Crop Profile for Cotton in Texas

Prepared: September, 1999

Revised: March, 2009

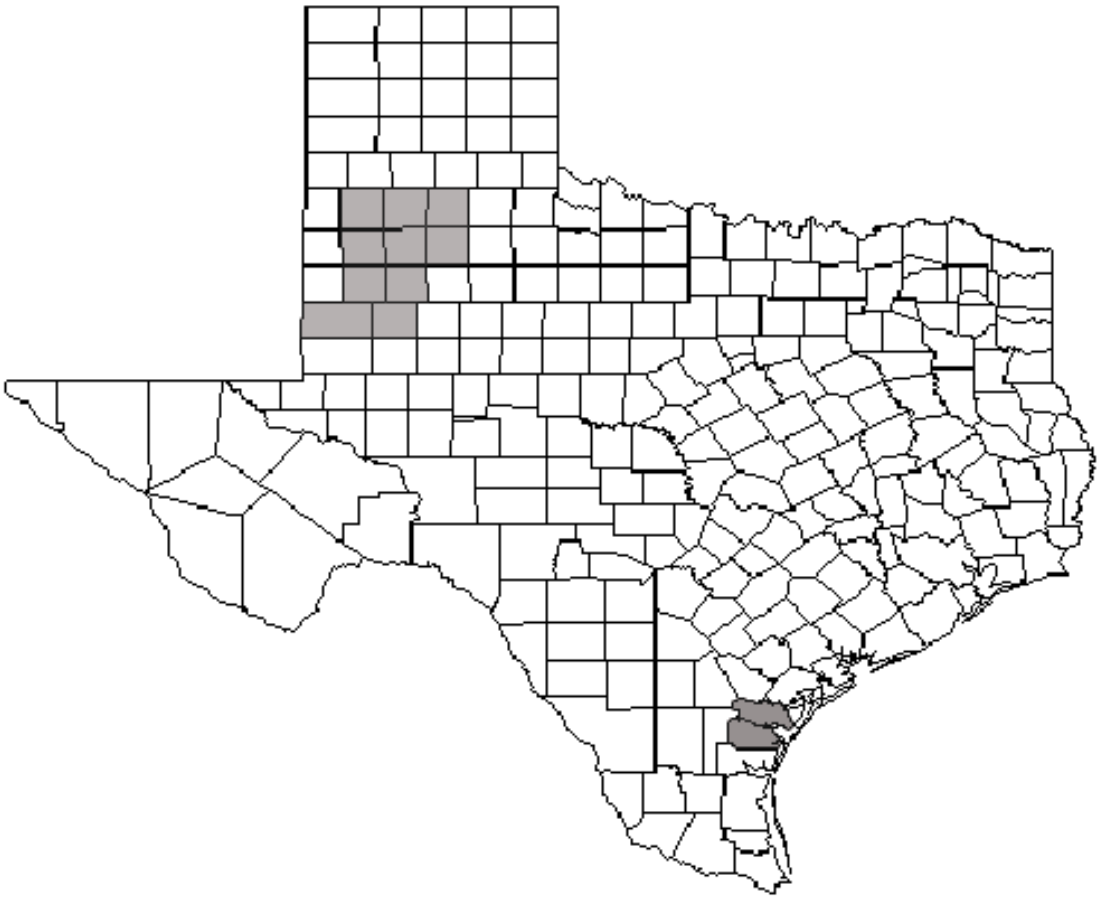
General Production Information

- Texas ranks first in cotton production in the U.S. Cotton is the leading cash crop in the state, and is grown on 5 million acres. This crop generates $1.6 billion in cash for farmers and has a total economic impact of $5.2 billion for the state. Texas accounts for approximately one-half of the cotton acres and roughly 40% of the total production in the U.S.

- More than 120 Texas counties in six different regions produce cotton (see Table 1). From the High Plains to the Lower Rio Grande Valley, each region differs vastly in the approaches to cotton production due to variations in climate, soil type, percentage of the crop that is irrigated, pests, and harvest techniques. Figure 1 identifies the top twelve cotton-producing counties in the state.

- Even with widespread use of non-chemical control methods, farmers must still battle pests by chemical means. Eighty-nine percent of the Texas cotton crop is scouted for weeds while 83% is scouted for insect pests. Cultivation occurs in 60% of cotton acres to control weeds.

Figure 1. Top twelve cotton-producing counties in Texas: Lubbock, Crosby, Hale, Lynn, Hockley, Floyd, Terry, Dawson, Gaines, Lamb, San Patricio, and Nueces.



Production Regions

The High Plains region of Texas is located north and south of Lubbock, Texas between the Caprock and the New Mexico border. This area consists of 27 counties that produce 64% of the state's cotton crop. The hot days and cool nights plus loam and sandy soil types make it vital to implement water and soil conservation methods. Fifty percent of the cotton is irrigated in this region. Average rainfall is 16-22 inches, but there are wide year to year variations in both total and seasonal rainfall. At harvest, 95% of High Plains farmers use a stripper harvester, although picker harvesting is on the increase.

The Rolling Plains region is located east of Lubbock and is comprised of 24 counties that produce 20% of Texas cotton. Moderate to hot days and cool nights characterize this region. Ten percent of the cotton is irrigated which makes it necessary to use the skip row

method of planting. Rainfall varies from 20-24 inches of rain a year on the sandy loam to loam soil. The stripper method of harvesting dominates 98% of this region.

The Blacklands of Texas is located south of Dallas. This region produces 4% of the state's total cotton crop. Deep prairie soils predominate this region. Temperate, warm nights and an abundance of rainfall (30-36 inches a year) lead to the fact that only five percent of this region is irrigated. At harvest 95% of the cotton is stripped.

The Coastal Bend and Upper Gulf Coast, around Corpus Christi and up the coast, produces 8% of Texas cotton. This region experiences temperate conditions with very high humidity. Ten percent of the crop is irrigated, and an average of 25-32 inches of rainfall is received per year. This area uses picker and stripper harvesters.

The Lower Rio Grande Valley (LRGV)is located between McAllen and Brownsville, adjacent to the Mexico border. This region plants early due to the subtropical climate and insect problems. Average rainfall is between 25 and 30 inches per year and 60% of the crop is irrigated. Seventy percent of the cotton is picker harvested. This area produces 3% of the state's crop.

Far West Texas is located between Pecos and El Paso and is an arid, desert environment. Rainfall averages 7-15 inches per year. Alluvial and desert soils predominate. High temperatures favor cotton growth and irrigation is essential. Ninety-five percent of the crop is picker harvested. Predominately upland cotton is produced in the Pecos area, but about 60% of the crop in the El Paso area is high-quality Pima cotton. The Trans-Pecos area produces 1% of Texas cotton.

Cultural Practices

Growing Season: Cotton is a perennial warm-season crop that requires a long growing period for fruiting and fiber maturation. Planting usually begins in February and March in the Lower Rio Grande Valley and progresses into June in the south High Plains. Upland cotton (*Gossypium hirsutum)* is the dominant type planted throughout Texas. The fiber is shorter than Pima. In Far West Texas, Pima (Egyptian) (*G. barbadense)* cotton is grown because of premium prices for the extra long fiber. Pima cotton requires an extended growing season and performs well in a desert environment. Numerous public and private varieties of cotton seed are sold with different HPR (Host Plant Resistance) traits.

Upland cotton has genetic variations that result in colored cotton fiber that range from green to brown. These mutations are currently produced in small quantities for novelty, or special fashion markets . More information about colored cotton can be found in Kohel (1984). Some white and colored lint cottons are produced organically.

Pesticide Needs: Acid-delinted seed is treated with a fungicide for planting in all regions of Texas. Acid delinting removes short fuzzy fibers and improves germination and planting uniformity. Seedcoat fungicides minimize the threat of seedling diseases. Virtually no fungicides are applied after planting. Herbicides are commonly applied on all cotton land to reduce annual and perennial weed problems. Insect pests are scouted on 83% of cotton farms, and insecticides are generally applied based on economic thresholds or criteria for the boll weevil eradication program.

Skip-Row and Irrigation Practices: Depending on regional rainfall, farmers may plant "skip-row" or "two in one out". This technique refers to leaving every third row unplanted to improve crop use of soil moisture in semi-arid regions. Irrigation is commonly practiced in areas with adequate underground water supplies. In the Lower Rio Grande Valley furrow irrigation is the most common because of the heavy soil. In the High Plains, center pivot systems are an efficient way to water. Low Energy Precision Application, or LEPA, irrigation systems allow growers to apply water at ground level with center pivot systems, with less pressure, lower evaporation losses, and savings in water. In recent years, drip irrigation has been implemented to some degree by producers in various production regions.

Ultra-Narrow Row Cotton (UNR): UNR cotton intercepts more sunlight for growth, utilizes rainfall better and reduces the time from planting to harvest. However, pest control is more challenging and early season weed control is essential, since cultivation is not possible in UNR cotton. Harvesting equipment designed especially for stripping UNR cotton is a limiting factor.

Harvest: Two techniques are used to harvest cotton in Texas. Stripper harvesting is generally performed in regions with a shorter growing season and low-input production systems. The entire cotton boll (carpels and seed cotton) is removed from the stalk and extraneous plant trash is separated at the gin. Strippers are used exclusively where tight-bolled, "stormproof" cotton varieties are grown. Picker harvesting is used in areas with long growing seasons and longer staple cotton. Pickers remove only the seed cotton (fiber and seeds), which results in less trash but higher harvest costs.

Harvest aid chemicals such as desiccants and defoliants are commonly applied prior to harvest. Desiccants are substances intended to artificially accelerate the drying of plant tissue and are used in regions with short growing seasons. Defoliants are applied in picker operations to remove leaves from the mature plant. Plant growth regulators, or boll openers, are used alone or in conjunction with defoliants and/or dessicants to allow more bolls to open prior to harvest.

Table 1. Summary of production regions and cultural diversity.

REGION	REGIONAL CLIMATE	SOIL TYPES	% IRRIGATED	COTTON TYPE
High Plains	hot days & cool nights.	loamy sands to loams	55% irrigated,	95% stripper

	3,000 ft elev. RF 16-20"		most dryland is skip row planted	
Rolling Plains	moderate to hot days, cool nights RF 20-24"	sandy loams to loams	10% irrigated most is skip row planted	98% stripper
Blacklands	temperate, warm nights RF 30 -36"	deep prairie soils	5% irrigated	95% stripper
Coastal Bend & Upper Gulf Coast	temperate, high humidity RF 25-32"	heavy soils	10% irrigated	60% picker
Lower Rio Grande Valley	subtropical, long season planted early RF 25-30"	heavy alluvial soils	35% irrigated	70% picker
Far West Texas	arid, desert environment RF 4-10"	Alluvial and desert soils	95% irrigated	95% picker, some pima

Worker Activities

Scouting
Scouting for insect pests and monitoring plant growth and development is the primary activity requiring workers to enter cotton fields during the growing season. Scouting is performed by consultants, County IPM Agents, summer scouts, growers, and industry employees. Summer scouts may be spend 30 or more hours per week in cotton fields.

Manual Weed Control
Hand weeding is less common than in years past primarily as a result of cost of labor and the widespread use of herbicide-tolerant cotton varieties.

Irrigation
The majority of irrigated acres in Texas use sprinkler or some type of overhead irrigation requiring very little worker activity in the fields. Some areas, such as the Lower Rio Grande Valley, use furrow irrigation which requires workers to place and repair siphon tubes and/or pipes within the field. Workers entering fields for irrigation purposes occurs during a limited portion of the season.

The majority of cotton production occurs through mechanized processes. Tillage, spraying, and harvest are accomplished using motorized equipment usually from an enclosed cab.

Insect Pests

Overview and Scouting:

Scouting is practiced on 83% of the Texas cotton crop to determine insect density and potential damage. Farmers and private crop consultants perform 94% of the total scouting. Producers then use economic threshold to decide how to handle their problem.

Several insects attack cotton at various stages of growth. The major insect pests include the boll weevil, bollworm, tobacco budworm, cotton fleahopper, plant bugs, aphids, and thrips. Other arthropod pests include cutworms, beet armyworms, fall armyworm, stink bugs, and spider mites. These pests and their control methods are discussed below.

Over 2.6 million pounds of insecticide were applied to Texas cotton in 2007. On average, there are 1.2 insecticide applications across all planted acres.

The Texas Boll Weevil Eradication Foundation Inc. was established by the Texas Legislature in 1993. The cotton-producer run, nonprofit foundation governs and oversees the implementation of the boll weevil eradication program in Texas. Currently, according to the Boll Weevil Eradication Foundation, roughly 85% of Texas cotton acres are either eradicated or functionally eradicated.

Stalk Destruction Laws

Upon request and petition of Texas Cotton Producers, the Texas Legislature passed the Cotton Pest Control Law in an effort to combat the boll weevil and pink bollworm. This law, which is enforced by the Texas Department of Agriculture, requires producers in a regulated county to culturally manage pest populations using habitat manipulation by planting and destroying cotton within an authorized time period. Appointed producers, who are members of local pest management zone committees, have established a series of cotton planting and stalk destruction deadlines for all producers in each regulated county. The battle against pink bollworms has been extremely successful. Because farmers have adhered to authorized planting and stalk destruction deadlines over

the past years, pink bollworm populations in most of the state have been reduced to levels that do not cause major economic damage.

Cutworms

Biology:
Cutworms occur periodically and are not common pests, but can be economic problems in some fields. Hence the term "occasional pests". Cutworms are most detrimental in the seedling stage. Cutworms cut the stem from the ground, kill the plant, and reduce crop stands and crop yields.

The main factor to consider for treatment of cutworms is to determine if the stand or crop population is threatened.

Cultural/Non-Chemical Controls:
To reduce the possibility of cutworm problems farmers should keep fields weed free for 3 weeks prior to planting, and plow under cover crops at least three weeks before planting.

Chemical Controls:

Insecticide	Pounds ai per acre	REI (hours)	MOA
Bifenthrin (Fanfare, Brigade)	0.04-0.10	12	3
Chlorpyrifos (Lorsban)	0.75-1.0	24	1B
Beta-cyfluthrin (Baythroid)	0.0625-0.125	12	3
Cypermethrin (Ammo)	0.025-0.1	12	3
Esfenvalerate (Asana)	0.03-0.05	12	3
Gamma cyhalothrin (Proaxis)	0.0075-0.01	24	3
Lambda-cyhalothrin (Karate, Silencer)	0.015-0.02	24	3
Methyl parathion (Methyl)	0.5-1	96	1B
Profenofos (Curacron)	0.5-1.0	48	1B
Zeta-cypermethrin (Mustang)	0.008-0.012	12	3
Zeta-cypermethrin + bifenthrin (Hero)	0.05-0.10	12	3

Thrips

Biology:
Adult thrips are winged and about 1/15 inch in length, straw colored, and slender. Cool, wet conditions favor high thrip infestations and cause delayed fruiting and crop maturity. Thrips cause silvering on the lower leaf surface, blackened leaves, and terminal and square loss. They feed on leaves, leaf buds, and very small squares. Scouting and early season control is essential.

Thrips cause greater yield reduction in earlier infestations. Inspection of the cotton plant should occur from the cotyledon stage through the fourth true leaf stage. Farmers should consider control when the average number of thrips per plant is equal to the number of true leaves present.

Cultural/Non-Chemical Controls:
Hard-driving rain storms can decrease thrips populations. Insecticide application is not recommended after the 5 to 7 true-leaf stage.

Chemical Controls:

***Seed**

Insecticide	**Per seed – mg-ai**	**MOA**
Thiodicarb + imidacloprid (Gaucho Grande)	0.375 + 0.375	1A + 4A
Abamectin (Avicta) + Thiamethoxam (Cruiser)	0.1-0.15 + 0.3-0.34	6 + 4A

***Planter Box**

Insecticide	**Pounds ai per acre**	**REI (hours)**	**MOA**
Acephate (Orthene)	0.18	NA	1B

***In-furrow**

Insecticide	**Pounds ai per acre**	**REI (hours)**	**MOA**
Aldicarb (Temik)	0.3-0.75	48	1A
Disulfoton (Di-Syston)	0.6	48	1B
Phorate (Thimet)	0.5	48	1B

***Foliar**

Insecticide	Pounds ai per acre	REI (hours)	MOA
Acephate (Orthene)	0.5-1	24	1B
Dicrotophos (Bidrin)	0.05-0.2	48	1B
Dimethoate (Dimethoate 4E)	0.125-0.25	12	1B
Methyl parathion (Methyl 4EC)	0.125-0.25	96	1B

Fleahoppers

Biology:
Adult fleahoppers are pale green and about 1/8 inch long. Adults and nymphs look similar except that adults have wings and are a darker shade of green. When the cotton begins to square, fleahoppers migrate from host weeds to suck the sap from the cotton plant. Smaller squares are the most susceptible to damage.

Several factors are involved in fleahopper control decision making and include, the number of fleahoppers present, cotton fruiting rate, and percent square set. During the first three weeks of squaring, 10 to 25 fleahoppers on 100 sampled terminals can be economically damaging.

Cultural/Non-Chemical Controls:
Populations of beneficial insects and spiders help control fleahoppers. Farmers are cautious in applying fleahopper insecticides too early. In the late blooming stage, insecticide application is rarely justified.

Chemical Controls:

Insecticide	Pounds ai per acre	REI (hours)	MOA
Acephate (Orhtene)	0.5-1.0	24	1B
Acetamiprid (Intruder)	0.025-0.05	12	4A
Chlorpyrifos (Lorsban)	0.188-0.5	24	1B
Chlorpyrifos + gamma cyhalothrin (Cobalt)	0.37–0.74 + 0.007–0.013	24	1B + 3
Dicrotophos (Bidrin)	0.05-0.2	48	1B
Dimethoate (Dimethoate 4E)	0.125-0.25	12	1B
Flonicamid (Carbine)	0.054-0.089	12	9C
Imidacloprid (Provado)	0.047	12	4A

Indoxacarb (Steward)	0.09-0.11	12	22
Lambda-cyhalothrin + thiamethoxam (Endigo)	0.028-0.038 + 0.03-0.05	24	3 + 4A
Methomyl (Lannate)	0.113-0.225	72	1A
Methyl parathion (Methyl)	0.125-0.25	96	1B
Oxamyl (Vydate)	0.25	48	1A
Thiamethoxam (Centric)	0.031-0.0625	12	4A

Boll Weevil:

Biology:
Boll weevils have been a problem for 100 years and have historically caused more damage than any other cotton insect pest. The progress of the eradication program has greatly diminished the damage caused by this pest. Boll weevils puncture squares or bolls for feeding and egg laying. Punctured squares fall to the ground. Large bolls may remain on the plant but fail to yield well, and produce lower-grade cotton. Fruit production is delayed, and can result in more chemical use. The life span of a boll weevil is 30 days, and a female will lay approximately 100 eggs during this time. In the fall, adults go into diapause (hibernation) and overwinter in leaf litter.

Management and decision making. All of the cotton acreage in Texas is now in the boll weevil eradication program. Producers should continue monitoring the plants for boll weevils and boll weevil damage. If boll weevils or boll weevil damage is found, producers should contact their local Texas Boll Weevil Eradication Foundation office.

Cultural/Non-Chemical Controls:
The most effective biological control of boll weevils in East Texas is the fire ant. Fire ants only control the larvae and pupae and do not prevent adult weevils from laying eggs. When four or more fire ants are found on a sample of 10 terminals, insecticide treatment usually is not necessary. Other non-chemical methods include trap cropping for suicidal emergence and early termination of the crop to reduce the number of over wintering females and stalk destruction in the fall.

Chemical Controls: Overwintered

Insecticide	**Pounds ai per acre**	**REI (hours)**	**MOA**
Endosulfan	0.5-1.5	24	2A
Malathion (Fyfanon ULV)	0.61-0.92	12	1B
Methyl parathion (Methyl)	0.125-0.25	96	1B
Oxamyl (Vydate)	0.25	48	1A

Chemical Controls: In-season

Insecticide	Pounds ai per acre	REI (hours)	MOA
Dicrotophos (Bidrin)	0.5	48	1B
Endosulfan	0.5-1.5	24	2A
Malathion (Fyfanon ULV)	0.61-0.92	12	1B
Methyl parathion (Methyl)	0.25-0.75	96	1B
Oxamyl (Vydate)	0.25	48	1A

Bollworm

Biology:
Larvae color varies from pink, green, or brown but is characterized by longitudinal stripes along the back. In periods of high temperatures and low humidity, moths deposit eggs on the squares, bolls, stems, and any other region on the lower part of the plant. Eggs hatch in 3 to 4 days and new worms feed on more tender leaves before attacking larger squares and bolls. In south Texas, the pink bollworm is also a problem.

Since eggs are deposited throughout the plant, detection and control of eggs and small worms is more difficult. Scouting should be done at least once a week. Frequent examination of leaves, stems, squares, and blooms is necessary to make good management decisions. Farmers know that bollworm populations can increase when an insecticide application destroys beneficials in the field.

Cultural/Non-Chemical Controls:
Some efficient non-chemical controls occur naturally. Weather can be effective in controlling bollworms that are shorter than ½ inch. Natural predators, such as beneficial insects and spiders, can reduce populations by feeding. Also, destruction of cotton stalks is extremely important in the prevention of regrowth for bollworms to feed on. Stalk destruction is vital to reduce pink bollworm populations.

Chemical Controls:
Chemical application is justified prior to first bloom when 15 percent of the green squares are worm damaged.

Insecticide	Pounds ai per acre	REI (hours)	MOA
Bacillus thuringiensis (Dipel, Javelin, Centari)	NA	4	11
Bifenthrin (Fanfare, Brigade)	0.04-0.10	12	3

Beta-cyfluthrin (Baythroid)	0.0125-0.02	12	3
Chlorpyrifos + gamma cyhalothrin (Cobalt)	0.37–0.74 + 0.007–0.013	24	1B + 3
Cyfluthrin + Imidacloprid (Leverage)	0.034-0.043 + 0.0475-0.0625	12	3 + 4A
Cypermethrin (Ammo)	0.04-0.1	12	3
Esfenvalerate (Asana)	0.03-0.05	12	3
Gamma cyhalothrin (Proaxis)	0.0125-0.02	24	3
Indoxacarb (Steward)	0.09-0.11	12	22
Lambda-cyhalothrin (Karate, Silencer)	0.025-0.04	24	3
Lambda-cyhalothrin + thiamethoxam (Endigo)	0.028-0.038 + 0.03-0.05	24	3 + 4A
Methomyl (Lannate)	0.45	72	1A
Methyl parathion (Methyl)	0.75	96	1B
Profenofos (Curacron)	0.5-1.0	48	1B
Spinosad (Tracer)	0.067-0.089	4	5
Thiodicarb (Larvin)	0.6-0.9	12	1A
Zeta-cypermethrin (Mustang)	0.033-0.045	12	3
Zeta-cypermethrin + bifenthrin (Hero)	0.05-0.10	12	3

Aphids

Biology:
Aphids are also referred to as plant lice. Three species feed on cotton: the cotton aphid, cowpea aphid, and the green peach aphid. These vary in appearance, but the damage to cotton is the same. Primary damage is increased plant stress due to sucking activity. Infestations that occur mid to late in the season cause down-grading of lint quality, due to a sticky deposit or "honey dew" deposited by the aphid on the foliage and fiber. Some textile mills refuse to purchase "sticky cotton" due to major problems in processing the fiber. Generally, aphids are located on the undersides of leaves, on stems, in terminals, and sometimes in the fruit. Insect damage also causes leaves to curl downward, turn yellow, and even fall to the ground.

Most economic damage happens during the blooming cycle. Aphids can rapidly increase in numbers, and fields need to be scouted two times per week. Insecticide application should be delayed until there are 50 aphids per leaf.

Cultural/Non-Chemical Controls:
The most effective non-chemical controls are unfavorable weather, predators, and parasites. These factors can hold aphid levels below damaging levels in some cases.

Chemicals Controls:

Insecticide	Pounds ai per acre	REI (hours)	MOA
Acetamiprid (Intruder)	0.025-0.05	12	4A
Chlorpyrifos (Lorsban)	0.125-1.0	24	1B
Dicrotophos (Bidrin)	0.25-0.5	48	1B
Dicrotophos + Bifenthrin (Bidrin XP)	0.25-0.4 + 0.063-0.1	48	1B + 3
Flonicamid (Carbine)	0.044-0.089	12	9C
Imidacloprid (Provado)	0.047	12	4A
Lambda-cyhalothrin + thiamethoxam (Endigo)	0.028-0.038 + 0.03-0.05	24	3 + 4A
Methomyl (Lannate)	0.225	72	1A
Profenofos (Curacron)	0.5	48	1B
Thiamethoxam (Centric)	0.031-0.05	12	4A

Lygus bugs

Biology:
In the Eastern, Southern and Blacklands areas of Texas, Lygus bugs, primarily the tarnished plant bug (*Lygus lineolaris*) is one of several Lygus species that feeds on cotton terminals, squares and small bolls. Adults are winged, vary in color from greenish to brown, and are 1/4 inch long. Immature tarnished plant bugs (nymphs) are light green. Late instars have four conspicuous black spots on the thorax and one large black spot near the base of the abdomen. The nymph's wings are not developed, but nymphs can move rapidly and are difficult to detect in cotton foliage. Small nymphs may be distinguished from aphids by their rapid movement. However, they may be confused with cotton fleahoppers and leaf hopper nymphs.

Cultural/Non-Chemical Controls:
When weedy fields are located near cotton, the lygus population in these fields may migrate when the weeds begin to dry. Avoid such migrations by removing the weeds before the population of lygus reaches the winged adult stage.

Chemical controls:

Insecticide	Pounds ai per acre	REI (hours)	MOA

Acephate (Orthene)	0.5-1.0	24	1B
Bifenthrin (Fanfare, Brigade)	0.04-0.10	12	3
Beta-cyfluthrin (Baythroid)	0.0125-0.02	12	3
Chlorpyrifos + gamma cyhalothrin (Cobalt)	0.37–0.74 + 0.007–0.013	24	1B + 3
Cyfluthrin + Imidacloprid (Leverage)	0.034-0.043 + 0.0475-0.0625	12	3 + 4A
Cypermethrin (Ammo)	0.04-0.1	12	3
Dicrotophos (Bidrin)	0.5	48	1B
Dimethoate (Dimethoate 4E)	0.25	12	1B
Esfenvalerate (Asana)	0.03-0.05	12	3
Flonicamid (Carbine)	0.054-0.089	12	9C
Gamma cyhalothrin (Proaxis)	0.01-0.015	24	3
Imidacloprid (Provado)	0.047-0.0625	12	4A
Indoxacarb (Steward)	0.065-0.09	12	22
Lambda-cyhalothrin (Karate, Silencer)	0.025-0.03	24	3
Lambda-cyhalothrin + thiamethoxam (Endigo)	0.028-0.038 + 0.03-0.05	24	3 + 4A
Methomyl (Lannate)	0.225	72	1A
Methyl parathion (Methyl)	0.125-1.0	96	1B
Oxamyl (Vydate 2L)	0.25	48	1A
Zeta-cypermethrin (Mustang)	0.035-0.05	12	3
Zeta-cypermethrin + bifenthrin (Hero)	0.10	12	3

Stink bugs

Biology:

Several species of stink bugs feed on bolls in the Eastern, Southern and Blacklands areas. Species of stink bugs regularly causing losses of cotton in these regions include the green stink bug, the southern green stink bug and the brown stink bug. Several other stink bug also occasionally contribute to early season losses in these production areas. Feeding on bolls by stink bugs may cause shedding of small bolls.

Cultural/Non-Chemical Controls:

There are no effective cultural control methods for stink bugs.

Chemical Control:

Brown stink bug

Insecticide	**Pounds ai per acre**	**REI (hours)**	**MOA**
Acephate (Orthene 90)	0.8	24	1B
Dicrotophos (Bidrin)	0.25-0.5	48	1B
Dicrotophos + Bifenthrin (Bidrin XP)	0.25-0.4 + 0.063-0.1	48	1B + 3
Methyl parathion (Methyl 4EC)	0.75	96	1B
Oxamyl (Vydate 3.77 C-LV)	0.33-0.5	48	1A

Green stink bug

Insecticide	**Pounds ai per acre**	**REI (hours)**	**MOA**
Acephate (Orthene 90S)	0.8	24	1B
Bifenthrin (Fanfare, Brigade)	0.04-0.10	12	3
Beta-cyfluthrin (Baythroid)	0.0125-0.02	12	3
Cyfluthrin + Imidacloprid (Leverage)	0.034-0.043 + 0.0475-0.0625	12	3 + 4A
Dicrotophos (Bidrin)	0.25-0.5	48	1B
Gamma cyhalothrin (Proaxis)	0.0125-0.02	24	3
Lambda-cyhalothrin (Karate, Silencer)	0.025-0.04	24	3
Lambda-cyhalothrin + thiamethoxam (Endigo)	0.028-0.038 + 0.03-0.05	24	3 + 4A
Methyl parathion (Methyl 4EC)	0.75	96	1B
Oxamyl (Vydate 3.77 C-	0.33-0.5	48	1A

LV)			
Zeta-cypermethrin (Mustang)	0.035-0.05	12	3
Zeta-cypermethrin + bifenthrin (Hero)	0.05-0.1	12	3

Beet Armyworm (BAW)

Biology:
Young beet armyworms BAW cluster and feed together. Leaves and terminals are targeted for feeding. The BAW skelentonizes leaves, rather than leaving holes. Late season infestations are damaging since BAWs feed on the terminals, squares, blooms, and bolls. Beet armyworm eggs are laid in clusters.

Inspecting the whole plant gives the best estimate of BAW. Insecticides may be needed if there are more than 20,000 small worms per acre, and at least 10 percent of the plants are infested. Infestations are usually spotty.

Cultural/Non-Chemical Controls:
Outbreaks are caused by several factors. A short, mild winter, late planting, and delayed crop maturity can increase infestations. Also, early season insecticide application destroys beneficials that would help keep (BAW) infestation levels low.

Chemical Controls:

Insecticide	**Pounds ai per acre**	**REI (hours)**	**MOA**
Chlorpyrifos (Lorsban)	0.75-1.0	24	1B
Chlorpyrifos + gamma cyhalothrin (Cobalt)	0.37–0.74 + 0.007–0.013	24	1B + 3
Diflubenzuron (Dimilin)	0.0313-0.125	12	15
Emamectin benzoate (Denim)	0.0075	48	6
Indoxacarb (Steward)	0.09-0.11	12	22
Methomyl (Lannate)	0.45	72	1A
Profenofos (Curacron)	0.75-1.0	48	1B
Spinosad (Tracer)	0.067-0.089	4	5
Tebufenozide (Confirm)	0.06-0.25	4	18
Thiodicarb (Larvin)	0.6-0.9	12	1A

Spider Mites

Biology:
Spider mites are found on the undersides of leaves and reduce yields by removing the sap from the plant which causes discoloration and early defoliation. This pest also attacks squares and bolls. Outbreaks usually result when an earlier insecticide has removed natural predators.

Treatment is encouraged when leaf damage becomes noticeable. When insect infestations are restricted to small areas, spot treatment is recommended.

Cultural/Non-chemical Controls:
There are natural predators of spider mites. One should be cautious not to destroy these insects during insecticide application.

Chemical Controls:

Insecticide	Pounds ai per acre	REI (hours)	MOA
Abamectin (Temprano)	0.0047-0.019	12	6
Dicofol (Kelthane)	0.75-1.5	12	Unknown
Profenofos (Curacron)	0.5-1.0	48	1B
Propargite (Comite 6.55E)	0.82-1.62	24	14
Spiromesifen (Oberon)	0.094-0.25	12	23
Thiodicarb (Larvin)	0.6-0.9	12	1A

Summary of Insecticide Use in Texas-All Insects*

Insecticide	Trade Name	% of Planted Acres Treated	Applications	Total lbs. (X 1000)
Malathion	Several	8	5.4	1,695
Acephate	Orthene	14	1.8	311
Aldicarb	Temik	10	1.0	264
Dicrotophos	Bidrin	7	1.6	143
Oxamyl	Vydate	1	1.6	31
Acetamiprid	Intruder	10	1.0	18
Cypermethrin	Ammo	2	1.0	8
Thiamethoxam	Centric	4	1.2	6
Imidacloprid	Provado	2	1.2	5

Esfenvalerate	Asana	1	1.0	2
Lambda-cyhalothrin	Karate	1	1.1	1
Others	Several			138
Totals				**2,624**

*Does not include Bt's and other biologicals.

Diseases

Seed Treatments:
Several seedling diseases attack cotton. Cottonseed in Texas is acid-delinted to remove fuzz fibers before a fungicide seed treatment is applied to help obtain uniform plant stands. All planting seed is commercially processed (conditioned) and receives one or more seed coat fungicides to reduce damping off and other seedling diseases. These precautionary fungicide treatments are applied by seed processors.

Diseases

*** Bacterial Blight:** This leaf disease causes defoliation which results in yield loss. It is becoming a more noticeable problem in the High Plains. Resistance is the only control for this disease.

***Cotton Root Rot (or Texas Root Rot):** This soil- borne disease is caused by the fungus *Phymatotrichum omnivorum* which invades the roots mid-season destroying the vascular system in maturing cotton. Root rot thrives in some soils and problems are spotty. The Blacklands, Coastal Bend, and Lower Rio Grande Valley regions experience significant problems. Symptoms include a slight yellowing of the foliage, wilting, and eventually death. Control measures are limited and include rotation with grain crops, application of organic manure, construction of barriers to prevent spread, and disinfection of infected areas with ammonia. No fungicides are available for cotton root rot.

***Fusarium (Cotton) Wilt:** This fungus disease attacks mid season and causes growth stunt and death to plants. The fusarium fungus usually enters the root through wounds left by nematodes and will then migrate throughout the plant. Yellowing, wilting, leaf death and dropping, and bare blackened stems are the indicators of cotton wilt. Several cotton varieties have a varying tolerance to cotton wilt and can help control the disease. Control of nematodes (see below) also will aid in the prevention of cotton wilt. Crop rotation to nonsusceptible crops and application of balanced fertilizers that contain potash can be beneficial.

Bronze Wilt: This is a recently recognized cotton disease characterized by bronze or red discoloration and wilting of leaves that can lead to boll shed. This disease occurs

primarily on Upland cotton. The symptoms of bronze wilt are difficult to differentiate from other disease symptoms, nutrient deficiencies and/or environmental stresses. The diagnostic symptom of this disease is the health of the upper taproot and lower stem. If leaves show symptoms and the upper taproot and lower stem appear healthy it is most likely bronze wilt. The best way to avoid this disease is to plant non-susceptible varieties.

Nematodes

Nematodes are microscopic, worm-like invertebrates that survive by feeding on the roots of cotton. There are no unique symptoms on the above ground portion of the plant; however, galls on the root are noticeable. Nematodes are a major problem, yet yield reductions commonly go unnoticed and vary throughout the regions. Several types of nematodes are found in Texas. In the LRGV nematode problems are most severe. Chemicals are not economical to apply for cotton.

Fungicide Use:
Planting seed is treated, but virtually no other fungicides are applied after the crop is planted.

Weeds

Controlling weeds in cotton in Texas is one of the most critical aspects of successful lint production. Unchecked weed populations can rob valuable moisture and nutrients from the crop as well as cause significant quality reductions at harvest. One of the most critical challenges in cotton weed control is to provide the seedling cotton plant with conditions that allow the crop to outgrow weeds, thus providing a height differential for directed sprays. Recent technological advancements have changed many aspects of weed control in cotton but challenges are ever present.

Approximately sixty percent of Texas cotton acres are planted to herbicide-tolerant varieties. The Roundup Ready and Liberty Link systems are the predominant weed control programs employed. In some cases, the utilization of herbicide-tolerant cotton varieties has allowed producers to increase yield and quality of the cotton produced.

However, the use of herbicide-tolerant cotton varieties has not provided a ‘cure-all’ for weed control in cotton. Issues such as narrow herbicide application windows, weed species population shifts and resistance, and rising technology fees have caused some producers to limit their use of herbicide-tolerant varieties. Recently, it has become difficult for cotton producers to acquire conventional planting seed as seed companies continue moving towards transgenic varieties. In the face of rising energy costs, potential changes in government subsidies, and a fluctuating world cotton market, cotton producers are left with fewer options to reduce their inputs.

* The Lower Rio Grande Valley (LRGV) and Coastal Bend areas experience early season and subtropical conditions, with long growing seasons. Winter annuals germinate in the

fall months. Summer annuals start to germinate early in January. Other weeds emerge throughout the year. Control methods must be started used before cotton is planted and throughout the season until June and July.

* Central Texas and the alluvial river bottom areas plant cotton shortly after the LRGV. Winter annuals infest land prepared in the fall. The goal is to plant cotton as soon as possible, once the soil warms up, and to produce and set bolls early. Early planting circumvents mid and late season insect problems.

* The Rolling and High Plains are regions where soil moisture is at a premium, even in irrigated fields. Although the soil does not heat up as early as in South Texas, weed control remains important. Weed presence prior to planting extracts moisture and interferes with the cotton stand. Weeds that emerge with the crop interfere with early growth. In these areas, fiber production is a race against time, since the cool nights near the end of the season retard fiber maturation. Weeds must be controlled early and for several weeks into the season to avoid loss of soil moisture. A few weeds present at harvest can increase harvest duration by two or three-fold, slow down the ginning process, and increase the trash content of lint reducing its value.

Cultural/Non-chemical Control:
Cultivation is practiced to control weeds, reduce wind erosion, and break up soil crusts. Rotation with other crops such as sorghum, peanut, corn, and wheat can provide limited weed control. Hand hoeing is sometimes practiced as a last resort to control low populations of weeds that escaped earlier control methods.

- Cultivation is practiced by 61% of farmers to control weeds.
- Hand hoeing is efficient in destroying the weed root, which helps reduce weed seed populations in the soil. Hand hoeing is used where there are spotty weed problems. However, it is time consuming and costly.
- 79% of cotton acres are treated with a preemergent herbicide while 87% of acres are sprayed with a postemergent herbicide
- Cultivation and non-chemical methods supplement chemical control but are not an alternative for herbicide use.

Common annual grasses:

- **Texas panicum** (*Panicum texanum*) or Colorado grass is a native weed found in every region of the state. Seeds are the only source of reproduction. It flourishes in warm conditions and competes very well with cotton.
- **Crabgrass** (*Digitaria* spp.) species are mostly native warm season weeds. Crabgrass produces large numbers of seed and can have both erect and decumbent growth habits.
- **Browntop panicum** (*Panicum fasciculatum*) is also a native warm season grassy weed. It is found in nearly every region of the state and can cause yield loss to cotton.

- **Sprangletops** (*Leptochloa* spp.) such as red sprangletop, green sprangletop, bearded sprangletop, and Mexican sprangletop are native grassy weeds. Commonly found across the state, these weeds compete with cotton for water and light.
- **Broadleaf signalgrass** (*Brachiaria platyphylla*) is a large-seeded annual weed that is native to Texas. Fine hairs on the wide leaves increase the competitive ability of this weed with sorghum.
- **Barnyardgrass** (*Echinochloa crus-gali*) is an introduced annual grass found in every region of the state. When left unchecked it can reach heights of 3-4 feet and decrease cotton yield significantly.
- **Hophornbeam copperleaf** (*Acalypha ostryifolia*) is a native broadleaf weed that competes closely with cotton in Texas fields. Control can be somewhat difficult as it is not controlled well with glyphosate.

Common perennial grasses:

- **Johnsongrass** (*Sorghum halapense*) is an introduced grassy weed that will stifle cotton if left uncontrolled. Reproducing either by seed or underground rhizomes, johnsongrass can be challenging to eradicate from cotton fields.
- **Bermudagrass** (*Cynodon dactylon*) is also an introduced perennial grassy weed that can be found in every area of the state. Commonly found in roadsides, ditches, lawns, and pastures bermudagrass is drought-tolerant and difficult to control.

Common annual broadleaf weeds:

- **Pigweed** (*Amaranthus* spp.) including Palmer amaranth, prostrate pigweed, spiny amaranth, tumble pigweed, smooth pigweed, redroot pigweed and common waterhemp are troublesome small-seeded broadleaf weeds. Pigweeds are prolific seed producers and can cause serious yield reduction if left uncontrolled. Recently in Texas waterhemp species have showed some tolerance to many cotton herbicides including glyphosate.
- **Common sunflower** (*Helianthus annuus*) is an extremely troublesome broadleaf weed across Texas. Sunflowers are native to North America and have been cultivated for centuries for their edible seeds. They are commonly found in fields, roadsides, ditches, and waste areas.
- **Cocklebur** (*Xanthium strumarium*) is another native annual belonging to the sunflower family. Cocklebur fruit are one inch long, woody, with hooked prickles covering the outside of the fruit. The burs are irritating to humans and animals and seeds and seedlings contain a glycoside that is toxic to all classes of livestock. The seed persists in soil and is not easily separated from cotton seed during ginning.
- **Devil's claw** (*Proboscidea louisianica*) is a foul-smelling native annual sometimes referred to as unicorn plant. Plants are covered with glandular hair

causing them to be very sticky. The fruit splits at maturity forming two claws, therego the common name. Has a unique hook-shaped seed pod that entangles harvest equipment.

- **Smellmelon** (*Cucumis melo* var. Dudaim) is a vining weed that reduces crop yields by competing for sunlight and moisture. Smellmelon also interferes with crop harvest by clogging and fouling pickers or strippers with vines. Each plant may produce as many as 40 melons, each containing approximately 400 seed. Mature melons will float, as will the dried sacks of seed following rotting of the melons. This weed has become a serious pest in cotton, sorghum and corn and appears to be increasing.
- **Kochia** (*Kochia scoparia*) is an annual weed growing from 2-5 feet tall and begins growth in late spring. Kochia is an annual plant originating in Eurasia, and introduced into America in the early 1900's. Primarily a weed pest in West Texas, its appearance was first recorded in Texas during the late 1940's.

Common perennial broadleaf weeds:

- **Silverleaf nightshade** (*Solanum elaeagnifolium*) is a creeping perennial spreading by roots or seeds. Silverleaf nightshade is native to the central United States and can be found in pastures, rangeland, waste areas, and cropland.
- Perennial **morningglory** (*Ipomoea* spp.) species such as sharppod morningglory are weedy vines that can cause significant yield reductions and harvest difficulties for cotton growers. Sharppod morningglory develops extensive underground perennial roots that can regenerate repeatedly after removal or disturbance of top growth.
- **Field bindweed** (*Convolvuvis arvensis*) is a perennial from an extensive root system often climbing or forming dense mats. Field bindweed was introduced from Europe and has become a widespread and serious weed pest in many parts of the United States. It is difficult to control because of a root system that can penetrate the soil to a depth of 20 feet and which gives rise to numerous long lateral roots. It is not controlled well with glyphosate or other commonly used cotton herbicides.

Common perennial monocot weeds:

- **Yellow nutsedge** (*Cyperus esculentus*) is an aggressive perennial superficially resembling a grass. Yellow nutsedge can spread by seed, creeping rootstocks, or by small underground tubers or nutlets. The many hard brown tubers may lie dormant in the soil for many years before producing new plants. More serious in irrigated than in dryland cotton.
- **Purple nutsedge** (*Cyperus rotundus*) is another spreading perennial similar to yellow nutsedge. The underground tubers are oblong and covered by persistent reddish scales and are often formed in chains that remain connected underground. Purple nutsedge is commonly found in turf, ornamental areas, cultivated fields, and ditches.

Chemical Controls:

Winter Weed Control

Herbicide	Product per acre	MOA (WSSA)	Weeds Controlled/ Comments
Prometryn (Caparol)	1.2-1.6 pt	5	Cool-season annual broadleaf control; fall or winter either pre or postemergence
Trifloxysulfuron (Envoke)	0.10 oz.	2	Cool-season annual broadleaf control; early preplant
Glyphosate	16-32 oz.	9	Broadleaf and grass control; postemergence
Oxyfluorfen (Goal 2XL)	1-2 pt.	14	Selected broadleaf control; pre or postemergence
Flumioxazin (Valor)	2-4 oz.	14	Selected broadleaf control; pre or postemergence
Glufosinate (Ignite)	23-29 oz	10	Selected weeds; postemergence
Glyphosate + Metolachlor (Sequence)	2.5-3.5 pt	9, 15	Annual and perennial grasses, broadleaves, and sedges; postemergence with residual control

Preplant

Herbicide	Product per acre	MOA (WSSA)	Weeds Controlled/ Comments
MSMA 6.6lb	1.33 qt	17	Johnsongrass, nutsedge, cocklebur control; apply once to emerged weeds
Paraquat dichloride (Gramoxone Inteon)	2.5-4.0 pt	22	Emerged annual weeds; allow maximum wed emergence before application
Thifensulfuron + tribenuron (Harmony Extra)	0.3-0.6 oz	2	Annual broadleaf weeds; add nonionic surfactant to mixture

Glyphosate	11-32 oz.	9	Annual and perennial grasses and broadleaves; postemergence when weeds are actively growing

Preplant Incorporated

Herbicide	Product per acre	MOA (WSSA)	Weeds Controlled/ Comments
Pendimethalin (Prowl)	1-4 pt	3	Annual grass and small-seeded broadleaf control; apply up to 60 days before planting
Trifluralin (Treflan)	1-2.5 pts	3	Annual grasses; should be incorporated within 24 hours of application

Preemergence

Herbicide	Product per acre	MOA (WSSA)	Weeds Controlled/ Comments
Prometryn (Caparol)	1.6-4.8 pt	5	Annual broadleaves, some grasses; do not use on sand or loamy sand
S-metolachlor (Dual Magnum)	1.25-2.0 pt	15	Annual grasses, some small-seeded broadleaves; apply either PPI or preemergence
Fluometuron (Cotoran 4L)	2.0-4.0 pt	7	Annual broadleaves, some grasses; do not use on sandy soils in West Texas
Diuron (Karmex 4L, others)	0.8-2.2 qt	7	Annual grasses and broadleaves; do not apply to sand or loamy sand
Pyrithiobac (Staple)	1.3-2.1 fl oz	2	Selected broadleaves; observe crop rotation restrictions

Postemergence or Post-Directed

Herbicide	Product per acre	MOA (WSSA)	Weeds Controlled/ Comments
Prometryn (Caparol)	1.0 pt early 1.0-1.3 pt late	5	Annual broadleaves; apply as directed spray; avoid contact with cotton leaves
Fluometuron (Cotoran 4L)	2.0-4.0 pt	7	Annual broadleaves; apply as directed, semi-directed or over-the-top spray
Diuron (Direx 4L)	0.4-.6 qt	7	Annual broadleaves; do not apply over-the-top; avoid contact with cotton leaves
Glufosinate (Ignite)	22-29 oz	10	Many grasses and broadleaves; apply over-the-top of Liberty Link cotton only
Trifloxysulfuron (Envoke)	0.10-0.15 oz over-the-top; 0.10-0.25 oz post-directed	2	Broadleaves and sedges; cotton must have at least 5 true leaves
Glyphosate + s-metolachlor (Sequence)	2.5-4.0 pt	15	Annual and perennial broadleaves and grasses; may be applied preplant, preemergence, or over-the-top in Roundup Ready cotton
Prometryn + trifloxysulfuron (Suprend)	1.0-1.5 lb	5, 2	Broadleaves, some sedges; use only in picker and Pima cotton varieties
Lactofen (Cobra)	12.5 oz	14	Annual broadleaves; directed spray only
DSMA 3.6	3.0-4.0 pt	17	Selected grasses and broadleaves; do not apply over-the-top or by plane
MSMA 6.6	1.0-1.25 pt	17	Selected grasses and broadleaves; do not apply over-the-top or by plane
Pyrithiobac (Staple)	1.3-3.8 fl oz	2	Selected broadleaves; weeds must be small; observe crop rotation restrictions

Fluazifop (Fusilade)	0.5-1.5 pt	1	Grasses; cultivation from 7 days before to 7 days after application may reduce control
Fluazifop + fenoxaprop (Fusion)	6-12 oz	1	Grasses; do not plant grass crops within 60 days of application
Clethodim (Select)	6-8 oz	1	Grasses; do not cultivate treated grasses within 7 days of application
Quizalofop (Assure II)	5-12 oz	1	Grasses; use adequate carrier; do not cultivate within 7 days
Sethoxydim (Poast Plus)	12-48 oz	1	Grasses; do not apply to grasses under stress
Oxyfluorfen (Goal 2XL)	1-2 pt	14	Selected grasses and broadleaves; postemergence as a directed spray to weeds not exceeding 4 true leaves
Glyphosate	0.5-1.0 qt	9	Annual and perennial grasses and broadleaves; may be applied to non-herbicide tolerant cotton using shielded sprayer; May be applied over-the-top to glyphosate-tolerant cotton
Bromoxynil (Buctril)	0.75-1.0 pt	6	Broadleaf weeds; use only on BXN (Buctril tolerant) cotton
Flumioxazin (Valor)	1-2 oz	14	Selected broadleaves, some annual grasses; may be tank-mixed with glyphosate or MSMA

Layby

Herbicide	**Product per acre**	**MOA (WSSA)**	**Weeds Controlled/ Comments**
Prometryn (Caparol)	1.6-3.2 pt	5	Annual broadleaves, some grasses; do not use on sand or loamy sand

Pendimethalin (Prowl)	1-4 pt	3	Annual grass and small-seeded broadleaf control; apply up to 60 days before planting
Trifluralin (Treflan)	1-2.0 pts	3	Annual grasses; should be incorporated within 24 hours of application
Flumioxazin (Valor)	1-2 oz	14	Selected broadleaves, some annual grasses; may be tank-mixed with glyphosate or MSMA

Preharvest

Herbicide	**Product per acre**	**MOA (WSSA)**	**Weeds Controlled/ Comments**
Glyphosate (Roundup Weathermax)	Up to 44 oz	9	Annual and perennial grasses and broadleaves; may be applied after 20% boll crack, allow 7 days before harvest

Cotton Stalk Destruction

If conditions after harvest are favorable, cotton plants can generate new squares and bolls in 3 to 4 weeks, providing a good habitat for boll weevils, one of the most destructive and costly cotton pests in Texas. When done area-wide, early harvest and stalk destruction are effective means of managing over-wintering boll weevils. If stalks are not completely destroyed soon after harvest, growers participating in the boll weevil eradication program will face the costs of more post-harvest spraying operations, more pesticide use and greater program/producer expenses.

Stalk destruction is more important in the state's southern and eastern regions where rainfall and warmer temperatures prolong fall cotton growth. An estimated 55% of cotton growers in the eastern and southern areas are using herbicides for stalk destruction. In the western and northwestern regions, freezing temperatures generally kill cotton plants before regrowth can develop. Herbicidal control is one of these methods.

Cultural/Non-chemical Controls:

When field conditions and weather are favorable for tillage, stalks can be shredded and disked to destroy the plant. Stubble stalk pullers also can be used to uproot the stalk. Although these mechanical methods can be effective, some stalks may survive. Many growers have adopted reduced tillage systems, leading to more interest in non-mechanical methods for stalk destruction.

Stalk Destruction:

Herbicide	Rate per acre	MOA (WSSA)	Weeds Controlled/ Comments
2,4-D	1-3 lb	4	Apply with surfactant; best results obtained by shredding stalks to 6-8 inches with application soon thereafter
Dicamba (Clarity)	4-64 oz	4	Apply with surfactant; best results obtained by shredding stalks to 6-8 inches with application soon thereafter
2,4-D + dicamba (Weedmaster)	0.5-6 pts	4	Apply with surfactant; best results obtained by shredding stalks to 6-8 inches with application soon thereafter

Herbicide Application: Methods, Application, and Timing:

Methods/Type of Application (Also see "Timing" below):

* **Ground** application sprayers are used on the majority of the acres treated with herbicides. Most of all herbicide applications are broadcast, where the whole area is treated. A much smaller percentage of acres are banded, wherein only a 10-18 inch strip over the row is treated. Directed postemergence applications, where the treatment is under the crop canopy, also account for a relatively small percentage of applications.

*** Aerial** application of herbicides is used on limited acres of cotton. Aerial applicators use GPS (global positioning system) for safe and more accurate application and records. Aerial application may be used when cotton has become too large to efficiently run ground rigs, or the land is too wet to allow use of ground equipment.

* **Spot Spraying** involves one or more laborers riding on seats of a motorized spray rig while applying chemical directly on the weed with a hand held spray wand. Spot spraying is efficient in controlling reoccurring patches of perennial weeds. Glyphosate (Roundup or Touchdown) is the most commonly used herbicide in spot spraying. However, it is more efficient to hoe some weeds rather than spraying, to be certain of killing the weed. Most spray rigs also are equipped with hoes so workers can dismount to chop weeds. (Also see "Postemergence" below)

Timing:

The timing of herbicide application can vary depending on chemical usage and targeted weeds. Application occurs either before planting, at planting, or after planting.

***Pre-Plant Incorporated:** Herbicide is applied and then incorporated into the soil to avoid breakdown in the sunlight and/or evaporate. The herbicides that are most commonly applied pre-plant incorporated would be trifluralin (Treflan) or pendimethalin (Prowl).

***Preemergence:** Herbicide is applied before weeds emerge. Commonly, preemergence herbicides are applied "at planting" before the crop emerges. This prevents major weed infestations that emerge with early-season rains. Summer annual grasses and broadleaf weeds are the target. Herbicides used include: prometryn (Caparol), metochlor (Dual), flurometuron (Cotoran), diuron (Karmex), and others.

***Postemergence**: The herbicide is applied directly to the weed, usually after the crop and weeds have emerged. This is usually a "clean-up" of the weeds that cultivation and prior chemicals have missed. "Directed Postemergence" indicated that the chemical is sprayed under the crop canopy or foliage on smaller weeds that emerge later and can not be controlled by cultivation. Chemicals include: DSMA, MSMA, glyphosate (Roundup or Touchdown) in glyphosate-tolerant cotton, fluazifop-P-butyl (Fusilade), clethodim (Select), and others. Hooded sprayers are also used.

Summary of Herbicide Use in Texas

Herbicide	Trade Name	% Acres Treated	Number of Applications	Lbs. Ingredient Applied (X 1000)
Glyphosphate	Various	84	2.2	7,220
Trifluralin	Treflan	50	1.1	2,330
Pendimethalin	Prowl	17	1	739

Diuron	Karmex	16	1.1	494
Prometryn	Caparol	7		279
S-Metolachlor	Dual Magnum	2	1.0	99
Glufosinate	Ignite	3	1.3	65
2,4-D	various	1	1.2	44
Pyrithiobac	Staple	9	1.0	28
Carfentrazone	Aim	9	1.0	9
Pyraflufen-ethyl	ET	10	1.0	2
Others	Several			223
Total Use				**11.532 Million lbs.**

Other Chemicals:

Plant Growth Regulators (PGR): PGRs modify plant growth and development to improve production efficiency. Under high fertility and high soil moisture conditions cotton tends to remain vegetative and produces excessive plant material. PGRs help retain early-produced cotton bolls, suppress late-season vegetative growth, and speed up reproductive progess. Improved lint yield, earlier maturity, and reduced insecticide needs are benefits of PGRs. Sixteen percent of Texas cotton is treated with PGR's.

Harvest-Aid Chemicals: Harvest-aid chemicals enable farmers to harvest earlier, reduce late-season pests, and reduce trash content. Fifty-seven percent of Texas cotton is treated with a harvest-aid chemical. In the High Plains region, the crop growth is frequently terminated by frost and cotton in that area is not treated with a harvest-aid. There are two types of harvest-aid chemicals.

Desiccants: Chemicals cause rapid water loss in plant tissue. The foliage dries and usually falls from the plant, the bolls dry faster, and the crop can be harvested sooner with less plant trash contamination. Desiccant use is common in areas with short growing seasons to enhance stripper harvesting. Timely crop termination also helps reduce the number of overwintering boll weevils.

Defoliants: Chemicals that cause abscission of leaves from mature plants. Leaf-drop chemicals are usually applied to picker harvested cotton in areas with long growing seasons.

Chemical Summary: PGR & Harvest Aid Chemicals Used in Texas

Chemical	Trade Name	% of Acres Treated	Total lbs. (X 1000)
PGRs			
Ethephon	Prep	56	3,261
Mepiquat Chloride	Pix	16	31
Cyclanilide	Finish	5	20
Mepiquat pentaborate	Pentia	7	34
Harvest Aid Chemicals			
Desiccants			
Paraquat	Several	32	597
Sodium Chlorate	Several	3	291
Defoliants			
Tribufos	DEF/ Folex	15	804
Monocarbamide dihyd.		5	600
Thidiazuron	Dropp	13	58
Totals			**5,696**

Contacts

Dr. Mark Matocha – Extension Program Specialist
Texas AgriLife Extension Service
College Station, TX 77843
Ma-matocha@tamu.edu

Dr. Charles Allen – Texas IPM Coordinator
Texas AgriLife Extension Service
San Angelo, TX
Ctallen@ag.tamu.edu

Dr. Randy Boman- Extension Agronomist
Texas AgriLife Extension Service
Lubbock, TX
R-boman@tamu.edu

Dr. Gaylon Morgan- Extension Cotton Specialist
Texas AgriLife Extension Service
College Station, TX 77843
Gmorgan@ag.tamu.edu

Dr. Paul Baumann – Extension Weed Specialist
Texas AgriLife Extension Service
College Station, TX 77843
Pbaumann@ag.tamu.edu

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