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WEED SCIENCE

Effect of Diuron and Fluometuron on Grain Sorghum and Soybean as Replacement Crops Following a Cotton Stand Failure

Lewis R. Braswell*, Alan C. York, David. L. Jordan, and Richard W. Seagroves

ABSTRACT

Preemergence herbicides are widely used in cotton (*Gossypium hirsutum* L.) to control glyphosate-resistant weeds. If a stand failure occurs after the acceptable replanting date for cotton, the most likely replacement crops are grain sorghum [*Sorghum bicolor* (L.) Moench.] and soybean [*Glycine max* (L.) Merr.]. When replanting to another crop, one must consider the potential impact of previously applied cotton herbicides on the replacement crop. The objective of this study was to determine the potential for sorghum and soybean as replacement crops following diuron- and fluometuron-treated cotton on coarse-textured, low organic matter soils. Specific objectives were to determine effects of tillage and time between herbicide application and replacement crop planting. Treatments consisted of a factorial arrangement of no herbicide, 1120 g ai ha^{-1} of fluometuron, or 840 g ai ha^{-1} of diuron, replant delays of three, six or nine wk after cotton herbicide application, and no tillage or disking prior to replacement crop planting. Soybean response to cotton herbicides was noted primarily with the three-wk replant delay, and greater response was noted with fluometuron. Soybean planted three wk after diuron and fluometuron application was injured 1 to 15% and 6 to 33%, respectively, depending upon location. Disking prior to soybean planting generally increased injury. Regardless of replant delay, diuron did not reduce soybean yield. Soybean yield was reduced at two of three locations by fluometuron in a three-wk replant delay but not with six- or nine-wk replant delays. No visible injury was noted on grain sorghum and yield was not reduced at any of four locations regardless of replant delay or cotton herbicide.

Glyphosate-resistant (GR) cotton (*Gossypium hirsutum* (L.)) cultivars, commercially released in 1997, offered a number of benefits to growers (Culpepper and York, 1998, 1999; Gianessi, 2008), and the technology was quickly adopted (Gianessi, 2005). Nearly all the cotton now grown in the Southeast and Mid-South regions of the United States (U.S.) Cotton Belt is resistant to glyphosate or glyphosate and glufosinate (USDA-AMS, 2014). Glyphosate-resistant cotton allowed growers to obtain good weed control while reducing or eliminating use of soil-applied residual herbicides (Culpepper and York, 1998, 1999; Scott et al., 2002). This alleviated concerns over crop injury from soil-applied herbicides and potential carryover to rotational crops (Bradley et al., 2001; Fisher et al., 2007; York, 1993). Unfortunately, extensive reliance on glyphosate in the absence of other herbicide modes of action led to selection for GR weed biotypes. Resistance to glyphosate has now been confirmed in 32 and 14 weed species globally and in the United States, respectively (Heap, 2015). The first confirmation of resistance to glyphosate in an *Amaranthus* species occurred with Palmer amaranth (*Amaranthus palmeri* S. Wats.) in Georgia in 2004 (Culpepper et al., 2006). By the end of 2014, GR Palmer amaranth had been confirmed in 24 states in the United States (Heap, 2015). Multiple resistance to glyphosate and acetolactate synthase (ALS)-inhibiting herbicides is also common (Heap, 2015; Nandula et al., 2012; Poirier et al., 2014; Sosnoskie et al., 2011). Cotton growers are once again integrating herbicides with alternative modes of action into their management systems in an attempt to control glyphosate- and ALS-resistant Palmer amaranth (Sosnoskie and Culpepper, 2014).

In North Carolina, cotton is historically seeded from late-April through late-May. Cotton requires a relatively long growing season and planting after late May typically results in reduced yield in North Carolina (Guthrie, 1991; Nuti et al., 2006). A cotton stand can be lost due to hail or other adverse

LR. Braswell*, A.C. York, D.L. Jordan, and R.W. Seagroves, Box 7620, North Carolina State University, Raleigh, NC 27695
*Corresponding author: lrbraswe@ncsu.edu

weather conditions or seedling diseases. If the stand failure occurs after the acceptable planting date for cotton, the grower must decide on a replacement crop. The most likely replacement crops in the southeastern United States are grain sorghum [*Sorghum bicolor* (L.) Monech.] and soybean [*Glycine max* (L.) Merr.]. Although grain sorghum and soybean typically produce greater yields when planted in May, both crops can be expected to mature when planted up to mid-July in North Carolina (Anonymous, 2011; Wiatrek et al., 2009). When replanting to another crop following a failed cotton stand, one must consider the potential impact of previously applied cotton herbicides on the replacement crop.

Eight soil-applied residual herbicides are currently recommended for weed management in cotton in North Carolina (York, 2015). Flumioxazin is commonly applied two to three wk prior to planting as part of a preplant burndown program in conservation tillage systems. Although no longer commonly used, trifluralin can be applied preplant incorporated (PPI). Pendimethalin can also be applied PPI but it is more commonly applied preemergence (PRE). Acetochlor, diuron, fluometuron, and fomesafen applied PRE are also widely used in North Carolina. Pyrithiobac can also be applied PRE but it is not widely used in this manner. Acetochlor, flumioxazin, fomesafen, pendimethalin, and trifluralin are registered for use in soybean (Anonymous, 2015a, 2015b, 2015c, 2015d, 2015e) and would not be expected to negatively impact soybean. Neither acetochlor nor flumioxazin would be expected to harm grain sorghum. Acetochlor is registered for PRE application to grain sorghum (Anonymous, 2015a) while flumioxazin is registered for application 30 d prior to grain sorghum planting (Anonymous, 2015b). Research in Texas has validated the safe use of flumioxazin PRE in grain sorghum (Grichar, 2006). Grain sorghum would not be a suitable replacement crop following cotton treated with pendimethalin, trifluralin, or fomesafen. Labels for the dinitroaniline herbicides, pendimethalin and trifluralin, have ten- and twelve-mo rotational restrictions, respectively, for grain sorghum (Anonymous, 2015d, 2015e), and research has shown potential injury to grain sorghum planted the season after dinitroaniline herbicide application (Fink, 1972). Fomesafen has relatively long persistence in soil (Mueller et al., 2014; Rauch et al., 2007), and grain sorghum is intolerant of fomesafen (Cobacci et al., 1998). The label for fomesafen specifies a ten-mo restriction when planting grain sorghum (Anonymous, 2015c). Neither grain sorghum nor soybean would be replant options following application of pyrithiobac. The pyrithiobac label has a ten-mo rotational restriction for both crops (Anonymous, 2015f). Johnson et al. (1993) reported injury to soybean and grain sorghum planted eight and sixteen wk, respectively, following pyrithiobac application, while Jordan et al. (1993) reported carryover to grain sorghum planted the growing season following application to cotton.

The potential to replant to grain sorghum or soybean following application of diuron or fluometuron is less definitive. The label for fluometuron (Anonymous, 2015g) specifies a nine-mo rotational restriction for both grain sorghum and soybean. The label for diuron (Anonymous, 2015h) simply states that grain sorghum and soybean can be planted the next spring following a broadcast application. It is known that some growers in North Carolina have successfully planted soybean following failed stands of fluometuron-treated cotton (A. C. York, personal communication). Published research concerning this practice is very limited. Jackson et al. (1978), working on loam and silt loam soils in Tennessee, broadcast fluometuron at 1700 g ha^{-1} followed by planting of grain sorghum and soybean at three, six, and nine wk. The soil was disked prior to replacement crop planting. On the silt loam soil, soybean stand was reduced in two of three years and yield was reduced each year when planted at six wk. Stand was not reduced when soybean was planted at nine wk, but significant injury was noted in two of three yr and yield was reduced in one of three yr. Less impact on soybean was observed on the loam soil. This was at least partially attributed to more organic matter in the loam soil and greater adsorption of the fluometuron. Soybean yield was reduced in one of two yr on the loam soil when soybean was planted three wk after fluometuron application, but there was no impact on yield when soybean was planted six or nine wk after application. Fluometuron had no effect on grain sorghum stand on the silt loam soil, but yield was reduced in two of two yr when grain sorghum was planted three wk after herbicide application. No yield impact was noted with the six- or nine-wk planting delays. Similar to results with soybean, less grain sorghum injury was also noted on the loam soil. Grain sorghum stand and yield were not reduced when grain sorghum was planted three wk following fluometuron application.

Sharp et al. (1982) conducted similar studies on silt loam and silty clay soils in Arkansas and reported a greater soybean response to fluometuron residues on the silt loam soil. On the silt loam, soybean yield was reduced in two of three yr when planted 29 to 30 d after application of 1700 g ha^{-1} of fluometuron. Greater injury to soybean was noted when soil was disked prior to soybean planting compared with no-till planting.

No research is available on the impact of fluometuron on soybean or grain sorghum as replacements crops behind cotton on coarse-textured soils. The only data available on diuron is that of Prostko et al. (2013) who reported greater tolerance of soybean than anticipated. Prostko et al. (2013) applied diuron at 70 to 2240 g ha^{-1} immediately after planting soybean on a sand soil with 0.4% organic matter. Diuron at 2240 g ha^{-1} reduced soybean stand in one of two yr, and soybean yield was reduced 23 and 41% by diuron at 1120 and 2240 g ha^{-1} in one of two yr. Diuron at 560 g ha^{-1} had no effect on stand or yield in either year.

Questions continue to arise concerning the planting of an alternative crop behind cotton when stand failures occur. In light of the very limited information available, we conducted experiments to determine the potential for grain sorghum and soybean as replacement crops following diuron- and fluometuron-treated cotton on coarse-textured, low organic matter soils typical of cotton production in the southeastern United States. Specific objectives were to determine the effects of tillage and time between application of the herbicides and replacement crop planting.

MATERIALS AND METHODS

Separate experiments for grain sorghum and soybean were conducted in North Carolina during 2013 and 2014 at the sites described in Table 1. Soils were characterized by the Agronomic Services Division of the North Carolina Department of Agriculture and Consumer Services. Soil humic matter was determined according to Mehlich (1984). The fields were disked at the initiation of the experiments. Treatments consisted of a factorial arrangement of three cotton herbicide options, three replant crop planting delays, and two tillage options for the replacement crops in a split-strip-strip design with treatments replicated four times. Cotton herbicides were the split plot, replant crop planting delays were the first strip, and tillage was the second strip. Replacement crop row spacing and plot dimensions are in Table 2.

Table 1. Description of soils at experiment sites

Site and GPS coordinates	Replacement crop	Year	Soil series[z]	Soil texture	Soil pH	Soil humic matter
Jackson Springs 35.19° N, -79.69° W	Sorghum	2013	Candor	Sand	6.8	0.6
Jackson Springs 35.18° N, -79.68° W	Sorghum	2014	Candor	Sand	6.5	0.5
Lewiston 36.13° N, -77.18° W	Sorghum	2013	Goldsboro	Sandy loam	6.6	0.9
Rocky Mount 35.87° N, -77.69° W	Sorghum	2014	Johns	Fine sandy loam	6.1	0.5
Lewiston 36.13° N, -77.18° W	Soybean	2013	Goldsboro	Sandy loam	6.6	0.9
Rocky Mount 35.90° N, -77.68° W	Soybean	2013	Norfolk	Loamy sand	6.2	0.5
Rocky Mount 35.89° N, -77.67° W	Soybean	2014	Goldsboro	Fine sandy loam	5.7	0.3

[z] Candor: sandy, kaolinitic, thermic Grossarenic Kandiudult; Goldsboro: fine-loamy, siliceous, subactive, thermic Aquic Paleudult; Johns: fine-loamy over sandy, silicious, semiactive, thermic Aquic Hapludult; Norfolk: fine-loamy, kaolinitic, thermic Typic Kandiudult.

Table 2. Cotton herbicide application dates, replacement crop planting dates and row spacing, and plot dimensions

Site	Crop	Year	Cotton herbicide application dates	Replacement crop planting dates			Row spacing	Plot width	Plot length
				3 wk	6 wk	9 wk			
							cm	rows	m
Jackson Springs	Sorghum	2013	25 April	17 May	5 June	25 June	38	16	25
Jackson Springs	Sorghum	2014	29 April	19 May	9 June	30 June	97	8	22
Lewiston	Sorghum	2013	26 April	16 May	6 June	26 June	91	4	25
Rocky Mount	Sorghum	2014	28 April	21 May	11 June	1 July	91	8	22
Lewiston	Soybean	2013	26 April	16 May	6 June	26 June	91	4	25
Rocky Mount	Soybean	2013	26 April	16 May	5 June	26 June	38	12	18
Rocky Mount	Soybean	2014	28 April	21 May	11 June	1 July	91	8	22

Cotton herbicides included diuron (Direx® 4L, ADAMA USA, Raleigh, NC) at 840 g ha^{-1}, fluometuron (Cotoran® 4L, ADAMA USA, Raleigh, NC) at 1120 g ha^{-1}, and no herbicide. Cotton herbicides were applied on the dates listed in Table 2 using a tractor-mounted sprayer equipped with flat-fan nozzles (DG11002 TeeJet® Drift Guard flat-spray nozzles, TeeJet Technologies, Wheaton, IL) calibrated to deliver 140 L ha^{-1} at 193 kPa. The application dates were within the normal cotton planting season in North Carolina (USDA-NASS, 1997). Following herbicide application, fields remained fallow until the replacement crops were planted. Replacement crops, grain sorghum or soybean, were planted either with no tillage or following disking at three, six, and nine wk (20 to 23, 40 to 42, and 61 to 64 d, respectively) after cotton herbicide application (Table 2). Grain sorghum hybrids were 83P17 (Pioneer Hi-Bred International, Johnston, IA) in 2013 and DKS28-05 (Monsanto Company, St. Louis, MO) in 2014. Grain sorghum seed were treated with fluxofenim (Concep® III, Syngenta Crop Protection, Greensboro, NC) seed protectant to protect against chloroacetamide herbicide damage. Soybean cultivars were AG6732 (Monsanto Company) at Rocky Mount in 2014 and AG5831 (Monsanto Company) at other locations. Atrazine at 1389 g ai ha^{-1} plus *S*-metolachlor at 1075 g ai ha^{-1} (Bicep II Magnum®, Syngenta Crop Protection) were applied PRE to grain sorghum to control weeds. The sodium salt of fomesafen at 266 g a.e. ha^{-1} plus *S*-metolachlor at 1215 g ai ha^{-1} (Prefix® Herbicide, Syngenta Crop Protection) was applied PRE to soybean. In treatments without disking prior to planting, paraquat dichloride (Parazone® 3SL, ADAMA USA) at 1260 g ai ha^{-1} plus crop oil concentrate was included with PRE soybean and grain sorghum herbicides. Soybean and grain sorghum herbicides were applied using a CO_2-pressurized backpack sprayer equipped with flat-fan nozzles (DG11002, TeeJet Technologies) delivering 140 L ha^{-1} at 165 kPa. Escaped weeds were removed by hand. Rainfall was recorded onsite.

Grain sorghum and soybean injury were estimated visually three and six wk after planting (WAP) according to Frans et al. (1986) and crop stand was determined at the time of the six-wk injury rating. Plots were mechanically harvested with separate harvest dates for the three planting dates. Data were subjected to analysis of variance, with partitioning to reflect the factorial treatment arrangement, using the PROC GLM procedure of SAS (version 9.3; SAS Institute Inc., Cary, NC) and means separated using Fisher's Protected LSD Test at P = 0.05 where appropriate.

RESULTS AND DISCUSSION

Soybean Response. Data are presented by location as treatment by location interactions were noted. Tillage by herbicide or tillage by replant delay interactions were not observed for soybean injury, stand, or yield. A cotton herbicide by replant delay interaction was noted for soybean injury. Greater injury was noted with fluometuron than with diuron, although this injury was primarily observed with the three-wk replant delay (Table 3). Evaluated at three WAP, soybean planted three wk after cotton herbicide application was injured 6, 11, and 33% by fluometuron at Lewiston, Rocky Mount in 2014, and Rocky Mount in 2013, respectively, while diuron injured soybean 2, 1, and 15% at the same locations. At six WAP, injury to soybean planted three wk after fluometuron and diuron application was 6% or less and 1% or less, respectively. Injury appeared primarily as foliar chlorosis.

Table 3. Soybean injury as affected by cotton herbicides and replant delays[z]

Cotton herbicides[y]	Replant delay[x]	Lewiston, 2013		Rocky Mount, 2013		Rocky Mount, 2014	
		3 WAP[w]	6 WAP	3 WAP	6 WAP	3 WAP	6 WAP
	wk	%					
diuron	3	2 b	1 a	15 b	1 b	1 d	0 b
diuron	6	0 c	0 c	0 c	0 b	2 c	0 b
diuron	9	0 c	0 c	0 c	0 b	0 e	0 b
fluometuron	3	6 a	3 b	33 a	6 a	11 a	2 a
fluometuron	6	0 c	0 c	2 c	0 b	5 b	0 b
fluometuron	9	0 c	0 c	0 c	0 b	1 d	0 b

[z] Data averaged over tillage and no tillage prior to planting soybean. Means within a column followed by the same letter are not different according to Fisher's Protected LSD Test at p = 0.05.

[y] Diuron and fluometuron applied at 860 and 1120 g ha^{-1}, respectively.

[x] Weeks after cotton herbicide application.

[w] WAP, weeks after soybean planting.

Soybean stands varied by planting dates. This likely was due to differing soil moisture conditions at the time of planting and shortly after. Because of variation by planting date, stand data are presented as percent reduction relative to the no-herbicide check within a replant delay and tillage system. A cotton herbicide by replant delay interaction was noted for soybean stand at Lewiston in 2013 and Rocky Mount in 2014. Regardless of replant delay, diuron reduced stands 6% or less (Table 4). In contrast, stand of soybean planted three wk after fluometuron application was reduced 16 to 21% at each location and 12% at Lewiston when soybean was planted six wk after fluometuron application. A cotton herbicide by replant delay interaction was not observed with stand at Rocky Mount in 2013 and differences between diuron and fluometuron were not observed. Averaged over herbicides, soybean stand at Rocky Mount in 2013 was reduced 15% when soybean was planted three wk after cotton herbicide application but only 2 to 4% with planting six or nine wk after diuron or fluometuron application.

Table 4. Soybean stand reduction as affected by cotton herbicides and replant delays[z]

Cotton herbicides[y]	Replant delay[x]	Lewiston 2013	Rocky Mount 2013	Rocky Mount 2014
	wk	% reduction[w]		
diuron	3	5 c	17	3 b
diuron	6	2 c	4	6 b
diuron	9	3 c	2	4 b
fluometuron	3	21 a	14	16 a
fluometuron	6	12 b	4	4 b
fluometuron	9	2 c	2	5 b
Main effect of herbicides				
diuron			7 A	
fluometuron			9 A	
Main effect of replant delays				
3 wk			15 A	
6 wk			4 B	
9 wk			2 B	

[z] Data averaged over tillage and no tillage prior to planting soybean. Means within a column for herbicide by replant delay combinations followed by the same lower case letter are not different according to Fisher's Protected LSD Test at p = 0.05. Means within a column and main effect followed by the same upper case letter are not different at p = 0.05.

[y] Diuron and fluometuron applied at 860 and 1120 g ha^{-1}, respectively.

[x] Weeks after cotton herbicide application.

[w] Expressed as percentage of no-herbicide check within a cotton herbicide and replant delay.

The tillage system for soybean had no effect on soybean injury six WAP or soybean stand (data not shown). Averaged over herbicides and replant delays, somewhat greater injury was observed three WAP when the land was disked prior to soybean planting. At that time, soybean planted following tillage at Lewiston, Rocky Mount in 2013, and Rocky Mount in 2014 was injured 2, 11, and 4%, respectively, while soybean planted without disking was injured 1, 6, and 3%, respectively (data not shown).

Tillage by herbicide or tillage by replant delay interactions were not observed for soybean yield at any location. Averaged over herbicides and replant delays, yield of soybean planted with no disking was 12 and 16% greater at Lewiston and Rocky Mount in 2013 but not different at Rocky Mount in 2014 (data not shown). A herbicide by replant delay interaction was noted with yield at Lewiston and Rocky Mount in 2013, although the interaction was only significant at p = 0.10 at Rocky Mount (Table 5). Compared to the no-herbicide check within a replant delay, diuron did not reduce yield with any replant delay. Yield of soybean planted three wk after fluometuron application was reduced 13 to 16% at Lewiston and Rocky Mount in 2013, but no yield reduction occurred when soybean was planted six or nine wk after fluometuron application. However, in spite of the injury and stand reduction (Tables 3 and 4), yield was still greater with soybean planted three wk after fluometuron application compared with the six-wk replant delay (Table 5). This reflects a strong effect of planting date on overall yield at those locations. Averaged over tillage, yield of the no-herbicide checks at Lewiston and Rocky Mount in 2013 were reduced 23 to 24% and 44 to 46% with six- and nine-wk replant delays, respectively, compared with the three-wk replant delay. Later planted soybean often yields less than an earlier planted crop (Beatty et al., 1982; Egli and Cornelius, 2009). Neither herbicides nor replant delays impacted soybean yield at Rocky Mount in 2014. Lack of an effect of planting date on yield at Rocky Mount in 2014 was likely due to excellent growing conditions. Row spacing or planting date may have little impact on soybean yield if the crop canopy reaches 1 m or more in height and closes the row middles by the early bloom stage (E. J. Dunphy, Extension Soybean Specialist, North Carolina State University, personal communication). Those parameters were met at Rocky Mount in 2014, in part because of above-normal rainfall in the six- to nine-wk period after cotton herbicide application and the following 60 d (Table 6).

Table 5. Soybean yield as affected by cotton herbicides and replant delays[z]

Cotton herbicides[y]	Replant delay[x]	Lewiston 2013	Rocky Mount 2013	Rocky Mount 2014
	wk		kg ha^{-1}	
no herbicide	3	2890 a	4230 a	3980
no herbicide	6	2200 bc	3240 c	3790
no herbicide	9	1630 e	2270 d	3880
diuron	3	2780 ab	4080 ab	4000
diuron	6	2070 c	2870 c	3880
diuron	9	1410 e	2020 d	3940
fluometuron	3	2440 b	3690 b	3760
fluometuron	6	2050 cd	2850 c	3570
fluometuron	9	1710 de	1980 d	3600
Main effect of herbicides				
no herbicide				3880 A
diuron				3940 A
fluometuron				3640 A
Main effect of replant delays				
3 wk				3910 A
6 wk				3750 A
9 wk				3810 A

[z] Data averaged over tillage and no tillage prior to planting soybean. Means within a column for herbicide by replant delay combinations at Lewiston and Rocky Mount in 2013 followed by the same lower case letter are not different according to Fisher's Protected LSD Test at p = 0.05 and p = 0.10, respectively. Means within a main effect at Rocky Mount in 2014 followed by the same upper case letter are not different at p = 0.05.

[y] Diuron and fluometuron applied at 860 and 1120 g ha^{-1}, respectively.

[x] Weeks after cotton herbicide application.

Table 6. Rainfall at experiment sites[z]

Location	Year	Application to 3-wk planting	3-wk planting to 6-wk planting	6-wk planting to 9-wk planting	0 to 30 d after 9-wk planting	31-60 d after 9-wk planting
		cm				
Jackson Springs	2013	10.3 (5.7)	13.1 (5.1)	14.6 (6.9)	30.3 (12.0)	13.5 (12.9)
Lewiston	2013	2.5 (5.5)	12.0 (6.6)	7.0 (6.8)	19.8 (10.9)	8.5 (11.6)
Rocky Mount	2013	3.9 (5.3)	6.2 (6.2)	17.0 (6.9)	19.3 (11.0)	11.6 (12.6)
Jackson Springs	2014	10.2 (5.7)	0.8 (5.1)	1.7 (6.9)	7.1 (12.0)	9.3 (12.9)
Rocky Mount	2014	12.0 (6.1)	2.7 (7.0)	10.4 (6.4)	16.9 (11.6)	22.4 (12.3)

[z] Values in parentheses are 30-yr averages, recorded from 1981 to 2010.

Diuron and fluometuron are degraded primarily by soil microorganisms. Soil moisture would, therefore, be expected to impact the rate of dissipation, with more rapid dissipation occurring with good moisture conditions (El Sebar et al., 2010, Mueller et al., 1992; Rogers et al., 1986). Rainfall at experiment sites varied by year and location (Table 6). Overall, 2013 was a wetter than normal season while 2014 was generally drier than normal. Rainfall between cotton herbicide application and the nine-wk planting date was 115, 14, and 47% above normal at Jackson Springs, Lewiston, and Rocky Mount, respectively, in 2013 and 28 to 29% below normal in 2014. However, greatest soybean injury (Table 3) was noted when planting occurred three wk after cotton herbicide application. Rainfall during that first three-wk period was below normal at Lewiston and Rocky Mount in 2013 and above normal at Rocky Mount in 2014 (Table 6). Soybean injury with the three-wk planting delay was greatest at Rocky Mount in 2013, intermediate at Rocky Mount in 2014, and least at Lewiston in 2013 (Table 3), hence there was no clear relationship between rainfall and soybean injury.

Grain Sorghum Response. No grain sorghum response (visible injury, stand reduction, yield) to previously applied cotton herbicides was noted at Jackson Springs in 2013 or 2014 or at Rocky Mount in 2014. Averaged over all treatments, grain sorghum yields were 2450, 3590, and 3670 kg ha^{-1} at Jackson Springs in 2013, Jackson Springs in 2014, and Rocky Mount in 2014, respectively (data not shown). A replant delay main effect for yield was observed at Lewiston in 2013. Yield was similar with replant delays of three and six wk (5050 and 4580 kg ha^{-1}, respectively) but less (2440 kg ha^{-1}) with the nine-wk replant delay (data not shown). Grain sorghum planted nine wk after cotton herbicide application at Lewiston failed to fully mature.

Our results are similar to those of Jackson et al. (1978) in that soybean was more sensitive to fluometuron than diuron residues and grain sorghum was less sensitive than soybean to fluometuron residues. Similar to results of Sharp et al. (1982), we found no benefit from tillage prior to planting replacement crops. Our results indicate grain sorghum can be planted no-till three wk after a failed stand of diuron- or fluometuron-treated cotton, and soybean can be planted no-till three wk after diuron-treated cotton. Yield of soybean was reduced at two of three locations when planted three wk after fluometuron, but yield was not reduced if planting was delayed six wk. However, because earlier planted soybean yielded more, yield of soybean planted three wk after fluometuron still exceeded yield of soybean planted six wk after fluometuron.

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