



IPM-0415

Cotton

Insect, Disease, Nematode, and
Weed Recommendations for 2023
(Some sections may not be updated.
Please see labels for potential changes.)



INSECT CONTROL (2023 UPDATES)

Maximum profits in cotton production depend on an effective and economical insect management program. To plan such a program, you must know what insects are present and the amount of damage they are doing. The “tools of technology” available in managing cotton insects are cultural practices, the selective use of insecticides, insect scouting, transgenic varieties, and beneficial arthropods. The effectiveness of these tools can be maximized when they are used by all growers over a large area. Insect management does not mean reduction of the insect population to zero but merely to below the level of economic damage.

Cultural Practices

Certain production practices can have a significant effect on insect management and thus should be evaluated by considering the overall effect of the practice. For example, cotton grown under various conservation tillage methods may increase the likelihood of cutworm problems but may reduce thrips infestations. Any practice that delays fruiting or extends the fruiting period will increase the potential for damage by a variety of insects. High plant populations, excessive nitrogen rates, late planting, and excessive or careless herbicide use can all delay or extend the fruiting period. Generally, cultural practices that promote the health, vigor, and normal maturation of the cotton crop will benefit insect management.

Beneficial Arthropods

Parasites and predators are the first line of defense against bollworms, beet armyworms, and tobacco budworms. Predators such as ants, nabids, big-eyed bugs, spiders, insidious flower bugs, green lacewings, and lady beetles are important regulators of caterpillars, particularly in early and mid season. Parasitic flies and wasps are less noticeable than are the predators, but their importance should not be underestimated. Cotton insecticides vary widely as to their toxicity toward beneficial arthropods and those characteristics should always be considered when choosing a product.

Selective Use of Insecticides

Selection of insecticides should be based on several factors; effectiveness in controlling target insects should not be the only consideration. Insects' potential to develop resistance, effects on beneficial arthropods and on other nontarget organisms, ease of application, human safety hazards, availability, and economic considerations are also important.

Apply insecticides only when the economic threshold level of the pest is reached. This can be determined only by thorough and regular scouting of the fields to obtain population densities

of both destructive and beneficial insects. The use of scouting and thresholds often reduces insecticide and application costs, lowers the amount of unnecessary insecticides in the environment, and helps maximize profits.

Insecticide Application

Proper timing and coverage of insecticide applications are extremely important. Only field scouting will enable you to time applications for best effectiveness. Good coverage using ground equipment usually involves applying 5 to 8 gallons of water per acre at 60 to 70 pounds per square inch. Keep nozzles clean and functioning correctly. Maintain appropriate boom height.

Fixed-wing aircraft used to apply insecticides should be equipped with standard nozzles or rotary atomizing devices that will deliver the majority of the insecticides in droplets within the range of 100 to 300 microns. Fly 10 feet above the crop for the most effective insecticide placement and least drift. Mix emulsifiable concentrates with water immediately before application and apply from 1 to 5 gallons of the insecticide-water mixture per acre. For mid- to late-season insect control, particularly “worms,” apply 3 to 5 gallons of total mixture per acre. Fly proper swath widths to obtain complete coverage of the field.

Insect Pests of Cotton

Boll Weevils. The boll weevil has now been eradicated from the state. Therefore, neither economic weevil numbers nor damage should exist in any fields this year. However, reinfestations may occur from non-eradicated areas of the country. If weevil infestations are observed, they should be reported immediately to the local Boll Weevil Eradication Program.

Bollworms. Both the cotton bollworm and tobacco budworm can be devastating pests of cotton. Widespread problems with insecticide resistance, especially with pyrethroids, have occurred in the state. Planting transgenic cotton or using alternative insecticides will be necessary to control high levels of budworms in most areas. Cotton bollworms are capable of damaging both transgenic and conventional cotton varieties. Caterpillars reaching 0.25 inch or longer often survive on transgenic cotton. Escaped bollworms are usually found in the blooming zone of the plant in Bollgard II and TwinLink cotton. Some caterpillars may also be found in the upper part of plants containing Widestrike technology.

During periods of moth activity, monitor fields twice weekly. In previously untreated fields, apply a recommended larvicide when you find ten small larvae per 100 plants. In previously

treated fields, apply a recommended larvicide when you find five small larvae per 100 plants.

Spider Mites. In some areas of Alabama, spider mites cause severe damage. Normally, they cause more trouble during hot, dry weather. Spider mites feed on plant juices and cause leaves to become discolored. A heavy infestation can cause complete defoliation of cotton.

Planting behind a winter cereal cover crop, as opposed to fallow ground, reduces the risk of early mite infestations. Conservation tillage acreage containing winter weeds should be burned down well in advance of planting.

If damaging populations develop, make foliar applications of a recommended miticide. Two-spotted spider mites are notorious for developing resistance, and lasting control with any product is seldom achieved before mid-July. Excellent coverage is critical to mite control.

Fall Armyworms. Fall armyworms may cause economic damage to cotton in Alabama. Fall armyworms feed on and inside squares, blooms, and bolls in a manner similar to bollworms. The eggs are laid in masses of 150 or more on the undersides of leaves that are on the lower parts of the plants. The larvae are light green or cream colored at hatching but turn darker shades of brown, black, or green as they mature. Small larvae may have a characteristic black dot above and behind the third pair of true legs. Fall armyworm larvae usually have a light colored inverted Y-shape on their heads. The fall armyworm that attacks pastures, lawns, etc. is a different strain and does not damage cotton.

Beet Armyworms. The beet armyworm is a sporadic pest of cotton. The eggs are deposited in a fuzzy mass, usually on the bottom of leaves, and are similar to the egg masses of the fall armyworm. The newly hatched larvae feed en masse, skeletonizing leaves near the old egg mass. As they mature, they disperse, eating the fruit and foliage as they do. The beet armyworm will damage blooms, squares, and small bolls and even bore into the stalk. Beet armyworm infestations often begin along field edges or in skippy stands.

The larvae vary from pale to dark olive green, have dark stripes down their backs and pale stripes down each side, and reach a maximum length of 1 inch. A characteristic black spot is located above the second pair of thoracic (true) legs. The spot is often obscured by a dark lateral line. Take care not to confuse the beet armyworm with other armyworms that often possess an evident spot on the side of the first abdominal segment.

Cabbage and Soybean Loopers. Loopers are small, greenish, looping worms with white stripes down their backs. These worms feed on leaves, causing a ragged appearance. Loopers that occur in late season in high numbers are most likely the soybean looper. Begin control when worms are small if the top bolls expected for harvest are not mature. Late-season looper infestations are seldom widespread but may defoliate all cotton in a community when they occur.

Cutworms. There are several species of cutworms that attack seedling cotton. Use control measures where cotton stands are threatened. Cotton planted into weedy fields, cotton produced under various conservation tillage systems, and cotton produced on cool cotton land soils are more susceptible to cutworm infestation.

Cotton Aphids. Aphids may be numerous in cotton fields at any time during the growing season. They are usually found on the underside of leaves, on stems, and on terminals. Curling and yellowing of leaves indicate infestation. At-planting insecticides may aid in controlling aphids early in the season. Apply additional control measures when honeydew production is heavy. Aphid populations normally crash in July due to a naturally occurring fungus.

Grasshoppers. Grasshoppers have emerged as a pest of seedling cotton in recent years, primarily in conservation tillage systems. They chew the main stem of young plants, causing a reduction in stands. Cotton is most susceptible to grasshopper injury from the time it begins to emerge in the "crook stage" until the plants have about six true leaves. Both the immature and the adult stages may cause injury. Controls are warranted when stands are threatened.

Thrips. Thrips feed on the young leaves and buds and stunt the growth of seedling cotton. A common sign of a heavy thrips infestation is distorted leaves that have turned brownish around the edges and cup upward. Early control of thrips increases yields and generally results in earlier maturity.

Plant Bugs and Fleahoppers. Plant bugs and fleahoppers migrate to cotton from weeds and various legumes. In prebloom cotton, both adults and nymphs feed on tiny squares, causing them to turn black. These insects are usually found in terminals and move quickly about the plant or fly when disturbed. Prior to bloom, make an application when sweep net samples detect 8 bugs per 100 sweeps. During the third week of squaring through bloom, treat when drop cloth samples collect 3 bugs per 5 row feet or sweep net samples detect 8 bugs per 100 sweeps. Do not allow square retention to drop below 80 percent due to plant bug feeding. Check plants by shaking terminals over a sweep net or drop cloth prior to first bloom. Sampling techniques are not adequate when the majority of the plant bug population is in the adult stage.

Plant bugs can also be a problem in blooming cotton (July-August). At this point of the season, a large portion of the plant bug population is nymphs, and large squares and young bolls are damaged in addition to the small squares. Plant bug damage to young bolls results in "hard-locking" of one or more locks per boll. Damage to large squares is revealed as "dirty blooms," which show necrotic flower parts and warty petals caused when the bugs feed on large squares.

Controlling plant bugs in blooming cotton generally is warranted when 15 to 20 percent of bolls the diameter of a quarter reveal internal plant bug damage.

Whiteflies. Whiteflies damage cotton by sucking sap from plants and by secreting honeydew on which sooty mold grows and stains the lint. Heavy whitefly feeding reduces plant vigor, causes premature defoliation, and reduces yield. All whitefly stages are found on the undersurface of cotton leaves. The tiny, white, gnat-like adults lay small eggs that hatch into immature whiteflies, which soon resemble scale insects.

Historically, the banded-wing whitefly is the species that has been present in Alabama. A new species, the silverleaf whitefly, has now been identified in many of the southern counties. It is much more difficult to control with insecticides. The adult banded-winged whitefly has faint but visible grayish zigzag bands on the wings; the silverleaf whitefly is solid white.

Stink Bugs (Various species). Three main species occur on cotton—the green stink bug, the southern green stink bug, and the brown stink bug. A new invasive species, the brown marmorated stink bug, has been found in most Alabama counties and the population is slowly increasing. Stink bugs are shield-shaped, about one-half inch long, and have sucking mouthparts.

The southern green stink bug adults are green, and the nymphal stage has white spots on the back or abdomen. The green stink bug is also green, but the nymphal stage has a striped abdomen. The brown stink bug closely resembles a predaceous stink bug, the spined soldier bug, but can be distinguished from it by the very sharply pointed “shoulders” on the spined soldier bug. Markings unique to the brown marmorated stink bug include light bands on the antennae and alternating dark bands on the thin outer edge of the abdomen. Stink bug eggs are barrel-shaped and metallic-colored and are deposited in a regular cluster on foliage. The leaf footed bug may be a part of the boll feeding bug complex, especially in the southern part of Alabama.

Stink bugs overwinter as adults in a variety of habitats, such as leaf litter, tree holes, and fields. Their primary host crops in Alabama are corn, wheat, soybeans, and peanuts. Cotton grown near corn or peanuts may be at a greater risk for stink bug infestations and damage. The egg stage lasts about four days, the nymphs develop over 33 days, and the adults live up to 58 days.

Stink bugs damage cotton by feeding on developing seeds within the bolls. Damaged bolls may or may not have a small black spot on the outside. To be certain whether bolls are damaged or not requires an internal examination. Seeds usually turn brown from their feeding and a warty growth is often present where the carpel wall was penetrated.

Stink bug damage is generally warranted when 15 to 20 percent of the quarter-sized bolls reveal damage.

Precautions and General Restrictions.

Read the label before using any insecticide to prevent misuse. When applying insecticides, change clothes at least once a day. If spray concentrates come in contact with your skin or clothing, remove the clothing immediately and wash your skin with soap and water. For field re-entry intervals, refer to the insecticide label or consult your county agent.

Restricted Use Pesticides. Your county Extension office has the necessary forms and information concerning all Restricted Use pesticides. Permits to use Restricted Use insecticides will be issued only by the State Department of Agriculture and Industries, Montgomery, Alabama.

Premixes/Combination Packages

Multiple insecticide active ingredients are being combined into single products, presumably to increase the number of pest species controlled or to address resistance issues. Premixes may be useful to insect management programs, but also may encourage the unnecessary use of some ingredients or encourage their use at less than optimum rates. Unnecessary applications or applications of reduced rates may lead to the development of insecticide resistance and flare untargeted pest species. Be sure the use of all active ingredients is warranted and that proper rates are being delivered.

Effectiveness of Insecticides and Transgenic Cotton on Target Pests

The insecticide ratings found in Tables 3 and 4 are based on research across the Cotton Belt and in field experiences by entomologists. Ratings should be considered only general guidelines for comparison purposes. Insecticide ratings assume standard rates, good timing, thorough coverage, no wash off, etc.

Table 1. Cotton Insect Control

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
BEET ARMYWORMS				
chlorantraniliprole PREVATHON 0.43 SC	14–27 oz.	0.047–0.09	21	Best results may be obtained by using rates of .065 lb. ai/ac or higher for the first application.
indoxacarb STEWARD 1.25EC	9.2–11.3 oz.	0.09–0.11	14	
methoxyfenozide INTREPID 2F	5–10 oz.	0.075–0.16	14	
spinosad BLACKHAWK	2.4–3.2 oz.	0.054–0.072	28	
methoxyfenozide + spinetoram INTREPID EDGE	5–8 oz.	0.113–0.187	28	

Table 1. Cotton Insect Control (cont.)

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
BOLLWORMS/TOBACCO BUDWORMS				
Seed				
Bt transgenic cotton BOLLGARD II BOLLGARD III TWINLINK TWINLINK PLUS WIDESTRIKE WIDESTRIKE 3				See Table 4 for activity against all caterpillar pests.
Bollworms: Larvicides				
alpha-cypermethrin FASTAC 0.83 EC	2.6–3.6 oz.	0.017–0.023	14	<i>In previously untreated fields where beneficials are present</i> , apply when ten small larvae (0.25 inch) per 100 plants are found. <i>In previously treated fields where beneficials are low or absent</i> , apply when five small larvae per 100 plants are found. Isolated problems with pyrethroid resistance have been reported throughout the eastern United States. For best results, apply pyrethroids to first and second instar larvae.
beta-cyfluthrin BAYTHROID XL 1EC Other brand names (See label.)	1.6–2.6 oz.	0.0125–0.0205	0	
bifenthrin BRIGADE 2EC Other brand names (See label.)	4–6.4 oz.	0.06–0.1	14	
chlorantraniliprole PREVATHON 0.43SC	14–27 oz.	0.047–0.09	21	
chlorantraniliprole + lambda-cyhalothrin BESIEGE	6.5–12.5 oz.	0.063–0.124	21	
cypermethrin AMMO 2.5EC Other brand names (See label.)	2–5 oz.	0.04–0.1	14	
deltamethrin DELTA GOLD 1.5 EC	1.6–2.6 oz.	0.019–0.030	21	
esfenvalerate ASANA XL 0.66EC	5.8–9.6 oz.	0.03–0.05	21	
gamma-cyhalothrin DECLARE 1.25EC Other brand names (See label.)	1.28–2.05 oz.	0.0125–0.02	21	
indoxacarb STEWARD 1.25EC	11.3 oz.	0.11	14	
lambda-cyhalothrin WARRIOR II Z 2.08CS Other brand names (See label.)	1.6–2.56 oz.	0.025–0.04	21	
methomyl LANNATE 2.4 LV	1.5–2 pt.	0.45–0.6	15	
spinosad BLACKHAWK	2.4–3.2 oz.	0.054–0.072	28	
spinetoram RADIANT 1 SC	4.25–8 oz.	0.0332–0.0625	28	
zeta-cypermethrin MUSTANG MAX 0.8EC	2.64–3.6 oz.	0.017–0.022	14	

Table 1. Cotton Insect Control (cont.)				
Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
BOLLWORMS/TOBACCO BUDWORMS (cont.)				
Tobacco Budworms: Larvicides				
chlorantraniliprole PREVATHON 0.43SC	14–27 oz.	0.047–0.09	21	<i>In previously untreated fields where beneficials are present</i> , apply when ten small larvae (0.25 inch) per 100 plants are found. <i>In previously treated fields where beneficials are absent</i> , apply when five small larvae per 100 plants are found. Tobacco budworms have proven to be more difficult to control with most insecticides (see Table 4). Minimum rates of the recommended insecticides may not be effective against larger larvae or under high pressure. Rates should be adjusted according to the size of the larvae and the level of infestation. Methomyl may be used as an ovicide to control the egg stage at rates of 0.125 to 0.25 pound active ingredient per acre.
chlorantraniliprole + lambda-cyhalothrin BESIEGE	6.5–12.5 oz.	0.063–0.124	21	
indoxacarb STEWARD 1.25EC	11.3 oz.	0.11	14	
methomyl LANNATE 2.4 LV	1.5 pt.	0.45	15	
spinosad BLACKHAWK	2.4–3.2 oz.	0.054–0.072	28	
COTTON APHIDS				
acetamiprid INTRUDER 70WP	0.6–1.1 oz.	0.025–0.05	28	Apply when leaves appear sticky. Make one application; repeat when necessary. At-planting treatments may also give effective early-season control (see Seedling Thrips). Aphids are resistant to many insecticides. Control may vary with location and time of season. Additional applications of the same chemicals are usually ineffective.
flonicamid CARBINE 50 WG	1.4–2.8 oz.	0.044–0.088	30	
imidacloprid ADMIRE PRO 4.6	1.3–1.7 oz.	0.047–0.061	14	
thiamethoxam CENTRIC 40WG	2 oz.	0.05	14	
sulfloxaflor TRANSFORM WG 50%	0.75–1 oz.	0.024–0.031	14	
CUTWORMS				
acephate ORTHENE 97	0.75 lb.	0.72	21	Apply when worms appear and stands are threatened; cover plants and surfaces of ground along rows with insecticide. Preplant or at-plant applications have been successful for high-risk fields.
alpha-cypermethrin FASTAC EC	1.3–1.9 oz.	0.008–0.012	14	
beta-cyfluthrin BAYTHROID XL 1EC	0.8–1.6 oz.	0.0065–0.125	0	
Other brand names (See label.)				
chlorpyrifos LORSBAN 4E	1 qt.	1	14	
Other brand names (See label.)				
cypermethrin AMMO 2.5EC	1.3–5 oz.	0.025–0.1	14	
Other brand names (See label.)				
deltamethrin DELTA GOLD 1.5 EC	1.1–1.6 oz.	0.013–0.019	21	
esfenvalerate ASANA SL 0.66EC	5.8 oz.	0.03	21	
gamma-cyhalothrin DECLARE 1.25EC	0.77–1.02 oz.	0.0075–0.01	21	
lambda cyhalothrin WARRIOR II Z 2.08CS	0.96–1.28 oz.	0.015–0.02	21	
Other brand names (See label.)				
zeta-cypermethrin MUSTANG MAX 0.8EC	1.3–2 oz.	0.008–0.012	14	

Table 1. Cotton Insect Control (cont.)

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
FALL ARMYWORMS				
chlorantraniliprole PREVATHON 0.43SC	14–27 oz.	0.047–0.09	21	Apply when ten or more larvae per 100 plants are found.
chlorantraniliprole + lambda-cyhalothrin BESIEGE	6.5-125. oz.	0.063-0.124	21	
indoxacarb STEWARD 1.25EC				
novaluron DIAMOND 0.83EC	9.2–11.3 oz.	0.09–0.11	14	
spinosad BLACKHAWK	6–12 oz.	0.039–0.077	30	
	2.4–3.2 oz.	0.054–0.072	28	
GRASSHOPPERS				
chlorpyrifos LORSBAN 4E Other brand names (See label.)	0.5–1.5 pt.	0.25–0.75	14	Lower rates may be used to control immature grasshoppers early in the spring (March, April). However, the highest suggested rates will be needed on the adult stage in May and June. Reinfestations may occur from field borders if the first application is made prior to planting. Under these conditions, a second application may be necessary if cotton is still younger than the sixth true leaf stage. Dimilin is an insect growth regulator and is only effective on nymphs.
dicrotophos BIDRIN 8EC	4–8 oz.	0.25–0.5	30	
diflubenzuron DIMILIN 2L	2 oz.	0.03	14	
pyrethroids	See label.			
PLANT BUGS, FLEAHOPPERS				
acephate ORTHENE 97 Other brand names (See label.)	0.45–0.75 lb.	0.43–0.73	21	Do not allow pinhead square retention to drop below 80 percent due to plant bug feeding. Prior to bloom, make an application when sweep net sampling detects 8 bugs per 100 sweeps. During the third week of squaring through bloom, treat when drop cloth samples detect 3 bugs per 5 row feet or sweep net samples collect 8 bugs per 100 sweeps. No threshold exists for percent dirty blooms, but if you find 10 to 15 percent dirty blooms, intensify scouting plant for bugs. During peak bloom and beyond, applications should be made when 15 percent of the bolls have damage and plant bugs are present. Diamond is an insect growth regulator and is only active on the immature stage of plant bugs. Use of Bidrin between pinhead square and first bloom is prohibited.
acetamiprid INTRUDER 70WP	1.1 oz.	0.05	28	
chlorpyrifos LORSBAN 4E Other brand names (See label.)	16 oz.	0.5	14	
clothianidin BELAY	3–6 fl.oz.	0.05–0.1	21	
dicrotophos BIDRIN 8EC	3.2–5.3 oz.	0.2–0.33	30	
flonicamid CARBINE	2.8 oz.	0.088	30	
imidacloprid ADMIRE PRO 4.6 Other brand names (See label.)	1.37–1.7 oz.	0.049–0.061	14	
novaluron DIAMOND 0.83EC	6–9 oz.	0.39–0.58	30	
oxamyl VYDATE C-LV 3.77	11.2–17 oz.	0.33–0.5	14	

Table 1. Cotton Insect Control (cont.)				
Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
PLANT BUGS, FLEAHOPPERS (cont.)				
pyrethroids sulfoxaflor TRANSFORM WG 50% thiamethoxam CENTRIC 40WG	See label. (See comments.) 1.5 oz.–2.25 oz. 2 oz.	See Table 3. 0.047–0.071 0.05	14 21	Research has shown that pyrethroids have not provided adequate control of plant bugs in most of north Alabama.
SEEDLING THRIPS				
Foliar Treatment				
acephate ORTHENE 97 Other brand names (See label.) dicotophos BIDRIN 8EC dimethoate 4E Other brand names (See label.) spinetoram RADIANT SC methoxyfenozide +spinetoram Intrepid Edge	3 oz. 1.6–3.2 oz. 6.4 oz. 1.5–3 oz. 3–6 oz.	0.18 0.2 0.2 0.012–0.023 0.68–0.135	21 30 14 28 28	Make one or more applications to seedling cotton (one- to four-leaf stage) when damage is evident. Foliar applications are most effective when applied to cotton near the first true leaf stage.
In-Furrow Treatment				
acephate ORTHENE 97 Other brand names (See label.) imidacloprid ADMIRE PRO 4.6 aldicarb AGLOGIC	1 lb. 7.4–9.2 oz. 3.5–5 lb.	0.97 0.266–0.33 0.33–0.53	21 21 90	Both Orthene and Admire Pro in-furrow sprays may be applied with a liquid fungicide at planting directed on or below the seed. Admire Pro rate depends on row spacing. Aldicarb is extremely toxic. Use caution when handling.
Seed Treatment				
imidacloprid GAUCHO 600 AERIS	See label.			These seed treatments are commercially applied.
SOYBEAN LOOPERS				
chlorantraniliprole PREVATHON 0.43SC indoxacarb STEWART 1.25EC methoxyfenozide INTREPID 2F spinosad BLACKHAWK methoxyfenozide + spinetoram INTREPID EDGE	20–29 oz. 6.7–9.2 oz. 5–10 oz. 2.4–3.2 oz. 5–8 oz.	0.067–0.097 0.065–0.09 0.075–0.16 0.054–0.072 0.113–0.187	21 14 14 28 28	Treat when four to five loopers per row foot are present and the top bolls expected for harvest are not mature. Populations of soybean loopers are resistant to pyrethroid insecticides.

Table 1. Cotton Insect Control (cont.)

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments	
SPIDER MITES					
abamectin AGRI-MEK 0.15EC Other brand names (See label.) AGRI-MEK 0.7SC Other brand names (See label.)	8–16 oz. 1.7–3.5 oz.	0.009–0.018 0.009–0.018	20 20	Foliar Treatment: Control of spider mites on rapidly growing cotton is difficult. Treat fields when mites are widely distributed and mottling of leaves is common. Hot, dry weather favors spider mite population increase.	
etoxazole ZEAL 2.88 SC ZEAL 72 WP	1.33–2 oz. 0.66–1 oz.	0.03–0.45 0.03–0.45	28 28		
fenpyroximate PORTAL 0.4	12–16 oz. (early season) 24–32 oz. (mid-season)	0.0375–0.05	14		
spiromesifen OBERON 2SC	8–16 oz.	0.125–0.25	30		
BROWN STINK BUGS, LEAF FOOTED BUGS					
acephate ORTHENE 97 dicotophos BIDRIN 8EC	0.75 lb. 6–8 oz.	0.72 0.375–0.5	21 10		The boll injury threshold should be adjusted up or down based on the number of susceptible bolls present. Use a 10 to 15 percent boll injury threshold during weeks 3 to 5 of bloom (numerous susceptible bolls present), 20 percent injury during weeks 2 and 6, and 30+ percent during weeks 7+ of bloom (fewer susceptible bolls present).
BROWN MARMORATED, GREEN AND SOUTHERN GREEN STINK BUGS					
Organophosphates					
acephate ORTHENE 90S ORTHENE 97 dicotophos BIDRIN 8EC	0.8 lb. 0.75 lb. 4–8 oz.	0.72 0.72 0.25–0.5	21 21 10	Use same thresholds as for brown stink bugs. Brown marmorated stink bugs can damage larger bolls than other stink bugs.	
Pyrethroids					
beta-cyfluthrin BAYTHROID XL1 Other brand names (See label.) bifenthrin BRIGADE 2EC Other brand names (See label.) cypermethrin AMMO 2.5EC Other brand names (See label.) deltamethrin DELTA GOLD 1.5 EC esfenvalerate ASANA SL 0.66EC gamma-cyhalothrin DECLARE 1.25EC lambda-cyhalothrin WARRIOR II Z 2.08CS Other brand names (See label.)	2.13–2.6 oz. 4–6.4 oz. 3.1–5 oz. 1.6–2.6 oz. 7.5–9.6 oz. 1.28–2.05 oz. 1.8–2.56 oz.	0.0166–0.0205 0.06–0.1 0.06–0.1 0.019–0.030 0.04–0.05 0.0125–0.02 0.03–0.04	0 14 14 21 21 21 21		

Table 1. Cotton Insect Control (cont.)

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
BROWN MARMORATED, GREEN AND SOUTHERN GREEN STINK BUGS (cont.)				
Pyrethroids (cont.)				
zeta-cypermethrin MUSTANG MAX 0.8EC	2.6–3.6 oz.	0.0165–0.022	14	
WESTERN FLOWER THRIPS				
acephate ORTHENE 97 Other brand names (See label.)	0.52–0.77 lb.	0.5–0.75	21	Economic thresholds are not well defined. To suppress, make two applications at 5- to 7-day intervals.
methoxyfenozide +spinetoram INTREPID EDGE	6 oz.	0.135	28	
spinetoram RADIANT	3 oz.	0.023	28	Use of an adjuvant with Radiant is recommended.
WHITEFLIES (BANDEDWING)				
acephate ORTHENE 97 Other brand names (See label.)	0.52–1 lb.	0.5–1	21	For actively growing cotton, apply when 50 percent of plant terminals have adults clustering on them. It may be necessary to apply more than once to control infestation. For mature or stressed cotton or cotton not growing, apply when honeydew or sooty mold appears on leaves, usually in late season. Make two or three applications 5 days apart.
acetamiprid INTRUDER 70WP	1.7–2.3 oz.	0.075–0.1	28	
imidacloprid ADMIRE PRO 4.6	0.9–1.7 oz.	0.032–0.061	14	
thiamethoxam CENTRIC 40WG	2 oz.	0.05	21	
WHITEFLIES (SILVERLEAF)				
acetamiprid INTRUDER 70WP	1.7–2.3 oz.	0.075–0.1	28	The insect growth regulator Knack is the most consistent treatment for management of silverleaf whiteflies. Knack has a long residual (several weeks) and is generally slow acting. When females feed on foliage treated with Knack, eggs will be sterile. Knack will control the immature stage as they pupate into adults; therefore, established nymphs will continue feeding for several days. Threshold: When 50% of sampled leaves (sample 5th expanded leaf below terminal) are infested with multiple immatures.
ASSAIL 30 SG	4.5-3 oz.	0.75-0.1	28	
STRAFER MAX 70 WP	1.7-2.3 oz	0.75-0.1	28	
buprofezin COURIER 40SC	9–12.5 oz.	0.25–0.35	14	
COURIER 3.6 SC	9–12.5 oz.	0.25–0.35	14	
dinotefuran VENOM 70WDG	1–3 oz.	0.045–0.134		
flupyradifurone SIVANTO PRIME 1.67	10.5-14 oz	0.137-0.183	14	
pyriproxfen KNACK 0.86EC	8–10 oz.	0.054–0.067	28	
spiromesifin OBERON 2	8-16 oz.	0.125-0.25	30	

Table 2. Transgenic Technology Ratings*

TRANSGENIC TECHNOLOGY	INSECTS							
	Beet Armyworm	Cotton Bollworm	Cutworm	European Corn Borer	Fall Armyworm	Loopers	Southern Armyworm	Tobacco Budworm
Bollgard**	3	2	5	1	4	5	5	1
Bollgard II	1	2	3	1	2	1–2	1	1
Bollgard III	1	1	?	1	1	1	1	1
TwinLink	1	2	3	1	1	1	1	1
TwinLink Plus	1	1	?	1	1	1	1	1
WideStrike	1	2	3	1	1–2	1	1	1
WideStrike3	1	1–2	?	1	1	1	1	1

* Ratings range from 1-5. 1 = Very Effective; 5 = Not Effective.

** Bollgard technology is no longer registered; it is listed as a reference only.

Some variation in the expression of Bt proteins can be caused by environmental conditions, time of season, and cultivar.

Table 3. Insecticide Effectiveness Ratings*

INSECTICIDES	INSECTS							
	Aphids	Beet Armyworms	Beneficial Insects**	Honey Bees***	Boll Weevils	Bollworms	Budworms	Fall Armyworms
Admire Pro	1–2	5	3	1	5	5	5	5
Altacor	5	1	4	1	5	1	1	2
Ammo	4	5	1	1	1–2	1	3	3
Asana XL	4	5	1	1	2	1	3	3
Baythroid XL	4	5	1	1	1–2	1	3	3
Belay	—	5	—	1	—	5	5	5
Bidrin	3	5	1	1	3	5	5	5
Blackhawk	5	1	5	2	5	1–2	1	1–2
Brigade	3	5	1	1	1	1	3	2
Carbine	1–2	5	3	3	5	5	5	5
Centric	1–2	5	2	1	5	5	5	5
Declare	4	5	1	1	1–2	1	3	2
Delta Gold	4	5	1	1	2	1	3	2
Diamond	5	2–3	3	3	4	4	4	2
Dimilin	5	3	5	3	4	5	5	3
Intrepid	5	1	5	3	5	3	3	2
Intruder	1	5	3	2	5	5	5	5
Karate	4	5	1	1	1–2	1	3	2
Knack	2	5	3	3	5	5	5	5
Lannate	4	3–4	3	1	5	2	2	2
Lorsban	4	2	2–3	1	3	3	4	2
Malathion	5	5	1	1	1	5	5	5
Mustang Max	4	5	1	1	1–2	1	3	2
Orthene	5	4–5	1	1	5	3	3–4	4
Prevathon	5	1	5	3	5	1	1	1
Radiant	5	5	5	2	5	—	—	—
Steward	5	1	4	1	5	2	1	2
Transform	1	5	5	1	5	5	5	5
Venom	—	5	—	1	5	5	5	5
Vydate	5	5	2	1	3	5	5	5

(continued)

*Ratings range from 1 - 5: 1 = Very Effective; 5 = Not Effective.

**A rating of 1 on beneficial insects means the chemical is very hard on beneficials; a rating of 5 indicates selectivity toward beneficials.

*****Toxicity Group 1** = Highly toxic to bees. Product contains any active ingredient with an acute LD₅₀ of 2 micrograms/bee or less.

Toxicity Group 2 = Toxic to bees. Product contains any active ingredient with an acute LD₅₀ of greater than 2 micrograms/bee but less than 11 micrograms/bee.

Toxicity Group 3 = All products not in toxicity groups 1 and 2. (No bee precautionary statement on label.)

Honey bee toxicity ratings adapted from “How to Reduce Bee Poisonings from Pesticides.” A Pacific Northwestern Extension Publication, PNW 591. Oregon State University, University of Idaho, and Washington State University.

continued

Table 3. Insecticide Effectiveness Ratings* (cont.)

INSECTICIDES	INSECTS						
	Plant Bugs**	Seedling Thrips	Soybean Loopers	Spider Mites	Stink Bugs (Brown)	Stink Bugs (Green)	Whiteflies
Abamectin	5	5	5	1	5	5	5
Admire Pro	2–3	2	5	5	4	4	2
Ammo	2–5	3	3	5	4	2	4
Asana XL	2–5	3	4	5	4	2	4
Baythroid XL	2–5	3	4	5	4	2	4
Belay	2	—	4	—	3	3	—
Bidrin	1	1	5	4	1	1	4
Blackhawk	5	5	1	5	5	5	5
Brigade	2–5	3	4	3	3	2	4
Carbine	2–3	2–3	5	5	—	—	—
Centric	2	1	5	5	2–3	2–3	2
Courier	5	5	5	5	5	5	1
Declare	2–5	3	3	5	4	2	4
Delta Gold	2–5	3	3	5	4	2	4
Diamond	2	5	2	5	2–3	2–3	5
Dimilin	5	5	4	5	5	5	5
Intrepid	5	5	1	5	5	5	5
Intruder	2–3	1–2	5	—	3	3	1–2
Karate 2.08 Z	2–5	5	4	5	4	2	4
Knack	4	3–4	5	3	4	4	1
Lannate	3	5	3	5	4	4	5
Lorsban	2	2	4	3	3	3	4
Malathion	1	4	5	5	1	1	5
Mustang Max	2–5	3	3	5	4	2	4
Orthene	1	1–2	3	5	2	2	2
Prevathon	5	—	1	—	5	5	—
Radiant	5	1	—	5	5	5	5
Steward	3	5	1	5	3	3	5
Transform	1	?	5	5	5	4	3
Venom	—	—	5	—	5	5	1
Vydate	3	3	5	5	2	2–3	4
Warrior II Z	2–5	5	4	5	4	2	4

*Ratings range from 1–5: 1 = Very Effective; 5 = Not Effective.

**Pyrethroids have not been effective in controlling plant bugs in most of north Alabama.

Insect control section prepared by **Ronald H. Smith**, Professor Emeritus; **Scott H. Graham**, *Extension Entomologist*, Assistant Professor; and **Alana Jacobson**, Research Entomologist, Associate Professor, all in Entomology and Plant Pathology, Auburn University.

DISEASE CONTROL (2023 UPDATES)

Control of Cotton Seedling Disease

Seedling disease is one of the major problems on cotton in Alabama. Losses range from less than 1 percent in some years up to 20 percent in others, depending on such factors as the condition of the soil at planting, seed quality, seed treatment, chemicals, nematode and insect populations, and climatic conditions. These adverse factors favor seedling disease by retarding seed germination and seedling growth and allowing fungal pathogens to overcome the plant's defenses. Vigorous, fast-growing seedlings can usually outgrow damage resulting from invasion by fungi. Planting too early in cold, wet soils is probably the one factor that is most responsible for making seedlings susceptible to seedling diseases.

In Alabama, the fungi most often implicated in seedling disease are *Rhizoctonia solani*, *Pythium* spp., *Fusarium* spp., and *Thielaviopsis basicola*. These fungi, along with several other pathogens of minor importance, usually attack cotton at any time during the first 6 to 8 weeks after planting.

For ease of identification, cotton seedling diseases are placed into the following three categories.

Seed Rot. *Pythium* and *Fusarium* attack cotton seed before or during germination, causing a soft, watery decay. These fungi spread rapidly from seed to seed.

Preemergence Damping-Off. This stage occurs between seed germination and emergence of seedlings from the soil. The newly formed root or stem may become infected, causing the seedlings to die before they emerge from the soil.

Seedling Root Rots and Postemergence Damping-Off. Symptoms occur on the root or hypocotyl after the seedlings have emerged from the soil. Plants may first appear stunted and light green, and as the disease progresses, plants will wilt and die. A close examination of the affected seedlings will reveal varying symptoms depending upon the organisms involved in the disease.

Fusarium and *Thielaviopsis* cause a dry, dark rot that progresses up the root into the stem. *Pythium* is characterized by a light, soft, watery decay of the tap root and is particularly severe in cool, wet weather. *Rhizoctonia* usually attacks the plant at soil level, causing reddish brown lesions (soreshin). It eventually moves into the stem tissue, giving the stem a "wirestem" appearance. In the advanced stage, stems fall over and die, leaving an uneven stand.

Seedling Disease Control Recommendations

The incidence of seedling disease can be reduced by the following practices.

Plant on Well-Prepared Seedbeds and in Well-Drained Soils. Wet soils favor the growth of many soil fungi and retard or slow the growth of cotton seedlings.

Plant in Warm Soil. Plant when the soil temperature at a 4-inch depth remains at least 65°F for three consecutive mornings. AVOID planting when soil temperatures are expected to drop below 50°F at anytime one week following planting. Germinating seed are extremely susceptible to chill injury, which occurs below 50°F, and may be killed outright or badly damaged. Remember, the warmer the soils, the less chance for seedling disease.

Lime Acid Soils. Apply lime as recommended by the Soil Testing Laboratory. Acid soil favors the development of seedling disease by restricting seedling growth and favoring the development of seedling disease-inciting fungi in the soil.

Avoid Chemical or Mechanical Injury. Excessive rates of herbicides, fertilizers, insecticides, or fungicides applied in the drill area can injure seedlings, making them more susceptible to seedling disease. Using high rates of dinitroaniline herbicides or incorporating them too deeply can inhibit root growth and increase seedling disease.

Plant High-Quality Seed. Poor-quality seed usually produces low-vigor seedlings which are more susceptible to attack by fungi that can cause seedling disease. Plant seed with a minimum of 80-percent germination.

Plant Only Treated Seed. Seed treatment will kill most fungal pathogens on the seed coat and protect the seed during germination (see Seed Treatment, below).

Use Soil Fungicides at Planting Time. These fungicides give added protection in areas where there is a history of seedling disease (see Soil Treatment, below).

Chemical Controls

Seed Treatment. Two or more fungicides must be applied to cotton seed in order to control the fungi species in the soil that cause seedling disease. For example, PCNB, Thiram, or Vitavax are active against *Rhizoctonia solani* and *Fusarium* spp. but not against *Pythium* spp., whereas Metalzyl®, Anchor®, and Apron XL® are primarily active against *Pythium* spp., Acceleron®, and Dividend® are active against a wide range of soilborne diseases.

Soil Treatment. Soil treatment is not intended to replace seed treatment; it is used as a supplement.

In-the-furrow granules provide additional protection against pathogenic fungi in the soil as seedlings develop. They can be applied with granular applicators, thus eliminating the need for additional spray equipment and water. For the most effective control with granular fungicides, proper granule placement and soil incorporation at the correct rates are necessary. Granular formulations may also contain a systemic insecticide to provide control against many early-season insects.

In-the-furrow sprays provide excellent protection in the zone around seed. For best results, apply fungicide through two flat fan type nozzle tips adjusted parallel to rows.

A minimum spray volume of 5 gallons per acre is required to give adequate coverage in the furrow. Mount the nozzle just behind the seed-drop tube to treat the soil immediately surrounding the seed.

Table 4. In-Furrow Fungicide Treatments for Cotton Seedling Disease Control

Fungicide and Formulation	Rate Per 1000 Row Feet	Comments
<i>Consult product guides and labels before applying fungicides and for plantback restrictions. Not all fungicides and formulations are listed due to space constraints.</i>		
azoxystrobin AFRAME AZOXY 2SC AZOXYSTROBIN SC DEXTER SC QUADRI FLOWABLE	0.4-0.8 fl.oz.	At-plant in-furrow spray for control of <i>Rhizoctonia</i> and <i>Pythium</i> seedling blight. Apply 3 to 7 gallons of water at planting and direct spray into the seed furrow before seed is covered. Use higher rate, particularly on early cotton when conditions favor disease.
azoxystrobin + benzovindiflupyr ELATUS	5-7.3 fl.oz. per acre	For early post emergent protection from <i>Rhizoctonia</i> damping off, apply in a 3- to 7-inch band over the top of the seedlings.
azoxystrobin + mefenoxam UNIFORM	0.32-0.48 fl.oz.	At-plant in-furrow spray for control of <i>Rhizoctonia</i> and <i>Pythium</i> seedling blight. Apply in 5 to 15 gallons of water at planting and direct spray into the seed furrow before seed is covered. Use higher rate when conditions favor disease development.
etridiazole TERRAMASTER 4EC	4-8 fl.oz.	Apply in 5 to 15 gallons of water over seed in open furrow at planting for control of <i>Pythium</i> seed rot and seedling blight. Listed rate is for 40-inch rows.
fluxapyroxad + pyraclostrobin PRIAXOR XEMIIUM	0.1-0.6 fl.oz.	Apply in-furrow or as a directed banded application over the seed furrow for control of <i>Rhizoctonia</i> seed and seedling rot, as well as suppression of Fusarium seed and seedling rot, and <i>Pythium</i> damping off.
mefenoxam RIDOMIL GOLD GR RIDOMIL GOLD SL	1.5-3 oz. 0.075-0.15 fl.oz.	Apply at-plant in-furrow for control of <i>Pythium</i> seedling blight. Mount application tubes so the granules are mixed with the soil covering the seeds. Apply at-plant in-furrow for control of <i>Pythium</i> seedling blight. Apply in water or fertilizer at planting. Direct spray over the seed in open furrow before seed are covered.
prothioconazole PROLINE 480SC	0.4-0.5 fl.oz.	For control of damping off caused by <i>Rhizoctonia solani</i> and Fusarium wilt. Application rate for 36-inch row spacing. May be applied in-furrow over seed or as a directed banded foliar application over emerging seedlings. Do not make more than two applications per year of Proline 480SC at rates above 0.4 fluid ounces (5.7 fl.oz./A).

Table 5. Fungicide Treatments for Leaf Spots and Boll Rots

Fungicide and Formulation	Rate Per Acre	Comments
<i>Consult product guides and labels before applying fungicides and for plantback restrictions. Not all fungicides and formulations are listed due to space constraints.</i>		
azoxystrobin AFRAME AZOXY 2SC AZOXYSTROBIN SC DEXTER SC QUADRI FLOWABLE	6-9 fl.oz.	For control of areolate mildew, <i>Anthracnose</i> , and <i>Ascochyta</i> blight and boll rot, hard lock, and Target spot (<i>Corynespora</i> leaf spot). Apply no earlier than early bloom or at early stages of disease development and repeat after 14 to 21 days as needed to control disease. Do not make more than two consecutive applications of Quadris Flowable or other Group 11 fungicides. See label for additional information concerning resistance management for strobilurin (Qol or Group 11) fungicides. Do not make more than three applications of Quadris or other Group 11 fungicides per acre per year.
azoxystrobin + difenconazole AMISTAR TOP	8-11.6 fl. oz.	For control of areolate mildew, boll rots, hardlock, leaf spots and blights, and target spot, make the first application at approximately first bloom or when conditions are conducive for disease development. For best control of target spot, adjust the GPA to ensure coverage of upper and lower leaves. Subsequent applications may be made on a 14- to 21-day interval. Do not apply more than two sequential applications of Amistar Top before alternating to another fungicide with a different mode of action. Apply by ground, air, or chemigation. See label for additional use restrictions.

Table 5. Fungicide Treatments for Leaf Spots and Boll Rots (cont.)

Fungicide and Formulation	Rate per Acre	Comments
<i>Consult product guides and labels before applying fungicides and for plantback restrictions. Not all fungicides and formulations are listed due to space constraints.</i>		
azoxystrobin + flutriafol TOPGUARD EQ	5-7 fl.oz.	For control of areolate mildew, Ascochyta blight, Cercospora leaf spot, boll rot, Stemphyllium leaf spot, and target spot. Make first application as when conditions favor disease development around first bloom. Make second application 14 to 21 days later depending on weather conditions. Do not exceed 3 foliar applications per year.
azoxystrobin + benzovindiflupyr ELATUS	5-7.3 fl.oz.	For target spot control, apply at first sign of disease or when conditions favor disease. Repeat as needed at least 14 days later with a nonionic or COC surfactant. May be applied by air, ground, or chemigation. Use sufficient water to obtain full coverage. Make no more than two applications of Elatus per crop.
flutriafol TOPGUARD	7-14 fl.oz.	Apply at first bloom in a minimum of 10 gallons of spray volume when applied by air or with ground equipment and repeat as needed 7- to 14-days later to control target spot, areolate mildew, Ascochyta blight, and Cercospora leaf spot. Make no more than two applications of Topguard per year.
fluxapyroxad + pyraclostrobin PRIAXOR XEMIMUM	4-8 fl.oz.	Apply prior to disease development and repeat as needed after 7 to 14 days. Make no more than 2 consecutive applications of Priaxor for control of Alternaria leaf spot and boll rot, areolate mildew, Ascochyta blight, Cercospora leaf spot, Stemphyllium leaf spot, and target spot before rotating to a non-Group 7 or Group 11 fungicide. Do not apply more than 24 fluid ounces of Priaxor Xemium per year.
mefenflufenconazole + pyraclostrobin + fluxapyroxad REVYTEK	8.0-15.0 fl.oz.	For control of areolate mildew and target spot. Do not make more than 2 sequential applications of Revytek before alternating to a labeled non-group 3, 7, or 11 fungicide. See cotton use labeling for all application instructions and restrictions.
prothioconazole PROLINE 480SC	5.0-5.7 fl.oz.	For control of target spot. Apply as a preventive foliar spray before disease symptoms appear on the leaves or stems and repeat after 14 days when conditions remain favorable for disease development. Do not exceed 17.1 fluid ounces of Proline 480SC per year.
prothioconazole + fluopyram PROPULSE	8.5-13.6 fl.oz.	Apply at first sign of target spot, Ascochyta blight, or Cercospora leaf spot, and repeat at a 14-day interval if favorable conditions for diseases development persist. Do not make more than 2 applications per year.
prothioconazole + trifloxystrobin DELARO 325SC	8.0-12.0 fl.oz.	Apply when target spot or rust appears and repeat at 14-day intervals if favorable conditions for disease development persist. Apply by ground, air, or chemigation. See label for additional use restrictions.
pydiflumetofen + difenoconazole MIRAVIS TOP	13.6 fl.oz.	For control of Alternaria leafspot, Areolate mildew, Ascochyta blight, boll rot, hardlock, leaf spot diseases, and target spot. For target spot, make first application at first bloom and repeat as needed after 14- to 21-day intervals. Do not make more than two (2) consecutive applications of Miravis Top. Apply by ground, air, or chemigation. See label for additional use restrictions.
pyraclostrobin HEADLINE HEADLINE SC	6-12 fl.oz.	For control of leaf spot and boll rot disease caused by <i>Alternaria</i> , <i>Ascochyta</i> (blight), <i>Cercospora</i> , <i>Corynespora</i> , <i>Fusarium</i> (hard lock), <i>Glomerella</i> (anthracnose), and <i>Phoma</i> . Begin applications prior to or at early stage of disease development and repeat after 7 to 14 days if conditions favor disease. Make no more than two consecutive applications of Headline. See label for additional information concerning resistance management with Qol fungicides.
pyraclostrobin + metconazole TWINLINE	7-8.5 fl.oz.	For control of leaf spot and boll rot disease caused by <i>Alternaria</i> , <i>Ascochyta</i> (blight), <i>Cercospora</i> , <i>Corynespora</i> , <i>Fusarium</i> , <i>Glomerella</i> (anthracnose), and <i>Phoma</i> . Apply before disease development and continue applications on a 7- to 14-day schedule as needed to control disease. Do not make more than two consecutive applications of Twinline before alternating to another fungicide with a different mode of action. A total of three Twinline applications may be made per year. See label for additional use restrictions.

NEMATODE CONTROL (2023 UPDATES)

Nematodes are microscopic worm-like animals that live in the soil. Most are harmless and feed only on dead organic matter, but a few feed on plant roots. Several of these plant parasitic nematodes attack cotton, causing serious yield reductions.

The cotton root-knot nematode (*Meloidogyne incognita*) and the reniform nematode (*Rotylenchulus reniformis*) are the most widespread and damaging nematodes on cotton.

Damage

Nematodes damage cotton by feeding on the roots and by breaking the cotton's resistance to Fusarium wilt. Nematodes feeding on the plant's roots impair its ability to take up water and nutrients from the soil. The plant becomes stunted and generally unthrifty. As a result of the nematodes' feeding activities, disease-causing bacteria and fungi enter through the wounds.

On cotton, seedling diseases, root rots, as well as Fusarium wilt are increased by nematode activity. Fusarium wilt, a soil-borne disease, can overcome Fusarium wilt-resistant cotton varieties by entering roots through nematode feeding wounds. Once the fungus is inside, it can rapidly plug the vascular system, stop the movement of water and, consequently, cause the plant to wilt and die.

Symptoms

Nematode symptoms can appear early in the season on young plants. Infected seedlings may be severely stunted and may occasionally die. Usually, symptoms do not appear until the middle of June or July as cotton begins to mature.

The first signs of root-knot or reniform nematode damage in newly infested fields appear as stunted cotton in localized spots in the field. These spots may comprise just a few plants or may cover an acre. In most fields with established reniform nematode populations, damage occurs generally throughout the field. As the season progresses, nematode-infested cotton will mature later than healthy cotton. If Fusarium wilt is in the field, cotton plants will turn yellow, wilt, and possibly die.

Roots of a nematode-infested plant are usually stubby and sparse and often rotted. If root-knot nematodes are present, small swellings or galls can be seen on the lateral roots.

A soil sample for nematode analysis should be taken from nematode-suspected fields for positive diagnosis. Take soil samples from around the plant's root zone, place in a plastic bag, and store in a cool place until they can be sent to the Auburn University Nematode Diagnostic Laboratory.

Control

Nematodes can be controlled most effectively by a combination of the following recommended control measures.

Rotate Crops. Crop rotation is a good cultural practice to follow, not only to control cotton diseases and nematodes but also to minimize weed problems and to avoid buildup of certain herbicides in the soil. Plant crops such as peanuts, small grains, millet, sudangrass, sorghum, pasture grasses, and some vetch varieties. The cotton root-knot nematode cannot reproduce on these crops, so its population can be effectively lowered.

Corn is an excellent host for cotton root-knot nematodes and should be avoided as a rotational crop in fields where root-knot is or could be a problem. Planting peanut, some soybean varieties, grasses, or grain sorghum or leaving the land fallow can effectively lower root-knot nematode populations.

In cotton fields where reniform nematodes are a problem, rotating with non-host crops such as grain sorghum, corn, small grains, and peanut will reduce populations.

Plant Resistant Varieties. Root-knot nematodes will predispose cotton to Fusarium wilt, so plant resistant varieties in fields that are known to be infested with root-knot nematodes or with a history of Fusarium wilt. Several commercial cotton varieties have acceptable tolerance to root-knot nematodes and are resistant to Fusarium wilt.

Plow up Cotton Stalks. Immediately after picking cotton, disk and plow the field. This practice reduces nematode populations by exposing them to the drying action of the sun and by depriving them of a food source. If erosion becomes a problem, plant a cover crop of rye. Avoid other legume-type crops because they will maintain the root-knot nematode populations.

Subsoil. Subsoiling under the row has been effective in reducing cotton damage caused by nematodes. It allows cotton roots to penetrate the subsoil more easily, thus compensating for much of the injury caused by nematodes.

Use Nematicides. Nematicides can be an effective way to reduce nematode damage to cotton when they are used with other recommended cultural practices.

Telone, a fumigant, must be injected 14 days prior to planting into well-prepared soils free of undercomposed organic matter and dirt clods. Aeris and Avicta are reported to be effective against low populations of reniform nematodes. Avicta, AgLogic 15G, and Aeris also have activity against early season insects while Telone II is only active against nematodes.

Table 6. Cotton Nematode Control

Nematodes	Amount of Formulation per Acre (38-Inch Row)	Nematode Population Level	Comments
ROOT-KNOT, RENIFORM			
1,3 dichloropropene TELONE II (Fumigant)	3-6 gal.	High	Preplant fumigation: Inject with one chisel per row to a final planting depth of at least 14 inches. Seal injection furrow with cultipacker or bedding equipment. Wait 7 days before planting. Rate based on 38-inch row spacing.
abamectin + thiamethoram AVICTA DUO COTTON (Seed treatment)	See label.	Low to moderate	Available only in Avicta Complete Pak with Dynasty CST. Applied only by Delta and Pine Land, and selected retailers.
aldicarb AGLOGIC ALDICARB 15G	3.5-7 lb.	Low to moderate	At-plant: Apply granules in the seed furrow and immediately cover with 1 inch or more of soil. Per 1000 square feet rate is 4.5 to 8.5 ounces per 1000 foot of row. Side-dress: Apply from 3 weeks of planting to first squaring in a furrow that is 6 to 10 inches to one or both sides of the row and 2 to 3 inches in depth. Immediately cover the soil by closing the furrow.
clothianidin + <i>Bacillus Firmimus</i> I-1582 PONCHO VOTiVO (Seed treatment)	2.4 fl.oz.	Low to moderate	Delinted cotton seed only. Available on DPL cotton seed.
fluopyram VELUM	5-6.84 fl.oz.	Low to moderate	Apply as an in-furrow spray during planting directed on or below seed or via chemigation into root-zone through low-pressure drip or trickle irrigation. Also suppresses Fusarium wilt. Do not apply more than 13.7 fluid ounces of Velum per acre per year.
imidacloprid + thiocarb AERIS (Seed treatment)	25.6 fl.oz./100 lb. seed	Low to moderate	Available through Stoneville, FiberMax, and Delta and Pine Land. Used in combination with Gaucho Grande.
oxamyl VYDATE C-LV	17 fl.oz. 8.5-17 fl.oz.	Low to moderate	Apply after planting to suppress reniform, root knot, and lance nematodes following the planting of nematicide-treated cotton seed or use of a soil fumigant or contact nematicide. Band or broadcast in the first through seventh true leaf stage. Reapply as needed 4 days after first application of Vydate C-LV. Apply following the application of a preplant or at-plant granular nematicide. Band or broadcast at the second to fifth true leaf stage and repeat 10 to 14 days later. Apply in sufficient water to cover foliage. Rates listed are for broadcast applications, so reduce rates accordingly for banded applications. See label for use restrictions and application guidelines.

Disease and Nematode Control section prepared by **Amanda Strayer-Scherer**, *Extension Plant Pathologist*, Assistant Professor, Entomology and Plant Pathology; **Edward J. Sikora**, *Extension Plant Pathologist*, Professor, Entomology and Plant Pathology; **Kathy S. Lawrence**, Plant Pathologist, Associate Professor, Entomology and Plant Pathology; and **Steve Brown**, *Extension Agronomist*, Assistant Professor, Crop, Soil, and Environmental Sciences, all with Auburn University.

WEED CONTROL (This section has not been updated for 2023. Please refer to labels for potential changes.)

Starting your cotton in a clean, weed-free field will be one of the keys to a successful crop whether growing conventional or no-till. An early preplant burndown with a residual herbicide will be essential to getting your cotton off to a good start. A combination of glyphosate plus Sharpen has provided the most consistent horseweed control. It must, however, be applied 42 days prior to planting. Glyphosate plus 2,4-D or dicamba tank-mixed with Valor in burndown has been giving consistent performance to control glyphosate-resistant pigweed, morningglory, cutleaf eveningprimrose, wild radish, sicklepod, and grass weeds.

Include a preemergence herbicide or combo to provide residual weed control. Postemergence applications must be timely, and a tank-mix of postemergence herbicides with Warrant, Dual Magnum, or Outlook will significantly improve pigweed, grass, and broadleaf control. Staple and Envoke can provide postemergence over-the-top (POST) broadleaf weed and nutsedge control after cotton reaches the 5 true leaf stage; however, they will not control ALS-resistant Palmer amaranth. Liberty Link, Xtend, and Enlist cotton are good options for fields infested with Palmer amaranth. Be sure to include residuals and other modes of action in these varieties.

Post-directed and Layby treatments may be applied in cotton that is greater than 12 inches tall where bark has formed on the cotton plant (Gramoxone, Aim, Liberty, Caparol, Cotoran, Direx, Layby Pro, Suprend, Valor, Zidua, etc.). With layby applications, generally higher applications rates are used. Spray drift from hood sprayer needs to be carefully managed to avoid cotton foliage burn. Prevent large pigweed from setting seeds before cotton harvest; hand pulling is usually needed in this case.

A weed management system in cotton may include the following:

- Preplant burndown
- Preemergence within 3 days after planting
- Postemergence with a residual herbicide
- Post-directed and layby treatments
- Preharvest defoliation and handweeding
- Cover crops, cultivation, crop rotation, and necessary tillage

REI: Re-entry interval

PHI: Pre-harvest interval

Table 7. Recommendation Guide

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
BURNDOWN								
Envoke	trifloxysulfuron	12 hr./ 60 d	0.1 oz.	0.005 lb. a.i.	2	Use as a fall- burndown (after November 15) or a minimum of 90 days before planting.	Many broadleaf weeds including horseweed and henbit.	Add a nonionic surfactant at 0.25% v/v. Do not exceed 0.4 oz. per acre of Envoke from all applications in one season. See label for tank- mix options. Apply malathion- containing insecticides at least 24 hours before or after Envoke. Do not tank-mix with graminicides.
Firstshot SG	thifensulfuron + tribenuron	12 hr./N/A	0.5–0.8 oz.	0.25–0.4 lb. a.i..	2	After weed emergence but 14 days prior to planting.	Postemergence control of broadleaf weeds such as buttercup, chickweed, curly dock, and henbit.	Apply to young, actively growing weeds. Full control will take approximately 13 weeks following application. A nonionic surfactant at 0.25% v/v or a crop oil concentrate at 1% v/v is necessary. See label for tank-mix partners and crop rotation intervals.
Various	glyphosate 4 hr./N/A	4 hr./N/A	32–48 fl.oz. (3 lb. ae) 24-35 fl.oz. (4.17 ae) 22-32 fl oz (4.5 lb ae)	0.75-1.13 lb ae	9	Apply prior to planting.	Most annual grasses and broadleaf weeds. Does not adequately control eveningprimrose or horseweed.	Adjuvant recommendations varies by glyphosate brand. See label for tank- mixing partners. Tank-mixes must follow the most- restrictive REI/PHIs. Use lower rate on smaller, easy to kill weeds; increase rate with larger weeds and perennials.
Various	2, 4-D amine	48 hr./ N/A	1–2 pt. of 4 lb./gal.	0.5–1.0 lb.	4	Apply 2,4-D before cotton planting. Most brands of 2,4-D may be applied at least 30 days ahead of cotton planting.	Broadleaf weeds	Higher 2,4-D rates (1.5-2 pt/A) provide better control of glyphosate-resistant horseweed, pigweed and cutleaf evening primrose. May not control Carolina geranium. DO NOT drift on cotton that are sensitive to 2,4-D. Can be tank mixed with glyphosate, glufosinate and other residual herbicides.
Aim	carfentrazone-ethyl	12 hr./7d	0.5–1 fl.oz.	0.008–0.016 lb. a.i.	14	Apply prior to planting.	Broadleaf weeds	Does not provide any residual weed control. Will control morninglory, small Palmer amaranth, small tropical spiderwort and small volunteer cotton.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
BURNDOWN (cont.)								
Clarity, Sterling blue, etc.	DGA dicamba	24 hr./N/A	8-12 fl oz	0.25-0.375 lb	4	Apply prior to planting at least 21 days prior to planting and following 1 inch of rainfall or irrigation.	Broadleaf weeds	Adding a residual herbicide such as Valor, Cotoran, Caparol, or Direx will enhance control of horseweed. See label for specific application instructions and tank-mixing partners. Can be tank mixed with glyphosate and glufosinate to increase weed control efficacy and spectrum.
Reflex	fomesafen	24 hr./ 70 d	1-1.5 pt	0.24-0.38 lb.	14	Apply as a preplant burndown no later than 14 days days prior to planting and 1 inch of rainfall must occur prior to planting.	Broadleaf weeds, nutsedge and some grasses	Apply as a preemergence application to coarse- textured soils only. Apply as a preplant surface application to medium or fine-textured soils up to 21 days prior to planting cotton. At least 0.5 inch of rainfall must occur before planting and plant cotton at least 0.75 inches. See label for tank-mix partners and adjuvant requirements. Very effective on Palmer amaranth but not PPO - resistant type
Sharpen	salfufenacil	12 hr./0 d	1 fl.oz.	0.02 lb.	14	Apply as a preplant burndown no later than 42 days prior to planting and 1 inch of rainfall or irrigation.	Most annual grasses and broadleaf weeds. Excellent glyphosate- resistant horseweed control.	DO NOT apply to coarse soils classified as sand with less than 1.5% organic matter or cotton injury may occur. Do not apply Sharpen with other Group 14 herbicides as a tank-mix or sequential application within 30 days of planting. See label for recommended adjuvants. DO NOT apply more than 2 fl oz per acre per season. Very effective on horseweed/marestail.
Valor SX	flumioxazin	12 hr./ 60 d	2 oz.	0.06lb.	14	Less than 30% ground cover: 28 days prior to planting if strip till is done before application, 7 days prior to planting if strip till is done after application. More than 30% ground cover: 21 days prior to planting if strip till is done before application, 7 days prior to planting if strip till is done after application.	Mainly broadleaf weeds, some grass and nutsedge suppression. Will not control emerged horseweed/ marestail.	DO NOT apply more than 2 oz. per application or 4 oz. per acre per season. DO NOT tank mix with Sharpen or Reflex or use Reflex as PRE in Valor-treated fields as injury may likely occur. Can be tank mixed with Roundup, dicamba, 2,4-D and Gramoxone. Extensive cleaning with Valor tank cleaning agent is required before sprayer can be used to spray over the top of cotton. Valor EZ formulation delivers similar amount of active ingredient per oz. as Valor SX formulation.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
BURNDOWN (cont.)								
Gramoxone SL 2.0/3.0	paraquat	24 hr./ 48 d	2–3 pt.	0.5–1.125 lb.	22	Apply prior to planting before crop emerges.	Annual broadleaf weeds and grasses.	Use a nonionic or oil-based surfactant and apply in 15-20 gallons of spray per acre. Use the higher rate for harder-to-kill weeds Complete coverage is essential for good weed desiccation. See label for specific application instructions and tank-mixing partners Better control of chickweed, henbit, purple deadnettle, and cutleaf eveningprimrose than glyphosate.
Liberty 280 SL	glufosinate-sodium	12 hr./ 70 d	29–43 fl oz	0.53–0.79 lb.	10	Apply prior to planting. Weeds should not exceed 3 to 6 inches.	Annual broadleaf, grasses, and nutsedge. Excellent control of morningglory, pigweed, and horseweed/ marestail less than 6 inches tall.	Apply in a minimum of 15 gallons per acre in medium size spray droplets. Application should be made 1.5-2 hr after sunrise until 2 hr before sunset. Weed control is improved with addition of 1.5-3 lb/A of ammonium sulfate under tough environmental conditions. Apply Liberty under bright sunlight, high humidity and warmer temperature. Crop oil adjuvant is not recommended with Liberty due to crop injury concern. DO NOT mix Liberty with dicamba or graminicides. Maximum use rate per season per acre is either 72 or 87 fl oz, depending on the highest application rate used.
Shredder LV4 and various	2,4-D amine	48hr/NA	8–16 oz	0.24–0.475 lb. ae	4	Apply prior 21 days prior to planting with 1 inch of rainfall or irrigation	Broadleaf weeds	Improves control of broadleaf weeds such as pigweed, sicklepod, wild radish, cutleaf eveningprimrose, chickweed, etc. Tank mix with Roundup, Gramoxone and Liberty along with a residual herbicide. Be aware of spray drift and sensitive crops during application. Surfactant is needed.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
BURNDOWN (cont.)								
Leadoff	rimsulfuron + thifensulfuron	4hr/NA	1.5 oz–2 oz	0.5–0.67 oz.	2	Apply at least 30 days prior to planting at 1.5 oz/A rate, at least 60 days before planting at 1.5-2 oz/A rate	Broadleaf weeds and grass suppression	Requiring surfactant such as crop oil concentration, methylated seed oil or nonionic surfactant. Tank mixing with Roundup, Liberty, 2,4-D or dicamba is recommended. Maximum use rate for cotton is 2 oz per acre. DO NOT apply to coarse textured sils with less than 1% organic matter. DO NO spray with high pH water or tank mix as rapid herbicide degradation will occur in tank
Prowl H2O	pendimethalin	24 hr./ 60 d	1.0–2.0 pts. (coarse) 2.0–3.0 pts (medium) 3.0–4.0 pt. (fine)	0.475–0.95 lb. (coarse) 0.95–1.43 lb. (medium) 1.43–1.9 lb. (fine)	3	Apply preplant incorporated (PPI) within 60 days of planting and incorporate or preplant within 15 days of planting.	Annual grasses and small-seeded broadleaf weeds.	Incorporate within 7 days of application if rainfall does not occur.
PREPLANT INCORPORATED								
Treflan	trifluralin	12 hr./ 90 d	1.0 pt. (coarse) 1.5 pt. (medium) 2.0 pt. (fine)	0.5 lb. (coarse) 0.75 lb. (medium) 1.0 lb. (fine)	3	Apply preplant incorporated (PPI) within 90 days of planting and incorporate.	Annual grasses and some small-seeded broadleaf weeds.	DO NOT apply to wet soils or soils subject to prolonged flooding.
PREEMERGENCE								
Brake	fluridone	48hr/NA	16-32 oz			Apply within 36 hours after planting and preplant up to 14 days prior to planting	Broadleaf weeds and grasses	If applying less than 21 oz per acre, another residual herbicide must be tank mixed with Brake. A minimum of 0.5 inch rainfall or irrigation is required to activate the herbicide. DO NOT apply more than 32 fl oz per acre per year. DO NOT apply this product to the same field more than two years in a row. Very effective at controlling Palmer amaranth including PPO-resistant type. Effective during wet growing season and when applied on cover crop residues

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
PREEMERGENCE (cont.)								
Command 3ME	clomazone	12 hr./ 65 d	1.33–2.67 pt.	0.5–1.0 lb.	13	Apply within 24 hours after planting	Annual grasses and broadleaf weeds	DO NOT apply unless either disulfoton or phorate organophosphate insecticide is applied in-furrow with the seed at planting time at a minimum of 0.75 lb. a.i./acre.
Cotoran	fluometuron	24 hr./ 60 d	2 pt. (coarse) 3 pt. (medium) 4 pt. (fine)	1.0 lb. (coarse) 1.5 lb. (medium) 2.0 lb. (fine)	7	Apply within 24 hours of planting	Annual broadleaf weeds	Caparol, Reflex can be added for improved pigweed control. Staple may also be added to Cotoran for improved control of prickly sida, spotted spurge, and pigweed.
Caparol	prometryn	12 hr./ 30 d	1.5–2.5 pt.	0.75–1.25 lb.	5	Apply within 24 hours after planting.	Annual broadleaf weeds.	Use the 1.5 pt./A rate for applications made from January 1 to 30 days before cotton planting. For control of emerged weeds, see label for a suitable adjuvant. If weeds exceed 2 inches in height, mix with a contact herbicide. See label of contact herbicide for rates, adjuvants, etc.
Direx, diuron 80 DF	diuron	12 hr/ 0 d	80DF: 1lb/A on sandy loam and slit loam	80DF: 0.8 lb. — 4L: 0.8 lb.	7	Apply within 24 hours after planting.	Annual broadleaf weeds.	DO NOT apply to soils with less than 1% organic matter. Do not use where soil- applied organophosphate insecticides are used. See label for tank-mix partners.
Direx, diuron 4L			4L: 0.8 qt/A on sandy loam and silt loam	4L: 0.8 lb.				

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
PREEMERGENCE (cont.)								
Engenia	BAPMA dicamba	24hr/7 day	12.8 oz	0.5 lb ae	4	Apply preemergence and over the top only on dicamba tolerant crops	Broadleaf weeds only	Restricted use pesticide. Mandatory training and record keeping is required. Cut off dates for cotton is July 30 for 2020 season. Maximum use rate is 51.2 fl oz per acre per year or four applications at 12.8 fl oz per acre rate. No more than two over the top applications can be made on tolerant crops. Apply in a minimum of 15 gallons of spray solution per acre. Only approved products can be mixed with Engenia. Check label for approved nozzles, pressure and products for tank mixing. Sprayer speed needs to be lower than 15 mph and boom height should be within 24 inches from spray target. Wind speed allowed for application is 3–10 mph. Downwind buffer is 240 ft for open boom sprayers and 110 ft for hooded sprayer. DO NOT apply if sensitive crops are in close proximity to the application area and wind is blowing to sensitive crops. Drift reducing agent and volatility reducing agent are required for application. DO NOT spray during temperature inversion or heavy rainfall is expected within the next 48 hours. DO NOT apply at night. DO NOT apply earlier than one hour after sunrise or later than two hours before sunset. Triple rinse sprayer tank and hoses with sufficient amount of water following each application. DO NOT apply through irrigation or airplane.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
PREEMERGENCE (cont.)								
Enlist Duo (Enlist Cotton ONLY)	2,4-D Choline + glyphosate	48 hr./ mid- bloom	3.5–4.75 pt.	1.44–1.96 lb.	4	Preemergence	Broadleaf weeds, nutsedge and grasses	DO NOT apply less than 10 gallons per acre output. DO NOT apply more than 4.75 pt per acre per application or more than 14.25 pt. per season. DO NOT apply to Enlist cotton later than the mid-bloom stage. DO NOT apply more than one preemergence and two postemergence applications per season. Allow a minimum of 12 days between applications. Apply to weeds that are less than 6 inches tall. Only use approved tank mixes, nozzles, and spray pressures listed in www.Enlist.com. DO NOT apply at night or during temperature inversion. DO NOT apply when wind is blowing to sensitive crops. DO NOT spray when wind speed is less than 3 or greater than 10 MPH. Follow label for buffer requirement to protect sensitive area. Clean spray equipment thoroughly after application.
Enlist One (Enlist Cotton ONLY)	2,4-D choline	48 hr./ mid- bloom	1.5-2 pt	0.71-0.95 lb	4	Preemergence	Broadleaf weeds only	DO NOT apply less than 10 gallons per acre output. DO NOT apply more than 2 pt per acre per application or more than 6 pt. per season. DO NOT apply to Enlist cotton later than the mid-bloom stage. DO NOT apply more than one preemergence and two postemergence applications per season. Allow a minimum of 12 days between applications. Apply to weeds that are less than 6 inches tall. Only use approved tank mixes, nozzles, and spray pressures listed in www.Enlist.com. DO NOT apply at night or during temperature inversion. DO NOT apply when wind is blowing to sensitive crops. DO NOT spray when wind speed is less than 3 or greater than 10 MPH. Follow label for buffer requirement to protect sensitive area. Clean spray equipment thoroughly after application. Can be tank-mixed with Liberty or glyphosate. Lower tank pH will not affect volatility.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
PREEMERGENCE (cont.)								
Xtendimax with Vaporgrip	DGA dicamba + potassium acetate (Vaporgrip)	24hr/7 day	22 oz	0.5 lb ae	4	Apply preemergence and over the top only on dicamba tolerant crops	Broadleaf weeds only	Restricted use pesticide. Mandatory training and record keeping is required. Cut off dates for cotton is July 30 for 2020 season. Maximum use rate is 88 fl oz per acre per year or four applications at 22 fl oz per acre rate. No more than two over the top applications can be made on tolerant crops. Apply in a minimum of 15 gallons of spray solution per acre. Only approved products can be mixed with Xtendimax. Check label for approved nozzles, pressure and products for tank mixing. Sprayer speed needs to be lower than 15 mph and boom height should be less than 24 inches from spray target. Wind speed allowed for application is 3-10 mph. Downwind buffer is 240 ft for open boom sprayers and 110 ft for hooded sprayer. DO NOT apply if sensitive crops present in close proximity to the application site and wind is blowing to sensitive crops. Drift reducing agent and volatility reducing agent are required for application. DO NOT spray during temperature inversion or heavy rainfall is expected within the next 48 hours. DO NOT apply at night. DO NOT apply earlier than one hour after sunrise or later than two hours before sunset. Triple rinse sprayer tank and hoses with sufficient amount of water following each application. DO NOT apply through irrigation or airplane.
Prowl H2O	pendimethalin	24 hr./ 60 d	1.0–2.0 pt. (coarse) 2.0–3.0 pt. (medium) 3.0–4.0 pt. (fine)	0.475–0.95 lb. (coarse) 0.95–1.43 lb. (medium) 1.43–1.90 lb. (fine)	3	Apply at planting or up to 2 days after planting.	Annual grasses and small-seeded broadleaf weeds.	Rates vary depending on whether using conventional or no-till. See label for rates. Higher rates will be used with no-till systems.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	RE/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
PREEMERGENCE (cont.)								
Reflex	fomesafen	24-hr./ 70 d	10–12 oz.	0.16–0.19 lb.	14	Apply preemergence to coarse textured soils only.	Annual broadleaf weeds and partial yellow nutsedge control.	Does not mix well with IPA salt formulations of glyphosate. See label for tank-mix partners. DO NOT use preemergence on heavy soils. Will provide control of small broadleaf weeds less than 1 inch tall. In most of the case, 10-12 fl oz/A rate is able to provide significant pigweed control without damaging cotton excessively.
Staple LX	pyrithiobac	4 hr./60 d	1.3–2.1 fl.oz.	0.0325-0.0525 lb.	2	Apply at planting.	Annual broadleaf weeds.	DO NOT use on coarse soils such as sands or loamy sands or on soils with less than 0.5% organic matter. See label for tank-mix partners. Will not control ALS-resistant Palmer amaranth.
Warrant	acetochlor	12 hr/ N/A	1.25–2 qt.	0.94–1.5 lb.	15	Apply within 24 hours of planting.	Annual grasses and small-seeded broadleaf weeds.	See label for tank-mix partners. Warrant should be applied in combination with other herbicides for optimum weed control.
Warrant Ultra	acetochlor + fomesafen	24 hrs/ 70 d	48–60 fl.oz.	1.29–1.62 lb.	15 + 14	Apply as a preplant in medium- and fine-textured soil or a PRE in coarse- textured soil.	Grasses and small- seeded broadleaves.	Cotton must be planted at least 0.75 inches deep. DO NOT apply to emerged cotton. See label for tank-mix partners.
POSTEMERGENCE OVER-THE-TOP								
Assure II	quizaflop-P-ethyl	12 hr./ 80 d	5–12 fl.oz.	0.034–0.083 lb.	1	Apply to actively growing grasses anytime prior to 80 days before harvest.	Annual and perennial grasses; excellent control of johnsongrass.	Add crop oil concentrate at 1% or a nonionic surfactant at 0.25% v/v. Do not apply more than 18 fluid ounces per season. DO NOT apply within 24 hours of a postemergence broadleaf herbicide. DO NOT cultivate within 7 days of application. Controls volunteer Roundup Ready.
Dual Magnum	S-metolachlor	24 hr./ 100 d	1.0–1.33 pt.	0.95–1.27 lb.	15	Apply when cotton is 3 to 12 inches tall.	Preemergence control of annual grasses and small- seeded broadleaf weeds.	Dual Magnum does not control emerged weeds. Crop injury can occur in environmentally stressed conditions. DO NOT apply within 100 days of harvest. See label for tank-mix partners.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
POSTEMERGENCE OVER-THE-TOP (cont)								
Engenia	BAPMA dicamba	24hr/7 day	12.8 oz	0.5 lb ae	4	Apply preemergence and over the top only on dicamba tolerant crops	Broadleaf weeds only	Restricted use pesticide. Mandatory training and record keeping is required. Cut off dates for cotton is July 30 for 2020 season. Maximum use rate is 51.2 fl oz per acre per year or four applications at 12.8 fl oz per acre rate. No more than two over the top applications can be made on tolerant crops. Apply in a minimum of 15 gallons of spray solution per acre. Only approved products can be mixed with Engenia. Check label for approved nozzles, pressure and products for tank mixing. Sprayer speed needs to be lower than 15 mph and boom height should be within 24 inches from spray target. Wind speed allowed for application is 3-10 mph. Downwind buffer is 240 ft for open boom sprayers and 110 ft for hooded sprayer. DO NOT apply if sensitive crops are in close proximity to the application area and wind is blowing to sensitive crops. Drift reducing agent and volatility reducing agent are required for application. DO NOT spray during temperature inversion or heavy rainfall is expected within the next 48 hours. DO NOT apply at night. DO NOT apply earlier than one hour after sunrise or later than two hours before sunset. Tripple rinse sprayer tank and hoses with sufficient amount of water following each application. DO NOT apply through irrigation or airplane.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	RE/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
POSTEMERGENCE OVER-THE-TOP (cont)								
Enlist One (Enlist Cotton ONLY)	2,4-D choline	48 hr./ mid- bloom	1.5-2 pt	0.71-0.95 lb	4	Postemergence, from planting to mid bloom stage.	Broadleaf weeds only.	DO NOT apply less than 10 gallons per acre output. DO NOT apply more than 2 pt per acre per application or more than 6 pt. per season. DO NOT apply to Enlist cotton later than the mid-bloom stage. DO NOT apply more than one preemergence and two postemergence applications per season. Allow a minimum of 12 days between applications. Apply to weeds that are less than 6 inch tall. Only use approved tank mixes, nozzles, and spray pressures listed in www.Enlist.com . DO NOT apply at night or during temperature inversion. DO NOT apply when wind is blowing to sensitive crops. DO NOT spray when wind speed is less than 3 or greater than 10 MPH. Follow label for buffer requirement to protect sensitive area and residential area. Clean spray equipment thoroughly after application. Can be tank-mixed with Liberty or glyphosate. Lower tank pH will not affect volatility.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
POSTEMERGENCE OVER-THE-TOP (cont.)								
Xtendimax with Vaporgrip	DGA dicamba + potassium acetate (Vaporgrip)	24hr/7 day	22 oz	0.5 lb ae	4	Apply preemergence and over the top only on dicamba tolerant crops	Broadleaf weeds only	Restricted use pesticide. Mandatory training and record keeping is required. Cut off dates for cotton is July 30 for 2020 season. Maximum use rate is 88 fl oz per acre per year or four applications at 22 fl oz per acre rate. No more than two over the top applications can be made on the tolerant crops. Apply in a minimum of 15 gallons of spray solution per acre. Only approved products can be mixed with Xtendimax. Check label for approved nozzles, pressure and products for tank mixing. Sprayer speed needs to be lower than 15 mph and boom height should be less than 24 inches from spray target. Wind speed allowed for application is 3-10 mph. Downwind buffer is 240 ft for open boom sprayers and 110 ft for hooded sprayer. DO NOT apply if sensitive crops present in close proximity to the application site and wind is blowing to sensitive crops. Drift reducing agent and volatility reducing agent are required for application. DO NOT spray during temperature inversion or heavy rainfall is expected within the next 48 hours. DO NOT apply at night. DO NOT apply earlier than one hour after sunrise or later than two hours before sunset. Triple rinse sprayer tank and hoses with sufficient amount of water following each application. DO NOT apply through irrigation or airplane.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
POSTEMERGENCE OVER-THE-TOP (cont.)								
Envoke	trifloxysulfuron	12 hr./ 60 d	0.1–0.15 oz.	0.008–0.0125 lb.	2	Apply when cotton has reached a minimum of 5 true leaves.	Broadleaf weeds including morningglory, sicklepod, pigweed, and nutsedge	Apply with a 80/20 nonionic surfactant blend, NOT a 90/10 blend at a rate of 1 quart per 100 gallons of water. DO NOT use with crop oil concentrate or tank-mix with Pix growth regulator or other pesticides. Never apply preemergence, or cotton injury will occur. Seeabel for tank-mix partners. Do not tank-mix with insecticides containing malathion, profenofos, or emamectin-benzoate or cotton injury may occur.
Fusilade DX	fluzafop	12 hr./ 90 d	6–12 fl.oz.	0.094–0.188 lb.	1	Apply to actively growing grasses.	Annual and perennial grasses including bermudagrass and rhizome johnsongrass.	Most annual grasses need to be sprayed before 4 inches; Volunteer Roundup Ready and glufosinate-tolerant Corn requires 2 applications at 10 fl. oz each; Add crop oil (1 gal.) or nonionic surfactant (2 pt.) per 100 gal of spray. 2 applications at 10 fl.oz. each; Add crop oil (1 gal.) or nonionic surfactant (2 pt.) per 100 gal. of spray.
Liberty 280 SL	glufosinate-sodium	12 hr./ 70 d	29–43 fl oz	0.53–0.79 lb	10	Apply from emergence up to early bloom stage. Weeds should not exceed 3 to 6 inches.	Excellent morningglory, cocklebur, hemp sesbania control. Good control of pigweeds.	Apply in a minimum of 15 gallons per acre in medium size spray droplets. Application should be made 1.5-2 hr after sunrise until 2 hr before sunset. Weed control is improved with addition of 1.5-3 lb/A of ammonium sulfate under tough environmental conditions. Apply Liberty under bright sunlight, high humidity and warmer temperature. Crop oil adjuvant is not recommended with Liberty due to crop injury concern. DO NOT mix Liberty with dicamba or graminicides. Maximum use rate per season per acre is either 72 or 87 fl oz, depending on the highest application rate used.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	RE/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
POSTEMERGENCE OVER-THE-TOP (cont.)								
Outlook	dimethenamid-P	12 hr./ none	12.0–21.0 fl.oz.	0.56–0.98 lb.	15	Apply from first true leaf up to mid-bloom stage (2 weeks after first bloom)	Annual grasses, and broadleaf weeds	DO NOT apply preplant/preemerge in cotton. DO NOT exceed 21 fluid ounces per acre per season. See label for tank-mix partners.
Poast Plus	sethoxydim	12 hr./ 40 d	1.5–2.25 pt.	0.188–0.28 lb.	1	Apply to actively growing grasses.	Annual and perennial grasses	Add crop oil concentrate at 1% A. second application may be made if needed. For best results, apply before grasses exceed 4 inches tall. Controls volunteer Roundup Ready and glufosinate-tolerant corn in cotton. DO NOT apply within 40 days of harvest. May only be tank-mixed with Buctril and glyphosate. If using Staple, apply Poast Plus 3 days prior to Staple.
SelectMax, Select 2EC	clethodim	24 hr/ 60 d	9–16 fl.oz. (1 EC) 6–16 fl.oz. (2 EC)	0.068–0.12 lb. 0.094–0.25 lb.	1	Apply postemerge to actively growing annual and perennial grasses.	Annual and perennial grasses	DO NOT apply within 1 hour of anticipated rainfall. DO NOT apply more than 32 fl.oz./A in a single application. DO NOT apply more than 64 fl.oz./A per season. For repeat applications, make a minimum of a 14-day interval. Controls volunteer Roundup Ready and glufosinate- tolerant corn in cotton. Use a Nis at 0.25% v/v or a coc at 1% v/v.
Sequence (FOR USE ON ROUNDUP READY FLEX COTTON ONLY)	S-metolachlor + glyphosate	24 hr./ 100 d	2.5 pt.	1.64 lb.	15 + 9	Apply from cotyledon stage up to 10 leaf, or 12” tall cotton.	Grasses and broadleaf weeds.	DO NOT include AMS or other adjuvants when applications are made postemergence in cotton. See label for tank-mix partners. DO NOT exceed 3.5 pints/acre of Sequence per season.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	RE/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
POSTEMERGENCE OVER-THE-TOP (cont.)								
Staple LX	pyrithiobac-sodium	4 hr./60 d	2.6–3.8 fl.oz	0.065–0.095 lb.	2	Apply over the top from first visible true leaf through 6 inches in height.	Controls most broadleaf weeds.	Apply with a nonionic surfactant at 0.25% v/v. Do not tank-mix with malathion-containing insecticides as crop injury may occur. To avoid injury, apply malathion-containing insecticides 24 hour before or after Staple LX. DO NOT tank-mix Staple LX with metolachlor (Dual Magnum) herbicides as a postemergence after Staple LX. DO NOT exceed 3.8 ounces per acre in a single application or 5.1 ounces per acre per season. DO NOT apply within 60 days of harvest.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
POSTEMERGENCE OVER-THE-TOP (cont.)								
Tavium with Vaporgrip	DGA dicamba + potassium acetate (Vaporgrip) + S-metolachlor	24hr/100 day	3.53 pt	0.5 lb ae Dicamba and 1 lb S-metolachlor	4+15	Apply over the top only on dicamba tolerant crops	Broadleaf weeds and grasses	Restricted use pesticide. Mandatory training and record keeping is required. Cut off dates for cotton is July 30 or 6-leaf cotton for 2020 season, whichever comes first. Only one over the top application at 3.53 pt per acre can be made on tolerant crops. Apply in a minimum of 15 gallons of spray solution per acre. Only approved products can be mixed with Tavium. Check label for approved nozzles, pressure and products for tank mixing. Sprayer speed needs to be lower than 15 mph and boom height should be less than 24 inches from spray target. Wind speed allowed for application is 3-10 mph. Downwind buffer is 240 ft for open boom sprayers and 110 ft for hooded sprayer. DO NOT apply if sensitive crops present in close proximity to the application site and wind is blowing to sensitive crops. Drift reducing agent and volatility reducing agent are required for application. DO NOT spray during temperature inversion or heavy rainfall is expected within the next 48 hours. DO NOT apply at night. DO NOT apply earlier than one hour after sunrise or later than two hours before sunset. Tripple rinse sprayer tank and hoses with sufficient amount of water following each application. DO NOT apply through irrigation or airplane.
Post-Directed and Layby								
Aim	carfentrazone-ethyl	12 hr./7 d	0.75–1.6 fl.oz.	0.013–0.025 lb. a.i.	14	Apply when cotton is at least 12 inches tall with sufficient bark.	Controls most broadleaf weeds including morningglories and pigweed.	Coverage is essential for good control. See label for tank-mix partners. Use a crop oil concentrate at 1% v/v or 1 gallon per 100 gallons of spray. DO NOT apply more than 3.2 ounces of Aim 2EC total per season by layby or postdirected applications.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	RE/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
Post-Directed and Layby (cont.)								
Anthem Flex	pyroxasulfone + carfentrazone	12 hr./ 7 d	2.73–3.8 fl.oz.	0.085–0.119 lb.	15 + 14	Apply when cotton is at least 6 inches tall up until bloom stage.	Annual grasses and broadleaf weeds	For optimum performance, use a nonionic surfactant (NIS), crop oil concentrate (COC), or methylated seed oil (MSO). Severe crop injury may result if applied to green or unbarked stem.
Caparol (or with MSMA)	prometryn	12 hr./ 30 d	2.4–3.2 pt.	1.2–1.5 lb.	5	Apply when cotton is at least 12 inches tall with sufficient bark.	Annual grasses and broadleaf weeds	Rate is dependent on soil texture. See label for specific rate and tank-mix partners. Add a nonionic surfactant (0.25% v/v) if weeds are present. Do not apply MSMA after first bloom.
Cobra	lactofen	12 hr./ 70 d	12.5 fl.oz.	0.2 lb.	14	Apply when cotton is at least 6 inches tall.	Broadleaf weeds	For post-directed application to 6-inch cotton, use a nonionic surfactant (NIS) at 0.25% V/V or crop oil concentrate (COC) at 1% V/V. Use the crop oil concentrate for applications to 12-inch or taller cotton.
Diuron (or with MSMA)	diuron	12 hr./0 d	1.6–2.4 pt.	0.8–1.2 lb.	7	Apply when cotton is at least 12 inches tall and cotton laps the row middles.	Late emerging annual grasses and small-seeded broadleaf weeds	If weeds are present, add a nonionic surfactant (0.25% v/v). See label for tank-mix partners. Do not apply MSMA after first bloom.
Dual Magnum	S-metolachlor	24 hr./ 80 d	1.0–1.33 pt.	0.95–1.27 lb.	15	Apply when cotton is 3 to 12 inches tall.	Preemergence control of annual grasses and small- seeded broadleaf weeds.	Dual Magnum does not control emerged weeds. Crop injury can occur in environmnetally stressed conditions. Do not apply within 80 days of harvest. See label for tank-mix partners.
Envoke	trifloxysulfuron	12 hr./ 60 d	0.1–0.25 oz.	0.004–0.012 lb.	2	Apply when cotton has reached 6 inches or above.	Broadleaf weeds including morningglory, sicklepod, pigweed, and nutsedge	Apply with a 80/20 nonionic surfactant blend, NOT a 90/10 blend at a rate of 1 quart per 100 gallons of water or with a crop oil concentrate at 0.5–1% V/V (2–4 qt/100 gal). See label for tank-mix partners. Do not tank- mix with insecticides containing malathion, profenofos, or emamectin-benzoate or cotton injury may occur.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	RE/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
Post-Directed and Layby (cont.)								
Fierce	flumioxazin + pyroxasulfone	12 hr./ 60 d	3 oz.	0.14 lb.	14 + 15	Apply with a shielded sprayer when cotton has reached a minimum of 6 inches in height. Apply as a layby application when cotton has reached a minimum of 16 inches in height. Must be directed to the lower 2 inches of the cotton stem to avoid injury.	Residual control of select broadleaf and annual grasses.	Severe crop injury may result if applied to green or unbarked stem. Do not exceed 6 ounces of Fierce during a growing season. Add a nonionic surfactant at 0.25% v/v. Do not use a crop oil concentrate, methylated seed oil, organo-silicant surfactant, or products containing these as severe crop injury may occur.
Goal 2XL	oxyfluorfen	24 hr./ 90 d	1–2 pt.	0.25–0.5 lb.	14 + 17	Apply when cotton has reached 6 inches or above.	1–2 pt.	If weeds have more than 3 true leaves, use the higher rate. Add surfactant at 1–2 quarts per 100 gallons of spray mix. DO NOT apply more than 2 pints per season.
Linex	linuron	24 hr./ 76 d	1–1.5 pt.	0.5–0.75 lb.	7	Apply after cotton is 12 inches tall.	Annual grasses and broadleaf weeds	Adjust nozzles to minimize contact to cotton leaves with spray as crop injury may result. Add 1 pint of surfactant for each 25 gallons of spray mixture.
MSMA	MSMA	12 hr./ N/A	2.67 pt.	2.0 lb.	17	Apply when cotton has reached 3 inches up until first bloom.		Slight burning and reddish discoloration of cotton leaf can occur but cotton will develop normally. DO NOT apply within 50 feet of permanent water bodies or aquatic habitats. MSMA can be tank- mixed with most herbicides labeled for post-directed use in cotton.
Layby Pro	linuron + diuron	24 hr./ 76 d	1.6–2.4 pt.	0.4–0.6 + 0.4–0.6 lb.	7+7	Apply after cotton is 15 inches tall and weeds no more than 4 inches tall.	Annual grasses and broadleaf weeds	If weeds are present, add a nonionic surfactant (0.25% v/v) or a crop oil concentrate (1% v/v). See label for tank-mix partners. Use rate based on soil type: 1.6 pt./A on coarse soils, 2 pt./A on medium soils, and 2.4 pt./A on fine soils. Do not use on sand or loamy sand or on soils containing less than 1% organic matter unless otherwise directed.

Table 7. Recommendation Guide (cont.)

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
Post-Directed and Layby (cont.)								
Suprend	prometryn + trifloxysulfuron	12 hr./ 60 d	20 oz.	1.56 lb.	5 + 2	Apply when cotton has reached 6 inches or above until bloom stage.	Annual grasses and broadleaf weeds	Adjust nozzles to minimize contact to cotton leaves with spray as crop injury may result.
Valor	flumioxazin	12 hr./ 60 d	1–2 oz.	0.5–1.0 lb.	15	Apply with a shielded sprayer when cotton has reached a minimum of 6 inches in height. Apply as a layby application when cotton has reached a minimum of 16 inches in height. Must be directed to the lower 2 inches of the cotton stem to avoid injury.	Provides control of broadleaf weeds.	Severe crop injury may result if applied to green or unbarked stem. DO NOT exceed 4 ounces of Valor during a growing season. Add a nonionic surfactant at 0.25% v/v. DO NOT use a crop oil concentrate, methylated seed oil, organo-silicant surfactant, or products containing these as severe crop injury may occur.
Zidua	pyraxosulfone	12 hr./0 d	Coarse: Do NOT Use Medium: 0.75–1.5 oz., Fine: 1.5–2.1 oz.	0.055–0.154 lb.	15	Apply as a layby application from 5 leaf to beginning bloom stage.	Residual control of select broadleaf and annual grasses..	See label for tank-mix partners. DO NOT use on a coarse textured soil type. There is no preharvest interval between Zidua application and cotton harvest.
HOODED SPRAYER								
Various	glyphosate	4 hr./N/A	32–48 fl.oz. (3 lb. ae) 24–35 fl.oz. (4.17 ae) 22–32 fl.oz. (4.5 lb. ae)	0.75–1.13 lb. ae	9	Apply in cotton at least 6 inches tall using hooded sprayers only.	Most annual grasses and broadleaf weeds. Does not adequately control evening primrose or horseweed	Adjuvant recommendations vary by glyphosate brand. See label for tank- mixing partners. Tank-mixes must follow the most-restrictive REI/PHIs. Use lower rate on smaller, easy-to-kill weeds; increase rate with larger weeds and perennials. Avoid crop contact. Operate hoods as close to soil surface as possible.

Table 7. Recommendation Guide

Herbicide (trade name)	Herbicide (common name)	REI/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
HOODED SPRAYER (cont.)								
Fierce	flumioxazin + pyroxasulfone	12 hr./ 60 d	3 oz.	0.14 lb.	14 + 15	Apply with a shielded sprayer when cotton has reached a minimum of 6 inches in height. Apply as a layby application when cotton has reached a minimum of 16 inches in height. Must be directed to the lower 2 inches of the cotton stem to avoid injury.	Residual control of select broadleaf and annual grasses..	Severe crop injury may result if applied to green or unbarked stem. DO NOT exceed 6 ounces of Fierce during a growing season. Add a nonionic surfactant at 0.25% v/v. Do not use a crop oil concentrate, methylated seed oil, organo-silicant surfactant, or products containing these as severe crop injury may occur.
Gramoxone SL	paraquat	24 hr./ 48 d	1.25–2.5 pt.	0.31–0.62 lb.	22	Apply to 6 inch cotton using hooded sprayers only.	Annual broadleaf weeds and grasses less than 6 inches tall.	Use a nonionic surfactant at 0.25% v/v or a crop oil concentrate at 1% v/v. Use the higher rate for harder-to-kill weeds. Complete coverage is essential for good weed desiccation. See label for specific application instructions and tank-mixing partners. Operate hoods as close to the soil surface as possible. Avoid crop contact with spray solution. Other formulations are NOT labeled for hooded sprayer applications. STATE LABEL ONLY.

Table 7. Recommendation Guide

Herbicide (trade name)	Herbicide (common name)	RE/PHI (hours or days)	Rate/Acre Broadcast		Herbicide Group	Time of Application	Weeds Controlled	Comments
			Formulated Product	Active Ingredient				
HOODED SPRAYER (cont.)								
Liberty 280 SL	glufosinate-sodium	12 hr./ 70 d	29–43 fl oz	0.53–0.79 lb	10	Apply from emergence through early bloom using a hooded sprayer.	Excellent morningglory, cocklebur, hemp sesbania control. Good control of pigweeds.	Thorough spray coverage is essential for optimum performance. Use only hooded sprayer equipment if not using varieties tolerant Liberty. Make up to 3 applications per season at 29 fl oz/A rate. DO NOT harvest cotton within 70 days of last Liberty application. Ground application requires a minimum of 15 gallons of water/acre. Avoid contact with plant foliage.
Valor	flumioxazin	12 hr./ 60 d	1–2 oz.	0.5–1.0 lb.	14	Apply with a hooded sprayer after cotton has reached 6 inches tall.	Provides control of broadleaf weeds.	Severe crop injury may result if applied to green or unbarked stem. DO NOT exceed 4 ounces of Valor during a growing season. Add a nonionic surfactant at 0.25% v/v. See label for tank-mix partners. Use only hooded sprayer equipment. Operate hoods as close to the soil surface as possible.

N = No control P = < 70% control F = 70–80% control G = 80–90% control E = 90% control

¹ Will not control ALS-resistant ryegrass.² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides											
Herbicides	FirstShot SG	Glyphosate	Glyphosate + 2, 4-D	Glyphosate + Aim	Glyphosate + Clarity	Glyphosate + Reflex	Glyphosate + Valor	Glyphosate + Sharpen	Gramoxone SL/Others	Liberty 280 SL	
Application Timing		BURNDOWN									PRE
Site of Action Group	2	9	9 + 4	9 + 14	9 + 4	9+14	9+14	9+14	22	10	
WEEDS											
annual bluegrass	N	E	E	E	E	E	E	E	G-E	F	
bermudagrass	N	F	F	F	F	F	F	F	P	N	
crabgrass, large	N	E	E	E	E	E	E	G	F	F	
crowfootgrass	N	F-G	F-G	F-G	F-G	F-G	F-G	F-G	P	G	
foxtail	N	F-G	F-G	F-G	F-G	F-G	G	F-G	F	F-G	
goosegrass	N	E	E	E	G	E	E	G	F-G	P	
johnsongrass (seedling)	N	G-E	G-E	G-E	G	G-E	G-E	F-G	P	G	
little barley	N		E	E	E	E	E	E	G	F-G	
ryegrass, Italian	N	G	G	G	G	G	G	F	F	F	
signalgrass, broadleaf	N	F-G	F-G	F-G	F-G	F-G	F-G	F-G	P	G	
Texas panicum	N	E	G-E	E	E	E	E	G	F-G	G	
purple nutsedge		F	F	F-G	F	F	G	F	P-F	P	
yellow nutsedge		P-F	P-F	P-F	P-F	P-F	F	P-F	P-F	P	
buttercup	E	G-E	G-E	G-E	E		F	E	E		
Carolina geranium	G-E	P-F	F	F-G	G		G	P	G-E	G	
chickweed	G-E	E	E	E	E		E	G	E	E	
cudweed		G	G	G-E	E				F-G		

curly dock	E	F	F	F	F	G-E		F	E	N-P	F
cutleaf eveningprimrose	G-E	P		G-E	F	G		E	F	F	F-G
henbit	F-G	F	F	F-G	F-G	G		E	G	G	P-F
horseweed	F	G	G	E	E	G	P	N	G	P-F	G-E
lambquarters, common		F-G	E	E	E	E				F-G	E
morningglories sp.	F-G	F	F	E	E	E	G	E	G	F-G	E
morningglory, smallflower	G	G	G	E	E	E	F	G	G	P	E
Palmer amaranth	P-F	E	E	E	E	E	E	P	E	F-G	F-G
Pennsylvania smartweed		F-G	G	G	E	E	F-G	E	G-E	P-F	G
prickly sida	P	F	F	G	E	E	G		F-G	P-F	P
purslane, common		F	F	G-E	E	E				G	F-G
ragweed, common		G	G	E	E	E		E	E	G	E
shepherdspurse	E	G	G		G	G		G-E	E	G	
sicklepod	P	G-E	E	E	E	E	F-G	G	G	G	E
swinecress		F-G	G	G	F-G	F-G			F	P-F	

N = No control P = <70% control F = 70–80% control G = 80–90% control E = 90% control

¹ Will not control ALS-resistant ryegrass ² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides (cont.)

Herbicides	Glyphosate	Glyphosate + 2,4-D	Glyphosate + Clarity	Glyphosate + Aim	Glyphosate + Diuron	Glyphosate + Harmony Extra	Glyphosate + Valor
Application Timing	BURNDOWN						
Site of Action Group	9	9+4	9 + 4	9+14	9+7	9+2	9+14

Weeds

GRASSES/SEDGES							
annual bluegrass	E	E	E	E	E	E	E
bermudagrass	F	F	F	F	F	F	F
crabgrass, large	E	E	E	E	G	E	E
crowfootgrass	F–G	F–G	F–G				
fall panicum							
foxtail	F–G	F–G					G
goosegrass	E	E	G	E	G	E	E
johnsongrass (seedling)	G–E	G–E	G	G–E	F–G	G–E	G–E
little barley		E	E	E	E	E	E
ryegrass, Italian	G	G	G	G	F	G	G
signalgrass, broadleaf							
Texas panicum	E	G–E	E	E	G	E	E
volunteer corn (not RR vol corn)	E	E	E	E	E	E	E
purple nutsedge	F	F	F	F–G	F–G	F–G	G
yellow nutsedge	P–F	P–F	P–F	P–F	F	P–F	F

N = No control

P = < 70% control

F = 70–80% control

G = 80–90% control

E = 90% control

¹ Will not control ALS-resistant ryegrass² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides (cont.)

Herbicides	Glyphosate	Glyphosate + 2,4-D	Glyphosate + Clarity	Glyphosate + Aim	Glyphosate + Diuron	Glyphosate + Harmony Extra	Glyphosate + Valor
Application Timing	BURNDOWN						
Site of Action Group	9	9 + 4	9 + 4	9+14	9+7	9+2	9+14
Weeds							
BROADLEAF WEEDS							
beggarweed, Florida	E	E	E	E	E	E	E
bristly starbur	E	E	E	E	E	E	E
black nightshade							
buttercup	G–E	G–E	E	G–E	G–E	G–E	F
Carolina geranium	P–F	F	G	F–G	G	G–E	G
chickweed	E	E	E	E	E	E	E
cocklebur	E	E	E	E	E	E	
coffee senna	E	E	E	E	E	E	
crotalaria, showy							
cudweed	G	G	E	G–E	E	E	
curly dock	F	F	G–E	F	P–F	E	F
cutleaf eveningprimrose	P	G–E	G	F	F–G	F	E
eclipta	G–E			G–E	G–E		
hemp sesbania	P–F	E		G–E	F–G		
henbit	F	F–G	G	F–G	G	E	E
horsenettle	P–F	F–G	F–G		F	P–F	
horseweed	G	E	G	E	G–E	G–E	N
groundcherries							
jimsonweed							
lambsquarters, common	F–G	E	E	E	G–E		
morningglories sp.	F	E	E	E	G	F	E
morningglory, smallflower	G	E	E	E	G–E	G	
Palmer amaranth	E	E	E	E	E	E	P
Palmer amaranth (glyphosate-resistant)	N	F	F	F	G	P	
Pennsylvania smartweed	F–G	G	E	E	G	E	E
prickly sida	F	G	E	E	F–G	F–G	
purslane, common	F	G–E	E	E	G	F	
ragweed, common	G	E	E	E	G		E
ragweed, giant							
redweed	G		G–E	G–E	G		
shepherdspurse	G		G	G			
sicklepod	G–E	E	E	E	E	G–E	
speedwell	E	E	E	E	E	E	
spurred anoda	G				G		
swinecress	F–G	G	F–G	F–G	G	G–E	
tropic croton	G–E	G–E	G–E	G–E	G–E		
velvetleaf	G				G		

N = No control

P = < 70% control

F = 70–80% control

G = 80–90% control

E = 90% control

¹ Will not control ALS-resistant ryegrass² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides (cont.)

Herbicides	Glyphosate + Sharpen	Gramoxone	Gramoxone + Clarity	Reflex	Treflan	Prowl	Command
Application Timing	BURNDOWN			PRE	PPI	PPI/PRE	PRE
Site of Action Group	9+14	22	22+4	14	3	3	
Weeds							
GRASSES/SEDGES							
annual bluegrass	E	G–E	E				
bermudagrass	F	P	F	N	N	N	P–F
crabgrass, large	G	F	E	P	E	E	E
crowfootgrasses	F–G	P			E	G	G
fall panicum				N	E	E	G–E
foxtail	F–G	F		N	E	E	E
goosegrass	G	F–G	E	P	E	E	E
johnsongrass (seedling)	F–G	P	G	N	P	P	G
little barley	E	G	E				
ryegrass, Italian	F	F	G				
signalgrass, broadleaf		P		N	G	G	E
Texas panicum	G	F–G	E		G	F	F
volunteer corn (not RR vol corn)	E	F	E				
purple nutsedge	F	P–F	F–G		N	N	N
yellow nutsedge	P–F	P–F	P–F	P	N	N	N

N = No control

P = < 70% control

F = 70–80% control

G = 80–90% control

E = 90% control

¹ Will not control ALS-resistant ryegrass² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides (cont.)

Herbicides	Glyphosate + Sharpen	Gramoxone	Gramoxone + Clarity	Reflex	Treflan	Prowl	Command
Application Timing	BURNDOWN			PRE	PPI	PPI/PRE	PRE
Site of Action Group	9+14	22	22+4	14	3	3	3
Weeds							
BROADLEAF WEEDS							
beggarweed, Florida		E	E	P	P	P	F–G
bristly starbur		E	E	G–E	N	N	P
black nightshade							
buttercup	E	E	E				
Carolina geranium	P	G–E	G				
chickweed	G	E	E				
cocklebur		G–E	E	G	N	N	F
coffee senna		F	E	N	N	N	P
crotalaria, showy					N	N	
cudweed		F–G	E				
curly dock	E	N–P	G–E				
cutleaf eveningprimrose	F	F					
eclipta		F		G–E	P	P	
hemp sesbania		F		P	N	N	F
henbit	G	G	G				
horsenettle		P–F			N	N	N
horseweed	G	P–F	E		N	N	N
groundcherries							
jimsonweed				N	N	N	G
lambsquarters, common		F–G	E	E	G	F–G	G
morningglories sp.	G	F–G	E	P–F	P	P	P–F
morningglory, smallflower		P	E	G–E	P	P	P
Palmer amaranth	E	F–G	E	E	F–G	P–F	N–P
Palmer amaranth (glyphosate-resistant)	E	F–G	F	E	E	F	N–P
Pennsylvania smartweed	G–E	P–F	E	F	N	N	E
prickly sida		P–F	E	N	N	N	E
purslane, common		G	E	G	E	G	G–E
ragweed, common	E	G	E	G	N	N	G
ragweed, giant							
redweed		F	G–E		N	N	G–E
shepherdspurse		G	G				
sicklepod		G	E	P	P	P	P
speedwell		G	E				
spurred anoda		F–G			N	N	G
swinecress	F	P–F	F–G				
tropic croton		F	G–E	F–G	N	N	E
velvetleaf		P		P	P	P	G

N = No control P = < 70% control F = 70–80% control G 80–90% control E = 90% control

¹ Will not control ALS-resistant ryegrass² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides (cont.)

Herbicides	Cotoran	Diuron	Warrant	Dual II Magnum	Staple LX	Envoke	Liberty
Application Timing	PRE				POST		
Site of Action Group	7	7	15	15	2	2	10
Weeds							
GRASSES/SEDGES							
annual bluegrass	N	N	N	N	N	N	N
bermudagrass	F–G	F–G	E	G–E	P	P	G
crabgrass, large	F–G	F–G	E	G–E		P	G
crowfootgrass	F	P	G	G–E	P–F	P	G
fall panicum	F–G		E	G–E	P	P	G
foxtail	F	F	E	G–E	P–F	P	P
goosegrass	P	P	F	G–E	N	N	G
johnsongrass (seedling)					N	P	G
little barley					N	P	G
ryegrass, Italian	P	P	F–G	G–E	N	P	G
signalgrass, broadleaf	P	P	P–F	P–F	N	P	G
Texas panicum					N	P	G
volunteer corn (not RR vol corn)	N	N	P	P	F	P	P
purple nutsedge	N	N	P	G	P–F	P	P
yellow nutsedge	N	N	P	G	P–F	P	P

N = No control

P = < 70% control

F = 70–80% control

G = 80–90% control

E = 90% control

¹ Will not control ALS-resistant ryegrass² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides (cont.)

Herbicides	Cotoran	Diuron	Warrant	Dual II Magnum	Staple LX	Envoke	Liberty
Application Timing	PRE				POST		
Site of Action Group	7	7	15	15	2	2	10
Weeds							
BROADLEAF WEEDS							
beggarweed, Florida	G–E	G	P–F	P–F	G	F–G	G
bristly starbur	G–E	F–G	P	P	G	G–E	G
black nightshade							
buttercup							
Carolina geranium							
chickweed							
cocklebur	F–G	F	P	P	N–P	E	G
coffee senna	F–G	F	P	P	G		G
crotalaria, showy	G	G	P	P			
cudweed							
curly dock							
cutleaf eveningprimrose							
eclipta	G						G
hemp sesbania	P	P	P	P	P		
henbit							
horsenettle			N	N			
horseweed			N	N			
groundcherries							
jimsonweed	G	G			F–G	N	E
lambsquarters, common	G–E	G–E	F	F	G		E
morningglories sp.	G–E	F	P	P	F–G	E	E
morningglory, smallflower	G–E	G–E	P	P	E	P–F	E
Palmer amaranth	F	G	G	G	G–E	P–F	F–G
Palmer amaranth (glyphosate-resistant)		G	G	G	G–E	P–F	F–G
Pennsylvania smartweed	G	G			G		G
prickly sida	E	F	F	F	G	N	F
purslane, common	E	E	G	G	G		F–G
ragweed, common	E	G	P	P	N–P		
ragweed, giant							
redweed	E	G–E			G–E		
shepherdspurse							
sicklepod	G	F	P		P	E	E
speedwell							
spurred anoda	P			N	G	P–F	
swinecress							
tropic croton	F–G	F–G	P	P	F		G
velvetleaf	P			N	E		F

N = No control P = < 70% control F = 70–80% control G 80–90% control E = 90% control

¹ Will not control ALS-resistant ryegrass

² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides (cont.)

Herbicides	Poast Plus	Select Max	Assure	Fusilade	Liberty	Glyphosate + Direx	Glyphosate + Aim
Application Timing	POST					EPD	
Site of Action Group	1	1	1	1	10	17	14+9
Weeds							
GRASSES/SEDGES							
annual bluegrass	F	G	G	G	N	F	F
bermudagrass	G–E	G	G	G	G	G–E	E
crabgrass, large	F–G	G–E	G	F	G	G–E	E
crowfootgrasses	E	E	G–E	G–E	G	G–E	E
fall panicum	E	E	E	E	G	G–E	E
foxtail	E	E	G	G	P	E	E
goosegrass	G	E	E	G–E	G	G–E	E
johnsongrass (seedling)		E			G	E	
little barley		E			G	G	
ryegrass, Italian	G–E	E		G–E	G	E	E
signalgrass, broadleaf	E	E	G	G	G	G–E	E
Texas panicum	E	E			G	E	E
volunteer corn (not RR vol corn)	N	N	N	N	P	G	G
purple nutsedge	N	N	N	N	P	F–G	F–G
yellow nutsedge	N	N	N	N	P	F–G	F–G

N = No control

P = < 70% control

F = 70–80% control

G = 80–90% control

E = 90% control

¹ Will not control ALS-resistant ryegrass² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides (cont.)

Herbicides	Poast Plus	Select Max	Assure	Fusilade	Liberty	Glyphosate + Direx	Glyphosate + Aim
Application Timing	POST					EPD	
Site of Action Group	1	1	1	1	10	17	14+9
Weeds							
BROADLEAF WEEDS							
beggarweed, Florida	N	N	N	N	G	E	E
bristly starbur	N	N	N	F	G	G–E	G–E
black nightshade	N	N	N	N			
buttercup	N	N	N	N			
Carolina geranium	N	N	N	N			
chickweed	N	N	N	N			
cocklebur	N	N	N	N	G	E	E
coffee senna	N	N	N	N	G	G	E
crotalaria, showy	N	N	N	N		G	G
cudweed	N	N	N	N			
curly dock	N	N	N	N			
cutleaf eveningprimrose	N	N	N	N			
eclipta	N	N	N	N	G	E	E
hemp sesbania	N	N	N	N			G–E
henbit	N	N	N	N			
horsenettle	N	N	N	N			
horseweed	N	N	N	N			
groundcherries	N	N	N	N			
jimsonweed	N	N	N	N	E	E	E
lambsquarters, common	N	N	N	N	E	G–E	G–E
morningglories sp.	N	N	N	N	E	G–E	E
morningglory, smallflower	N	N	N	N	E	E	E
Palmer amaranth	N	N	N	N	F–G	F–G	E
Palmer amaranth (glyphosate-resistant)	N	N	N	N	F–G	F–G	P–F
Pennsylvania smartweed	N	N	N	N	G	G	G–E
prickly sida	N	N	N	N	F	G	F–G
purslane, common	N	N	N	N	F–G	G–E	G
ragweed, common	N	N	N	N		E	E
ragweed, giant	N	N	N	N			
redweed	N	N	N	N		G–E	G–E
shepherdspurse	N	N	N	N			
sicklepod	N	N	N	N	E	E	E
speedwell	N	N	N	N			
spurred anoda	N	N	N	N			
swinecress	N	N	N	N			
tropic croton	N	N	N	N	G	E	E
velvetleaf	N	N	N	N	F		

N = No control P = < 70% control F = 70–80% control G 80–90% control E = 90% control

¹ Will not control ALS-resistant ryegrass

² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides (cont.)		
Herbicides	Glyphosate + Valor	Glyphosate + Zidua
Application Timing	LPD	LAYBY
Site of Action Group	14+9	15+9
Weeds		
GRASSES/SEDGES		
annual bluegrass	F	F
bermudagrass	E	E
crabgrass, large	E	E
crowfootgrass	E	E
fall panicum	E	E
foxtail	E	E
goosegrass	G–E	E
johnsongrass (seedling)		
little barley		
ryegrass, Italian	E	E
signalgrass, broadleaf	E	E
Texas panicum	E	E
volunteer corn (not RR vol corn)	F	P
purple nutsedge	F	F
yellow nutsedge	N	N

N = No control

P = < 70% control

F = 70–80% control

G = 80–90% control

E = 90% control

¹ Will not control ALS-resistant ryegrass² Weeds must not be larger than 2 inches at time of application.

Table 8. Weed Response to Cotton Herbicides (cont.)		
Herbicides	Glyphosate + Valor	Glyphosate + Zidua
Application Timing	LPD	LAYBY
Site of Action Group	14+9	15+9
Weeds		
BROADLEAF WEEDS		
beggarweed, Florida	E	E
bristly starbur	E	P–F
black nightshade		
buttercup		
Carolina geranium		
chickweed		
cocklebur	E	E
coffee senna	E	E
crotalaria, showy		G
cudweed		
curly dock		
cutleaf eveningprimrose		
eclipta	E	E
hemp sesbania		P–F
henbit		
horsenettle		
horseweed		
groundcherries		
jimsonweed	E	E
lambsquarters, common	G–E	G
morningglories sp.	E	F–G
morningglory, smallflower	E	G
Palmer amaranth	E	E
Palmer amaranth (glyphosate-resistant)	P–F	P
Pennsylvania smartweed	G	G
prickly sida	G–E	F–G
purslane, common	G–E	F–G
ragweed, common	E	E
ragweed, giant		
redweed		G–E
shepherdspurse		
sicklepod	E	E
speedwell		
spurred anoda		
swinecress		
tropic croton	E	E
velvetleaf		

Table 9. Weed Response to Cotton Herbicides – Auxin Technology (Restricted Use Pesticides)

These may be applied at Burndown, Preemergence, and Postemergence (see label for restrictions)

Herbicides	Enlist Duo	Enlist One	Engenia/FeXpan
Application Timing	BURNDOWN, PRE, POST		
Site of Action Group	4 + 15	4	4
Weeds			
BROADLEAF WEEDS			
beggarweed, Florida	E	G-E	E
bristly starbur			
black nightshade	G-E	G	E
buttercup	E	E	E
Carolina geranium	E	G-E	G-E
chickweed	E	E	E
cocklebur	E	E	E
coffee senna	G	G	G-E
crotolaria, showy	G-E	G-E	G-E
cudweed	G	F	F
curly dock	G	G	G
cutleaf eveningprimrose	G-E	G	G
eclipta			
hemp sesbania	E	E	E
henbit	G	G	G
horsenettle	F	F	G
horseweed	G	G	E
groundcherries	G-E	G	G-E
jimsonweed	E	E	E
lambquarter	E	E	E
morningglories, sp.	E	E	E
morningglory, smallflower	E	E	E
palmer amaranth	E	E	E
palmer amaranth (glyphosate-resistant)	E	E	E
Pennsylvania smartweed	E	E	G-E
prickly sida	F-G	F	E
purslane, common	G-E	G	G-E
ragweed, common	E	E	E
ragweed, giant	G	F-G	G
redweed			
shepherdspurse	G	G	G
sicklepod	E	E	G-E
speedwell			
spurred anoda	E	G-E	G-E
swinecress	E	G-E	G-E
tropic croton	G	F-G	G-E
velvetleaf	E	E	E
GRASSES/SEDGES			
annual bluegrass	G	N	N
bermudagrass	P	N	N
crabgrass, large	G	N	N
crowfootgrass	E	N	N

Table 9. Weed Response to Cotton Herbicides – Auxin Technology (Restricted Use Pesticides) (cont.)			
These may be applied at Burndown, Preemergence, and Postemergence (see label for restrictions)			
Herbicides	Enlist Duo	Enlist One	Engenia/FeXpan
Application Timing	POST		
Site of Action Group	4 + 15	4	4
fall panicum	E	N	N
foxtail	G-E	N	N
goosegrass	G	N	N
johnsongrass (seedling)	E	N	N
little barley	E	N	N
ryegrass, Italian	G ³	N	N
signalgrass, broadleaf	E	N	N
Texas panicum	E	N	N
volunteer corn (not RR vol corn)	E	N	N
purple nutsedge	P	N	N
yellow nutsedge	F	N	N

N = No control

P = < 70% control

F = 70–80% control

G = 80–90% control

E = 90% control

³ Will not control glyphosate-resistant Italian ryegrass.

Weed Control section prepared by **Steve Li**, *Extension Specialist*, Assistant Professor, Crop, Soil, and Environmental Sciences, Auburn University.

COTTON DEFOLIATION GUIDE

The defoliation of cotton, under favorable circumstances, is a very desirable production practice. Defoliation can result in higher grades of cotton. It can reduce damage from boll rot by exposing greater portions of the plants to sunlight and air. Also, defoliation can facilitate the harvesting schedule. It tends to hasten the start of the picking season and allows picking to start earlier on mornings when the dew is heavy.

Is Defoliation Profitable?

Over several years and under favorable circumstances, defoliation is profitable. That is, the added returns from defoliation are greater than the added costs. However, results can vary considerably from year to year and from farm to farm, and even from field to field. As a consequence, the extra profits earned from defoliation are a reward for alert cotton producers who vary their use of the practice depending on the circumstance. This superior management involves combining close observation with a thorough knowledge of plant growth characteristics and the attributes of various defoliant materials.

A defoliant application will likely be profitable when:

- Plants are tall.
- Fruit set is heavy.
- Foliage is dense and succulent.
- Plants have cut-out but are not completely inactive.
- Secondary growth is not excessive.

A defoliant application will likely not be as profitable when:

- Plants are short.
- Leaves are sparse.
- Leaves are inactive due to drought, lack of plant food, complete maturity, etc.
- Boll set is light.
- Natural leaf drop is high.
- Plants are actively growing with no sign of cut-out.

Between these two extremes, the economic basis for defoliation is not so clear-cut. The advantages relate chiefly to creating a better environment for the opening bolls and facilitating the harvesting schedule as well as the mechanics of picker operation.

Timing of Application

The best time to defoliate varies with the weather, the condition of the crop, and the principal benefits expected. Often, something must be sacrificed to realize this benefit. Defoliating early to take advantage of higher temperatures and to permit earlier harvesting may result in sacrificing part of the top crop. Delaying defoliation of large, high-yielding plants until late-set bolls are fully mature may mean that lower temperatures will prevent good leaf drop and may result in excessive field deterioration of fiber and seed in the bolls that opened early.

In general, defoliation should be timed to permit the most efficient picking schedule with machines. If the application is delayed until 60 percent of the total crop to be harvested is open, 75 to 90 percent of the crop can likely be harvested within two weeks after the application, except when weather conditions are very favorable.

A defoliant should not be applied to the entire acreage at one time. The defoliation schedule should be coordinated with the harvest in such a way that harvest can follow defoliation within about two weeks. Defoliating too far ahead of picking can result in second growth problems, excessive field loss, and quality deterioration.

Materials

Aim, ET, Resource. These products provide good defoliation of mature cotton leaves but have minimal activity on juvenile growth. They may be mixed with ethephon and/or thidiazuron to speed boll opening and/or suppress regrowth. Adding crop oil concentrate at 1 to 2 pints per acre is needed for optimum activity.

CottonQuik, Finish. These “activated” ethephon products contain proprietary additives that increase the speed of boll opening and in some cases defoliation. Other harvest aides such as thidiazuron, Def, Harvade, Aim, ET, or Resource must often be added to increase overall defoliation.

Sodium Chlorate. Sodium chlorate is generally not used as a defoliant on spindle-picked cotton. Leaf sticking may occur with high application rates, and at normal rates it is usually not as effective as other defoliants. It is not a strong inhibitor of terminal regrowth and is not very effective on young immature leaves. **DO NOT** mix sodium chlorate with surfactants, oils, insecticides, or other defoliants.

Def 6. This phosphate-type material has been a standard defoliant for several years in Alabama. Although this material does not strongly inhibit regrowth, it is effective on young immature leaves. A rain-free period of 2 hours is sufficient for phosphate-type defoliants. The use of surfactants and/or crop oil has enhanced the performance of this material under very adverse conditions.

Thidiazuron (Dropp, etc.). Thidiazuron provides defoliation essentially equal to the phosphate-type defoliants. However, thidiazuron is a strong inhibitor of terminal regrowth. Thidiazuron activity is relatively sensitive to cool weather. Tank mixing thidiazuron with DEF or ethephon (Prep, etc.) will enhance the activity of thidiazuron under cool conditions. Thidiazuron requires a 24-hour rain-free period. Make sure to follow the label instructions for tank cleanup when using thidiazuron. Failure to follow label tank-cleaning instructions may cause premature defoliation of cotton when the sprayer is used the following year.

Ethephon. Ethephon (Prep, etc.) has been shown to accelerate the opening of cotton bolls. Increasing the rate of boll opening has allowed harvest operations to begin several days earlier, increased the percentage of the crop harvested during the first picking, and eliminated the need for a second harvest in many fields. However, some quality reduction may occur if a large percentage of the total harvest is immature bolls, which will be opened and harvested. The crop should be well matured prior to the use of this material to avoid reductions in fiber quality.

Although ethephon is not labeled as a defoliant, it does have some defoliant activity. It has provided satisfactory defoliation at the higher rate of application (2 pounds active ingredient per acre) under optimum conditions on well-matured cotton. The addition of ethephon at lower rates with other defoliants has been reported to increase the degree of defoliation under adverse conditions. Ethephon is compatible with Def, Harvade, thidiazuron, Aim, ET, and Resource but should **NOT** be mixed with sodium chlorate.

Desiccants. Desiccants (sodium chlorate, paraquat) are generally not used as a harvest aid for cotton harvested with spindle-type pickers. If desiccation is necessary because of regrowth or weeds, it is best to apply a defoliant, wait until leaf drop occurs, and then apply the desiccant. Desiccants kill the entire plant and burn immature bolls. Therefore, 90 percent of the crop should be open before applying a desiccant.

Coverage

Adequate spray coverage is essential. Good defoliation requires that the chemical be sprayed on each leaf. Where cotton is tall and foliage is dense, failure to distribute the material over the entire plant is a frequent cause of poor results. Too often the application is concentrated on the upper leaves which may be “burned” too drastically and fail to drop while the lower foliage remains green and unaffected.

For plants up to 5 feet tall which are not densely over-lapped between the rows, satisfactory spray coverage can be obtained with 5 to 8 gallons of total spray per acre applied by airplane and 15 to 20 gallons by ground machine. It is not satisfactory to fly 3 to 4 gallons per acre twice or to overlap the swaths in order to apply 6 to 8 gallons. In these cases, the spray is concentrated on the upper leaves as described above.

With ground equipment, coverage of entire plants can be accomplished using three nozzles per row with one over-the-top and one on each side. This is particularly advantageous for cotton that has rank growth. With aerial applications to rank cotton, two applications about 1 week apart may be required to get spray on all the leaves.

Surfactants

Surfactants are used to obtain more thorough wetting and adsorption. Read the container label for surfactant-use requirements.

Evaluating Cotton for Maturity

Determining when to defoliate and terminate a crop is often difficult. Cotton requires approximately 40 to 50 days for an early-season white bloom to develop into a mature boll. That interval will increase to as many as 60 days later in the season. The cutoff dates for white blooms to develop into mature bolls are generally predicted to be August 15 for North Alabama and September 1 for South Alabama. These dates may be earlier or later, depending on the temperature, rainfall, and length of the fall season.

Several methods can be used to predict the number of mature bolls that will probably be harvested. One involves simply counting down four to five nodes from the top of the plant. All bolls below that point should mature in time for harvest. Another method, called Nodes Above Cracked Boll, involves locating the uppermost cracked boll (already cracked when found) on the first fruiting position. The bolls located four to five nodes above this point are generally considered mature, and defoliation at that time would not decrease yield or quality.

Traditionally, producers have used a method that involves cutting the bolls with a sharp knife. If the boll cannot be cut without stringing fiber and if the seed coats have begun to darken, the boll is considered mature.

COTTON GROWTH REGULATORS AND HARVEST AID PRODUCTS

Growth Regulation

Plant growth regulators (PGRs) have long been used for controlling cotton height and vegetative production to facilitate insecticide application, reduce boll rot, and improve picker efficiency. The products currently marketed for controlling excessive vegetative growth in actively grown, non-stressed cotton contain the following: mepiquat chloride, mepiquat pentaborate, or cyclanilide plus mepiquat chloride. Research conducted over many years and/or locations across the Cotton Belt has indicated that these products will consistently control cotton plant height and often result in increased earliness when compared to untreated cotton. PGRs will likely provide the greatest growth-regulating benefits in fields where excessive growth traditionally occurs; fields where excessive vegetative production can occur due to irrigation, high fertilization rates, or poor fruit set; and fields planted in varieties known to have excessive growth habits. Treatment strategies may change depending on the sensitivity of the variety to PGRs. In many cases PGRs for cotton can be tank-mixed with insecticides, miticides, and/or foliar fertilizer according to specific product label directions and precautions.

Boll Opening

It may be desirable to accelerate the opening of mature cotton bolls in order to harvest earlier or for a once-over harvest operation. Ethephon has been shown to accelerate the opening of bolls and to enhance defoliation. Immature bolls will also be affected and, depending on the stage of maturity, the fiber may be immature, quality of seed may be lowered,

and yield may be reduced. Application should not be made until sufficient mature, unopened bolls have developed to produce the desired yield.

Cool, damp conditions occurring within 48 hours before or after treatment may severely inhibit the effectiveness of ethephon.

Defoliants and Boll-Opening Products

Several chemicals are labeled for use as defoliants (see table, below). They will defoliate cotton but will not kill the stalk under normal use. Some regrowth will occur with all of these products. For more information on cotton defoliation, see Circular ANR-715, "Cotton Defoliation."

Desiccants

A desiccant primarily dries plant tissue. These chemicals usually act so rapidly that leaves are killed and stick to the stalk and defoliation does not occur. Desiccants are generally recommended in areas where cotton is harvested by strippers. In Alabama, they should be used only as a last resort to eliminate second growth.

Additives

Additives are materials that are included in a tank mix with defoliants or boll openers to enhance the mixture's performance. Additives are often used to increase the speed of activity. They are also used when weather conditions are less than ideal. Before using an additive with harvest aides, carefully consider the crop condition and environmental conditions. Lush plants and hot (greater than 90°F) temperatures may be conducive to leaf sticking if additives are used.

Table 10. Rain-safe Period and Carrier Volume¹

PRODUCT	—————Rain-safe Period—————		—Minimum Water Carrier Volume—	
	without surfactant ²	with surfactant	aerial	ground
mepiquat chloride (Pix)	8 hours	4 hours	2 gpa	2 gpa
mepiquat pentaborate	2 hours	1 hour	2 gpa	10 gpa
cyclanilide + mepiquat chloride	4-8 hours	2 hours	2 gpa	10 gpa

¹ Specifications in this table are according to manufacturer's label directions.

² Rain-safe period may vary according to the product used, rain-fall duration, and the inclusion of a high-quality EPA-exempt surfactant.

Table 11. Plant Growth Regulators		
Trade Name	Common Name	Application Instructions
PIX and various trade names and formulations	mepiquat chloride (MC)	Apply Pix (8 to 16 fluid ounces) when cotton is approximately 20 to 30 inches tall and is not more than 7 days beyond the early bloom stage (five to six blooms per 25 row feet) or when poorly fruited cotton is 24 inches tall. Subsequent applications can begin 2 to 3 weeks after the first one. MC products can also be applied in low-rate multiple treatments when cotton is at the match-head square stage with additional treatments made at 7- to 14-day intervals if re-growth occurs. Low rate multiple application rates may increase according to the vegetative vigor of the field. Do not apply more than 48 fluid ounces of standard Pix or its active ingredient equivalent (0.132 pound mepiquat chloride) per acre per season. Late-season applications can be made up to 30 days prior to harvest. Since there are many trade names and formulations of MC available, read and follow use directions for the specific product.
PENTIA (8-24 fl.oz.)	mepiquat pentaborate (0.026-0.154 lb.)	Make initial application after cotton has reached the pinhead square stage and is actively growing and the second application after 2 weeks on vigorously growing cotton that has greater than five NAWF. Subsequent applications can be made as needed. Pentia can also be applied late in the bloom cycle on cotton likely to experience additional vegetative growth or re-growth up to 30 days prior to harvest. Do not exceed 48 fluid ounces of Pentia per acre per season.
STANCE (2-4 fl.oz.)	cyclanilide + mepiquat chloride	Begin applications at match-head square when 50 percent of the cotton plants have one or more match-head squares or later. Sequential applications should begin 7 to 14 days later or when re-growth occurs with a minimum of 7 days between applications. Do not apply within 30 days of harvest. Rate is dependent upon field examination and vegetative vigor. Do not exceed 22 fluid ounces of Stance per acre per year.

Table 12. Boll Opening Products		
Trade Name (Product/A)	Common Name (Rate a.i./A)	Application Instructions
BOLL'D* ETHEPHON PREP SUPER BOLL (1.33-2.67 pt.)	ethephon (1-2 lb.)	Apply in 5 to 50 gallons of water per acre when 40 to 60 percent of the bolls are open and when there are sufficient mature unopened bolls to produce the desired yield. Ethephon can be used 4 to 7 days prior to application of defoliant as a preconditioning agent, tank mixed with defoliants, or applied after defoliation. DO NOT harvest cotton sooner than 7 days after ethephon application. DO NOT mix ethephon with sodium chlorate products because toxic chlorine gas fumes will be produced.
* The addition of 5.33 fluid ounces of ethephon to Dropp or Folex is registered for use in Alabama. These mixtures have provided accelerated defoliation in some cases over the defoliant used alone, especially under less than ideal conditions.		

Table 13. Defoliants		
Trade Name (Product per Acre)	Common Name (Rate a.i. per Acre)	Application Instructions
SODIUM CHLORATE (several brands) Read label for rates.	sodium chlorate with fire suppressant (3-3.25 lb.)	Apply to mature cotton plants after the youngest bolls expected to make cotton are at least 30 days old. DO NOT apply later than 7 days before harvest. With ground equipment, use 10 to 20 gallons of spray solution per acre; by air, use 5 to 10 gallons per acre.

Table 13. Defoliant (cont.)

Trade Name (Product per Acre)	Common Name (Rate a.i. per Acre)	Application Instructions
AIM 2EC (1-1.6 fl.oz.) + Crop Oil Concentrate (1 pt.)	carfentrazone (0.01-0.025 lb.) + crop oil concentrate	Apply when 60- to 70-percent of the bolls are open or according to Cooperative Extension System recommendations. Aim may be applied as a tank mix with other cotton harvest aids or as a sequential treatment. When applied alone, Aim provides cotton defoliation and dessication of annual morningglory vines.
BLIZZARD EC (0.6 fl.oz.) + Crop Oil Concentrate (1 pt.)	fluthiacet (0.004 lb.) + crop oil concentrate	Apply when 60 percent or more of the bolls are open AND there are no more than four nodes between the highest first position cracked boll and the highest first position harvestable boll. May be mixed with other harvest aide products.
FIRSTPICK or COTTONQUICK (2-3.5 qt.)	ethephon plus tetraoxosulfate (4.8-8.4 lb.)	CottonQuick is a combination product designed to provide defoliation and open bolls. Dropp may be added to the tank mix to increase regrowth control.
DEF 6 (1-2 pt.)	phosphoro-trithioate (0.75-1.5 lb.)	Apply Def when 50 percent or more of the bolls are open and 7 to 10 days prior to anticipated picking. Use the low rate when the crop is mature and the weather is warm. When plants are still green and actively growing, when the temperature is cool, or when the weather is dry, use higher rates or a tank mix with another defoliant. Spray-mix of 5 to 25 gallons per acre should be applied.
DROPP SC or Generic Forms (3-6 fl.oz.)	thidiazuron (0.1-0.2 lb.)	Apply Dropp to plants ONLY when 60 to 70 percent of the bolls are open. Apply in 10 to 25 gallons of water per acre by ground equipment and 2 to 10 gallons per acre by air. Use higher rates during periods of low temperatures. Apply at least 5 days prior to picking. May be tank mixed with Def or Prep. Thidiazuron rates as low as 0.05 pound per acre (0.1 pound Dropp 50 WP or 1.5 fluid ounces Free Fall SC) may be used in tank mixes. Spray tanks should be cleaned immediately after using Dropp. To make cleanup easier, a non-ionic surfactant or compatibility agent is recommended when using tank mixes of Dropp plus Def. See label for more information.
ET 0.2E (1.5-2 oz.) + Crop Oil Concentrate (1 pt.)	pyraflufen (0.0015-0.003 lb.) + crop oil concentrate	Apply when 50 to 70 percent of bolls are open or according to label recommendations. ET provides cotton defoliation and dessication of annual morningglory vines when used alone.
FINISH 6 PRO (1.3-2 pt.)	ethephon + cyclanilide (1-1.5 lb.)	Finish is a combination product designed to provide defoliation, boll opening, and regrowth control in one product. May be mixed with Def, Dropp, or Harvade.
GINSTAR 1.5E (0.4-1 pt.)	thidiazuron + diuron	Ginstar provides defoliation and regrowth control in cooler weather than Dropp. Adjuvants (crop oil concentrates, non-ionic surfactants) are not required with Ginstar. May be mixed with Prep (ethephon) to provide boll opening.
RESOURCE (4-8 fl.oz.)	flumiclorac (0.027-0.054 lb.)	Apply with 1 to 2 pints crop oil concentrate per acre to cotton at least 60 percent open. Resource can be tank mixed with other harvest aides to increase boll opening or suppress regrowth. A sequential application may be made 7 days after the initial application at up to 6 fluid ounces per acre.
ROUNDUP or TOUCHDOWN or GLYPHOSATE (generic)	glyphosate (1-2 lb.)	For preharvest use to control weeds and to provide regrowth control on non-Roundup Ready cotton. Apply at least 7 days prior to harvest. May be applied when cotton is 20 percent open with no fruiting gaps. Roundup will not defoliate cotton; therefore, a defoliant must be used following a Roundup application. Or, a tank mix with defoliant can be applied at the proper timing for defoliant use.

Table 14. Desiccants

Trade Name (Product per Acre)	Common Name (Rate a.i. per Acre)	Application Instructions
GRAMOXONE LS (1-2 pt.) or FIRESTORM (0.67-1.33 pt.) + Non-ionic Surfactant (1 pt./100 gal. spray mix)	paraquat (0.25-0.5 lb.) + non-ionic surfactant	Apply as a desiccant when 80 percent or more of the bolls are open and the remaining bolls to be harvested are mature. DO NOT apply within 3 days before harvest. Low rates of paraquat may be used to speed boll opening when used with ethephon. Consult specific paraquat label for rate. Paraquat is a RESTRICTED USE pesticide.
SODIUM CHLORATE (several brands)	sodium chlorate (4 lb.)	Apply when cotton is fully mature and 70 percent or more of the bolls are open. DO NOT mix with other harvest aids. Picking should begin no later than 7 days after treatment.

Table 15. Additives

Trade Name (Product per Acre)	Common Name (Rate a.i. per Acre)	Application Instructions
AMS 99% Powder (2 lb.)	ammonium sulfate (2 lb.)	Research has shown a small quantity of ammonium sulfate added to the spray mixture can increase the amount of defoliant which penetrates the cotton leaf.
PREP (other trade names) (5-6 fl.oz.)	ethephon (0.25 lb.)	The addition of 5 to 6 fluid ounces of ethephon per acre to defoliant has increased leaf drop in some cases. This rate will not open bolls.
ADJUVANTS	crop oil concentrates non-ionic surfactants penetrants wetting agents spreader-stickers organo silicones	Adjuvants form a broad group of materials sold under a variety of trade names to be used with post-applied chemicals. Read the harvest aid label to determine if any adjuvant should or can be used.

WEED MAPS

Importance of Weed Maps

Maps showing locations of weed infestations in cotton fields are extremely helpful in planning and conducting weed control programs. Knowing the location of perennial weeds such as bermudagrass in fields helps in winter tillage programs and spot treatment with herbicides. The identification and location of weeds such as prickly sida (teaweed), spurred anoda, and velvetleaf should be extremely helpful in herbicide selection and rates needed.

Time of Year.

Weed maps should be made near the end of the growing season, with the ideal time being just before picking. Producers who employ scouts to check for insects could let the scouts

make weed maps of the fields the last time they scout the cotton. It is important to be as accurate as possible so that weed maps will reflect the weed problems in the field.

How to Make a Weed Map

In an average field, make a minimum of one count per 10 acres at random in the field. If one weed dominates in an area of the field, note on the field diagram the area of high population. Step off 500 feet. Count and record the number of different weeds for two crop rows and one middle. Count all weeds no matter how small. As you are moving through the field, note and diagram weeds such as johnsongrass, bermudagrass, and nutsedge on the field outline. In skip row cotton, count the skip and the rows on each side.

Cotton Defoliation Guide and Cotton Growth Regulators and Harvest Aid Products prepared by **Steve Li**, *Extension Specialist*, Assistant Professor, Crop, Soil and Environmental Sciences, Auburn University; **Charles Burmester**, *Extension Agronomist*, Crop, Soil and Environmental Sciences, Auburn University; **Dale Monks**, *Extension Agronomist*, Professor, Crop, Soil and Environmental Sciences, Auburn University; and **John W. Everest**, Professor Emeritus, Department of Crop, Soil and Environmental Sciences, Auburn University.

FOR MORE INFORMATION on pesticides, pesticide safety, or submitting samples for analysis, see the following publications in the IPM series:

IPM 1293, "Safety." Safety contact information; worker protection standards; the safe use, handling, and storage of pesticides

IPM 1294, "Submitting Samples." Procedures for submitting samples for diagnosis, analysis, and identification

IPM 1295, "General Pesticide Information." Federal and state restricted use pesticide lists; pesticides and water quality

IPM 1317, "Appendix." Pesticide guidelines for agronomic crops, including preharvest intervals; rain-free requirements; grazing restrictions; crop rotation guidelines; and the names, classifications, and toxicities of pesticides.

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For more information, contact your county Extension office. Visit www.aces.edu/counties or look in your telephone directory under your county's name to find contact information.

Use pesticides **only** according to the directions on the label. Follow all directions, precautions, and restrictions that are listed. Do not use pesticides on plants that are not listed on the label

The pesticide rates in this publication are recommended **only** if they are registered with the Environmental Protection Agency or the Alabama Department of Agriculture and Industries. If a registration is changed or canceled, the rate listed here is no longer recommended. Before you apply **any** pesticide, check with your county Extension agent for the latest information.

Trade names are used **only** to give specific information. The Alabama Cooperative Extension System does not endorse or guarantee any product and does not recommend one product instead of another that might be similar.

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