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# WEED SCIENCE

## Effect of Autumn Management on Winter Annual Weeds Prior to Cotton Planting

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### ABSTRACT

**Field studies were conducted to evaluate the efficacy of autumn tillage and herbicide applications on the control of cutleaf evening-primrose prior to planting cotton. In one study, different timings and combinations of autumn disking and glyphosate applications were evaluated following harvest of the preceding cotton or corn crop. Treatments implemented following corn harvest were inconsistent for annual winter weed control. Relative to the nontreated control, treatments that included disking or glyphosate at 5 wk after harvest (WAH) of cotton had lower cutleaf evening-primrose ground cover estimates and plant population densities, with the exception of glyphosate applied at 5 WAH in 2004. Critical establishment of cutleaf evening-primrose occurred in these studies around 5 wk after cotton harvest (first week of November), whereas post-corn harvest treatments were applied prior to cutleaf evening-primrose establishment. In the second study, pre-plant applications of 2,4-D in three tillage systems were evaluated for cutleaf evening-primrose growth. Application of 2,4-D effectively controlled cutleaf evening-primrose, leaving no green plants at the time of cotton planting. There were differences in the number of cutleaf evening-primrose remnant plants among both tillage and 2,4-D systems. Conventional tillage had fewer cutleaf evening-primrose plants than reduced tillages. Application of 2,4-D to both strip-tillage and no-tillage reduced cutleaf evening-primrose plant density by 70% or greater. Although there was no effect of tillage system on cotton yield, preplant applications of 2,4-D increased cotton growth and yield relative to nontreated controls. 2,4-D was an effective option for cutleaf evening-primrose control prior to cotton planting.**

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Conservation tillage (> 30% residue) has become a common practice in agronomic crop production systems in Georgia. In 1996 in Georgia and the southern region of the U.S., approximately 12% of the cotton ha used conservation tillage practices (CTIC, 2005). By 2004 the southern region had 22% of the cotton ha in conservation tillage and Georgia had 41%. Conservation tillage improves soil moisture and water infiltration and reduces soil erosion and crusting, sand-blasting of young seedlings associated with wind erosion, and costs associated with labor and equipment (Potter et al., 2008; Shurley, 2006; Wilcut et al., 1993; York et al., 2004).

Although there are many benefits associated with conservation tillage, these systems can be plagued by the occurrence of winter annual weeds at spring crop planting. Primary tillage was used previously, not only to prepare a seedbed for crop planting, but also as an effective means of eliminating existing winter annual weeds. Common winter annual weeds encountered in conservation tillage systems in Georgia are similar to the common and troublesome weeds of small grains and include cutleaf evening-primrose (*Oenothera laciniata* Hill), cudweeds (*Gamochaeta* spp.), henbit (*Lamium amplexicaule* L.), wild radish (*Raphanus raphanistrum* L.), and annual bluegrass (*Poa annua* L.) (Webster, 2008).

In conservation tillage systems, applications of non-selective herbicides (e.g., glyphosate and paraquat) have replaced primary tillage for cool-season weed control, which is effective for most of the common species. However, previous studies have demonstrated that cutleaf evening-primrose control with glyphosate and paraquat is variable and often not effective (Culpepper et al., 2002; Johnson et al., 2000; Reynolds et al., 2000).

Germination of cutleaf evening-primrose seed in response to constant and alternating temperatures indicates that this species can emerge between May and September in North Carolina (Clewis et al., 2007). In Georgia, seed germination of this species begins in early autumn and continues through spring, although cues for establishment (i.e., temperature, moisture, soil disturbance) have not been characterized. Cutleaf evening-primrose forms a basal rosette that might interfere with crop planting and establishment, especially in reduced tillage fields. Johnson et al. (2000) reported that sequential harrowing of fields in November, January, and March controlled cutleaf evening-primrose 89% and greater, based on a rating of plant density. Less frequent soil disturbance controlled cutleaf evening-primrose 44 to 76% and 66 to 86% for one and two harrowing operations, respectively (Johnson et al., 2000). In addition to interfering with establishment and early-season growth of agronomic crops, cutleaf evening-primrose can be a secondary host of several pests of associated crops (Gitaitis et al., 1998; Hollowell et al., 2003; Idol and Slosser, 2005; McPherson et al., 2003; Sudbrink et al., 1998).

Studies were initiated to evaluate the control of cutleaf evening-primrose and other winter annual weeds in response to different management regimes. The effects of post-crop harvest treatments, which included different timings and combinations of disking and glyphosate applications, were evaluated following both corn (*Zea mays* L.) and cotton (*Gossypium hirsutum*) harvest. The objective of a second study was to determine the response of cutleaf evening-primrose to applications of 2,4-D (2,4-D amine 4, Helena Chemical Company, Collierville, TN) in three tillage systems and determine the impact of these treatments on cotton growth and yield.

## MATERIALS AND METHODS

**Autumn Weed Control Study.** Field studies were initiated at the USDA-ARS Jones Farm near Chula, GA (31°30′55″N, 83°32′38″W) following corn and cotton harvest in autumn of 2002 and 2003. The soil type was a Tifton loamy sand (fine-loamy, siliceous, thermic plinthic Kandiudults) with a pH of 6.0 to 6.2 and 0.5 to 0.8% organic matter. Corn was harvested 28 August 2002 and 21 August 2003 and cotton was harvested 1 October 2002 and 30 September 2003. Treatments consisted of different timings and combinations of disk harrowing (disking) and glyphosate (Roundup UltraMax, Monsanto Company, St. Louis, MO) application (1.1 kg ae $ha^{-1}$) following both corn and cotton harvest. Treatments included: 1) disking at 1 WAH, 2) disking 1 WAH followed by (fb) disking 5 WAH, 3) disking 1 WAH fb glyphosate 5 WAH, 4) glyphosate 1 WAH, 5) glyphosate 5 WAH, and 6) nontreated control. Disking involved two passes with a disk harrow, cutting to a depth of 10 to 15 cm. Glyphosate was applied using a $CO_2$-pressurized sprayer calibrated to deliver 140 L $ha^{-1}$ volume. Following these autumn treatments, the experimental area was managed uniformly. In the spring, glyphosate (1.1 kg $ha^{-1}$) was applied 3 wk prior to cotton planting. All treatments were planted to 'Deltapine DP 458 B/RR' (Delta Pine and Land Co., Scott, MS) cotton on 28 April 2003 and 'Deltapine DP 555 BG/RR' (Delta Pine and Land Co., Scott, MS) on 27 April 2004. Pendimethalin (Prowl, BASF, Research Triangle Park, NC) at 0.9 kg ai $ha^{-1}$ and fluometuron (Cotoran, Griffin LLC, Valdosta, GA) at 1.1 kg ai $ha^{-1}$ were applied to the soil surface 1 d after planting, followed by 1.3 cm of irrigation to activate the herbicides. Glyphosate (1.1 kg $ha^{-1}$) was applied postemergence (POST) prior to the 4-leaf stage of cotton and at layby.

Visual estimates of ground cover for cutleaf evening-primrose on a scale of 0 (none living) to 100% (soil surface completely covered) were evaluated 3 wk before cotton planting, just prior to glyphosate application. Weed densities were nondestructively sampled using four 0.25 $m^2$ quadrats in each plot. Data were analyzed using PROC Mixed in SAS with variances partitioned into random effects of year and replication (SAS, 2003). Weed population data were square root transformed prior to analysis of variance. Transformed treatment means were separated by Fisher's Protected $LSD_{0.05}$, but presented in their original form for clarity.

**Spring Weed Control Study.** Field studies were conducted in 2003 and 2004 at the previously described site following cotton. Treatments included three tillage systems: conventional tillage, strip tillage, and no-tillage; coupled with either an application of the amine salt of 2,4-D at 0.5 kg ae $ha^{-1}$ or no treatment. Application of 2,4-D was made to appropriate plots 6 wk prior to planting using previously described procedures. Tillage treatments were implemented approximately 4 wk after 2,4-D application. Conventional tillage consisted of two passes with a disk harrow followed by a combination in-row subsoiler (set to a depth of 45 cm) with bed-shaper. Strip tillage consisted of an in-row subsoiler and ground-driven crumblers that disturbed a 20-cm band for crop planting, leaving a 71-cm undisturbed area between crop rows. No-tillage plots were not disturbed prior to planting. Following tillage, an application of glyphosate (1.1 kg $ha^{-1}$) was made 2 wk prior to cotton planting. All treatments were planted with cotton and received pendimethalin and fluometuron preemergence (PRE) and glyphosate as previously described.

Visual estimates of cutleaf evening-primrose ground cover (rated as previously described) and height of live cutleaf evening-primrose plants were evaluated just prior to tillage treatments. Cutleaf evening-primrose plant densities were evaluated at planting, as previously described. Cotton plant height was measured just prior to harvesting and evaluating cotton yield. Data were transformed, analyzed, and presented as previously described.

## RESULTS AND DISCUSSION

**Autumn Weed Control Study.** Due to lack of treatment-by-year interactions for estimates of cutleaf evening-primrose ground cover and cudweed population densities following corn harvest, data were combined across years. There were significant treatment-by-year interactions for cutleaf evening-primrose, common chickweed [*Stellaria media* (L.) Vill.], henbit, and total weed population densities; therefore, these data were analyzed and presented by years.

Cutleaf evening-primrose population densities in the spring were affected by treatments in the previous autumn, with more consistent trends following cotton harvest than corn harvest. After corn harvest in 2003, estimates of cutleaf evening-primrose ground cover were lowest (8 to 20%) when glyphosate was applied 5 WAH, compared to the non-disturbed control (60%) (Table 1). However, with exception of two diskings, all treatments and the nontreated control had similar cutleaf evening-primrose plant densities following corn harvest in 2003. The discrepancy between ground cover ratings and plant density reflects the difference in the sizes of cutleaf evening-primrose plants. However, these trends were not present in 2004. The treatment with the lowest ground cover estimate (8%) and plant density (8 plants $m^{-2}$) in 2003 (disked 1 WAH fb glyphosate 5 WAH) had the greatest ground cover estimate (45%) in 2004. All other treatments following corn harvest in 2004 were similar in ground cover estimates, with no detectable differences among treatments in plant population density.

Following cotton harvest, all treatments reduced estimates of cutleaf evening-primrose ground cover relative to the nontreated control, with the exception of glyphosate 1 WAH (Table 2). Treatments that included disking or glyphosate at 5 WAH reduced cutleaf evening-primrose population densities relative to the nontreated control (with the exception of glyphosate 5 WAH in 2004). Treatments with only disking or glyphosate at 1 WAH had cutleaf evening-primrose population densities similar to the non-disturbed control. It appears that critical establishment of cutleaf evening-primrose in Georgia may occur at or around 5 WAH for cotton, which corresponded to the first week in November. In Georgia, approximately 46% of the cotton ha (5 yr average) was harvested by 1 November (USDA-NASS, 2008). Establishment of winter cover crops, especially cereal rye (*Secale cereale* L.), tend to have fewer cutleaf evening primrose plants than non-cover cropped areas in a field (personal observation). Although increased competition for resources (e.g., light, water, nutrients) by the rye cover crop likely hinders weed establishment, the data in the current study indicate that the physical disturbances associated with seeding rye in early November may also be critical in reducing potential cutleaf evening-primrose problems the following spring. Treatments following corn harvest, with the final treatment during the last week in September, were applied prior to cutleaf evening-primrose establishment in both years. Approximately 91% of the Georgia corn ha was harvested (5 yr average) by the final week of September (USDA-NASS, 2008).

**Table 1. The influence of autumn treatments following corn harvest on cutleaf evening-primrose ground cover and population density[z]**

| Treatment 1 WAH | Treatment 5 WAH | Ground cover 2003 | | Ground cover 2004 | | Population density 2003 | | Population density 2004[y] |
|---|---|---|---|---|---|---|---|---|
| | | % | | | | plants/$m^2$ | | |
| Disked | Non-treated | 65 | A | 19 | B | 14 | BC | 9 |
| Disked | Disked | 41 | AB | 19 | B | 22 | A | 8 |
| Disked | Glyphosate | 8 | C | 45 | A | 8 | C | 10 |
| Glyphosate | Non-treated | 69 | A | 21 | B | 18 | AB | 5 |
| Non-treated | Glyphosate | 20 | BC | 24 | B | 11 | BC | 7 |
| Non-treated | Non-treated | 60 | A | 21 | B | 14 | BC | 6 |

[z] Treatment means were transformed prior to analysis, separated using Fisher's Protected $LSD_{0.05}$, but presented in original form for clarity. Differences among treatment means within a column signify statistical differences.

[y] There were no detectable differences among treatments.

**Table 2. The effect of post-cotton harvest treatments on cutleaf evening-primrose ground cover estimates, population densities, and plant diameters[z]**

| Treatment 1 WAH | Treatment 5 WAH | Ground Cover | | Population density 2003 | | Population density 2004 | |
|---|---|---|---|---|---|---|---|
| | | --------- % --------- | | ----------------- plants $m^{-2}$ ----------------- | | | |
| Disked | Non-treated | 21 | BC | 52 | A | 32 | A |
| Disked | Disked | 3 | D | 12 | B | 2 | C |
| Disked | Glyphosate | 8 | CD | 2 | C | 4 | B |
| Glyphosate | Non-treated | 26 | AB | 56 | A | 28 | AB |
| Non-treated | Glyphosate | 9 | CD | 12 | B | 36 | A |
| Non-treated | Non-treated | 39 | A | 56 | A | 32 | A |

**[z] Treatment means were transformed prior to analysis, separated using Fisher's Protected $LSD_{0.05}$, but presented in original form for clarity. Differences among treatment means within a column signify statistical differences.**

Other winter annual weed species were affected by the autumn weed management treatments. However, following corn harvest there were no consistent trends within the treatments in terms of population densities of cudweed or total weed density (Table 3). Common chickweed population density was higher in disking 1 WAH fb 5 WAH relative to the nontreated control following corn harvest. Following cotton harvest, treatments that included disking or glyphosate at 5 WAH reduced cudweed population densities, relative to the nontreated control, similar to observations with cutleaf evening-primrose (Table 4). Disking 1 WAH fb 5 WAH following cotton harvest increased common chickweed (56 plants $m^{-2}$) and henbit (48 plants $m^{-2}$) population densities relative to the nontreated control in 2003 (16 common chickweed plants $m^{-2}$) and 2004 (21 henbit plants $m^{-2}$), respectively. These species likely filled a niche that was opened through exclusion of cutleaf evening-primrose establishment by these treatments. Autumn treatments altered weed species composition, but total weed populations remained high in all treatments (52 to 105 plants $m^{-2}$). However, the shift in weed species composition represented a change from a difficult to control winter annual species (cutleaf evening-primrose) to weeds that are readily controlled with burndown treatments that include glyphosate (Collins et al., 2010).

**Spring Weed Control Study.** There were significant treatment effects on cutleaf evening-primrose ground coverage (evaluated prior to tillage treatments), therefore data were analyzed for the effect of 2,4-D treatment across tillage treatments. Preplant applications of 2,4-D controlled cutleaf evening-primrose, leaving no live plants 4 wk after treatment (Table 5). In contrast, plots not sprayed with 2,4-D were characterized by cutleaf evening-primrose plants that provided 81% ground coverage.

**Table 3. The effect of post-corn harvest treatments on winter annual weed densities prior to cotton planting[z]**

| Treatment 1 WAH | Treatment 5 WAH | Cudweed 2003 | | Cudweed 2004 | | Common chickweed | | Total weed density 2003 | | Total weed density 2004 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ---------------------------------------- plants $m^{-2}$ ---------------------------------------- | | | | | | | | | |
| Disked | Non-treated | 8 | D | 34 | A | 9 | B | 47 | C | 66 | A |
| Disked | Disked | 24 | AB | 31 | A | 18 | A | 91 | AB | 66 | A |
| Disked | Glyphosate | 18 | BC | 27 | AB | 11 | AB | 67 | BC | 66 | A |
| Glyphosate | Non-treated | 12 | CD | 21 | BC | 8 | B | 53 | C | 50 | AB |
| Non-treated | Glyphosate | 39 | A | 15 | CD | 12 | AB | 97 | A | 47 | AB |
| Non-treated | Non-treated | 22 | BC | 12 | D | 4 | B | 66 | BC | 34 | B |

**[z] Treatment means were transformed prior to analysis, separated using Fisher's Protected $LSD_{0.05}$, but presented in original form for clarity. Differences among treatment means within a column signify statistical differences.**

**Table 4. The effect of post-cotton harvest treatments on population densities of cudweeds, common chickweed, henbit, and total weeds[z]**

| Treatment 1 WAH | Treatment 5 WAH | Cudweed | | Common chickweed 2003 | | Common chickweed 2004 | Henbit 2003 | | Henbit 2004 | | Total weed density 2003 | | Total weed density 2004 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | plants $m^{-2}$ | | | | | | | | | | | | |
| Disked | Non-treated | 27 | A | 35 | B | 16 | 0 | AB | 33 | B | 88 | A | 105 | A |
| Disked | Disked | 5 | B | 56 | A | 26 | 2 | B | 48 | A | 68 | B | 92 | AB |
| Disked | Glyphosate | 8 | B | 21 | C | 19 | 13 | A | 29 | B | 52 | C | 68 | D |
| Glyphosate | Non-treated | 24 | A | 21 | C | 21 | 2 | B | 24 | B | 84 | AB | 88 | A-C |
| Non-treated | Glyphosate | 12 | B | 17 | C | 21 | 23 | A | 25 | B | 80 | AB | 68 | CD |
| Non-treated | Non-treated | 25 | A | 16 | C | 18 | 11 | A | 21 | B | 92 | A | 80 | B-D |

[z] Treatment means were transformed prior to analysis, separated using Fisher's Protected $LSD_{0.05}$, but presented in original form for clarity. Differences among treatment means within a column signify statistical differences.

**Table 5. The effect of 2,4-D treatment as a burndown prior to cotton planting**

| Treatment | Cutleaf evening-primrose Cover[z] | Cutleaf evening-primrose Height | Cutleaf evening-primrose Conventional[y] | Cutleaf evening-primrose Strip | Cutleaf evening-primrose No-till | Cotton Height | Cotton Yield |
|---|---|---|---|---|---|---|---|
| | % | cm | plants $m^{-2}$ | | | cm | Kg $ha^{-1}$ |
| 2,4-D | 0.0 | 0.0 | 0.0 C | 6.3 B | 7.3 B | 134.0 | 1,180 |
| Non-treated | 81.0 | 33.7 | 0.5 C | 24.9 A | 25.5 A | 125.4 | 1,040 |
| F-Test | 288.0 | 805.0 | 20.26 | | | 7.37 | 8.97 |
| P-value | <0.0001 | <0.0001 | <0.0001 | | | 0.0127 | 0.0067 |

[z] Cutleaf evening-primrose ground cover estimates and plant height measurements were evaluated 4 wk after 2,4-D application.

[y] Cutleaf evening-primrose population density measurements in each of the tillage systems was evaluated at cotton planting. Treatment means separated using Fisher's Protected $LSD_{0.05}$.

All cutleaf evening-primrose were controlled by 3 wk after planting through a combination of glyphosate, fluometuron, and pendimethalin. However, in strip tillage and no-tillage systems that did not receive 2,4-D, high densities (25 cutleaf evening-primrose $m^{-2}$) of killed, but intact, plants persisted (Table 5). The presence of these killed weeds could interfere with efficient planting, hindering seed placement and/or soil-seed contact; however, cotton stand was similar among treatments (data not shown). Application of 2,4-D to both strip-tillage and no-tillage systems 4 wk before planting reduced cutleaf evening-primrose remant-plant density by greater than 70% (7 plants $m^{-2}$ or less) compared to the nontreated controls in both systems. Although there was no effect of tillage system on cotton yield, application of 2,4-D increased vegetative growth of cotton and lint yield relative to nontreated controls (Table 5). These data support previous research in Georgia and North Carolina that found this rate of 2,4-D did not reduce cotton establishment or yield (York et al., 2004).

Prior to soybean [*Glycine max* (L.) Merr.] planting, spring burndown applications of glyphosate mixed with flumioxazin, thifensulfuron, tribenuron, sulftentrazone, chlorimuron, carfentrazone, or oxyfluorfen controlled cutleaf evening-primrose less than 90% (Poston et al., 2004). However, mixtures that included 2,4-D controlled cutleaf evening-primrose greater than 90% (Poston et al., 2004). Cutleaf evening-primrose control was 98% at 7 wk after a mid-March application of 2,4-D applied alone or mixed with either paraquat or glyphosate (Wilson et al., 2004). Other studies have demonstrated that 2,4-D mixed with either glyphosate or paraquat controlled cutleaf evening-primrose at least 96% at 30 d after application (Culpepper et al., 2002). It appears that 2,4-D is an excellent option for controlling cutleaf evening-primrose prior to cotton planting. An alternative to this type of application may be the use of timely post-summer crop harvest operations aimed at disrupting the establishment of cutleaf evening-primrose plants around the first of November.

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## REFERENCES

Clewis, S.B., D.L. Jordan, J.F. Spears, and J.W. Wilcut. 2007. Influence of environmental factors on cutleaf eveningprimrose (*Oenothera laciniata*) germination, emergence, development, vegetative growth, and control. Weed Sci. 55:264–272.

Collins, G., A.S. Culpepper, D. Day, G. Harris, R.C. Kemerait, P. Roberts, D. Shurley, A. Smith, and J. Whitaker. 2010. 2010 Georgia Cotton Production Guide. University of Georgia Cooperative Extension Service, public. no. CSS-10-01. Available at:

http://commodities.caes.uga.edu/fieldcrops/cotton/2010cottonguide/2010CottonProductionGuide.pdf (verified 29 June 2010).

CTIC. 2005. (Conservation Tillage Information Center) National crop residue management survey: conservation tillage data. Available online at http://www.ctic.purdue.edu/CTIC/CRM.html (password required) (verified 2 June 2005).

Culpepper, A.S., A.C. York, and S. Carlson. 2002. Cutleaf eveningprimrose (*Oenthera laciniata*) and wild radish (*Raphanus raphanistrum*) control with burndown herbicides for conservation tillage cotton (*Gossypium hirsutum*). P.A. Dotray, ed. Proc. South. Weed Sci. Soc., 2002. Atlanta, GA.

Gitaitis, R., G. MacDonald, R. Torrance, R. Hartley, D.R. Sumner, J.D. Gay, and W.C. Johnson. 1998. Bacterial streak and bulb rot of sweet onion: II. Epiphytic survival of *Pseudomonas viridiflava* in association with multiple weed hosts. Plant Dis. 82:935–938.

Hollowell, J.E., B.B. Shew, M.A. Cubeta, and J.W. Wilcut. 2003. Weed species as hosts of *Sclerotinia minor* in peanut fields. Plant Dis. 87:197–199.

Idol, G.B., and J.E. Slosser. 2005. Spring emergence and development of the cotton fleahopper (Heteroptera : Miridae) in host plants of the Texas rolling plains. Southw. Entomol. 30:73–84.

Johnson, W.C., III, J.A. Baldwin, and B.G. Mullinix Jr. 2000. Winter fallow management of volunteer peanut (*Arachis hypogaea* L.) and cutleaf eveningprimose (*Oenthera laciniata* Hill). Peanut Sci. 27:67–70.

McPherson, R.M., R.J. Beshear, W.C. Johnson, N. Martinez-Ochoa, and M.L. Wells. 2003. Winter and early-Spring survey of thrips vectors and host plants of tomato spotted wilt tospovirus in and near a flue-cured tobacco farmscape. J. Entomol. Sci. 38:660–668.

Poston, D.H., C.H. Koger, M.A. Blaine, and B.L. Spinks. 2004. Winter weed management in early-planted soybean. P.A. Dotray, ed. Proc. South. Weed Sci. Soc., 2004. Memphis, TN.

Potter, T.L., C.C. Truman, T.C. Strickland, D.D. Bosch, and T.M. Webster. 2008. Herbicide incorporation by irrigation and tillage impact on runoff loss. J. Environ. Qual. 37:839–847.

Reynolds, D., S. Crawford, and D. Jordan. 2000. Cutleaf eveningprimrose control with preplant burndown herbicide combinations in cotton. J. Cotton Sci. 4:124–129.

SAS. 2003. SAS Procedures Guide. Version 9.1. SAS Institute, Cary, NC..

Shurley, W.D. 2006. Conservation tillage in Georgia cotton production. College of Agricultural and Environmental Sciences, University of Georgia. Pub. No. AGE-CON-06-112. Available at http://commodities.caes.uga.edu/fieldcrops/cotton/TILLAGEPUBFINAL.pdf (verified 29 June 2010).

Sudbrink, D.L., T.P. Mack, and G.W. Zehnder. 1998. Alternate host plants of cowpea curculio, (Coleoptera : Curculionidae) in Alabama. Fla. Entomol. 81:373–383.

USDA-NASS. 2008. Crop Progress: Georgia. available at http://www.nass.usda.gov/QuickStats/Create_Federal_Indv.jsp (Accessed 20 March 2009).

Webster, T.M. 2008. Weed survey—southern states: grass crop subsection. W.K. Vencill, ed. Proc. South. Weed Sci. Soc., 2008. Jacksonville, FL.

Wilcut, J.W., A.C. York, and D.L. Jordan. 1993. Weed management for reduced tillage southeastern cotton. *In*: M.R. McClelland, T.D. Valco, and R.E. Frans, eds. Conservation-tillage systems for Cotton: A Review of Research and Demonstration Results from across the Cotton Belt. Spec. Rep. 160. Arkansas Agric. Exp. Stn., Fayetteville, AR.

Wilson, D.G., Jr., A.C. York, and A.S. Culpepper. 2004. Weed control for cutleaf eveningprimrose in reduced tillage cotton. P.A. Dotray, ed. Proc. South. Weed Sci. Soc., 2004. Memphis, TN. York, A.C., A. S. Culpepper, and A.M. Stewart. 2004. Response of strip-tilled cotton to preplant applications of dicamba and 2,4-D. J. Cotton Sci. 8:213–222.