Weed Technology

www.cambridge.org/wet

Research Article

Cite this article: Shay NJ and Prostko EP (2025) Peanut response to delayed applications of fluridone and trifludimoxazin. Weed Technol. **39**(e92), 1–5. doi: 10.1017/wet.2025.10039

Received: 8 May 2025
Revised: 24 July 2025
Accepted: 30 July 2025

Associate Editor:
Donnie Miller, Louisiana State University AgCenter

Nomenclature:
Fluridone; trifludimoxazin; peanut; *Arachis hypogaea* L.

Keywords:
Application timing; herbicide injury; yield impact

Corresponding author:
Nicholas J. Shay;
Email: Nicholas.Shay@uga.edu

Peanut response to delayed applications of fluridone and trifludimoxazin

Nicholas J. Shay[1] and Eric P. Prostko[2]

[1]Assistant Professor and Extension Grains Agronomist, Department of Crop & Soil Sciences, The University of Georgia, Tifton, GA, USA and [2]Professor and Extension Weed Specialist, Department of Crop & Soil Sciences, The University of Georgia, Tifton, GA, USA

Abstract

The limited number of herbicides for use in peanut makes it difficult to diversify modes of action to combat advantageous weed species with reports of increasing herbicidal resistance. It is critically necessary to explore both new and repurposed chemistries with different modes of action for potential use on peanut crops. Little research has investigated peanut response to scenarios in which preemergence applications of fluridone or trifludimoxazin are delayed. Replicated field trials using small plots were conducted at the University of Georgia from 2022 to 2024 to identify any deleterious effects of fluridone applied at 126 g ai ha^{-1} or trifludimoxazin applied at 37 g ai ha^{-1} 1, 3, 5, or 7 d after planting (DAP). The peanut population was not affected, regardless of herbicide or application timing. At 13 DAT, plant growth was reduced by 5% to 9% when fluridone had been applied 1, 3, 5, and 7 DAP. Visual crop growth was reduced by 10% to 19% with applications of trifludimoxazin, with the greatest effect occurring when it was applied at 7 DAP. Trifludimoxazin also caused 7% foliar leaf necrosis when averaged over application timings. Regardless of application timing, peanut height was reduced by both herbicides at 30 DAP but not at 80 DAP. However, at 80 DAP, plant width was reduced by 4% after fluridone and trifludimoxazin had been applied. Peanut yield was not affected by herbicide treatment regardless of when it was applied. Fluridone and trifludimoxazin applied as late as 7 DAP can injure peanut but not affect yield.

Introduction

Peanut is one of many agricultural commodities that face weed management challenges in an era of herbicide resistance. Producers in the southeastern United States rely heavily upon herbicides such as flumioxazin, a protoporphyrinogen oxidase (PPO) inhibitor in the n-phenylphthalimide family, to target Palmer amaranth (*Amaranthus palmeri* S. Watson) and other small-seeded broadleaf weeds (UGA Extension 2025; Whitaker et al. 2011). The intensive use of herbicide chemistries to manage the diversity of troublesome weeds in peanut-producing regions threatens the long-term efficacy of an already limited pool of herbicidal options (Neve et al. 2011; Vencill et al. 2012). As concerns begin to surface regarding PPO-resistant Palmer amaranth, the loss of flumioxazin as a weed control option would negatively affect peanut weed management (Culpepper and Vance 2019; Randell-Singleton et al. 2024).

Integrated strategies are needed to delay the evolution of herbicidal resistance (Norsworthy et al. 2012). One of the foremost strategies for combatting resistance challenges is the use of herbicide diversity through multiple modes of action (MOAs) (Hill et al. 2016). A common practice in peanut production often includes the application of a preplant burndown of glyphosate (WSSA Group 9) + 2,4-D (WSSA Group 4), followed by a preemergence application of paraquat (WSSA Group 22) + pendimethalin (WSSA Group 3) + flumioxazin (WSSA Group 14) + diclosulam (WSSA Group 2), and a postemergence application of imazapic (WSSA Group 2) + *S*-metolachlor (or some other WSSA Group 15 herbicide) + 2,4-DB (WSSA Group 4) (UGA Extension 2025). (Herbicide groups are categorized by the Weed Science Society of America [WSSA].) This practice demonstrates a diverse portfolio; however, glyphosate (Culpepper et al. 2006), acetolactate synthesis (ALS), and PPO-resistant biotypes reduce confidence in their long-term efficacy. The development of MOAs for peanut is needed, thereby necessitating the need to investigate new chemistries and to repurpose other herbicides for potential uses in peanut production.

Before fluridone was registered for use on peanut crops in 2023, for several decades it was used as a systemic herbicide to selectively manage invasive submersed aquatic vegetation, and more recently, as a for use as a preemergence herbicide in cotton (*Gossypium hirsutum* L.) production to control Palmer amaranth, annual grasses, and other small-seeded broadleaf weeds (Anonymous 2023; Braswell et al. 2016; Grichar et al. 2020; Miller and Carter 1983; Rasmussen et al. 2022; UGA Extension 2025). The intended purpose of adding fluridone to the peanut weed management toolbox was to target similar weed species with a new MOA. As a phytoene desaturase inhibitor (PDI) (WSSA Group 12), when applied, susceptible plants exhibit bleaching in both leaf and vegetative structures as a result of inhibition of pigment biosynthesis, which provides critical functions for photoregulation (Bartels and Watson 1978; Bartley and Scolnik 1995; Zou et al. 2018).

Recent research demonstrated acceptable peanut tolerance and weed control with preemergence applications of fluridone when used in a weed management program (Abbott et al 2025a). Under normal growing conditions, regardless of cultivar, peanut was tolerant of fluridone when it was applied at rates of 128 g ha^{-1}. Negative peanut stand and yield losses occurred when fluridone rates exceeded 252 g ha^{-1}. Additionally, in years when growing conditions were less than ideal, including greater than normal precipitation and temperatures (>30 C), especially during early vegetative development, peanut metabolic activity was more than likely compromised, thereby increasing peanut sensitivity to fluridone.

Trifludimoxazin, a PPO inhibitor and member of the pyrimidinedione family, is registered for use on several agronomic and tree fruit crops, and nonagricultural lands (Anonymous 2021a, 2021b). Research conducted by Abbot et al. (2025b) showcased the tolerance of peanut to trifludimoxazin and noted that adding it to the peanut weed management arsenal will benefit users with lower use rates and less potential injury compared with other PPO-inhibiting herbicides. However, peanut growers in Georgia and neighboring states already use another PPO inhibitor, flumioxazin, on more than 64% of planted hectares (USDA-NASS 2024). This is concerning for a region that has recently confirmed a PPO-resistant Palmer amaranth population (Armel et al. 2017; Randell-Singleton et al. 2024). Previous research has shown that the high bioactivity and differential binding site for trifludimoxazin targets herbicide-resistant Palmer amaranth biotypes (Armel et al. 2017). However, Randell-Singleton et al. (2024) have documented resistance to trifludimoxazin in Palmer amaranth.

Each year producers face challenges that impede the critical timeliness of applying soil-activated herbicides (Adcock and Banks 1991). The weather in Georgia during planting season, between April and May, is generally consistently wet, which limits field access and delays the application of broadcast herbicides after planting (Bosch et al. 1999). In addition to challenging weather patterns, growers commonly encounter logistical challenges, including equipment malfunctions and operational constraints that can also delay timely preemergence applications. Currently, the fluridone label recommends that its application should be restricted to within the initial 36 h after planting because delayed applications have yet to be fully explored. In addition to fluridone, no such recommendation exists yet for Trifludimoxazin has not yet been approved for use on peanut (Anonymous 2023; Johnson et al. 2006). Previous research has shown that delaying applications of some preemergence herbicides can impede peanut development and yield (Johnson et al. 2006). Currently, limited published information exists regarding peanut response to delayed preemergence applications of fluridone and trifludimoxazin. Therefore, the objective of this study was to compare the response of peanut to timely and delayed preemergence applications of fluridone and trifludimoxazin.

Materials and Methods

Field experiments were conducted at the University of Georgia, Ponder Research Farm near Ty Ty (31.5080°N, −83.6570° W) from 2022 through 2024. The experimental site is nearly level (<2% slope) and consisted primarily of Tifton loamy sand soil with 96% sand, 2% silt, 2% clay, 1.2% organic matter, and an average soil pH of 6.0 (USDA-NRCS 2023). Planting, application, inverting, and harvest dates are presented in Table 1. In all studies, the peanut cultivar Georgia-06G (Branch 2007) was planted in conventionally tilled plots that were 1.8 m by 7.6 m in a twin-row configuration, including traditional single rows set to 91.4 cm with an inner twin-row offset at 22.9 cm, delivering 152,460 seeds ha^{-1}. Plots were maintained weed-free with sequential postemergence herbicide applications including imazapic and *S*-metolachlor + lactofen, followed by clethodim + *S*-metolachlor (UGA Extension 2025). Supplemental irrigation was applied as needed to maximize crop production with a lateral-irrigation system. Irrigation and rainfall data were captured during the first 21 d after planting (DAP) (Table 2).

Table 1. Test parameters and peanut stages of growth in response to delayed timing applications of fluridone and trifludimoxazin.[a,b]

Parameter	Year 2022	2023	2024
Peanut planting date	May 3	May 2	May 1
1 DAP	May 4	May 3	May 2
Peanut stage, radical/root length	V0, 0 cm	V0, 0 cm	V0, 0.32 cm
3 DAP	May 6	May 5	May 4
Peanut stage, radical/root length	V0, 1.27 cm	V0, 0.32 cm	V0, 1.27 cm
5 DAP	May 8	May 7	May 6
Peanut stage, radical/root length	V0, 4.45 cm	V0, 1.27 cm	V0, 5.70 cm
7 DAP	May 10	May 9	May 8
Peanut stage, radical/root length	VE, 5.08 cm	VE, 2.54 cm	VE, 6.25 cm
Inverting date	September 16	September 20	September 19
Harvest date	September 20	September 25	September 24

[a]Abbreviation: DAP, days after planting.
[b]V0 indicates peanut plants did not emerge; E indicates peanut plants did emerge, and the seed radical/root length is shown in centimeters.

Experiments were conducted in a randomized complete block design with treatments replicated four times. Treatments were applied using a CO_2-pressurized backpack sprayer at 140 L ha. Treatments included a factorial arrangement of herbicides: fluridone at 120 g ha^{-1}, or trifludimoxazin at 37 g ha^{-1} applied at 1, 3, 5, or 7 DAP, plus a nontreated control (NTC).

Documented responses to herbicide treatments included determination of growth stages at 1, 3, 5, and 7 DAP; plant population (number of plants per twin row per 1.5 m); foliar bleaching from fluridone; and foliar necrosis from trifludimoxazin according to common herbicide symptomology; plant height and width (five measurements per plot averaged prior to analysis); and peanut yield. Visible estimates of peanut injury were obtained 13, 30, 50, and 80 DAP using a subjective scale of 0% to 100% where 0% = no injury and 100% = plant death. Peanut yield was obtained by harvesting each plot individually using commercial inverting and harvesting equipment, and adjusted to 10% moisture.

Statistical Analysis

Data were subjected to the GLIMMIX procedure using SAS software (v.9.4; SAS, Cary, NC) (Littell et al. 2006). Conditional residuals for control were used for checking assumptions of

https://doi.org/10.1017/wet.2025.10039

Table 2. Irrigation/rainfall total during the first 21 d after peanut planting and applications of fluridone and trifludimoxazin.[a]

	2022			2023			2024		
Days after planting	Irrigation	Rain	Total	Irrigation	Rain	Total	Irrigation	Rain	Total
	mm								
0	7.6	0	7.6	0	0	0	0	0	0
1	0	0	0	0	0	0	12.7	0	12.7
2	5.1	0	5.1	0	0	0	0	0	
3	0	11.4	11.4	0	0	0	0	21.1	21.1
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	9.7	0	9.7	0	0	0	0	0	0
8	0	0	0	0	0	0	0	17.0	17.0
9	0	0	0	12.7	0	12.7	0	26.2	26.2
10	0	0	0	0	63.5	63.5	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	27.9	27.9
13	0	0	0	0	0	0	0	4.6	4.6
14	12.7	0	12.7	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	24.4	24.4
17	0	0	0	0	0	0	0	34.3	34.3
18	0	0	0	0	2.5	2.5	0	23.9	23.9
19	0	0	0	0	0	0	0	0.25	0.25
20	0	0	0	0	19.1	19.1	0	0	0
21	12.7	0	12.7	0	7.6	7.6	0	0	0
Total	47.8	11.4	59.2	12.7	92.7	105.4	12.7	179.7	192.4

[a]Planting dates were May 5, 2022; May 2, 2023; and May 1, 2024.

Table 3. Peanut density 13 d after planting following fluridone and trifludimoxazin applications.[a,b]

Herbicide	Density
	plants/1.5 m/twin row
Nontreated control	25 a
Fluridone	25 a
Trifludimoxazin	25 a

[a]Means within a column followed by the same letter are not significantly different from each other according to Tukey's HSD test at $P < 0.10$. Data were combined over 3 site-years and four application timings (1, 3, 5, 7 d after planting).
[b]Fluridone was applied at 120 g ha^{-1}, trifludimoxazin was applied at 37 g ha^{-1}.

normality, independence of errors, homogeneity, and multiple covariance structures. Fixed effects included herbicide treatments (nontreated, fluridone, and trifludimoxazin) and application timings (1, 3, 5, and 7 DAP). Location, year, and replicates represented random effects. Treating year as a random effect, data were combined over years and timings. Means were compared using the LSMEANS procedure with a Tukey's HSD test, with differences considered significant at $P < 0.10$.

Results and Discussion

Peanut Density

The influence of fluridone and trifludimoxazin timing on the peanut population is presented in Table 3. Photographs of peanut seed and seedlings at the various times are shown in Figure 1. Peanut density observed at 13 DAP indicated no differences compared with the NTC, averaging 25 plants/1.5 m/twin row. Plant populations of 20 to 25 plants/1.5 m of row will usually maximize yield and grade of peanut in twin-row management (Monfort 2022; Sarver et al. 2017).

Peanut Bleaching/Necrosis

Observed herbicide symptomology for fluridone application at 13 and 30 DAP indicated a herbicide by application timing interaction, which is presented in Table 4. Regardless of application timing, fluridone caused a significant increase in bleaching compared with that in the NTC. Applications made at 1, 3, 5, and 7 DAP resulted in bleaching injury levels of 5%, 7%, 14%, and 21%, respectively. Bleaching increased with each delay in fluridone application once it was applied beyond 3 DAP. By 30 DAP, fluridone continued to cause an increase in herbicide symptomology with 5%, 5%, 6%, and 9% bleaching occurring after it was applied at 1, 3, 5, and 7 DAP, respectively. However, a corresponding response with the delay in application occurred when fluridone was applied 7 DAP. Trifludimoxazin did not cause peanut bleaching, and this is not considered a common injury symptom of that herbicide. However, leaf necrosis is. The level of necrosis observed was not influenced by application timing. When averaged over the four application timings, necrosis of 7% and 2% was observed at 13 and 30 DAP, respectively. This type of necrotic symptomology is common on young peanut vegetative structures, and is typically caused by soil splashing, which occurs with other PPO-inhibiting herbicides such as flumioxazin, which is used in peanut production (Abbott et al. 2025b; Johnson et al. 2006). By 80 DAP, leaf necrosis was not observable (data not reported).

Peanut Height, Width, and Yield

The influence of fluridone and trifludimoxazin application timing on peanut height, width, and yield is presented in Table 5. There was no year by herbicide by application timing interaction; therefore, data are combined across years and timings. Plant heights at 30 DAP were 11.2, 10.7, and 11.4 cm for fluridone and trifludimoxazin applications, and for the NTC, respectively. At 30 DAP, compared with the NTC, measurements indicated that plant height was reduced by 2% and 6% respectively, when fluridone and

https://doi.org/10.1017/wet.2025.10039

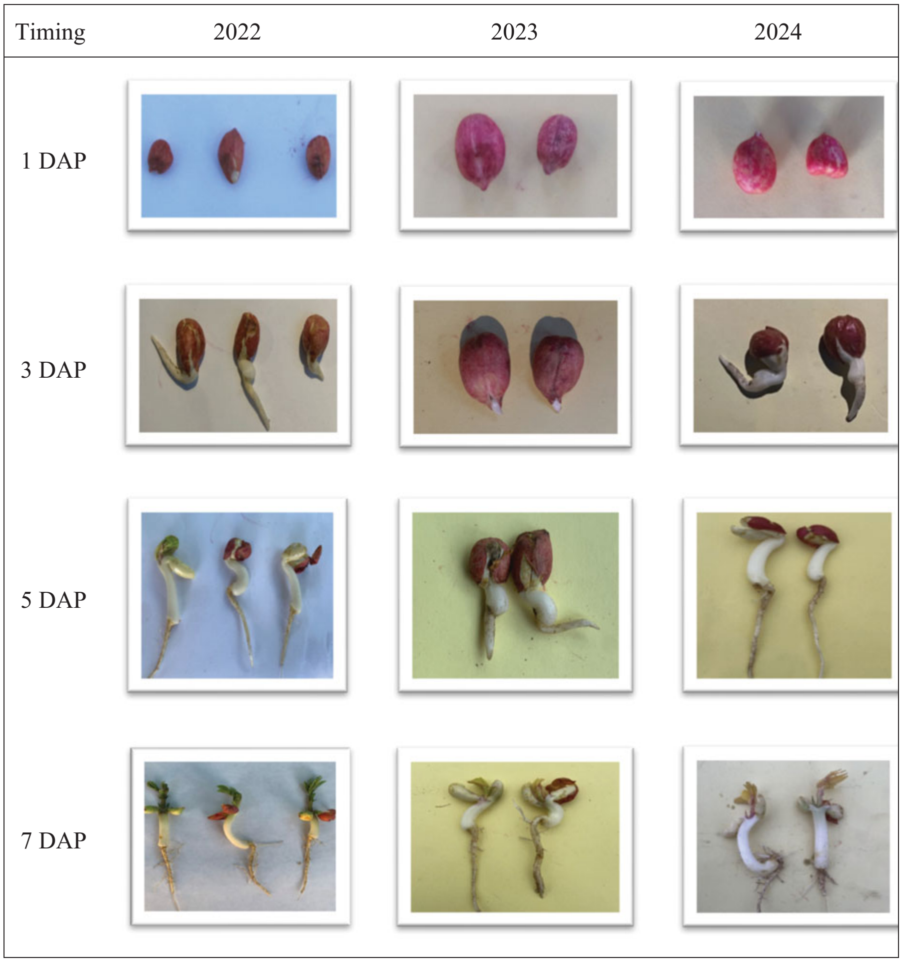

Figure 1. Peanut seed/seedling development following fluridone and trifludimoxazin applications at 1, 3, 5, and 7 d after planting (DAP).

Table 4. Peanut bleaching and necrosis evaluated 13 and 30 d after planting following fluridone and trifludimoxazin applications 1, 3, 5, and 7 d after planting.[abcd–e]

	Bleaching		Necrosis	
Herbicide	13 DAP	30 DAP	13 DAP	30 DAP
	%			
Nontreated control	0 d	0 c	0 b	0 b
Fluridone 1 DAP	5 c	5 b	–	–
Fluridone 3 DAP	7 c	5 b	–	–
Fluridone 5 DAP	14 b	6 ab	–	–
Fluridone 7 DAP	21 a	9 a	–	–
Trifludimoxazin	–	–	7 a	2 a

[a]Abbreviation: days after planting.
[b]Means within a column followed by the same letter are not significantly different from each other according to Tukey's HSD test at $P < 0.10$. Results indicated a fluridone by timing interaction at 13 and 30 DAP. All other treatments indicated there was no timing by herbicide interaction; therefore, data were combined over herbicide timing for each respective herbicide.
[c]Bleaching was not reported with trifludimoxazin use, but this is not a common herbicide symptomology; necrosis was not reported with fluridone use, but this is not a common herbicide symptomology observed at this stage of growth.
[d]Trifludimoxazin necrosis data were not collected for 30 DAP in 2023.
[e]Fluridone was applied at 120 g ha^{-1}; trifludimoxazin was applied at 37 g ha^{-1}.

Table 5. Peanut height, width, and yield following fluridone and trifludimoxazin treatments.[a,b,c]

	Peanut				
	Height		Width		Yield
	30	80	30	80	
	cm				kg ha^{-1}
Nontreated control	11.4 a	38.1 a	17.3 a	64.3 a	5,120 a
Fluridone	11.2 b	38.1 a	16.3 b	62.0 b	5,180 a
Trifludimoxazin	10.7 c	38.1 a	15.5 c	61.5 b	5,300 a
Treatment effects					
1 DAP	–	–	16.8 a	64.5 a	5,210 a
3 DAP	–	–	16.5 a	61.5 b	5,080 a
5 DAP	–	–	16.3 ab	63.0 ab	5,200 a
7 DAP	–	–	15.5 b	61.5 b	5,290 a

[a]Abbreviation: DAP, days after planting.
[b]Means within a column followed by the same letter are not significantly different from each other according to Tukey's HSD test at $P < 0.10$. Data were combined across three-site years and four application timings (1, 3, 5, 7 DAP).
For peanut width, there was an herbicide and timing interaction but no herbicide by timing interaction; therefore, data are presented separately: herbicide, combined across timing; and timing, combined across herbicide.
[c]Fluridone was applied at 120 g ha^{-1}; trifludimoxazin was applied at 37 g ha^{-1}.

https://doi.org/10.1017/wet.2025.10039

trifludimoxazin were applied. By 80 DAP, plant height was similar in plots that received herbicide treatments. Peanut width at 30 DAP was reduced by 6% and 10% with applications of fluridone and trifludimoxazin, respectively, a trend that was similar to that observed with height. Peanut row middles were lapped (i.e., complete canopy closure) in the NTC by 80 DAP, but width was reduced by 4% overall in plants that were treated with fluridone and trifludimoxazin. Regardless of herbicide and application timing, peanut yield was not influenced by herbicide or timing, and ranged from 5,120 to 5,300 kg ha^{-1}. Other research has demonstrated that peanut can tolerate fluridone and trifludimoxazin when they are applied in a timely manner (Abbott et al. 2025a, 2025b).

Practical Implications

Fluridone and trifludimoxazin add value to peanut weed management programs by adding chemicals that target new sites of action. As the evolution of herbicide resistance continues to unfold, it is critically necessary to continue to investigate ways to diversity herbicide usage, particularly for row crops such as peanut. This study expands the current understanding of peanut response to fluridone, which has been newly registered for use on peanut crops, and trifludimoxazin, which is expected to receive registration. These observed early season responses increase our understanding of peanut establishment, vegetative growth, and maturation when herbicide applications are delayed. As a result, when peanut growers are confronted with circumstances in which a preemergence application is delayed, they can have the confidence that fluridone or trifludimoxazin will not negatively influence yield when applied up to 7 DAP.

Acknowledgments. This research could not have been conducted without the technical support of Dewayne Dales, Charlie Hilton, and Tim Richards. The support and technical input of A.S. Culpepper, R.C. Kemerait, W.S. Monfort, and T. Randell-Singleton is greatly appreciated.

Funding statement. This research was partially funded in partnership with BASF and SePro Ag.

Competing interests. The authors declare they have no competing interests.

References

Abbott CC, Shay, NJ, Prostko EP (2025a) Peanut cultivar tolerance and weed control with fluridone. Peanut Sci 52:26–37
Abbott CC, Shay NJ, Prostko EP (2025b) Cultivar response and weed control in peanut with trifludimoxazin. Weed Technol 39:1–7
Adcock TE, Banks PA (1991) Effects of preemergence herbicides on the competitiveness of selected weeds. Weed Sci 39:54–56
Anonymous (2021a) Tirexor herbicide product label. Florham Park, NJ: BASF
Anonymous (2021b) Voraxor herbicide product label. Florham Park, NJ: BASF
Anonymous (2023) Brake herbicide product label. Carmel, IN: SePro Ag
Armel GR, Hanzlik K, Witschel M, Hennigh DS, Bowe S, Simon A, Liebl R, Makin L (2017) Trifludimoxazin: a new PPO inhibitor that controls PPO resistance weed biotypes. Proceeding of the Weed Science Society of America Annual Meeting. Tucson, Arizona, February 6–9, 2017
Bartels PG, Watson CW (1978) Inhibition of carotenoid synthesis by fluridone and norflurazon. Weed Sci 26:198–203
Bartley GE, Scolnik PA (1995) Plant carotenoids: pigments for photoprotection, visual attractions, and human health. Plant Cell 7:1027
Bosch DD, Sheridan JM, Davis FM (1999) Rainfall characteristics and spatial correlation for the Georgia Coastal Plain. Trans ASAE 42:1637–1644
Branch WD (2007) Registration of 'Georgia-06G' peanut. J Plant Regist 1:120
Braswell LR, Cahoon CW Jr, Seagroves RW, Jordan DL, York AC (2016) Integrating fluridone into a glufosinate-based program for Palmer amaranth control in cotton. J Cotton Sci 20:394–402
Culpepper AS, Grey TL, Vencill WK, Kichler JM, Webster TM, Brown SM, York AC, Davis JW, Hanna WM (2006) Glyphosate-resistant Palmer amaranth (*Amaranthus palmeri*) confirmed in Georgia. Weed Sci 54:620–626
Culpepper AS, Vance JC (2019) Palmer amaranth control in Georgia cotton during 2019. Extension Circular 952. Athens: University of Georgia Extension
Grichar WJ, Dotray PA, McGinty JA (2020) Using fluridone herbicide systems for weed control in Texas cotton (*Gossypium hirsutum* L.). J Adv Agric 11:1–14
Hill ZT, Norsworthy JK, Barber LT, Gbur E (2016) Residual weed control in cotton with fluridone. J Cotton Sci 20:76–85
Johnson WC III, Prostko EP, Mullinix BG (2006) Phytotoxicity of delayed applications of flumioxazin on peanut (*Arachis hypogaea*). Weed Technol 20:157–163
Littell R, Milliken G, Stroup W, Wolfinger R, Schabenberger O (2006) SAS for Mixed Models, 2nd ed. Cary, NC: SAS Institute 828 p
Miller JH, Carter CH (1983) Fluridone for annual weed control in western irrigated cotton (*Gossypium hirsutum*). Weed Sci 31:290–293
Monfort WS ed. (2022) Peanut Production Guide. Extension Bulletin 1146. Athens: University of Georgia Extension. https://extension.uga.edu/publications/detail.html?number=B1146. Accessed: August 14, 2024
Neve P, Norsworthy JK, Smith KL, Zelaya IA (2011) Modeling glyphosate resistance management strategies for Palmer amaranth (*Amaranthus palmeri*) in cotton. Weed Technol 25:335–343
Norsworthy JK, Ward SM, Shaw DR, Llewellyn RS, Nicholas RL, Webster TM, Bradley KM, Frisvold G, Powles SB, Burgos NR, Witt WW, Barret M (2012) Reducing the risks of herbicide resistance: best management practices and recommendations. Weed Sci 60:31–62
Randell-Singleton T, Hand LC, Vance JC, Wright-Smith HE, Culpepper AS (2024) Confirming resistance to PPO-inhibiting herbicides applied preemergence and postemergence in a Georgia Palmer amaranth population. Weed Technol 38:23
Rasmussen N, Conrad JL, Green H, Khanna S, Wright H, Hoffmann K, Caudill J, Gilbert P (2022) Efficacy and fate of fluridone applications for control of invasive submersed aquatic vegetation in the estuarine environment of the Sacramento-San Joaquin Delta. Estuar Coast 45:1842–1860
Sarver JM, Tubbs RS, Beasley Jr JP, Culbreath AK, Grey TL, Rowland DL, Smith NB (2017) Evaluating plant population and replant method effects on peanut planted in twin rows. Peanut Sci 44:19–25
UGA Extension (2025) Georgia Pest Management Handbook Commercial Edition 2025. https://ipm.uga.edu/georgia-pest-management-handbook/. Accessed: January 30, 2025
[USDA-NASS] U.S. Department of Agriculture–National Agricultural Statistics Service (2024) 2023 Agrichemical Use Survey-Peanut, No 2024-3 https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/2023_Barley_Oats_Peanuts_Soybeans/ChemHighlights-Peanuts-2023.pdf. Accessed: May 10, 2024
[USDA-NRCS] U.S. Department of Agriculture–Natural Resources Conservation Service (2023) Web Soil Survey https://websoilsurvey.sc.egov.usda.gov/. Accessed: November 27, 2023
Vencill WK, Nicholas RL, Webster TM, Soteres JK, Mallory-Smith C, Burgos NR, Johnson WC III, McClelland MR (2012) Herbicide resistance: towards an understanding of resistance development and the impact of herbicide-resistant crops. Weed Sci 60:2–30
Whitaker JR, York AC, Jordan DL, Culpepper AS, Sosnoskie LM (2011) Residual herbicides for Palmer amaranth control. J Cotton Sci 15:89–99
Zou Z, Zou X, Zhao S, Xia C, Qian K, Wang P, Yin C (2018) Fluridone induces leaf bleaching by inhibiting pigment biosynthesis via downregulated transcription levels of pigment biosynthetic genes in rice (*Oryza sativa* L.). J Plant Growth Regul 37:1385–1395

https://doi.org/10.1017/wet.2025.10039