisher's protected LSD test at  $P \leq 0.05$ .

<sup>c</sup>Crop oil concentrate added at 2.3 L/ha.

<sup>d</sup>Nonionic surfactant added a 0.25% v/v.

<sup>e</sup>Second application of glyphosate followed the initial application by 2 wks.

For the WPGRF location, data are presented separately by years due to a treatment by year interaction. Since peanut control did not change drastically over the two rating dates, only the 4 wk after the initial herbicide application is presented.

### South Texas

In 2004, bromoxynil and fluometuron failed to control peanut (< 50%) while glyphosate at 0.42 kg/ha provided only fair (70%) control (Table 1). Fluometuron plus MSMA controlled peanut 80% while glyphosate at 0.84 kg/ha, linuron, and prometryn controlled peanut 87 to 89%. All other herbicide treatments controlled peanut at least 94%. In 2005, bromoxynil, fluometuron, and prometryn failed to control peanut (27 to 66%). MSMA controlled peanut 74% while diuron, fluometuron plus MSMA, linuron, and trifloxysulfuron plus prometryn controlled peanut 85 to 89%. Diuron plus MSMA, all rates of glyphosate, glyphosate plus flumioxazin, glufosinate, and trifloxysulfuron controlled peanut 91 to 99%.

Bromoxynil has been evaluated in peanut (Grichar and Colburn, 1996). They reported no peanut injury but bromoxynil will cause peanut yellowing and stunting (authors personal observation). York *et al.* (1994) reported that fluometuron plus MSMA controlled peanut more effectively than MSMA alone. Our data showed inconsistent results. In 2004, MSMA alone controlled peanut better than fluometuron plus MSMA, while in 2005, fluometuron plus MSMA controlled peanut better than MSMA alone.

Peanut controlled by glufosinate was apparent 3 to 4 d after herbicide application and gradually increased over time (data not shown). Glyphosate can provide inconsistent peanut control (Baughman *et al.*, 2001). In 2004, glyphosate at 0.42 and 0.84 kg/ha controlled peanut less than 90% while in 2005 control of peanut with glyphosate at these rates was at least 91%. Improved peanut control with glyphosate under drier conditions has been seen in previous years

**Table 2. Response of Spanish peanut to cotton herbicides when rated four weeks after initial treatment at the Western Peanut Growers Research Farm in west Texas.<sup>a</sup>**

Herbicides	Rate kg ai/ha	Appl timing <sup>b</sup>	Control	
			2003	2004
			%	
Check	-	-	0 d	0 e
Glyphosate	0.84	EP	63 c	80 ab
Glyphosate	1.26	EP	77 b	91 a
Glyphosate	0.84	MP	70 bc	57 d
Glyphosate	1.26	MP	93 a	63 cd
Glufosinate <sup>c</sup>	0.73	EP	63 c	67 bcd
MSMA	2.24	EP	65 c	75 bc

<sup>a</sup>Means within a column followed by the same letter are not significantly different according to Fisher's protected LSD test at  $P < 0.05$ .

<sup>b</sup>Application timing, EP (early postemergence), peanuts were 4 to 8 cm tall; MP (mid postemergence), peanuts were 8 to 13 cm tall.

<sup>c</sup>Ammonium sulfate added at the rate of 3.8 kg/ha, crop oil concentrate added at 2.3 L/ha.

(Todd Baughman, personal communication). Also, York *et al.* (1994) reported that as the glyphosate rate increased peanut control generally increased.

Porterfield and Wilcut (2003) reported trifloxysulfuron applied POST at 3.75 to 7.5 g/ha controlled Virginia peanut similar to two applications of glyphosate at 1.12 kg/ha (York *et al.* 1994). Their data indicated that it was unlikely that trifloxysulfuron would be developed for use in peanut and their conclusion was that trifloxysulfuron applied POST would be an effective treatment for volunteer peanut control in cotton.

#### West Texas

All herbicides provided inconsistent Spanish peanut control (Table 2). In 2003, glyphosate at 0.84 kg/ha applied early-postemergence (EPOST) or mid-postemergence (MPOST) controlled peanut 63 to 70% while glyphosate at 1.26 kg/ha controlled peanut greater than 90% when applied MPOST but less than 80% when applied EPOST. Glufosinate and MSMA controlled peanut less than 70%. In 2004, glyphosate at 0.84 or 1.26 kg/ha applied EPOST controlled peanut 80 and 91%, respectively, while glyphosate applied MPOST controlled peanut less than 65%. Peanut control with MSMA was 75% but glufosinate controlled less than 70%. Initial herbicide applications were made when peanut was 4 to 8 cm tall with the subsequent application when peanut were 8 to 13 cm in height. York *et al.* (1994) reported poor control with glyphosate and attributed this to extreme moisture stress at the time of application. They also attributed inconsistent control to differences in peanut size at time of herbicide application and

reported better control with glyphosate when applied late-POST.

In conclusion, the results of our study show that all peanut runner cultivars responded similar to the cotton herbicides. In south Texas, diuron plus MSMA, glyphosate at 0.84 kg/ha applied twice, glyphosate applied once at 1.26 kg/ha, glyphosate plus flumioxazin, glufosinate, and trifloxysulfuron controlled volunteer peanut at least 90%. Peanut response to glufosinate was quickest with injury within 3 d and complete peanut death within 5 to 7 d. In west Texas, results were inconsistent on Spanish peanut with all herbicides. While volunteer peanut and planted peanut behave differently with respect to time of emergence, growth, and development they are genetically the same and their response to POST cotton herbicides should be similar; therefore, these results should provide growers with the information to effectively control volunteer peanuts in cotton.

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