# Peanut Response to Fluometuron Applied to a Preceeding Cotton Crop[1]

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**ABSTRACT**

An experiment was conducted to determine the potential for fluometuron to carry over to peanut (*Arachis hypogaea* L.). Fluometuron was applied preemergence to cotton (*Gossypium hirsutum* L.) at 1.12 and 2.24 kg ai ha$^{-1}$ as a broadcast spray or as a 30-cm band in 91-cm rows. Each preemergence application was followed by zero, one, or two postemergence-directed applications of fluometuron at 1.12 kg ha$^{-1}$ plus MSMA at 2.24 kg ae ha$^{-1}$ in a 30-cm band. Herbicide treatments did not adversely affect cotton yield or fiber quality. Fluometuron injury was not observed on peanut planted the following year. Peanut yield, grade, and value were not affected by previous fluometuron treatments.

Key Words: *Arachis hypogaea* L., *Gossypium hirsutum* L., herbicide carryover, herbicide persistence, fiber quality, peanut grade, yield.

Fluometuron {*N,N*-dimethyl-*N'*-[3-(trifluoromethyl) phenyl]urea} is a phenylurea herbicide commonly used for weed control in cotton (*Gossypium hirsutum* L.) (5). Fluometuron applied preemergence (PRE) controls many broadleaf weeds (8, 20, 21, 23). Fields heavily infested with broadleaf weeds, however, often require additional herbicides applied postemergence for optimum cotton yield, to avoid cotton grade reductions due to foreign matter, and to reduce weed-related harvesting problems (13, 20, 23). Applied postemergence-directed (POST-DIR) in combination with MSMA (monosodium salt of methylarsonic acid) or DSMA (disodium salt of methylarsonic acid), fluometuron controls many troublesome broadleaf weeds (12, 20, 21).

Fluometuron is moderately persistent in soil (3, 10). Studies conducted on silt loam or silty clay soils have shown injury to wheat (*Triticum aestivum* L.) and hairy vetch (*Vicia villosa* Roth.) planted in the fall or soybean [*Glycine max* (L.) Merr.], rice (*Oryza sativa* L.), and cucumber (*Cucumis sativis* L.) planted in the spring following cotton treated with fluometuron during the preceeding spring (18, 19). Injury also has been observed on soybean and sorghum [*Sorghum bicolor* (L.) Moench] planted as a replacement crop 6 to 9 weeks after cotton treated with fluometuron (11). In other studies, however, carryover was not observed with normal use rates of fluometuron (6, 8). No studies have been conducted to determine the potential for fluometuron to carry over to peanut (*Arachis hypogaea* L.).

Peanut commonly is grown in rotation with cotton in North Carolina. Fluometuron is applied PRE to virtually all cotton in the state (5). Herbicides applied POST-DIR to cotton improve control of broadleaf weeds and often increase cotton yield (12, 13, 21, 23). Timing of POST-DIR herbicide application is critical; best results are obtained when POST-DIR herbicides are applied to small weeds. In most situations, the optimum time for application is when the cotton is 8 to 15 cm tall (22). Fluometuron plus MSMA or DSMA is the only herbicide combination currently available for POST-DIR application to cotton at this growth stage. Growers are reluctant to apply fluometuron POST-DIR following a PRE application because of fear of carryover to peanut.

The objective of this study was to determine the potential for fluometuron carryover to peanut planted following cotton treated with fluometuron at various rates and numbers of applications.

## Materials and Methods

The 2-year experiment was conducted on the Peanut Belt Research Station at Lewiston, NC during 1990 and 1991 (site 1) and 1991 and 1992 (site 2) and on the Upper Coastal Plain Research Station at Rocky Mount, NC during 1990 and 1991 (site 3) and 1991 and 1992 (site 4). Corn (*Zea mays* L.) was grown at each site during the year prior to initiation of the experiment. After harvest, corn stalks were shredded and the test area was disked.

The soil at site 1 was a Bonneau loamy sand (loamy, siliceous, thermic Arenic Paleudults) with 1.2% organic matter, 82% sand, 10% silt, 8% clay, and a pH of 5.8. Site 2 was on a Norfolk sandy loam (fine-loamy, siliceous, thermic Typic Paleudults) with 1.6% organic matter, 76% sand, 16% silt, 8% clay, and a pH of 6.4. The soil at site 3 was a Norfolk sandy loam with 1.6% organic matter, 59% sand, 25% silt, 16% clay, and a pH of 5.6. Site 4 was on a Rains sandy loam (fine-loamy, siliceous, thermic Typic Paleaquults)

[1]This research was supported in part by a grant from the N. C. Peanut Growers Assoc.

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[3]X-77 (contains alkylaryl-polyoxyethylene, glycols, free fatty acids, isopropanol). Valent U.S.A. Corp., 1333 N. California Blvd., Walnut Creek, CA 94596.

[4]TeeJet 11003 flat spray tip. Spraying Systems Co., North Avenue, Wheaton, IL 60188.

[5]TeeJet 8003E even flat spray tip. Spraying Systems Co., North Avenue, Wheaton, IL 60188.

[6]TeeJet OC-02 off-center flat spray tip. Spraying Systems Co., North Avenue, Wehaton, IL 60188.

Soils were characterized using the chromic acid colorimetric method (16) for organic matter determination.

Cotton was planted in the first year of the experiment. Plot size was six 91-cm rows by 24 m. Seedbed preparation included disking followed by bedding with under-the-row subsoiling. Trifluralin [2,6-dinitro-*N*,*N*-dipropyl-4-(trifluoromethyl)benzenamine] at 0.56 and 0.84 kg ai $ha^{-1}$ at Lewiston and Rocky Mount, respectively, was applied to all plots and incorporated on the beds with a power-driven vertical action tiller. McNair 235, Stoneville KC 380, Stoneville Coker 304, and McNair 235 cotton was planted at sites 1, 2, 3, and 4, respectively. Planting dates were 2 May 1990, 25 April 1991, 9 May 1990, and 2 May 1991 at sites 1, 2, 3, and 4, respectively. Aldicarb [2-methyl-2-(methylthio)propionaldehyde *O*-(methylcarbamoyl)oxime] insecticide at 0.45 kg ai $ha^{-1}$ was applied in the seed furrow at planting.

Fluometuron at 1.12 and 2.24 kg ai $ha^{-1}$ was applied PRE to cotton as a broadcast spray or in a 30-cm band over the row (equivalent to 0.37 and 0.75 kg $ha^{-1}$ on a planted-area basis). Each PRE application of fluometuron was followed by zero, one, or two POST-DIR applications of fluometuron at 1.12 kg $ha^{-1}$ plus MSMA at 2.24 kg ae $ha^{-1}$. A nonionic surfactant[3] at 0.25% (v/v) was included in the POST-DIR sprays. The first POST-DIR treatment was made 26 to 35 days after planting (DAP) when the cotton was 10 to 15 cm tall and in the V4 to V6 stage of growth (9). The second POST-DIR treatment was made 36 to 54 DAP when the cotton was 25 to 40 cm tall and in the R2 to R6 stage of growth. A no-fluometuron check also was included.

Broadcast and banded PRE sprays were applied with a tractor-mounted sprayer equipped with flat fan nozzles[4] delivering 230 L $ha^{-1}$ at 207 kPa and even-spray flat fan nozzles[5] delivering 460 L $ha^{-1}$ at 296 kPA, respectively. POST-DIR sprays were applied with a tractor-mounted shielded sprayer equipped with two off-center flat fan nozzles per row delivering 420 L $ha^{-1}$ at 138 kPa.

Normal cotton cultivation, fertilization, insect control, and defoliation practices were followed. Cotton injury was estimated visually using a scale of 0 = no injury to 100 = complete kill at 18 to 21 DAP and 7 to 10 and 18 to 21 days after treatment (DAT) with the POST-DIR herbicides. The four center rows of each plot were harvested with a spindle picker. A subsample of harvested seed cotton from each plot was collected and used for percent lint determinations. Fiber length, fiber length uniformity, fiber strength, and micronaire at sites 2 and 4 were determined by High Volume Instrumentation testing (17).

After harvest, the cotton stalks were shredded and the test area was disked once. The land was disked again the following spring and, with known reference points to ensure locating plots in the same area as in the previous year, bedded with under-row subsoiling. All tillage operations were performed parallel to the rows of the preceeding cotton crop to minimize lateral movement of fluometuron to adjacent plots. Plot length for peanut was reduced to 15 m to compensate for any longitudinal movement of fluometuron.

NC 10C peanut was planted 2 May 1991 and 4 May 1992 at sites 1 and 2, respectively. NC 7 peanut was planted 9 May 1991 at site 3, and NC 9 peanut was planted 13 May 1992 at site 4. Aldicarb at 1.2 kg $ha^{-1}$ at sites 1 and 2 or 2.4 kg $ha^{-1}$ at sites 3 and 4 was applied in the seed furrow at planting. Vernolate (S-propyl dipropylcarbamothioate) at 2.5 kg ai $ha^{-1}$ plus benefin [N-butyl-N-ethyl-2,6-dinitro- 4-(trifluoromethyl)benzenamine] at 1.2 kg ai $ha^{-1}$ at sites 1 and 2 or vernolate at 2.9 kg $ha^{-1}$ plus benefin at 1.7 kg $ha^{-1}$ at sites 3 and 4 were applied preplant incorporated. Metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide] at 1.7 kg ai $ha^{-1}$ at sites 1 and 2 or 2.8 kg $ha^{-1}$ at sites 3 and 4 was applied PRE. The sodium salt of acifluorfen {5-[2-chloro-4- (trifluoromethyl)phenoxy]-2-nitrobenzoic acid} at 0.28 kg ae $ha^{-1}$ plus the sodium salt of bentazon [3-(1-methylethyl)-(1*H*)-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide] at 0.56 kg ae $ha^{-1}$ plus the dimethylamine salt of 2,4-DB [4-(2,4-dichlorophenoxy)butanoic acid] at 0.28 kg ae $ha^{-1}$ were applied postemergence at all sites. Fertilization and disease and insect control practices were normal for peanut production.

Visual estimates of fluometuron injury to peanut were recorded at biweekly intervals throughout the growing season. The two center rows of each plot were dug with an inverter digger and allowed to dry in the field for 4 to 6 days before harvesting with a combine. Pod yields were adjusted to 7% moisture. A subsample of pods from each plot was shelled and graded to determine percentage (wt/wt) of fancy pods, extra large kernels, and total sound mature kernels (7). Crop value per kilogram was calculated based upon the Agricultural Stabilization and Conservation Service peanut loan schedule for the 1992 crop year.

The experimental design was a randomized complete block with treatments replicated four times. Data were subjected to analysis of variance, and means were compared with Fisher's Protected LSD Test at the 5% level of probability. Data were pooled over sites as appropriate.

# Results and Discussion

Rainfall during the first 10 DAP totaled 4.1, 5.9, and 6.8 cm at sites 1, 2, and 3, respectively (data not shown). At site 4, 4.0 cm of rain was received during the first 17 DAP. Although rainfall was sufficient for good herbicide activity, especially at sites 1, 2, and 3, no cotton injury was observed from fluometuron applied PRE. Injury from fluometuron plus MSMA applied POST-DIR was 5% or less 7 to 10 DAT (data not shown). Injury appeared as chlorosis on foliage contacted by the spray. No injury was noted 18 to 21 DAT with fluometuron plus MSMA.

Data for seed cotton yield could not be pooled across all sites because of a site by treatment interaction. However, data from both sites at Lewiston could be pooled as could data from both sites at Rocky Mount. All plots at sites 3 and 4 at Rocky Mount were nearly weed-free, and fluometuron had no effect on seed cotton yield (Table 1). At Lewiston, yield of cotton receiving any fluometuron treatment was greater than the yield of cotton not receiving fluometuron. However, no differences were noted in yield among the various fluometuron treatments. The lower yield in the no-fluometuron checks at Lewiston was due to weed competition. Plots not receiving fluometuron were severely infested with eclipta (*Eclipta prostrata* L.) while plots receiving fluometuron were nearly weed-free. Excellent control of eclipta by fluometuron applied PRE has been reported previously (23).

Cotton fiber quality, determined only at sites 2 and 4, was not affected by fluometuron. Averaged over treatments, fiber length (upper half mean, or length of fibers in the upper 25% length range), fiber length uniformity, fiber strength, and micronaire were 28.4 mm, 83.7%, 244 kN m/kg, and 5.4 standard units, respectively, at site 2 and 29.4 mm, 84.2%, 271 kN m/kg, and 5.1 standard units, respectively, at site 4 (data not shown). Fluometuron treatments also had no effect on lint percentage. Averaged over treatments, lint percentage was 42.7, 40.1, 42.3, and 36.9 at sites 1, 2, 3, and 4, respectively (data not shown).

MSMA enhances weed control with fluometuron and other postemergence-applied herbicides (12) and is routinely included with POST-DIR sprays to cotton (5). MSMA has no activity in soil (1). Hence, any effects on peanut from herbicide treatments applied the previous year would have been due to fluometuron. No symptoms of fluometuron injury were noted on peanut at any time during the growing season. Additionally, fluometuron applied the preceeding year had no effect on peanut yield (Table 2) or grade factors. Averaged over treatments, grade factors were as follows: 92, 33, 77, and 40% fancy size pods at sites 1, 2, 3, and 4, respectively; 46, 19, 29, and 31% extra large kernels at sites 1, 2, 3, and 4, respectively; and 72, 71, 73, and 71% total sound mature kernels at sites 1, 2, 3, and 4, respectively (data not shown). Because there was no effect of fluometuron treatments on yield or grade, there also was no effect of treatments on peanut value. Averaged over treatments, peanut value was $0.80, $0.77, $0.81, and $0.77 per kg at sites 1, 2, 3, and 4, respectively (data not shown).

Microbial degradation is the major mechanism of fluometuron dissipation from soil (3, 4). Hence, soil moisture

**Table 1. Seed cotton yield as affected by fluometuron.**

| Fluometuron applied PRE | | Lewiston[a] Number of POST-DIR applications[d] | | | Rocky Mount[b] Number of POST-DIR applications | | |
|---|---|---|---|---|---|---|---|
| Rate[c] | Method | 0 | 1 | 2 | 0 | 1 | 2 |
| kg ha$^{-1}$ | | kg ha$^{-1}$ | | | | | |
| 1.12 | 30-cm band | 2320 | 2450 | 2430 | 1900 | 1990 | 2130 |
| 2.24 | 30-cm band | 2490 | 2300 | 2490 | 2170 | 2230 | 2200 |
| 1.12 | Broadcast | 2350 | 2300 | 2310 | 2140 | 2280 | 2280 |
| 2.24 | Broadcast | 2270 | 2530 | 2510 | 1990 | 2200 | 2170 |
| 0 | | 1530 | | | 2090 | | |
| LSD 0.05 | | | 290 | | | NS | |

[a]Data pooled over sites 1 and 2.
[b]Data pooled over sites 3 and 4.
[c]Rates for banded applications equivalent to 0.37 and 0.75 kg ha$^{-1}$ on a planted-area basis.
[d]Fluometuron plus MSMA applied in 30-cm band at 1.12 plus 2.24 kg ha$^{-1}$, respectively; rates equivalent to 0.37 plus 0.75 kg ha$^{-1}$ of fluometuron plus MSMA, respectively, on a planted-area basis.

and temperature affect the rate of dissipation (19). However, an effect of temperature on fluometuron dissipation rate is observed only with relatively large differences in temperatures. Bouchard et al. (3) reported no difference in the rate of fluometuron dissipation at 23 and 37 C. Average air temperatures were 1 to 2 C above normal at all sites during both the summer (May through October) and winter (November through April) months (Table 3). The slightly warmer than normal conditions encountered during the experiment likely had little effect on the rate of fluometuron dissipation and hence the potential for carryover to peanut.

Below-normal rainfall was received during the winter months at all sites (Table 3). Although microbial degradation of fluometuron proceeds more slowly in drier soils (19), the below-normal rainfall during winter months likely had little effect on the rate of fluometuron degradation because microbial degradation is slow in cold soils regardless of soil moisture (19). However, leaching also may contribute to fluometuron dissipation (2, 3, 14). In lighter-textured soils such as those in this experiment, leaching may remove fluometuron from the surface soil layer thereby rendering it unavailable to young seedlings (15). Hence, the below-normal rainfall during the winter months likely increased the potential for fluometuron carryover.

Rainfall during the summer months was above normal at sites 1 and 2 and below normal at sites 3 and 4 (Table 3).

**Table 2. Peanut yield as affected by fluometuron applied during the preceding year.[a]**

| Fluometuron applied PRE | | Number of POST-DIR applications[c] | | |
|---|---|---|---|---|
| Rate[b] | Method | 0 | 1 | 2 |
| kg ha$^{-1}$ | | kg ha$^{-1}$ | | |
| 1.12 | 30-cm band | 4750 | 5020 | 4900 |
| 2.24 | 30-cm band | 4930 | 5170 | 4990 |
| 1.12 | Broadcast | 4810 | 5000 | 4800 |
| 2.24 | Broadcast | 4640 | 4790 | 4810 |
| 0 | | 4940 | | |
| LSD 0.05 | | | NS | |

[a]Data pooled over four sites.
[b]Rates for banded applications equivalent to 0.37 and 0.75 kg ha$^{-1}$ on a planted-area basis.
[c]Fluometuron plus MSMA applied in 30-cm band at 1.12 plus 2.24 kg ha$^{-1}$, respectively; rates equivalent to 0.37 plus 0.75 kg ha$^{-1}$ of fluometuron plus MSMA, respectively, on a planted-area basis.

**Table 3. Cumulative rainfall and average temperature during the first two 6-month periods following cotton planting.[a]**

| Period | Cumulative rainfall | Average temperature |
|---|---|---|
| | cm | C |
| | Site 1 | |
| May through October | 73.2 (+3.0) | 24 (+2) |
| November through April | 47.4 (-6.6) | 11 (+2) |
| | Site 2 | |
| May through October | 81.6 (+11.4) | 24 (+2) |
| November through April | 38.1 (-15.9) | 10 (+1) |
| | Site 3 | |
| May through October | 52.7 (-12.2) | 23 (+1) |
| November through April | 38.8 (-12.7) | 10 (+1) |
| | Site 4 | |
| May through October | 53.5 (-11.4) | 23 (+1) |
| November through April | 49.5 (-2.0) | 10 (+1) |

[a]Rainfall and temperature recorded on site. Numbers in parentheses are departures from the 40-yr average at sites 1 and 2 and the 30-yr average at sites 3 and 4.

Below-normal rainfall during the summer months at sites 3 and 4 likely reduced fluometuron dissipation by both microbial degradation and leaching relative to what one might expect in a year with normal rainfall. However, as discussed earlier, no fluometuron injury symptoms or effects on peanut yield or grade were noted at either site.

POST-DIR herbicides are key components of good weed management programs for cotton (12, 13, 21, 23). This experiment demonstrates that fluometuron may be applied PRE and twice POST-DIR to cotton without carryover to peanut planted the following year.

## Acknowledgments

Steve Barnes and Tommy Perry at the Peanut Belt Research Station and Clyde Bogle and Almond Stallings at the Upper Coastal Plain Research Station provided invaluable assistance in the conduct of this research.

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Accepted July 10, 1993