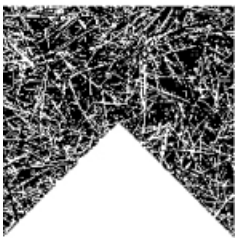
IPM Cotton



Insect, Disease, Nematode, and Weed Control Recommendations for 2013

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. 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 trangenic and conventional cotton varieties. Caterpillars reaching 0.25 inch or longer often survive on transgenic cotton. Escaped bollworms are usually found in the blooming zone of the plant in Bollgard II cotton. Some caterpillars may also be found in the upper part of plants containing Widestrike technology.

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

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

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

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

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

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

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

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

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

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

G**rasshoppers.** 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.

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. (See Table 2.) Premixes may be useful to insect management programs, but also may encourage the unnecessary use of some ingredients or encourage their use at less than optimum rates. Unnecessary applications or applications of reduced rates may lead to the development of insecticide resistance and flare untargeted pest species. Be sure the use of all active ingredients is warranted and that proper rates are being delivered.

Effectiveness of Insecticides and Transgenic Cotton on Target Pests

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

Table 1. Cotton Insect Control

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
BEET ARMYWORMS				
chlorantraniliprole				
CORAGEN 1.67 SC	5-7 oz.	0.065-0.09	21	
PREVATHON 0.43 SC	14-27 oz.	0.047-0.09	21	
emamectin benzoate				
DENIM 0.16EC	6-8 oz.	0.0075-0.01	21	
flubendiamide				
BELT 4SC	2-3 oz.	0.063-0.094	28	
indoxacarb				
STEWARD 1.25EC	9.2-11.3 oz.	0.09-0.11	14	
methoxyfenozide				
INTREPID 2F	4-10 oz.	0.06-0.16	14	
spinosad				
BLACKHAWK	2.4-3.2 oz.	0.054-0.072	28	
TRACER 4SC	2.14-2.9 oz.	0.067-0.089	14	

Table 1. Cotton Insect Control (cont.)

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
BOLLWORMS/TOBACCO BUDWORMS				
Seed				
Bt transgenic cotton BOLLGARD II WIDESTRIKE				Control of tobacco budworms should be excellent and control of bollworms generally should be adequate. See Table 3 for activity against all caterpillar pests.
Bollworms: Larvicides				
beta-cyfluthrin BAYTHROID XL 1EC Other brand names (See label.)	1.6-2.6 oz.	0.0125-0.0205	0	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.
bifenthrin BRIGADE 2EC Other brand names (See label.)	4-6.4 oz.	0.06-0.08	14	
chlorantraniliprole CORAGEN 1.67SC	5-7 oz.	0.065-0.09	21	
PREVATHON 0.43SC	14-27 oz.	0.047-0.09	21	
cypermethrin AMMO 2.5EC Other brand names (See label.)	2-5 oz.	0.04-0.1	14	
esfenvalerate ASANA XL 0.66EC	5.8-9.6 oz.	0.03-0.05	21	
flubendiamide BELT 4SC	3 oz.	0.094	28	
gamma-cyhalothrin PROLEX 1.25EC Other brand names (See label.)	1.3-2.0 oz.	0.0125-0.02	21	
indoxacarb STEWARD 1.25EC	11.3 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 -2 pt.	0.45	15	
spinosad BLACKHAWK	2.4-3.2 oz.	0.054-0.072	28	
TRACER 4SC	2.14-2.9 oz.	0.067-0.089	28	
zeta-cypermethrin MUSTANG MAX 0.8EC	2.64-3.6 oz.	0.017-0.022	14	

Table 1. Cotton Insect Control (cont.)

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
BOLLWORMS/TOBACCO BUDWORMS (cont.)				
Tobacco Budworms: Larvicides				
chlorantraniliprole				***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 absent,*** apply when five small larvae per 100 plants are found. Tobacco budworms have proven to be more difficult to control with most insecticides (see Table 4). Minimum rates of the recommended insecticides may not be effective against larger larvae or under high pressure. Rates should be adjusted according to the size of the larvae and the level of infestation. Methomyl may be used as an ovicide to control the egg stage at rates of 0.125 to 0.25 pound active ingredient per acre.
CORAGEN 1.67SC	5-7 oz.	0.065-0.09	21	
PREVATHON 0.43SC	14-27 oz.	0.047-0.09	21	
flubendiamide				
BELT 4SC	3 oz.	0.094	28	
indoxacarb				
STEWARD 1.25EC	11.3 oz.	0.11	14	
methomyl				
LANNATE 2.4 LV	1.5 pt.	0.45	15	
spinosad				
BLACKHAWK	1.6-3.2 oz.	0.036-0.072	28	
TRACER 4SC	1.4-2.9 oz.	0.045-0.089	28	
COTTON APHIDS				
acetamiprid				Apply when leaves appear sticky. Make one application; repeat when necessary. At-planting treatments may also give effective early-season control (see Seedling Thrips). Aphids are resistant to many insecticides. Control may vary with location and time of season. Additional applications of the same chemicals are usually ineffective.
INTRUDER 70WP	0.6-1.1 oz.	0.025-0.05	28	
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	
thiamethoxam				
CENTRIC 40WG	2 oz.	0.05	21	
CUTWORMS				
beta-cyfluthrin				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.
BAYTHROID XL 1EC	0.8-1.6 oz.	0.0065-0.125	0	
Other brand names (See label.)				
chlorpyrifos				
LORSBAN 4E	1 qt.	1	14	
Other brand names (See label.)				
cypermethrin				
AMMO 2.5EC	1.3-5 oz.	0.025-0.1	14	
Other brand names (See label.)				
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	0.96-1.28 oz.	0.015-0.02	21	
Other brand names (See label.)				
zeta-cypermethrin				
MUSTANG MAX 0.8EC	1.3-2 oz.	0.008-0.012	14	

Table 1. Cotton Insect Control (cont.)

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
FALL ARMYWORMS				
chlorantraniliprole				Apply when ten or more larvae per 100 plants are found.
CORAGEN 1.67SC	5-7 oz.	0.065-0.09	21	
PREVATHON 0.43SC	14-27 oz.	0.047-0.09	21	
flubendiamide				
BELT 4SC	2-3 oz.	0.063-0.094	28	
indoxacarb				
STEWARD 1.25EC	9.2-11.3 oz.	0.09-0.11	14	
novaluron				
DIAMOND 0.83EC	6-12 oz.	0.39-0.77	30	
spinosad				
BLACKHAWK	2.4-3.2 oz.	0.054-0.072	28	
TRACER 4SC	2.14-2.9 oz.	0.067-0.089	28	
GRASSHOPPERS				
chlorpyrifos				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.
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	See label..	See Table 3.		
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. Use of Bidrin between pinhead square and first bloom is prohibited
ORTHENE 90SP	0.37-0.55 lb.	0.33-0.5	21	
ORTHENE 97	0.35-0.55 lb.	0.33-0.53	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.)				
clothianidin				
BELAY	3-6 fl.oz.	0.05-0.1	21	
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	
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	

Table 1. Cotton Insect Control (cont.)

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
SEEDLING THRIPS				
Foliar Treatment				
acephate				Make one or more applications to seedling cotton (one- 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. Radiant provides suppression; it must be used with an adjuvant.
ORTHENE 90SP	3.2 oz.	0.18	21	
ORTHENE 97	3 oz.	0.18	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	
spinetoram				
RADIANT SC	1.5-3 oz.	0.012-0.023	28	
thiamethoxam				
CENTRIC 40WG	2 oz.	0.05	21	
In-Furrow Liquid Treatment				
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	
Seed Treatment				
imidacloprid	See label.			
GAUCHO 600				
AERIS				
thiamethoxam	See label.			
CRUISER				
AVICTA				
SOYBEAN LOOPERS				
chlorantraniliprole				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.
CORAGEN 1.67SC	5-7.5 oz.	0.065-0.098	21	
PREVATHON 0.43SC	20-29 oz.	0.067-0.097	21	
emamectin benzoate				
DENIM 0.16EC	2 oz.	0.063	21	
flubendiamide				
BELT 4SC	2-3 oz.	0.063-0.094	28	
indoxacarb				
STEWARD 1.25EC	6.7-9.2 oz.	0.065-0.09	14	
methoxyfenozide				
INTREPID 2F	4-10 oz.	0.06-0.16	14	
spinosad				
BLACKHAWK	2.4-3.2 oz.	0.054-0.072	28	
TRACER 4SC	2.14-2.9 oz.	0.067-0.089	28	

Table 1. Cotton Insect Control (cont.)

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
SPIDER MITES				
abamectin				**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. Bifenthrin may not control spider mite populations; it can be used for suppression.
AGRI-MEK 0.15EC	8-16 oz.	0.009-0.018	20	
Other brand names (See label.)				
bifenthrin				
BRIGADE 2EC	3.8-6.4 oz.	0.06-0.1	14	
Other brand names (See label.)				
chlorpyriphos				
LORSBAN 4E	1 pt.	0.5	14	
Other brand names (See label.)				
dicofol				
DICOFOL 4E	1.5-3 pt.	0.75-1.5	30	
Other brand names (See label.)				
dimethoate 4EC	1 pt.	0.5		
Other brand names (See label.)				
etoxazole				
ZEAL	0.66-1 oz.	0.03-0.45	28	
fenpyroximate				
PORTAL 0.4	12-16 oz. (early season) 24-32 oz. (mid-season)	0.0375-0.05	14	
propargite				
COMITE II 6	20-36 oz.	0.94-1.69	50	
spiromesifen				
OBERON 2SC	8-16 oz.	0.125-0.25	30	
BROWN STINK BUGS, LEAF FOOTED BUGS				
acephate				The boll injury threshold should be adjusted up or down based on the number of susceptible bolls present. Use a 10 to 15 percent boll injury threshold during weeks 3 to 5 of bloom (numerous susceptible bolls present), 20 percent injury during weeks 2 and 6, and 30+ percent during weeks 7+ of bloom (fewer susceptible bolls present).
ORTHENE 90S	0.8 lb.	0.72	21	
ORTHENE 97	0.75 lb.	0.72	21	
dicrotophos				
BIDRIN 8EC	6-8 oz.	0.375-0.5	10	
methyl parathion 4EC				
METHYL PARATHION 4EC	16 oz.	0.5	7	
GREEN AND SOUTHERN GREEN STINK BUGS				
Organophosphates				
acephate				Use same thresholds as for brown stink bugs.
ORTHENE 90S	0.8 lb.	0.72	21	
ORTHENE 97	0.75 lb.	0.72	21	
dicrotophos				
BIDRIN 8EC	4-8 oz.	0.25-0.5	10	
methyl parathion 4EC				
METHYL PARATHION 4EC	16 oz.	0.5	7	

Table 1. Cotton Insect Control (cont.)

Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest	Comments
GREEN AND SOUTHERN GREEN STINK BUGS (cont.)				
Pyrethroids				
beta-cyfluthrin				
BAYTHROID XL1	2.13-2.6 oz.	0.0166-0.0205	0	
Other brand names (See label.)				
bifenthrin				
BRIGADE 2EC	4-6.4 oz.	0.06-0.08	14	
Other brand names (See label.)				
cypermethrin				
AMMO 2.5EC	3.1-5 oz.	0.06-0.1	14	
Other brand names (See label.)				
esfenvalerate				
ASANA SL 0.66EC	7.5-9.6 oz.	0.04-0.05	21	
gamma-cyhalothrin				
PROLEX 1.25EC	1.3-2 oz.	0.0125-0.02	21	
lambda-cyhalothrin				
KARATE Z 2.08CS	1.8-2.56 oz.	0.03-0.04	21	
Other brand names (See label.)				
zeta-cypermethrin				
MUSTANG MAX 0.8EC	2.6-3.6 oz.	0.0165-0.022	14	
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 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	
buprofezin				
COURIER 40SC	9-12.5 oz	0.25-0.35	14	
dinotefuran				
VENOM 70WDG	1-3 oz.	0.045-0.134		
pyriproxfen				
KNACK 0.86EC	8-10 oz.	0.054-0.067	28	

Table 2. Premix/Combination Packages

Premix/combination insecticide packages are available and include the following: (See page 3 for more detailed information about premix/combination insecticide packages.)	
avermectin B1 + bifenthrin (ATHENA)	flubendiamide + buprofexin (TOURISMO)
bifenthrin + zeta-cymethrin (HERO)	imidacloprid + bifenthrin (BRIGADIER)
clorantraniprole + lambda-cyhalothrin (BESEIGE)	imidacloprid + cyfluthrin (LEVERAGE 2.7)
chlorpyrifos + gamma-cyhalothrin (COBALT)	imidacloprid + beta-cyfluthrin (LEVERAGE 360)
chlorpyrofos + lambda-cyhalothrin (COBALT ADVANCED)	spinosad + gamma-cyhalothrin (CONSERO)
dicrotophos + bifenthrin (BIDRIN XP II)	thiamethoxam + lambda-cyhalothrin (ENDIGO)

Table 3. 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) [2.13]	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]

Table 4. 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	1-2	4	1	2	1-2	3	1
WideStrike	1	2	4	1	1-2	1	1	1

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

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

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

Table 5. Insecticide Effectiveness Ratings*

INSECTICIDES	INSECTS						
	Aphids	Beet Armyworms	Beneficial Insects**	Boll Weevils	Bollworms	Budworms	Fall Armyworms
Altacor	5	1	4	5	1	1	2
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
Belay	—	5	—	—	5	5	5
Belt	5	1	4	5	2	1	2
Bidrin	3	5	1	3	5	5	5
Blackhawk	5	1	5	5	1-2	1	1-2
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
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	4
Penncap M	4	5	3	1	3	5	4
Prevathon	5	1	5	5	1	1	1
Prolex	4	5	1	1-2	1	3	2
Radiant	5	5	5	5	—	—	—
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
Venom	—	5	—	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 5. Insecticide Effectiveness Ratings* (cont.)

INSECTICIDES	INSECTS						
	Plant Bugs	Seedling Thrips	Soybean Loopers	Spider Mites	Stink Bugs (Brown)	Stink Bugs (Green)	Whiteflies
Altacor	5	5	2	5	5	5	5
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
Belay	2	—	4	—	3	3	—
Belt	5	5	1	5	5	5	5
Bidrin	1	1	5	4	1	1	4
Blackhawk	5	5	1	5	5	5	5
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
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
Prevathon	5	—	1	—	5	5	—
Prolex	2	1	3	5	4	2	4
Radiant	5	1	—	5	5	5	5
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
Venom	—	—	5	—	5	5	1
Vydate	3	3	5	5	2	2-3	4

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

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DISEASE 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 dinitroanaline 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 Metalzxyl®, Anchor®, and Apron XL® are primarily active against Pythium spp. Maxim®, Dynasty®, and Dividend® are active against a wide range of soilborne diseases.

Table 6 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 6. Commercial Seed Treatment Products[1]

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

[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 7. In-Furrow Fungicide Treatments for Cotton Seedling Disease Control

Fungicide and Formulation	Rate Per 1000 Row Feet	Comments
Consult product guides and labels before applying fungicides and for plantback restrictions. Not all fungicides and formulations are listed due to space constraints.		
azoxystrobin QUADRIS FLOWABLE	0.4-0.8 fl.oz.	**At-plant in-furrow spray for control of** *Rhizoctonia* **and** *Pythium* **seedling blight.** Apply 3 to 7 gallons of water at planting and direct spray into the seed furrow before seed is covered. Use higher rate, particularly on early cotton when conditions favor disease.
etridiazole TERRAMASTER 4EC	4-8 fl.oz.	Apply over seed in open furrow at planting for control of *Pythium* seed rot and seedling blight. Listed rate is for 40-inch rows.
mefenoxam RIDOMIL GOLD GR	1.5-3 oz.	A**pply at-plant in-furrow for control of** *Pythium* **seedling blight.** Mount application tubes so the granules are mixed with the soil covering the seeds.
RIDOMIL GOLD SL	0.075-0.15 fl.oz.	**Apply at-plant in-furrow for control of** *Pythium* **seedling blight.** Apply in water or fertilizer at planting. Direct spray over the seed in open furrow before seed are covered.
pentachloronitrobenzene + mefenoxam RIDOMIL GOLD PC GR	8.6-12.3 oz.	Apply at-plant in-furrow to control seed rots and seedling diseases caused by *Pythium* and *Rhizoctonia*. Mount application tubes so that granules are mixed with soil covering the seeds. Use higher rate when soil conditions are unfavorable for rapid seed germination and seedling growth.
pyraclostrobin HEADLINE SC	0.1-0.8 fl.oz.	For control of *Rhizoctonia* and *Pythium* and seedling diseases. Apply at-plant by directing spray into the furrow before seed is covered. Use minimum of 2.5 gallons spray volume per acre. Refer to label for rates for specific row spacings.

Table 8. Fungicide Treatments for Leaf Spots and Boll Rots

Fungicide and Formulation	Rate Per 1000 Row Feet	Comments
Consult product guides and labels before applying fungicides and for plantback restrictions. Not all fungicides and formulations are listed due to space constraints.		
azoxystrobin QUADRIS FLOWABLE	6-9 fl.oz.	For control of *Anthracnose* and *Ascochyta* blight and boll rot, hard lock, and Target spot (*Corynespora* leaf spot). Apply before pin head square to early bloom or at early stages of disease development and repeat after 14 to 21 days as needed to control disease. Do not make more than two consecutive applications of Quadris flowable. See label for additional information concerning resistance management for strobilurin (Qol or Group 11) fungicides.
pyraclostrobin HEADLINE 2.09SC	6-12 fl.oz.	For control of leaf spot and boll rot disease caused by *Alternaria*, *Asochyta* (blight), *Cercospora*, *Corynespora*, *Fusarium* (hard lock), *Glomerella* (anthracnose), *Phoma*, and *Stemphyllum*. Begin applications prior to or at early stage of disease development and repeat after 7 to 14 days if conditions favor disease. Make no more than two consecutive applications of Headline 2.09SC. See label for additional information concerning resistance management with Qol fungicides.
pyraclostrobin + metconazole TWINLINE	7-8.5 fl.oz.	For control of leaf spot and boll rot disease caused by *Alternaria*, *Asochyta* (blight), *Cercospora*, *Corynespora*, *Fusarium* (hard lock), *Glomerella* (anthracnose), *Phoma*, and *Stemphyllum*. Apply before disease development and continue applications on a 7- to 14-day schedule as needed to control disease. Do not make more than two consecutive applications of Twinline before alternating to another fungicide with a different mode of action. A total of three Twinline applications may be made per year. See label for additional use restrictions.

NEMATODE CONTROL

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 (*Meliodogyne 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 rootknot nematodes and are resistant to Fusarium wilt.

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

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

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

Telone, a fumigant, must be injecteed 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. Aeris and Avicta are reported to be effective against low populations of reniform nematodes. Temik, Avicta, and Aeris also have activity against early season insects while Telone II is only active against nematodes.

Table 9. Cotton Nematode Control

Nematodes	Nematicide and Formulation	Amount of Formulation per Acre (38-Inch Row)	Comments
		ROOT-KNOT, RENIFORM	
1,3 dichloropropene			Preplant fumigation: Inject with one chisel per row to a final planting depth of at least 14 inches. Seal injection furrow with cultipaker or bedding equipment. Wait 7 days before planting. Rate based on 38-inch row spacing.
	TELONE II (Fumigant)	3-6 gal.	
abamectin + thiamethoram			Available only in Avicta Complete Pak with Dynasty CST. Applied only by Delta and Pine Land, Monsanto, and selected retailers.
	AVICTA DUO COTTON	See label.	
imidaclorprid + thiocarb			Available through Stoneville, FiberMax, and Delta and Pine Land. Used in combination with Gaucho Grande.
	AERIS (Seed treatment)	25.6 fl.oz./100 lb. seed	
oxamyl			Apply after planting to suppress reniform, root knot, and lance nematodes following the planting of nematicide-treated cotton seed. Band or broadcast in the second through fifth true leaf stage. Reapply as needed 14 days after first application of Vydate C-LV.
	VYDATE C-LV	17 fl.oz.	
		8.5-11 fl.oz.	Apply following the application of a preplant fungicide or at-plant granular nematicide. Band or broadcast at the second to fifth true leaf stage and repeat 10 to 14 days later. Apply in sufficient water to cover foliage. Rates listed are for broadcast applications, so reduce rates accordingly for banded applications. See label for use restrictions and application guidelines.
	VYDATE L	1 pt.	To suppress reniform, root knot, and lance nematodes: Apply at second to fifth true leaf stage and repeat 10 to 14 days later.
		2 pt.	Apply at first to seventh true leaf stage. See label for use restrictions and application guidelines. Treatment must follow application of a preplant fumigant or at-plant granular nematicide

Disease and Nematode Control section prepared by Austin Hagan, Extenson Plant Pathologist, Professor, Entomology and Plant Pathology, Auburn University; Edward J. Sikora, Extension Plant Pathologist, Professor, Entomology and Plant Pathology, Auburn University; Kathy S. Lawrence, Plant Pathologist, Associate 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. *MOA–PPO inhibitor
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. MOA–Synthetic auxin
CAPAROL 4L or PROMETRYN 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. MOA–Photosystem II inhibitor
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. MOA–PPO inhibitor
GRAMOXONE LS (1.25-2.5 pt.) or FIRESTORM (0.8-1.6 pt.) + Non-ionic Surfactant (1 pt./25 gal. spray mix)	paraquat (0.31-0.62 lb.) + non-ionic surfactant	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. MOA–Photosystem I inhibitor
HARMONY EXTRA (0.3-0.5 oz.) + Non-ionic Surfactant (1 pt./50 gal. spray mix)	thifensulfuron + tribenuron (0.23-0.38oz.) + non-ionic surfactant	Apply up to 14 days prior to planting for control of curly dock, henbit, wild radish, and several other winter weeds. Mix with glyphosate for added control. MOA–ALS inhibitor
LIBERTY (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 or within 21 days if dicamba is used. MOA–Glutamine synthetase inhibitor
KARMEX or DIURON 4L (1.5 pt.)	diuron (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. MOA–Photosystem II inhibitor

*MOA = mechanism of action. Herbicides with different MOAs should be used in weed resistance management programs. See Table 11.

Table 10. Cotton Weed Control (cont.)

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
	PREPLANT FOLIAR (BURNDOWN) (cont.)	
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). MOA–PPO inhibitor
ROUNDUP or TOUCHDOWN or GLYPHOSATE + Non-ionic Surfactant (1 pt./25 gal. spray mix)	glyphosate (1-2 lb.) + non-ionic surfactant	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. MOA–EPSP inhibitor
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. MOA–PPO inhibitor
	PREPLANT INCORPORATED	
PROWL 3.3EC (1.2-3.6 pt.) or PROWL H_20 (1-3 pt.) or TREFLAN TRILIN TRIFLURALIN EC	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. MOA–Mitosis inhibitor
SOLICAM DF (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. MOA–Carotenoid biosynthesis inhibitor
	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. MOA–Photosystem II inhibitor

Table 10. Cotton Weed Control (cont.)

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
	PREEMERGENCE (cont.)	
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. MOA–Carotenoid biosynthesis inhibitor
COTORAN 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. MOA–Photosystem II inhibitor
COTORAN 4L (2-3 pt.) + SOLICAM DF (1.5-1.9 lb.)	fluometuron (1-1.5 lb.) + norflurazon (1.2-1.5 lb.)	See Comments for each herbicide, above and on the next page. MOA–Photosystem II inhibitor + carotenoid biosynthesis inhibitor
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. MOA–Photosystem II inhibitor
REFLEX (1 pt.)	fomesafen (0.25 lb.)	Apply to the soil surface immediately after planting **ONLY** to coarse-textured soils (sandy loam, loamy sand, sandy clay loam) for control of pigweed, nutsedge, and other weeds. May be applied to medium- and fine-textured soils up to 21 days ahead of planting. A minimum of 0.5 inch of rainfall or sprinkler irrigation must occur before planting cotton on these soils. (See 24C label.) MOA–PPO inhibitor
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. MOA–ALS inhibitor

Table 10. Cotton Weed Control (cont.)

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
	PREEMERGENCE (cont.)	
SOLICAM DF (1.25-2.5 lb.)	norflurazon (1-2 lb.)	Apply to soil surface ar 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. MOA–Carotenoid biosynthesis inhibitor
WARRANT (2.5-4 pt.)	acetochlor (0.94-1.5 lb.)	Apply before or after planting but before cotton emerges. Provides residual control of several annual grasses and broadleaf weeds including pigweed. MOA–Mitosis inhibitor
	POSTEMERGENCE OVER-THE-TOP	
ASSURE II (7-10 fl.oz.) + Crop Oil Concentrate (2 pt./25 gal. spray mix) or Non-ionic Surfactant (1 pt./25 gal. spray mix)	quizalofop (0.09-0.125 lb.) + crop oil concentrate or non-ionic surfactant	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. MOA–ACCase inhibitor
ENVOKE 75DF (0.1-0.15 oz.) + Non-ionic Surfactant (1 pt./50 gal. spray mix)	trifloxysulfuron (0.047-0.0118 lb.) + non-ionic surfactant	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. **DO NOT** apply to cotton under severe stress. May be applied over-the-top in mix with Staple for control of smallflower morningglory. May be tank mixed with Caparol, Dual Magnum, MSMA, etc., for post-directed application at rates up to 0.25 ounce. **DO NOT** apply within 60 days of harvest. MOA–ALS inhibitor
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 stolen (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). MOA–ACCase inhibitor
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. MOA–ACCase inhibitor
LIBERTY (1.8-2.7 pt.)	glufosinate (0.52-0.78 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. MOA–Glutamine synthetase inhibitor

Table 10. Cotton Weed Control (cont.)

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
POSTEMERGENCE OVER-THE-TOP (cont.)		
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. MOA–ACCase inhibitor
ROUNDUP or TOUCHDOWN or GLYPHOSATE + Non-ionic Surfactant (0.5 pt./25 gal. spray mix)	glyphosate (1-1.4 lb.) + non-ionic surfactant	**For Use Only on Roundup-Ready Flex Cotton.** A total of 128 fluid ounces 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. MOA–EPSP inhibitor
DUAL MAGNUM (1 pt.) or Generic Brand (1.3 pt.) + ROUNDUP or TOUCHDOWN	metolachor (0.95 lb.) + glyphosate	Apply over-the-top of Roundup-Ready or Roundup Ready Flex cotton in tank mixture with glyphosate prior to the four-leaf stage. Provides residual control of annual grass and pigweed. MOA–Mitosis inhibitor
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. MOA–EPSP inhibitor + mitosis inhibitor
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. MOA–ACCase inhibitor

Table 10. Cotton Weed Control (cont.)

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
POSTEMERGENCE OVER-THE-TOP (cont.)		
STAPLE LX (2.6-3.8 fl.oz.) + Non-ionic Surfactant (0.5 pt./25 gal. spray mix)	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. May be used at rates of 1.3 to 3.8 fluid ounces per acre in combination with glyphosate on Roundup Ready Flex cotton or Liberty on Liberty Link cotton at rates up to 2.7 fluid ounces. **DO NOT** apply mixture after pinhead square. MOA–ALS inhibitor
WARRANT (3 pt.)	acetochlor (1.12 lb.)	Apply over-the-top of Roundup Ready Flex cotton from one- to four-leaf stage in tank mixture with glyphosate for residual control of annual grasses and small-seeded broadleaf weeds like pigweed. MOA–Mitosis inhibitor
POSTEMERGENCE DIRECTED		
CAPAROL 4L (1-1.5 pt.) + DSMA (several forms) or MSMA (several forms)	prometryn (0.5-0.75 lb.) + DSMA (3 lb.) or 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. MOA–Photosystem II inhibitor + unknown
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. MOA–PPO inhibitor
COTORAN 4L (2-4 pt.) + MSMA (several forms) or DSMA (several forms) + Non-ionic Surfactant	fluometuron (1-2 lb.) + MSMA (2 lb.) or 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. MOA–Photosystem II inhibitor + unknown
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.

Table 10. Cotton Weed Control (cont.)

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
	POSTEMERGENCE DIRECTED (cont.)	
DUAL MAGNUM (1 pt.) or STALWART (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. MOA–Mitosis inhibitor + unknown
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. MOA–PPO inhibitor
GRAMOXONE LS (1.2-2.4 pt.) or FIRESTORM (0.8-1.6 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. MOA–Photosystem I inhibitor
KARMEX DF (0.5 lb.) or DIREX 4L (0.8 pt.) + Non-ionic Surfactant (0.5 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. MOA–Photosystem II inhibitor
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. MOA–Photosystem II inhibitors
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. MOA–Photosystem II inhibitor
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. MOA–Photosystem II inhibitor + ALS inhibitor

Table 10. Cotton Weed Control (cont.)

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 erratic. 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 morninggloriy and other broadleaf weeds. May be mixed with other herbicides to obtain broad spectrum activity. Keep spray off green cotton tissue. MOA–PPO inhibitor
COTORAN 4L (2 pt.)	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. MOA–Photosystem II inhibitor
COTTON-PRO 4L CAPAROL 4L or PROMETRYN 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. MOA–Photosystem II inhibitor
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. MOA–PPO inhibitor
KARMEX DF or DIURON 80 DF (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. MOA–Photosystem II inhibitor
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. MOA–Photosystem II inhibitors
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. MOA–PPO inhibitor
	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. MOA–Unknown

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 Quality[1]

WEEDS	HERBICIDES							
	2,4-D (PPF)	Harmony Extra (PPF)	Prowl (PPI)	Treflan (PPI)	Caparol (PRE)	Command (PRE)	Cotoran (PRE)	Cotoran + Solicam (PRE)
GRASSES								
Bermudagrass	0	0	1	1	1	5	0	2
Crabgrass	0	0	9	9	7	8	8	8
Crowfootgrass	0	0	9	9	8	7	8	8
Fall panicum	0	0	8	8	6	6	7	8
Goosegrass	0	0	9	9	7	7	7	8
Johnsongrass (rhizomes)	0	0	2	3	0	3	0	0
Johnsongrass (seedlings)	0	0	8	8	6	6	6	7
Sedges (nutgrass)	0	5	0	0	0	2	0	5
BROADLEAF WEEDS								
Bristly starbur	6	—	1	1	7	3	8	8
Cocklebur	8	6	0	0	5	6	7	8
Coffee senna	7	6	0	0	5	6	5	6
Common groundsel	9	8	9	9	7	7	8	9
Common ragweed	8	6	3	3	8	6	9	9
Cutleaf eveningprimrose	9	4	9	9	8	5	8	9
Florida beggarweed	3	—	0	0	8	—	8	8
Florida pusley	7	—	9	9	8	4	9	9
Horseweed	9	2	8	8	7	7	8	9
Jimsonweed	8	—	3	3	7	6	7	8
Lambsquarter	6	—	7	7	8	8	9	9
Morningglory	7	—	4	4	6	5	7	8
Pigweed	8	2	8	8	8	3	9	7
Prickly sida	2	—	0	0	8	8	8	9
Sicklepod	7	—	0	0	8	2	8	8
Smartweed	5	—	2	2	6	6	6	6
Spotted spurge	3	—	2	2	6	5	5	8
Spurred anoda	6	—	0	0	3	8	4	7
Tropic croton	6	—	0	0	—	7	5	8
Velvetleaf	8	—	0	0	3	9-10	4	7
Wild garlic	5	8	0	0	4	4	4	5
Wild radish	6	7	0	0	8	6	8	9

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.

KEY TO CONTROL RATINGS AND ABBREVIATIONS

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

PPF = Preplant Foliar; PPI = Preplant Incorporated; PRE = Preemergence.

Table 11. Estimated Effectiveness of Recommended Herbicide Treatments on Important Weeds Infesting Cotton in Alabama and Properties That May Affect Water Quality[1] (cont.)

WEEDS	HERBICIDES							
	Karmex (PRE)	Solicam (PRE)	Warrant (PRE)	Assure, Select (POST)	Gramoxone (POST)	Fusilade (POST)	Fusion (POST)	Poast (POST)
GRASSES								
Bermudagrass	0	3	1	8	2	8	7	6
Crabgrass	8	8	8	8	5	8	8	9
Crowfootgrass	8	8	8	9	8	9	9	9
Fall panicum	6	8	8	9	8	9	9	9
Goosegrass	8	8	8	8	8	8	8	8
Johnsongrass (rhizomes)	0	0	1	9	3	9	8	7
Johnsongrass (seedlings)	6	7	7	8	8	8	8	8
Sedges (nutgrass)	0	5	4	0	3	0	0	0
BROADLEAF WEEDS								
Bristly starbur	6	7	0	0	5	0	0	0
Cocklebur	6	5	0	0	5	0	0	0
Coffee senna	4	0	4	0	8	0	0	0
Common groundsel	8	5	—	0	5	0	0	0
Common ragweed	8	8	4	0	7	0	0	0
Cutleaf eveningprimrose	9	5	—	0	4	0	0	0
Florida beggarweed	8	7	5	0	9	0	0	0
Florida pusley	8	8	9	0	4	0	0	0
Horseweed	9	5	—	0	4	0	0	0
Jimsonweed	6	7	5	0	9	0	0	0
Lambsquarter	9	4	8	0	5	0	0	0
Morningglory	5	5	5	0	8	0	0	0
Pigweed	9	9	9	0	8	0	0	0
Prickly sida	4	9	4	0	4	0	0	0
Sicklepod	5	5	5	0	9	0	0	0
Smartweed	5	4	3	0	6	0	0	0
Spotted spurge	5	7	4	0	7	0	0	0
Spurred anoda	3	8	4	0	7	0	0	0
Tropic croton	5	4	2	0	5	0	0	0
Velvetleaf	4	7	—	0	7	0	0	0
Wild garlic	4	4	—	0	5	0	0	0
Wild radish	8	4	—	0	8	0	0	0

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.

KEY TO CONTROL RATINGS AND ABBREVIATIONS

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

PRE = Preemergence; POST = Postemergence.

Table 11. Estimated Effectiveness of Recommended Herbicide Treatments on Important Weeds Infesting Cotton in Alabama and Properties That May Affect Water Quality[1] (cont.)

WEEDS	HERBICIDES								
	DSMA Liquid (OTT)	Envoke (OTT)	Ignite (OTT)	Roundup (OTT)	Staple (OTT)	Dual + Glyphosate (OTT)	Warrant + Glyphosate (OTT)	AIM (PDS)	Caparol +MSMA (PDS)
GRASSES									
Bermudagrass	0	0	2	8	0	3	3	0	0
Crabgrass	6	0	8	8	0	9	9	0	9
Crowfootgrass	6	0	8	8	0	9	9	0	8
Fall panicum	4	1	9	9	0	9	9	0	7
Goosegrass	3	0	9	9	0	8	8	0	8
Johnsongrass (rhizomes)	6	0	2	9	0	5	8	0	3
Johnsongrass (seedlings)	4	6	9	9	0	9	9	0	8
Sedges (nutgrass)	6	7	4	6	2	5	4	0	6
BROADLEAF WEEDS									
Bristly starbur	7	8	8	8	9	7	7	—	9
Cocklebur	8	8	9	9	9	8	8	7	9
Coffee senna	0	8	8	8	9	8	8	—	7
Common groundsel	5	5	7	5	3	7	7	7	8
Common ragweed	5	7	8	8	4	8	9	7	8
Cutleaf eveningprimrose	5	5	7	2	2	2	2	3	9
Florida beggarweed	8	7	8	8	9	8	8	—	8
Florida pusley	2	6	6	6	6	9	8	—	8
Horseweed	4	5	7	0	4	0	0	7	8
Jimsonweed	4	—	8	8	9	8	8	—	9
Lambsquarter	5	4	8	8	4	8	8	—	7
Morningglory	4	8	8	8	8	7	8	8	8
Pigweed	3	8	9	9	9	9	9	7	8
Prickly sida	4	2	8	8	7	7	7	—	8
Sicklepod	4	8	8	8	3	7	8	0	8
Smartweed	2	—	—	—	8	6	6	6	7
Spotted spurge	0	—	8	8	8	7	7	6	7
Spurred anoda	0	3	8	8	9	7	7	8	7
Tropic croton	4	—	8	8	5	6	6	—	8
Velvetleaf	0	8	8	8	9	6	6	9	5
Wild garlic	3	3	3	5	3	3	3	2	4
Wild radish	4	4	7	6	3	7	7	5	6

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.

KEY TO CONTROL RATINGS AND ABBREVIATIONS

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

OTT = Over The Top; PDS = Postemergence Directed Spray. .

Table 11. Estimated Effectiveness of Recommended Herbicide Treatments on Important Weeds Infesting Cotton in Alabama and Properties That May Affect Water Quality[1] (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 groundsel	7	5	4	7	8	6	7	8
Common ragweed	8	8	8	7	8	6	8	9
Cutleaf eveningprimrose	8	7	8	6	8	3	6	9
Florida beggarweed	9	9	—	7	7	9	8	8
Florida pusley	9	7	—	8	8	3	7	7
Horseweed	8	7	7	7	8	3	6	8
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
Wild garlic	4	3	3	2	2	1	2	3
Wild radish	7	5	7	6	6	2	4	7

[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.

KEY TO CONTROL RATINGS AND ABBREVIATIONS

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

PDS = Postemergence Directed Spray.

Table 12. Herbicide Classified by Mechanism of Action

Mechanism of Action	Herbicide
Acetyl CoA Carboxylase (ACCase) inhibitor	Poast, Fusilade, Select, Assure
Acetolactase Synthase (ALS) inhibitors	Staple, Envoke, Harmony Extra
Carotenoid biosynthesis inhibitor	Command, Solicam
Enolpyruval shikimate-3-phospate (EPSP) inhibitor	Roundup, Touchdown
Glutamine synthesis inhibitor	Liberty
Mitosis inhibitor	Treflan, Prowl, Dual, Warrant
Photosystem I inhibitor	Gramoxone Interon, Firestorm
Photosystem II inhibitor	Cotoran, Caparol, Direx, Layby Pro, Linex
Protoporphyrinogen oxidase (PPO) inhibitor	Aim, ET, Reflex, Resource, Valor, Cobra, Goal
Synthetic auxin	2,4-D, Clarity

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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 beharvested within two weeks after the application, except when weather conditions are very favorable.

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

Materials

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

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

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

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

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

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

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

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

Coverage

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

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

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

Surfactants

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

Evaluating Cotton for Maturity

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

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

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

COTTON GROWTH REGULATORS AND HARVEST AID PRODUCTS

Growth Regulation

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

Boll Opening

It may be desirable to accelerate the opening of mature cotton bolls in order to harvest earlier or for a once-over harvest operation. Ethephon has been shown to accelerate the opening of bolls and to enhance defoliation. Immature bolls will also be affected and, depending on the stage of maturity, the fiber may be immature, quality of seed may be lowered, and yield may be reduced. Application should not be made until sufficient mature, unopened bolls have developed to produce the desired yield.

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

Defoliants and Boll-Opening Products

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

Desiccants

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

Additives

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

Table 13. Rain-safe Period and Carrier Volume[1]

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

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

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

Table 14. Plant Growth Regulators

Trade Name	Common Name	Application Instructions
PIX and various trade names and formulations	mepiquat chloride (MC)	Apply Pix (8 to 16 fluid ounces) when cotton is approximately 20 to 30 inches tall and is not more than 7 days beyond the early bloom stage (five to six blooms per 25 row feet) or when poorly fruited cotton is 24 inches tall. Subsequent applications can begin 2 to 3 weeks after the first one. MC products can also be applied in low-rate multiple treatments when cotton is at the match-head square stage with additional treatments made at 7- to 14-day intervals if re-growth occurs. Low rate multiple application rates may increase according to the vegetative vigor of the field. Do no apply more than 48 fluid ounces of standard Pix or its active ingredient equivalent (0.132 pound mepiquat chloride) per acre per season. Late-season applications can be made up to 30 days prior to harvest. Since there are many trade names and formulations of MC available, read and follow use directions for the specific product.
PENTIA (8-24 fl.oz.)	mepiquat pentaborate (0.026-0.154 lb.)	Make initial application after cotton has reached the pinhead square stage and is actively growing and the second application after 2 weeks on vigorously growing cotton that has greater than five NAWF. Subsequent applications can be made as needed. Pentia can also be applied late in the bloom cycle on cotton likely to experience additional vegetative growth or re-growth up to 30 days prior to harvest. Do not exceed 48 fluid ounces of Pentia per acre per season.
STANCE (2-4 fl.oz.)	cyclanilide + mepiquat chloride	Begin applications at match-head square when 50 percent of the cotton plants have one or more match-head squares or later. Sequential applications should begin 7 to 14 days later or when re-growth occurs with a minimum of 7 days between applications. Do not apply within 30 days of harvest. Rate is dependent upon field examination and vegetative vigor. Do not exceed 22 fluid ounces of Stance per acre per year.

Table 15. Boll Opening Products

Trade Name (Product/A)	Common Name (Rate a.i./A)	Application Instructions
BOLL'D* ETHEPHON PREP SUPER BOLL (1.33-2.67 pt.)	ethephon (1-2 lb.)	Apply in 5 to 50 gallons of water per acre when 40 to 60 percent of the bolls are open and when there are sufficient mature unopened bolls to produce the desired yield. Ethephon can be used 4 to 7 days prior to application of defoliants as a preconditioning agent, tank mixed with defoliants, or applied after defoliation. **DO NOT** harvest cotton sooner than 7 days after ethephon application. **DO NOT** mix ethephon with sodium chlorate products because toxic chlorine gas fumes will be produced.

* The addition of 5.33 fluid ounces of ethephon to Dropp or Folex is registered for use in Alabama. These mixtures have provided accelerated defoliation in some cases over the defoliant used alone, especially under less than ideal conditions.

Table 16. Defoliants

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

Table 16. Defoliants (cont.)

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

Table 17. Desiccants

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

Table 18. Additives

Trade Name (Product per Acre)	Common Name (Rate a.i. per Acre)	Application Instructions
AMS 99% Powder (2 lb.)	ammonium sulfate (2 lb.)	Research has shown a small quantity of ammonium sulfate added to the spray mixture can increase the amount of defoliant which penetrates the cotton leaf.
PREP (other trade names) (5-6 fl.oz.)	ethephon (0.25 lb.)	The addition of 5 to 6 fluid ounces of ethephon per acre to defoliants 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.

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

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

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

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

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