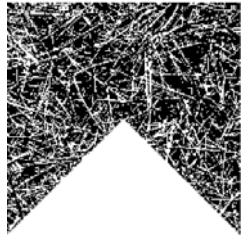


IPM



Cotton

Insect, Disease, Nematode, and Weed Control Recommendations for 2008

INSECT CONTROL

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 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 5 to 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. Correct swath widths depend on the type aircraft used, weather, number and kind of insects present, and other factors.

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 during the past several years. 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 and Bollgard II 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.

Systemic insecticides applied as granules in the soil at planting time will retard the buildup of spider mites. If populations develop, make foliar applications of a recommended miticide. 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 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. 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. Make one or more applications when 100 adults and/or nymphs are found per 100 row feet. If early square set is less than 80 percent, make one or more applications when populations exceed 50 adults and/or nymphs per 100 row feet. 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 Baldwin, Mobile, and

Houston 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. They 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 another predaceous stink bug, the spined soldier bug, but can be distinguished from it by the very sharply pointed “shoulders” on the spined soldier bug. 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.

Table 1. Cotton Insect Control

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
Beet Armyworms					
	emamectin benzoate DENIM 0.16EC	6-8 oz.	0.0075-0.01	21	
	indoxacarb STEWARD 1.25SC	9.1-10.7 oz.	0.09-0.11	14	
	methoxyfenozide INTREPID 2F	4-10 oz.	0.06-0.16	14	
	spinosad TRACER 4SC	2.14-2.9 oz.	0.067-0.089	14	

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
Bollworms/Tobacco Budworms					
<i>Seed</i>					
	Bt transgenic cotton BOLLGARD BOLLGARD II WIDESTRIKE				Excellent activity should be achieved against the tobacco budworm. Bollgard provides suppression against bollworms, and this activity is improved by Bollgard II. See Table 3 for activity against all caterpillar pests.
<i>Bollworms: Larvicides</i>					
	beta-cyfluthrin BAYTHROID XL 1EC Other brand names (see label)	1.6-2.6 oz.	0.0125- 0.0205	0	<i>In previously untreated fields where beneficials are present, apply when ten small larvae (0.25 inch) per 100 plants are found. In previously treated fields where beneficials are low or absent, apply when five small larvae per 100 plants are found. Isolated problems with pyrethroid resistance have been reported throughout the eastern United States.</i>
	bifenthrin BRIGADE 2EC Other brand names (see label)	2.56-5.12 oz.	0.04-0.08	14	
	cypermethrin AMMO 2.5EC Other brand names (see label)	2-3 oz.	0.04-0.06	14	
	esfenvalerate ASANA XL 0.66EC	5.8-9.6 oz.	0.03-0.05	21	
	gamma-cyhalothrin PROLEX 1.25EC	1.3-2.0 oz.	0.0125-0.02	21	
	indoxacarb STEWARD 1.25SC	10.7 oz.	0.11	14	
	lambda-cyhalothrin KARATE 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 pt.	0.45	15	
	spinosad TRACER 4SC	2-2.9 oz.	0.063-0.089	28	
	thiodicarb LARVIN 3.2F	1.5 pt.	0.6	28	
	zeta-cypermethrin MUSTANG MAX 0.8EC	2.64-3.6 oz.	0.017-0.022	14	

Insect	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.)					
<i>Tobacco Budworms: Larvicides</i>					
	indoxacarb STEWARD 1.25SC	10.7 oz.	0.11	14	<p><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.</p> <p>Tobacco budworms have proven to be more difficult to control with most insecticides (see Table 3). 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.</p> <p>Methomyl and thiodicarb may be used as ovicides to control the egg stage at rates of 0.125 to 0.25 pound active ingredient per acre.</p>
	methomyl LANNATE 2.4 LV	1.5 pt.	0.45	15	
	spinosad TRACER 4SC	1.4-2.9 oz.	0.045-0.089	28	
	thiodicarb LARVIN 3.2F	1.5 pt.	0.6	28	
Cotton Aphids					
	acetamiprid INTRUDER 70WP	0.6-1.1 oz.	0.025-0.05	28	<p>Apply when leaves appear sticky. Make one application; repeat when necessary. At-planting treatments may also give effective early-season control (see Seedling Thrips).</p> <p>Aphids are resistant to many insecticides. Control may vary with location and time of season. Additional applications of the same chemicals are usually ineffective. Leverage is an insecticide mixture designed to control a combination of insect species including bollworms, plant bugs, fleahoppers, cotton aphids, and stinkbugs.</p>
	flonicamid CARBINE 50WG	1.4-2.8 oz.	0.044-0.088	30	
	imidacloprid TRIMAX PRO 4.4	0.9-1.37 oz.	0.03-0.047	14	
	imidacloprid + cyfluthrin LEVERAGE 2.7	3-3.75 oz.	0.063-0.079	7	
	thiamethoxam CENTRIC 40WG	2 oz.	0.05	21	

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments	
Cutworms						
	beta-cyfluthrin BAYTHROID XL 1EC Other brand names (see label)	0.8-1.6 oz.	0.0065-0.125	0	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.	
	chlorpyrifos LORSBAN 4E Other brand names (see label)	1 qt.	1	14		
	cypermethrin AMMO 2.5EC Other brand names (see label)	1.3-5 oz.	0.025-0.1	14		
	esfenvalerate ASANA SL 0.66EC	5.8 oz.	0.03	21		
	gamma-cyhalothrin PROLEX 1.25EC	0.77-1.0 oz.	0.0075-0.01	21		
	lambda cyhalothrin KARATE Z 2.08CS Other brand names (see label)	0.96-1.28 oz.	0.015-0.02	21		
	zeta-cypermethrin MUSTANG MAX 0.8EC	1.3-2 oz.	0.008-0.012	14		
Fall Armyworms						
	acephate ORTHENE 90SP ORTHENE 97 Other brand names (see label)	1.1 lb. 1 lb.	1 0.97	21 21		Apply when ten or more larvae per 100 plants are found.
	chlorpyrifos LORSBAN 4E Other brand names (see label)	0.5-2 pt.	0.25-1	14		
	indoxacarb STEWARD 1.25SC	9.1-10.7 oz.	0.09-0.11	14		
	methomyl LANNATE 2.4LV	0.3-0.5 lb.	0.3-0.45	15		
	novaluron DIAMOND 0.83EC	6-12 oz.	0.39-0.77	30		
	pyrethroids	Use high labeled rates.	See Table 2.			
	spinosad TRACER 4SC	2.14-2.9 oz.	0.067-0.089	28		
	thiodicarb LARVIN 3.2F	24-36 oz.	0.6-0.9	28		

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
Grasshoppers					
	acephate				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.
	ORTHENE 90SP	0.3-1.2 lb.	0.25-1	21	
	ORTHENE 97	0.52-1 lb.	0.25-1	21	
	Other brand names (see label)				
	chlorpyrifos				
	LORSBAN 4E	0.5-1.5 pt.	0.25-0.75	14	
	Other brand names (see label)				
	dicrotophos				
	BIDRIN 8EC	4-8 oz.	0.25-0.5	10	
	diflubenzuron				
	DIMILIN 2L	2 oz.	0.03	---	
	pyrethroids	Use labeled rates.	See Table 2.		
Plant Bugs, Fleahoppers					
	acephate				If pinhead square set is less than 80 percent, make one or more applications when populations exceed 50 adults and/ or nymphs per 100 row feet. If square set is greater than 80 percent, applications may be needed when 100 adults and/or nymphs are found per 100 row feet. During peak bloom and beyond, applications should be made when 15 to 20 percent of the bolls have damage. Diamond is an insect growth regulator and is most active on the immature stage of bugs.
	ORTHENE 90SP	0.37-0.55 lb.	0.33-0.5	21	
	ORTHENE 97	0.35-0.55 lb.	0.33-0.5	21	
	Other brand names (see label)				
	acetamiprid				
	INTRUDER 70WP	1.1 oz.	0.05	28	
	chlorpyrifos				
	LORSBAN 4E	16 oz.	0.5	14	
	Other brand names (see label)				
	dicrotophos				
	BIDRIN 8EC	3.2-5.3 oz.	0.2-0.33	10	
	flonicamid				
	CARBINE	2.8 oz.	0.088	30	
	imidacloprid				
	TRIMAX PRO 4.4	1.37 oz.	0.047	14	
	Other brand names (see label)				
	methomyl				
	LANNATE 2.4 LV	13 oz.	0.25	15	
	methyl parathion				
	METHYL PARATHION 4EC	0.5-1 pt.	0.25-0.5	7	
	PENNCAP-M 2FM	1-2 pt.	0.25-0.5	7	
	Other brand names (see label)				
	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	
	thiamethoxam				
	CENTRIC 40WG	2 oz.	0.05	21	

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
Seedling Thrips					
<i>Foliar Treatment</i>					
	acephate				Make one or more applications to seedling cotton (two- to four-leaf stage) when damage is evident and early crop maturity is important. If western flower thrips are present, higher rates will be necessary for control. See recommendations listed under western flower thrips.
	ORTHENE 90SP	0.11-0.22 lb.	0.1-0.2	21	
	ORTHENE 97	0.11-0.21 lb.	0.1-0.2	21	
	Other brand names (see label)				
	dicrotophos				
	BIDRIN 8EC	3.2 oz.	0.2	10	
	dimethoate 4E				
	Other brand names (see label)	6.4 oz.	0.2	14	
	thiamethoxam				
	CENTRIC 40WG	2 oz.	0.05	21	
<i>In-Furrow Granular Treatment</i>					
	aldicarb				Apply as granules in soil at planting.
	TEMIK 15G	3.5-5 lb.	0.53-0.75	90	
<i>In-Furrow Liquid Treatment</i>					
	acephate				Both Orthene and Admire in-furrow sprays may be applied with a liquid fungicide.
	ORTHENE 90SP	1 lb.	0.9	21	
	ORTHENE 97	1 lb.	0.97	21	
	Other brand names (see label)				
	imidacloprid				
	ADMIRE	17.9 oz.	0.28	21	
<i>Seed Treatment</i>					
	imidacloprid	See label.			
	GAUCHO GRANDE				
	thiamethoxam	See label.			
	CRUISER				
	AVICTA				
Soybean Loopers					
	emamectin benzoate				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 now resistant to many cotton insecticides.
	DENIM 0.16EC	8-12 oz.	0.01-0.015	21	
	indoxacarb				
	STEWARD 1.25SC	6.7-9.1 oz.	0.065-0.09	14	
	methoxyfenozide				
	INTREPID 2F	4-10 oz.	0.06-0.16	14	
	spinosad				
	TRACER 4SC	2.14-2.9 oz.	0.067-0.089	28	

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments	
Spider Mites						
	bifenthrin BRIGADE 2EC Other brand names (see label)	3.8-6.4 oz.	0.06-0.1	14	FOLIAR TREATMENT: Treat field when leaves begin to redden and mites are numerous. Resistance to most acaricides is common; therefore, results may vary. Control of spider mites on rapidly growing cotton is difficult.	
	chlorpyrifos LORSBAN 4E Other brand names (see label)	1 pt.	0.5	14		
	dicofol KELTHANE 4MF Other brand names (see label)	1.5-3 pt.	0.75-1.5	30		
	dimethoate 4EC Other brand names (see label)	1 pt.	0.5	14		
	etoxazole ZEAL	0.66-1 oz.	0.03-0.45	28		
	profenofos CURACRON 8E	0.75 pt.	0.75	14		
	spiromesifen OBERON 2SC	8-16 oz.	0.25-0.5	30		
Stink Bugs, Leaf Footed Bugs						
	acephate ORTHENE 90S ORTHENE 97 Other brand names (see label)	8.6 oz. 0.5 lb.	0.5 0.5	21 21		Apply controls when 15 to 20 percent of medium-sized bolls the diameter of a quarter display internal signs of feeding and stink bugs are observed or when stink bug numbers exceed one per 18 row feet. Organophosphates should be used for control of brown stink bugs and leaf footed bugs. Diamond is an insect growth regulator and is most active against the immature stage of stink bugs.
	dicrotophos BIDRIN 8EC	4-8 oz.	0.25-0.5	10		
	methyl parathion 4EC METHYL PARATHION 4EC	1-2 pt.	0.5-1	7		
	PENNCAP-M 2FM Other brand names (see label)	2 pt.	0.5	7		
	novaluron DIAMOND 0.83EC	9-12 oz.	0.058-0.077	30		
	oxamyl VYDATE CLV 3.77	8.5-10 oz.	0.25-0.33	14		
	pyrethroids	Use labeled rates.				

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
Western Flower Thrips					
	acephate				Economic thresholds are not well defined. To suppress, make two applications at 5- to 7-day intervals.
	ORTHENE 90SP	0.6-0.83 lb.	0.5-0.75	21	
	ORTHENE 97	0.52-0.77 lb.	0.5-0.75	21	
	Other brand names (see label)				
Whiteflies (Bandedwing)					
	acephate				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.
	ORTHENE 90SP	0.6-1.2 lb.	0.5-1	21	
	ORTHENE 97	0.52-1 lb.	0.5-1	21	
	Other brand names (see label)				
	acetamiprid				
	INTRUDER 70WP	1.7-2.3 oz.	0.075-0.1	28	
	imidacloprid				
	TRIMAX 4F	1.5 oz.	0.047	14	
	thiamethoxam				
	CENTRIC 40WG	2 oz.	0.05	21	
Whiteflies (Silverleaf)					
	acetamiprid				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 five immature whiteflies are found in an area the size of a nickle on the underside of the leaf surface.
	INTRUDER 70WP	1.7-2.3 oz.	0.075-0.1	28	
	pyriproxfen				
	KNACK 0.86EC	8-10 oz.	0.054-0.067	28	

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.

Table 2. Pyrethroid Rates for Cotton in Pounds Active per Acre, Acres per Gallon, and Ounces per Acre

Materials and Formulation	Pounds Active per Acre, (Acres per Gallon), [Ounces per Acre]		
	Low	Medium	High
Ambush 2	0.1 (20) [6.4]	0.15 (13) [9.6]	0.2 (10) [12.8]
Ammo 2.5	0.04 (63) [2] – 0.05 (50) [2.6]	0.06 (42) [3.1]	0.08 (31) [4]
Asana 0.66	0.02 (33) [3.9] – 0.03 (22) [5.8]	0.04 (17) [7.5]	0.05 (13) [9.7]
Baythroid XL	0.0125 (80) [1.6] – 0.014 (71) [1.8]	0.0166 (60) [21.3]	0.0205 (49) [2.6]
Brigade 2	0.04 (50) [2.6] – 0.05 (40) [3.2]	0.06 (33) [3.9]	0.08 (25) [5.1]
Decis 1.5	0.019 (79) [1.6]	0.025 (60) [2.1]	0.03 (50) [2.6]
Karate 2.08	0.015 (140) [1]	0.03 (69) [1.8]	0.04 (52) [2.6]
Mustang Max 0.8	0.008 (100) [1.3]	0.0165 (50) [2.6]	0.022 (36) [3.6]
Pounce 3.2	0.1 (32) [4]	0.15 (21) [6]	0.2 (16) [8]
Prolex 1.25	0.0075 (167)[0.77]	0.0125 (100) [1.3]	0.02 (62) [2.0]

EFFECTIVENESS OF INSECTICIDES AND TRANSGENIC COTTON ON TARGET PESTS

The insecticide ratings found in Tables 3 and 4, below and on the following pages, 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. In this rating

scale, 1 indicates good control; 2 means the product gives control but is not quite as good as products that are rated 1; 3 means some suppression but growers would likely not be pleased with the level of control achieved; 4 or 5 means little or no control activity at all.

Table 3. 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	1	5	1	2	1-2	3	1
WideStrike	1	1-2	5	1	1-2	1	1	1

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

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

Table 4. Insecticide Effectiveness Ratings*

INSECTICIDES	INSECTS						
	Aphids	Beet Armyworms	Beneficial Insects**	Boll Weevils	Bollworms	Budworms	Fall Armyworms
Ammo	4	5	1	1-2	1	3	3
Asana XL	4	5	1	2	1	3	3
Baythroid XL	4	5	1	1-2	1	3	3
Bidrin	3	5	1	3	5	5	5
Brigade	3	5	1	1	1	3	2
Carbine	1-2	5	3	5	5	5	5
Centric	1-2	5	2	5	5	5	5
Curacron	5	3	2-3	4	2	3	2
Decis	4	5	1	2	1	3	2
Denim	5	1	4	5	3	3	2
Diamond	5	2-3	3	4	4	4	2
Dimilin	5	3	5	4	5	5	3
Intrepid	5	1	5	5	3	3	2
Intruder	1	5	3	5	5	5	5
Karate	4	5	1	1-2	1	3	2
Knack	2	5	3	5	5	5	5
Lannate	4	3-4	3	5	2	2	2
Larvin	5	2	3	5	2	2	2
Lorsban	4	2	2-3	3	3	4	2
Malathion	5	5	1	1	5	5	5
Methyl Parathion	4	5	2	1	3	5	4
Monitor	5	5	1	5	5	5	5
Mustang Max	4	5	1	1-2	1	3	2
Orthene	5	4-5	1	5	3	3-4	3
Pennacp M	4	5	3	1	3	5	4
Prolex	4	5	1	1-2	1	3	2
Steward	5	1	4	5	2	1	2
Tracer	5	1	4	5	2	1	2
Trimax Pro	1-2	5	3	5	5	5	5
Vydate	5	5	2	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.

Table 4. Insecticide Effectiveness Ratings* (cont.)

INSECTICIDES	INSECTS						
	Plant Bugs	Seedling Thrips	Soybean Loopers	Spider Mites	Stink Bugs (Brown)	Stink Bugs (Green)	Whiteflies
Ammo	2	1	3	5	4	2	4
Asana XL	3	1	4	5	4	2	4
Baythroid XL	3	1	4	5	4	2	4
Bidrin	1	1	5	4	1	1	4
Brigade	1	1	4	3	3	2	4
Carbine	2-3	2-3	5	5	--	--	--
Centric	2	1	5	5	2-3	2-3	2
Curacron	3	3	3	2	3	3	4
Decis	3	1	3	5	4	2	4
Denim	4	5	1	3	5	5	5
Diamond	2	5	2	5	2-3	2-3	5
Dimilin	5	5	3	5	5	5	5
Intrepid	5	5	1	5	5	5	5
Intruder	2-3	1-2	5	--	3	3	1-2
Karate	1	1	4	5	4	2	4
Knack	4	3-4	5	3	4	4	1
Lannate	3	5	3	5	4	4	5
Larvin	4	5	2	5	5	4	5
Lorsban	2	2	4	3	3	3	4
Malathion	1	4	5	5	1	1	5
Methyl Parathion	1	3	4	5	1	1	5
Monitor	2	2	5	5	4	4	2
Mustang Max	2	1	3	5	4	2	4
Orthene	1	1-2	3	5	2	2	2
PennCap M	3	4	4	5	1	1	4
Prolex	2	1	3	5	4	2	4
Steward	3	5	1	5	3	3	5
Tracer	5	5	1	5	5	5	5
Trimax Pro	2-3	2	5	5	4	4	2
Vydate	3	3	5	5	2	2-3	4

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

DISEASE AND NEMATODE CONTROL

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 solania* and *Fusarium* spp. but not against *Pythium* spp., whereas Metalxyl®, Anchor®, and Apron XL® are primarily active against *Pythium* spp. Maxim®, Dynasty®, and Dividend® are active against a wide range of soilborne diseases.

Table 5 lists individual companies and the seed treatment products they offer. This list includes fungicide and insecticide products.

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 5. Commercial Seed Treatment Products¹		
Company Name	Fungicide	Insecticide
Delta and Pine Land	Allegience Apron XL azoxystrobin Baytan Dynasty CST® Kodiak Maxim 4FS Metalaxyl NuFlow M NuFlow ND Systane Thiram Vitavax PCNB	Acephate Cruiser Gaucho Lorsban
FiberMax (Bayer Crop Science)	Argent 30FL Allegience LS Baytan Baytan FL Captan Kodiak Thiram	Lorsban
Phytogen	Maxim 4FS Thiram Systhane WP	Gaucho
Stoneville	Apron XL Maxim 4FS Thiram Systhane WP	Gaucho Cruiser

¹ This list includes some of the fungicides and insecticides that are available as commercial seed treatments. Seed companies and agricultural chemical companies including Bayer Ag Chemical and Syngenta offer a wide variety of seed treatments that are effective against soilborne seedling disease and early season insects. Other seed treatments not listed in this table are also available.

Table 6. In-Furrow Fungicide Treatments for Cotton Seedling Disease Control

Consult product guides and labels before applying fungicides and for plantback restrictions. Not all fungicides and formulations are listed due to space constraints.

Fungicide and Formulation	Amount Formulation per Acre (40-Inch Row)	Comments
In-Furrow (Granules)		
PCNB TERRACLOR 15 G	6-10 lb.	Apply PCNB in the seed furrow at planting where <i>Rhizoctonia</i> is the major seedling disease problem.
PCNB + metalaxyl RIDOMIL GOLD PC GR	7-10 lb.	DO NOT follow Ridomil with a root crop within 12 months of application. Apply granule formulation in open furrow.
PCNB + terrazole TERRACLOR SUPER X GRANULAR TERRACLOR SUPER X 18.8G	8-12 lb. 5.5-10 lb.	
PCNB + terrazole + disulfoton TERRACLOR SUPER X with DI-SYSTON	See label.	
QUADRIS GR	See label.	See label.
In-Furrow (Spray)		
azoxystrobin QUADRIS FLOWABLE	See label.	For control of <i>Rhizoctonia</i> and <i>Pythium</i> . Use high rate if field has history of <i>Pythium</i> or if a minimum tillage program is in place.
iprodione ROVRAL	6.5 oz./A	
PCNB TERRACLOR FLOWABLE	1.5-3 pt./3-10 gal. water	Apply PCNB in the seed furrow and covering soil where <i>Rhizoctonia</i> seedling disease is the major problem.
TERRACLOR 2-LB. EMULSIFIABLE TERRACLOR 75WP	3-6 pt./5-15 gal. water 1.33-2.75 lb./15 gal. water	
PCNB + metalaxyl RIDOMIL GOLD PC LIQUID	1-3 oz.	See label.
PCNB + terrazole TERRACLOR SUPER X EMULSIFIABLE	3-6 pt.	Apply in the furrow as a spray. DO NOT follow Ridomil with a root crop within 12 months of application. Apply fungicides in 5 to 15 gallons of water per acre.
PCNB + terrazole + disulfoton TERRACLOR SUPER X + DI-SYSTON EC	4-5.5 pt.	Di-Syston is included for early season insect control.

Nematodes

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. Table 7 lists varieties grown in Alabama and their reaction to the root-knot/Fusarium wilt complex.

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 undecomposed organic matter and dirt clods. Temik, a granule, is applied in the seed furrow at planting. Aeri and Avicta are reported to be effective against low populations of reniform nematodes. Temik, Avicta, and Aeri also have activity against early season insects while Telone II is only active against nematodes.

Table 7. Results from a Three-Year Study to Evaluate Commercial Cotton Varieties' Response to Fusarium Wilt/Root-Knot Nematode Complex

COTTON VARIETY	PERCENT FUSARIUM WILT			
	2004	2005	2006	2007 ¹
Rowden	79	68	44	–
CG 3020 B2RF	•	•	0	–
DG2520 B2RF	•	•	0	–
DP143 B2RF	•	•	1	–
DP147 B2AF	•	•	2	–
DP 444 BG/RR	3	2	•	–
DP 445 BG/RR	•	•	0	–
DP 449 BG/RR	5	7	•	–
DP 451 BG/RR	1	•	•	–
DP 454 BG/RR	•	19	4	–
DP 488 BG/RR	3	5	•	–
DP 491	3	4	•	–
DP 515 BG/RR	•	•	1	–
DP 555 BG/RR	7	5	3	–
FM 958 LL	59	18	•	–
FM 965 LLB2	•	•	2	–
FM 991 BR	•	1	•	–
FM 960 BR	10	3	1	–
FM 989 BR	15	1	•	–
FM 9063 B2F	•	•	1	–
PHY 410 RR	8	10	•	–
PHY 480 WR	•	•	2	–
PHY 485 WRF	•	•	1	–
ST 4664 RF	•	•	0	–
ST 4686 R	•	1	•	–
ST 4892 BR	10	8	•	–
ST 5303 R	5	3	•	–
ST 5599 BR	2	6	•	–
ST 6611 B2RF	•	•	1	–

• = Variety not tested that year. – = Data not available.

CG = Crop Gen., DG = DynaGro, DP = Delta Pine, FM = FiberMax, PHY = PhytoGen, ST = Stoneville

¹ 2007 data not available due to lack of disease pressure as the result of extremely dry conditions.

Table 8. Cotton Nematode Control

Nematodes	Nematicide and Formulation	Amount of Formulation per Acre (38-Inch Row)	Comments
Root-knot, Reniform			
aldicarb TEMIK 15G		5 lb. 5lb. + 5 lb.	DO NOT exceed 7 pounds per acre when applying in-furrow. Side-dress at pinhead square.
AERIS (Seed treatment)			Available through Stoneville, FiberMax, and Delta and Pine Land. Used in combination with Gaucho Grande.
AVICTA 500 FS (Seed treatment)		See label.	Available only in Avicta Complete Pak with Dynasty CST and Cruiser. Applied only by Delta and Pine Land and Monsanto and selected retailers.
TELONE II (Fumigant)		3 gal.	Inject Telone 12 to 16 inches below soil surface. Seal immediately with a coulter or cultipacker. Wait 7 to 14 days before planting.
VAPAM		3-5 gal	Inject Vapam 12 to 16 inches below soil surface. Seal immediately with a coulter or cultipacker. Wait 7 to 14 days before planting.
VYDATE C-LV		8.5-17 oz.	Apply as a foliar spray at pinhead square as a supplement to in-furrow Temik 15G application. See label for details.

Disease and Nematode Control section prepared by William S. Gazaway, former *Extension Plant Pathologist*, Professor Emeritus, Entomology and Plant Pathology, Auburn University; Kathy S. Lawrence, *Plant Pathologist*, Associate Professor, Entomology and Plant Pathology, Auburn University; Edward J. Sikora, *Extension Plant Pathologist*, Professor, Entomology and Plant Pathology, Auburn University; Dale Monks, *Extension Agronomist*, Professor, Agronomy and Soils, Auburn University; and Charles Burmester, *Extension Agronomist*, Agronomy and Soils, Auburn University.

WEED CONTROL

Table 10. Cotton Weed Control

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
Preplant Foliar (Burndown)		
AIM EC (2 oz.)	carfentrazone (0.031 lb.)	Apply prior to planting or within 24 hours after planting for burndown of several broadleaf weeds. May be mixed with glyphosate, glufosinate, 2,4-D, or dicamba to increase spectrum. Obey the most restrictive product label. Add non-ionic surfactant (1 quart per 100 gallons) or crop oil concentrate (1 gallon per 100 gallons of spray mix) to spray solution.
CLARITY or VISION (8 fl. oz.)	dicamba (0.25 lb.)	Apply to cotton fields that will not be planted within 21 days. A minimum of 1 inch of rainfall or overhead irrigation is required within the 21-day interval. May be mixed with other herbicides. Consult label for tank-mix partners.
CAPAROL 4L (1.5 pt.)	prometryn (0.75 lb.)	Apply to cotton fields that will not be planted within 14 days. Add crop oil concentrate or surfactant if weeds have emerged. May be mixed with other herbicides. Consult label for tank-mix partners.
ET 0.2EC (0.5-2 fl.oz.)	pyraflufen (0.0008-0.003)	Apply prior to or immediately after planting for control of several broadleaf weeds. May be mixed with other products to increase weed spectrum. See label. Add non-ionic surfactant at 2 pints or crop oil concentrate at 8 pints per 100 gallons of spray mix.
GRAMOXONE INTEON (1.25-2.5 pt.) or FIRESTORM (0.8-1.6 pt.) +	paraquat (0.31-0.62 lb.) +	Apply to emerged winter weeds and grasses prior to cotton planting or emergence. Adding Caparol (prometryn) to Gramoxone increases the effectiveness of this treatment. If Caparol is added, a restriction on planting date after treatment must be observed. See label. Add non-ionic surfactant at 2 pints per 100 gallons of spray solution.
Non-ionic Surfactant (1 pt./25 gal. spray mix)	non-ionic surfactant	
IGNITE 280 (29 oz.)	glufosinate (0.53 lb.)	Apply prior to or immediately after planting but before emergence of cotton to control winter weeds. May be tank mixed with glyphosate, dicamba, or 2,4-D to increase weed spectrum. DO NOT apply within 30 days of planting if 2,4-D (at 1 pint per acre or less) is used.
RESOURCE (2-4 fl.oz.)	flumiclorac (0.013-0.027 lb.)	Use with glyphosate and other products labeled for burndown of winter weeds to increase activity on weeds such as cutleaf evening primrose. Consult label of tank-mix partner for planting restrictions. Add non-ionic surfactant (1 quart per 100 gallons) or crop oil concentrate (1 gallon per 100 gallons spray mix).
ROUNDUP or TOUCHDOWN or GLYPHOSATE (Other generic forms available) +	glyphosate (1-2 lb.) +	Apply to emerged winter weeds and grasses prior to cotton planting or emergence. Effective on horseweed (marestail) and several other species. Consult label for tank-mix partners.
Non-ionic Surfactant (1 pt./25 gal. spray mix)	non-ionic surfactant	

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
Preplant Foliar (Burndown) (cont.)		
VALOR HERBICIDE (1-2 oz.) + Non-ionic Surfactant (1 pt./25 gal. spray mix)	flumioxazin (0.03-0.06 lb.) + non-ionic surfactant	Apply with glyphosate or other labeled burndown herbicide for control of emerged winter weeds. May be applied 14 days prior to planting if 1 ounce rate is used or 21 days prior if 2 ounce rate is used. Field must contain stubble from the previous crop. Provides residual control at 2 ounce rate.
Preplant Incorporated		
PROWL 3.3EC (1.2-3.6 pt.) or PROWL H ₂ O (1-3 pt.) or TREFLAN TRILIN TRIFLURALIN EC See Comments.	pendimethalin (0.5-1.5 lb.) trifluralin (0.5-1 lb.)	If a preemergence overlay is used, use the lowest labeled rate of these preplant incorporated herbicides. DO NOT incorporate deeper than 2 inches. Shallow incorporation is best achieved with a rolling cultivator or “do-all.” If the soil is bedded, incorporate on top of bed after final knock-down of bed. Several trade names for trifluralin are available. See label of specific product for rate.
SOLICAM 80 (1.25-2.5 lb.)	norflurazon (1-2 lb.)	Solicam may be applied as a split application with half the rate incorporated and half applied as an overlay alone or in combination with Cotoran. DO NOT incorporate deeper than 3 inches. DO NOT incorporate more than 1 pound per acre of Solicam 80 on Coastal Plains soils. Use lower rate on light soils. For 1 year following Solicam application, treated acreage may be rotated ONLY to cotton, soybeans, or peanuts.
Preemergence		
CAPAROL 4L COTTON-PRO 4L PROMETRYN 4L (3.2-4.8 pt.)	prometryn (1.6-2.4 lb.)	Application to the soil surface at planting gives good control of many broadleaf weeds and grasses. Control tolerant weeds and weeds from deep-germinating seed that escape this treatment with timely post-directed sprays. Use low rate on sandy loam soil. CAUTION: DO NOT use on coarse sand and loamy sand soils.
COMMAND 3ME (1.33-3.33 pt.)	clomazone (0.5-1.25 lb.)	Apply as a broadcast or band treatment over the drill for control of many annual grasses and some broadleaf weeds. Velvetleaf and spurred anoda can generally be controlled using the lowest labeled rate. To avoid serious crop injury, Command must be used in conjunction with the in-furrow insecticides Disulfoton or Phorate. Command should be tank mixed with fluometuron (Cotoran, Meturon, etc.) for broad spectrum control. Off-site movement of spray drift or volatilization can cause highly visible injury (bleaching) to non-target plants. Wet soils and/or windy conditions contribute to problems with off-target injury. Consult the label for specific rotational intervals and replanting instructions.
COTORAN 80 (2-2.5 lb.) or COTORAN 4L or METURON 4L (3.2-4 pt.)	fluometuron (1.6-2 lb.)	Application to the soil surface at planting provides control of many broadleaf weeds and grasses. Control tolerant weeds and weeds from deep-germinating seed that escape this treatment with timely post-directed sprays. Use lower rate on medium soils and higher rate on fine-textured soils. CAUTION: May interact with organophosphate systemic insecticides to cause injury to young cotton seedlings. To minimize risk of injury, DO NOT exceed recommended rates for specific soil types. For coarse-textured soils low in organic matter, rates should be reduced to 1 to 1.75 pounds of Cotoran 85DF or to 2 to 3 pints of Cotoran 4L or Meturon 4L.

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
Preemergence (cont.)		
COTORAN 4L or METURON 4L (2-3 pt.) +	fluometuron (1-1.5 lb.)	See Comments for each herbicide, above and on the next page.
SOLICAM 80 (1.5-1.9 lb.)	norflurazon (1.2-1.5 lb.)	
KARMEX DF or DIURON 80W (1-1.25 lb.) or DIREX 4L (1.5-2 pt.)	diuron (0.8-1 lb.)	Application to the soil surface at planting provides control of many broadleaf weeds and grasses. Control tolerant weeds and weeds from deep-germinating seed that escape this treatment with timely post-directed sprays. Use lower rate on medium soils and higher rate on fine-textured soils. CAUTION: May interact with organophosphate systemic insecticides to cause injury to young cotton seedlings. To minimize risk of injury, DO NOT exceed recommended rates for specific soil types.
STAPLE LX (1.3-2.1 fl.oz.)	pyrithiobac (0.032-0.043 lb.)	Provides soil-residual activity on sicklepod, morningglory, pigweed, and some other species. The addition of fluometuron (Cotoran, etc.) or diuron (Karmex, etc.) will broaden the spectrum of weeds controlled.
SOLICAM 80 (1.25-2.5 lb.)	norflurazon (1-2 lb.)	Apply to soil surface at planting for control of annual grasses and broadleaf weeds. Solicam also suppresses nutsedge. Solicam has given excellent control of spurred anoda. Soybeans may be planted as a replacement crop if a stand failure should occur. Peanuts may also be planted 30 days after Solicam application as a replacement crop. For 1 year following a Solicam application, treated acreage may be rotated ONLY to cotton, soybeans, or peanuts.
Postemergence Over-The-Top		
ASSURE II (7-10 fl.oz.) +	quizalofop (0.09-0.125 lb.) +	Apply postemergence to actively growing grasses. Use a minimum of 10 gallons spray solution per acre if applied with ground equipment. Use lower rates on annual grasses less than 6 inches tall and higher rates on perennial grasses such as bermudagrass and johnsongrass. A second application may be required with perennial grasses. Use crop oil concentrate with perennials.
Crop Oil Concentrate (2 pt./25 gal. spray mix) or Non-ionic Surfactant (1 pt./25 gal. spray mix)	crop oil concentrate or non-ionic surfactant	
BUCTRIL 4EC (0.5-1 pt.)	bromoxynil (0.25-0.5 lb.)	Apply ONLY to "BXN" cotton varieties which have been genetically modified to tolerate bromoxynil herbicide. Application to standard varieties will kill cotton. Provides control of several broadleaf weeds, including annual morningglory, cocklebur, prickly sida, and coffee senna. Buctril alone may be applied prior to emergence until 75 days prior to harvest. Up to a total of 3 pints per acre may be applied. Add MSMA at 0.75 to 1 pound per acre to increase activity on sicklepod when cotton is at least 3 inches tall but before first bloom.
ENVOKE 75DF (0.1-0.25 oz.) +	trifloxysulfuron (0.047-0.118 lb.) +	Apply as an over-the-top or post-directed treatment to cotton that has a minimum of six true leaves for control of several annual broadleaf weeds and sedges. DO NOT apply more than 0.15 ounce over-the-top. May be tank mixed with Caparol, Dual Magnum, MSMA, etc., for post-directed application at rates up to 0.25 ounce. DO NOT apply to cotton under severe stress. May be applied over-the-top in mix with Staple for control of smallflower morningglory.
Non-ionic Surfactant (1 pt./50 gal. spray mix)	non-ionic surfactant	

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
Postemergence Over-The-Top (cont.)		
FUSILADE DX (0.75 pt.) + Crop Oil Concentrate (2 pt./25 gal. spray mix) or Non-ionic Surfactant (0.5 pt./25 gal. spray mix)	fluazifop-butyl (0.2 lb.) + crop oil concentrate or non-ionic surfactant	Apply over-the-top of cotton for control of annual and perennial grasses. Annual grasses should be treated when they are 2 to 4 inches tall. Johnsongrass should be 12 to 18 inches tall and bermudagrass 3 inches in height to 6 to 12 inches in stolon (runner) length. A second application may be necessary for complete control of johnsongrass and bermudagrass. Use a minimum of 10 gallons of solution per acre and 30 to 60 psi nozzle pressure to ensure complete coverage. Fusilade does not control sedges (nutgrass).
FUSION 2.5E (6-10 fl.oz.) + Crop Oil Concentrate (2 pt./25 gal. spray mix) or Non-ionic Surfactant (0.5 pt./25 gal. spray mix)	fluazifop + fenoxaprop + crop oil concentrate or non-ionic surfactant	Apply postemergence to actively growing grasses. Annual grasses should be less than 6 inches tall when treated. Use 12-fluid-ounce rate for bermudagrass. A finished spray volume of 10 to 20 gallons per acre is sufficient. A second application may be needed for perennial grasses.
IGNITE 280 (1.8-2.7 pt.)	glufosinate (0.42 lb.)	Apply ONLY to Liberty-Link cotton that is tolerant to Ignite herbicide. May be applied to Liberty-Link cotton from emergence to 70 days prior to harvest. Provides broad-spectrum control of annual grasses and broadleaf weeds. Ignite has no soil residual activity. DO NOT apply more than 43 fluid ounces in a single application or more than 87 fluid ounces per acre per year. Consult label for tank mixes.
POAST PLUS (1.5-2.25 pt.) + Crop Oil Concentrate (2 pt.)	sethoxydim (0.2-0.3 lb.) + crop oil concentrate	Apply over-the-top of cotton for control of annual and perennial grasses. Annual grasses should be treated when they are 4 to 8 inches tall except crabgrass and goosegrass, which should be treated before reaching 4 inches in height. Johnsongrass should be 15 to 20 inches in height and bermudagrass should not exceed 6 inches in plant diameter for Poast application. A second application may be necessary for complete control of perennial grasses. Use a minimum of 10 gallons of solution per acre and 40 psi nozzle pressure to ensure thorough spray coverage of foliage. Poast does not control sedges (nutgrass). DO NOT mix with other herbicides.
ROUNDUP or TOUCHDOWN or GLYPHOSATE (other generic forms available)	glyphosate (1 lb.)	FOR USE ONLY ON ROUNDUP-READY COTTON. DO NOT apply over the top beyond four-leaf stage. Provides broad-spectrum control of annual grasses and broadleaf weeds. No surfactant is required. Can be post-directed to the base of the cotton stalk after the four-leaf stage. A total of 4 pounds of active glyphosate may be applied from cotyledon to layby, but DO NOT apply more than 1 pound active in a single application. Wait a minimum of 10 days and obtain two nodes growth between applications. Some formulations of glyphosate may require additional surfactant. Check label.
ROUNDUP or TOUCHDOWN or GLYPHOSATE (other generic forms available)	glyphosate (1-1.4 lb.)	FOR USE ONLY ON ROUNDUP-READY FLEX COTTON. A total of 128 fluid ounce of Roundup Weather Max or Original Max may be applied from emergence to 60 percent open bolls. Do not exceed 32 fluid ounces per application. There is no required waiting period or cotton growth stage between applications. Consult label for tank mixes.

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
Postemergence Over-The-Top (cont.)		
DUAL MAGNUM or STALWART (1 pt.) + ROUNDUP or TOUCHDOWN	metolachlor (0.95 lb.) + glyphosate	Apply over-the-top of Roundup-Ready or Roundup Ready Flex cotton prior to the four-leaf stage. Provides residual control of annual grass and pigweed.
SEQUENCE 5.25EC (2.5 pt.)	glyphosate (0.7 lb.) + metolachlor (0.95 lb.)	Apply to Roundup Ready or RR Flex cotton from 3-inch to four-leaf stage for foliar and residual control of several annual grasses and broadleaf weeds. Residual control is dependent on rainfall or sprinkler irrigation within 5 to 7 days after application.
SELECT 2EC (6-16 fl.oz.) + Crop Oil Concentrate (2 pt./25 gal. spray mix) or Non-ionic Surfactant (1 pt./25 gal. spray mix)	clethodim (0.1-0.25 lb.) + crop oil concentrate or non-ionic surfactant	Apply postemergence to actively growing grasses. Annual grasses should be less than 6 inches tall when treated. A finished spray volume of 10 to 20 gallons per acre is sufficient. Use the higher rate on thick bermudagrass stands. A second application may be needed with perennial grasses. Use crop oil concentrate with perennials.
STAPLE LX (2.6-3.8 fl.oz.) + Non-ionic Surfactant	pyrithiobac (0.06-0.09 lb.) + non-ionic surfactant	Apply to weeds that are less than 3 inches tall. Provides control of several broadleaf weeds including annual morningglory, cocklebur, coffee senna, and pigweed. Add non-ionic surfactant at a rate of 1 pint per 50 gallons of spray mix. DO NOT plant corn or grain sorghum the season following Staple application. Staple alone may be used from first true leaf until 60 days prior to harvest. MSMA at 1 pint per acre (0.75 pound active) may be added to increase sicklepod control. DO NOT apply mixture after pinhead square.
Postemergence Directed		
CAPAROL 4L (1-1.5 pt.) + DSMA (several forms) or MSMA (several forms)	prometryn (0.5-0.75 lb.) + DSMA (3 lb.) MSMA (2 lb.)	Apply as a postemergence directed spray after cotton is 10 inches high on medium and fine soils and after cotton is 12 inches high on coarse soils. As a postemergence spray, Caparol is effective on small annual morningglory, cocklebur, prickly sida, and pigweed. Higher rate of Caparol will provide better residual control of late germinating weeds. Use 1 pint of non-ionic surfactant per 50 gallons of spray mix. DO NOT apply over-the-top of cotton.
COBRA 2E (0.75 pt.) + MSMA (several forms) + Crop Oil Concentrate	lactofen (0.2 lb.) + MSMA (2 lb.) + crop oil concentrate	Apply as a postemergence directed spray after cotton is at least 10 inches tall. Add 1 pint of crop oil concentrate per acre. Cobra is effective on common cocklebur, tropic croton, annual morningglory, and other broadleaf weeds. Weeds should be less than 4 inches tall. Cobra may also be tank mixed with Karmex. DO NOT apply later than 90 days before harvest. DO NOT apply over-the-top of cotton.
COTORAN 80 (1.25-2.33 lb.) or COTORAN 4L (2-4 pt.) + MSMA (several forms) or DSMA (several forms) + Non-ionic Surfactant	fluometuron (1-2 lb.) + MSMA (2 lb.) DSMA (3 lb.) + non-ionic surfactant	Make one to two directed spray applications after cotton is 3 to 4 inches tall. Controls most small annual weeds. DO NOT apply after cotton starts blooming. NOT recommended as an over-the-top spray. Add 1 pint of non-ionic surfactant per 50 gallons of spray mix.

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
Postemergence Directed (cont.)		
DSMA or MSMA See Comments.	DSMA (3 lb.) or MSMA (2 lb.)	Several trade names and formulations are available. See specific product label for rate. Apply as a postemergence directed spray after cotton is 3 to 4 inches tall but before first bloom. Controls most small annual broadleaf weeds and grasses. Repeat applications control nutsedge and johnsongrass. Cotton appears to have slightly more tolerance to DSMA. If a surfactant is not included in the formulated product, add 1 pint of non-ionic surfactant per 25 gallons of spray mix. DO NOT make more than two applications per season. NOT recommended as an over-the-top spray.
DUAL MAGNUM or STALWART (1-1.33 pt.) + MSMA	metolachlor (0.95-1.25 lb.) + MSMA (1.5-2 lb.)	Apply as a directed spray for yellow nutsedge and annual grass control. Will not control Texas panicum or purple nutsedge. DO NOT apply with liquid fertilizer or make more than one application per growing season. DO NOT apply after first bloom. Rainfall or sprinkler irrigation is needed to activate Dual.
GOAL 1.6E (1.25 pt.) + MSMA (several forms) + Non-ionic Surfactant	oxyfluorfen (0.25 lb.) + MSMA (2 lb.) + non-ionic surfactant	Apply as a postemergence directed spray to cotton at least 10 inches tall. DO NOT apply under windy or wet conditions. Add non-ionic surfactant at 1 pint per 50 gallons of final spray solution. Controls a variety of annual broadleaf weeds. DO NOT apply over-the-top of cotton. DO NOT apply within 90 days of harvest.
GRAMOXONE MAX or FIRESTORM (0.8-1.6 pt.) or GRAMOXONE INTEON (1.2-2.4 pt.) hooded + Non-ionic Surfactant	paraquat (0.3-0.6 lb.) + non-ionic surfactant	Apply with a hooded sprayer between rows to avoid contact with the crop. Add non-ionic surfactant at 2 pints per 100 gallons of spray mix. Gramoxone is a RESTRICTED USE pesticide.
KARMEX DF (0.5 lb.) or DIREX 4L (0.8 pt.) + Non-ionic Surfactant (1 pt./25 gal. spray mix)	diuron (0.4 lb.) + non-ionic surfactant	Apply as a directed spray to cotton at least 6 inches tall. Add DSMA (2 pounds active ingredient per acre) to increase overall weed control.
LAYBY PRO (1 pt.)	linuron (0.25 lb.) + diuron (0.25 lb.)	Apply as a directed or hooded/shielded spray to cotton a minimum of 6 inches tall for control of weeds less than 2 inches tall. May be tank mixed with other herbicides; consult label for mixes. Apply in 10 to 30 gallons of spray solution per acre.
LINEX 4L (1-3 pt.) + Non-ionic Surfactant	linuron (0.5-1.5 lb.) + non-ionic surfactant	Apply post-directed to cotton at least 8 inches tall and when weeds are 2 inches or less in size. MSMA may be added to increase weed spectrum. Use higher rates for layby applications.
SUPREND (1-1.5 lb.) + Non-ionic Surfactant (1 pt./50 gal. spray mix)	prometryn (0.8-1.2 lb.) + trifloxysulfuron (0.007-0.0105 lb.) + non-ionic surfactant	Apply as a directed spray to cotton 8 inches tall or taller. Provides foliar and residual control of several annual grasses and broadleaf weeds. May be tank mixed with other herbicides. Consult label.

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
Layby		
Layby treatments are recommended where late-season weeds are expected to be a problem or where stands are er-		ratic. Read the label for maximum amount of a herbicide that can be used in any one year. DO NOT exceed that amount.
AIM 2E (0.8-1.6 fl.oz.) + Crop Oil Concentrate (1 pt.)	carfentrazone (0.01-0.025 lb.) + crop oil concentrate (1 pt.)	Apply as a directed or hooded spray to the base of cotton plants at least 12 inches tall. Provides postemergence control of annual morningglory and other broadleaf weeds. May be mixed with other herbicides to obtain broad spectrum activity. Keep spray off green cotton tissue.
COTORAN 80 (1.25 lb.) or COTORAN 4L (2 pt.) or METURON 80DF (1.25 lb.)	fluometuron (1 lb.)	Apply after last cultivation, using flooding-type or other suitable nozzles mounted close to the ground to keep spray off cotton. If weeds have already emerged, add 1 pint of a non-ionic surfactant per 25 gallons of mix.
COTTON-PRO 4L or CAPAROL 4L (2.5-3.5 pt.)	prometryn (1.25-1.75)	Apply after last cultivation, using flooding-type or other suitable nozzles mounted close to the ground to keep spray off cotton. If weeds have already emerged, add 1 pint of a non-ionic surfactant per 25 gallons of mix.
ET 0.2E (1-2 oz.) + Crop Oil Concentrate (1 pt.)	pyraflufen (0.001-0.003 lb.) + crop oil concentrate	Apply using hooded spray equipment to the base of cotton a minimum of 12 inches tall. Provides control of annual morningglory and other broadleaf weeds. May be mixed with other herbicides to obtain broad spectrum activity. Keep spray off green cotton tissue.
KARMEX DF or DIURON 80WP (1-1.5 lb.) or DIREX 4L (1.5-2.2 pt.)	diuron (0.8-1.25 lb.)	Apply after last cultivation, using flooding-type or other suitable nozzles mounted close to the ground to keep spray off cotton. If weeds have already emerged, add 1 pint of a non-ionic surfactant per 25 gallons of mix.
LAYBY PRO (1.6-2.4 pt.)	linuron (0.4-0.6 lb.) + diuron (0.4-0.6 lb.)	Apply as a directed or hooded/shielded spray to cotton a minimum of 15 inches tall for control of weeds up to 4 inches tall. Provides residual control of germinating weeds following application if activated by rainfall or sprinkler irrigation. Apply in 10 to 30 gallons of spray solution per acre.
VALOR HERBICIDE (1-2 oz.) + Non-ionic surfactant (1 pt./50 gal.)	flumioxazin (0.03-0.06 lb.) + non-ionic surfactant	Apply with glyphosate or MSMA as a hooded spray to cotton a minimum of 6 inches tall or as a layby to cotton at least 18 inches tall. DO NOT use crop oil concentrate.
Salvage Treatment		
DSMA LIQUID	DSMA (2 lb.)	May be applied over-the-top of cotton as a salvage treatment. Apply when cotton has one to five true leaves. DO NOT apply after squaring. Make only one application per season.

NOTE: The crop oil concentrates listed in this table are defined as products that contain 80- to 85-percent petroleum oil plus 15- to 20-percent surfactants and emulsifiers. Non-ionic surfactant is defined as a product that contains at least 80-percent ingredients that act as surface-active agents, spreader stickers, or wetting agents.

Table 11. Estimated Effectiveness of Recommended Herbicide Treatments on Important Weeds Infesting Cotton in Alabama and Properties That May Affect Water Quality¹

WEEDS	HERBICIDES						
	Prowl (PPI)	Treflan (PPI)	Caparol (PRE)	Command (PRE)	Cotoran (PRE)	Cotoran + Solicam (PRE)	Karmex (PRE)
GRASSES							
Bermudagrass	1	1	1	5	0	2	0
Crabgrass	9	9	7	8	8	8	8
Crowfootgrass	9	9	8	7	8	8	8
Fall Panicum	8	8	6	6	7	8	6
Goosegrass	9	9	7	7	7	8	8
Johnsongrass (rhizomes)	2	3	0	3	0	0	0
Johnsongrass (seedlings)	8	8	6	6	6	7	6
Sedges (nutgrass)	0	0	0	2	0	5	0
BROADLEAF WEEDS							
Bristly Starbur	1	1	7	3	8	8	6
Cocklebur	0	0	5	6	7	8	6
Coffee Senna	0	0	5	6	5	6	4
Common Ragweed	3	3	8	6	9	9	8
Florida Beggarweed	0	0	8	--	8	8	8
Florida Pusley	9	9	8	4	9	9	8
Jimsonweed	3	3	7	6	7	8	6
Lambsquarter	7	7	8	8	9	9	9
Morningglory	4	4	6	5	7	8	5
Pigweed	8	8	8	3	9	7	9
Prickly Sida	0	0	8	8	8	9	4
Sicklepod	0	0	8	2	8	8	5
Smartweed	2	2	6	6	6	6	5
Spotted Spurge	2	2	6	5	5	8	5
Spurred Anoda	0	0	3	8	4	7	3
Tropic Croton	0	0	--	7	5	8	5
Velvetleaf	0	0	3	9-10	4	7	4
Surface-Loss Potential²	M	M	M	M	M	M	M
Leaching Potential³	S	S	S	M	M	M	M

continued

¹ Based on observations of research plots and field use of herbicides under average weather conditions for several years by weed control workers in Alabama. Control may vary depending on factors such as time and method of application, weather conditions, size of weeds, etc. Leaching and surface-loss potentials are based in part on herbicide chemical characteristics and pesticide behavior models developed by USDA scientists as well as on field observations.

² The surface-loss potential indicates the tendency of the pesticide to move with sediment in runoff.

³ The leaching potential indicates the tendency of the pesticide to move in solution with water and to leach below the root zone.

KEY TO CONTROL RATINGS AND ABBREVIATIONS

0 = No control; 10 = 100% control; -- = Information not available.

PPI = Preplant Incorporated; PRE = Preemergence. S = Small; M = Medium.

Table 11. Estimated Effectiveness of Recommended Herbicide Treatments on Important Weeds Infesting Cotton in Alabama and Properties That May Affect Water Quality¹ (cont.)

WEEDS	HERBICIDES					
	Solicam (PRE)	Assure, Select (POST)	Gramoxone (POST)	Fusilade (POST)	Fusion (POST)	Poast (POST)
GRASSES						
Bermudagrass	3	8	2	8	7	6
Crabgrass	8	8	5	8	8	8
Crowfootgrass	8	9	8	9	9	9
Fall Panicum	8	9	8	9	9	9
Goosegrass	8	8	8	8	8	8
Johnsongrass (rhizomes)	0	9	3	9	8	8
Johnsongrass (seedlings)	7	8	8	8	8	8
Sedges (nutgrass)	5	0	3	0	0	0
BROADLEAF WEEDS						
Bristly Starbur	7	0	5	0	0	0
Cocklebur	5	0	5	0	0	0
Coffee Senna	0	0	8	0	0	0
Common Ragweed	8	0	7	0	0	0
Florida Beggarweed	7	0	9	0	0	0
Florida Pusley	8	0	4	0	0	0
Jimsonweed	7	0	9	0	0	0
Lambsquarter	4	0	5	0	0	0
Morningglory	5	0	8	0	0	0
Pigweed	9	0	8	0	0	0
Prickly Sida	9	0	4	0	0	0
Sicklepod	5	0	9	0	0	0
Smartweed	4	0	6	0	0	0
Spotted Spurge	7	0	7	0	0	0
Spurred Anoda	8	0	7	0	0	0
Tropic Croton	4	0	5	0	0	0
Velvetleaf	7	0	7	0	0	0
Surface-Loss Potential²	M	M	S	M	M	M
Leaching Potential³	M	S	S	S	S	S

continued

¹ Based on observations of research plots and field use of herbicides under average weather conditions for several years by weed control workers in Alabama. Control may vary depending on factors such as time and method of application, weather conditions, size of weeds, etc. Leaching and surface-loss potentials are based in part on herbicide chemical characteristics and pesticide behavior models developed by USDA scientists as well as on field observations.

² The surface-loss potential indicates the tendency of the pesticide to move with sediment in runoff.

³ The leaching potential indicates the tendency of the pesticide to move in solution with water and to leach below the root zone.

KEY TO CONTROL RATINGS AND ABBREVIATIONS

0 = No control; 10 = 100% control; -- = Information not available.

PRE = Preemergence; POST = Postemergence. S = Small; M = Medium.

Table 11. Estimated Effectiveness of Recommended Herbicide Treatments on Important Weeds Infesting Cotton in Alabama and Properties That May Affect Water Quality¹ (cont.)

WEEDS	HERBICIDES							
	Buctril (OTT)	DSMA Liquid (OTT)	Envoke (OTT)	Ignite (OTT)	Roundup (OTT)	Staple (OTT)	AIM (PDS)	Caparol + MSMA (PDS)
GRASSES								
Bermudagrass	0	0	0	2	8	0	0	0
Crabgrass	0	6	0	8	8	0	0	9
Crowfootgrass	0	6	0	8	8	0	0	8
Fall Panicum	0	4	1	9	9	0	0	7
Goosegrass	0	3	0	9	9	0	0	8
Johnsongrass (rhizomes)	0	6	0	2	9	0	0	3
Johnsongrass (seedlings)	0	4	6	9	9	0	0	8
Sedges (nutgrass)	0	6	7	4	6	2	0	6
BROADLEAF WEEDS								
Bristly Starbur	7	7	8	8	8	9	--	9
Cocklebur	9	8	8	9	9	9	7	9
Coffee Senna	9	0	8	8	8	9	--	7
Common Ragweed	8	5	7	8	8	4	7	8
Florida Beggarweed	9	8	7	8	8	9	--	8
Florida Pusley	5	2	6	6	6	6	--	8
Jimsonweed	7	4	--	8	8	9	--	9
Lambsquarter	6	5	4	8	8	4	--	7
Morningglory	9	4	8	8	8	8	8	8
Pigweed	5	3	8	9	9	9	7	8
Prickly Sida	7	4	2	8	8	7	--	8
Sicklepod	0	4	8	8	8	3	0	8
Smartweed	5	2	--	--	--	8	6	7
Spotted Spurge	7	0	--	8	8	8	6	7
Spurred Anoda	8	0	3	8	8	9	8	7
Tropic Croton	8	4	--	8	8	5	--	8
Velvetleaf	8	0	8	8	8	9	9	5
Surface-Loss Potential²	S	S	M	S	S	M	L	M
Leaching Potential³	S	S	S	S	S	S	L	S

continued

¹ Based on observations of research plots and field use of herbicides under average weather conditions for several years by weed control workers in Alabama. Control may vary depending on factors such as time and method of application, weather conditions, size of weeds, etc. Leaching and surface-loss potentials are based in part on herbicide chemical characteristics and pesticide behavior models developed by USDA scientists as well as on field observations.

² The surface-loss potential indicates the tendency of the pesticide to move with sediment in runoff.

³ The leaching potential indicates the tendency of the pesticide to move in solution with water and to leach below the root zone.

KEY TO CONTROL RATINGS AND ABBREVIATIONS

0 = No control; 10 = 100% control; -- = Information not available.

OTT = Over The Top; PDS = Postemergence Directed Spray. S = Small; M = Medium; L = Large.

Table 11. Estimated Effectiveness of Recommended Herbicide Treatments on Important Weeds Infesting Cotton in Alabama and Properties That May Affect Water Quality¹ (cont.)

WEEDS	HERBICIDES							
	Cobra + MSMA (PDS)	Cotoran + MSMA (PDS)	ET (PDS)	Goal + Surfactant (PDS)	Karmex + MSMA (PDS)	MSMA + Surfactant (PDS)	Layby Pro (Layby)	Valor + glyphosate (Layby)
GRASSES								
Bermudagrass	--	0	0	--	0	0	1	6
Crabgrass	6	9	0	--	9	7	7	8
Crowfootgrass	6	8	0	--	7	7	8	8
Fall Panicum	8	8	0	--	8	8	7	8
Goosegrass	5	6	0	--	8	5	7	8
Johnsongrass (rhizomes)	5	7	0	--	3	5	1	6
Johnsongrass (seedlings)	5	8	0	--	8	6	7	8
Sedges (nutgrass)	6	6	0	--	6	7	2	6
BROADLEAF WEEDS								
Bristly Starbur	7	9	--	7	9	8	9	8
Cocklebur	9	9	8	8	9	9	9	9
Coffee Senna	5	5	--	8	5	2	8	8
Common Ragweed	8	8	8	7	8	6	8	9
Florida Beggarweed	9	9	--	7	7	9	8	8
Florida Pusley	9	7	--	8	8	3	7	7
Jimsonweed	6	9	--	8	8	6	8	9
Lambsquarter	6	6	8	8	7	4	8	9
Morningglory	8	7	8	9	8	6	9	9
Pigweed	9	7	8	9	8	4	8	9
Prickly Sida	8	6	--	7	6	3	7	8
Sicklepod	7	6	0	3	8	5	8	9
Smartweed	4	6	7	7	6	2	7	8
Spotted Spurge	7	4	--	6	4	1	7	8
Spurred Anoda	5	4	6	6	5	1	7	8
Tropic Croton	8	7	--	8	8	6	6	8
Velvetleaf	6	5	--	6	5	1	6	8
Surface-Loss Potential²	M	M	L	L	M	S	M	M
Leaching Potential³	M	M	L	S	M	S	M	S

¹ Based on observations of research plots and field use of herbicides under average weather conditions for several years by weed control workers in Alabama. Control may vary depending on factors such as time and method of application, weather conditions, size of weeds, etc. Leaching and surface-loss potentials are based in part on herbicide chemical characteristics and pesticide behavior models developed by USDA scientists as well as on field observations.

² The surface-loss potential indicates the tendency of the pesticide to move with sediment in runoff.

³ The leaching potential indicates the tendency of the pesticide to move in solution with water and to leach below the root zone.

KEY TO CONTROL RATINGS AND ABBREVIATIONS

0 = No control; 10 = 100% control; -- = Information not available.

PDS = Postemergence Directed Spray. S = Small; M = Medium; L = Large.

Table 12. Common Names and Trade Names of Cotton Herbicides

Herbicide Common Name	Trade Names and Some Available Formulations ¹
Diuron	Direx 4L, Diuron 4L, Diuron 80WP, Karmex DF
DSMA	DSMA 4, DSMA Herbicide, DSMA Liquid, DSMA Slurry
Fluometuron	Cotoran 4L, Cotoran 85DF, Meturon 4L
MSMA	Bueno 6, MSMA 6 Plus
Prometryn	Caparol 4L, Cotton-Pro 4L, Prometryne 4L
Trifluralin	Treflan 4EC, Trifluralin 4E, Trilin 4EC

¹ Other trade names and formulations may also be available.

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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.

CottonQuick, 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.

Harvade. Harvade has generally provided defoliation equivalent to that of the phosphate-type materials. Like these materials, Harvade is not a strong inhibitor of terminal regrowth. Harvade has been reported to be less sensitive to low temperatures than other defoliants. The addition of a crop oil is necessary for acceptable defoliation. Rainfall within 6 hours may reduce the effectiveness of Harvade.

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 overlapped 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.

COTTON GROWTH REGULATORS AND HARVEST AID PRODUCTS

Growth Regulation

Regulating cotton growth is generally a reference to controlling cotton height and vegetative production in order to facilitate insecticide application, reduce boll rot, and improve picking efficiency. The only products currently marketed for controlling excessive growth in actively growing cotton (not under drought or moisture stress) are those that contain **mepiquat chloride (MC)** or **mepiquat pentaborate**. Historical research has shown that mepiquat chloride-containing products will consistently reduce plant height and can result in increased earliness when compared to untreated cotton. Situations where mepiquate chloride or mepiquate pentaborate will provide the greatest growth-regulating benefits include (but are not limited to) the following: fields

where excessive growth traditionally occurs; fields where excessive vegetative production can occur due to high fertilization rates or low fruit set; and fields planted in cotton varieties known to have aggressive growth habits (i.e., DP 555B/RR). Treatment strategies may change depending on the sensitivity of the cotton variety to plant growth regulators.

The time required for the mepiquat-containing products to become rainfast is generally 8 hours when no surfactant is added. When an approved, high-quality EPA-exempt surfactant is added to the spray mix, the time interval for these products to become rainfast is generally 4 hours for mepiquat chloride-containing products and 2 hours for mepiquat pentaborate.

Trade Name (Product/A)	Common Name (Rate a.i./A)	Application Instructions
PIX and various trade names (0.5-1 pt.) or PENTIA (0.25- 1 pt.)	mepiquat chloride (0.022-0.044 lb.) mepiquat pentaborate (0.026-0.103 lb.)	Apply in 5 to 20 gallons of water per acre when cotton is approximately 20 to 30 inches tall and is not more than 7 days past early bloom (five to six white blooms per 25 row feet) or when poorly fruited cotton is 24 inches tall. Additional applications can be made beginning 2 to 3 weeks later if needed. Add 1 pint of an approved non-ionic surfactant per 100 gallons of spray mix if rainfall is expected within 8 hours after application. Mepiquate chloride or mepiquate pentaborate-containing products can also be applied in low-rate multiple treatments. The initial treatment should be made at match-head square with additional applications made at 7- to 14-day intervals if regrowth occurs. Rates vary depending on vegetative vigor and product used.

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.

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 defoliant, 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.

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 crack-

ed 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.

Defoliant and Boll-Opening Products

Several chemicals are labeled for use as defoliant (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."

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.
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.) + cropoil 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 (2-3.5 qt.)	ethephon plus tetraoxosulfate (4.8-8.4 lb.)	CottonQuik 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 FREE FALL SC (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.

Trade Name (Product per Acre)	Common Name (Rate a.i. per Acre)	Application Instructions
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 desiccation 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.

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.

Trade Name (Product per Acre)	Common Name (Rate a.i. per Acre)	Application Instructions
GRAMOXONE MAX or FIRESTORM (0.67-1.33 pt.) or GRAMOXONE INTEON (1-2 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.

Additives

Additives are materials that are included in a tank mix with defoliant 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.

Trade Name (Product per Acre)	Common Name (Rate a.i. per Acre)	Application Instructions
ACCELERATE (1.5 pt.)	endothall (0.1 lb.)	This product will generally speed the rate of leaf drop when added to standard defoliant such as Def/Folex, Dropp, Harvade, or ethephon.
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.

Table 13. Herbicide Classification by Mode of Action

Mode of Action	Herbicides
AMINO ACID SYNTHESIS INHIBITORS	Envoke, Roundup, Staple
CELL MEMBRANE DISRUPTORS	Buctril, Cobra, Goal, Gramoxone
LIPID SYNTHESIS INHIBITORS	Assure, Fusilade, Fusion, Poast, Select
PHOTOSYNTHETIC INHIBITORS	Caparol, Cotoran, Karmex
PIGMENT SYNTHESIS INHIBITORS	Command, Zorial
RESPIRATION INHIBITORS	DSMA, MSMA
ROOT GROWTH INHIBITORS	Dual, Prowl, Treflan

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For more information, call your county Extension office. It is listed in your telephone directory under your county's name.

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 cancelled, 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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