

# Pink Bollworm

## Management

## In Texas

Charles T. Allen\*



P

ink bollworm was first discovered in the U.S. at Hearne, Texas, in 1917. Since that time it has spread westward, causing millions of dollars in damage and control costs each year. In recent years, U.S. losses have averaged about 22,000 bales, worth approximately \$5.5 million, despite extensive efforts to control the pest.

In Texas, pink bollworms have caused damage across the southern and southwestern regions of the state. Severe infestations throughout the central part of the state, as far north as Waco and Dallas, occurred during the 1950s. Since that time, however, pink bollworm problems have been restricted to Far West Texas, primarily along and west of the Pecos River. In recent years, yield losses in the Trans Pecos have averaged 1,052 bales/year, worth over \$260,000. Localized severe infestations have destroyed the crop in some fields despite extensive spraying.

Management systems are available which can greatly reduce or

eliminate pink bollworm damage. These systems are multiple tactic but rely heavily on cultural controls. They have proven to be effective in Texas, California and Arizona.

## Description

### Moth

The adult pink bollworm moth is a 3/8 inch long grayish-brown moth. Poorly defined black spots cover the wings which are held folded over the back when not in use. The back edge of the wing is slightly fringed and lighter in color than the rest of the wing. The antennae are 1/2 the length of the body and normally held alongside the body.

### Eggs

The eggs are pearly white or pink and oval shaped. They are smaller than a pinhead and are laid primarily on plant vegetative parts early in the season and on young bolls later on.



Adult pink bollworm moth.

### Larvae

The larvae are white with a black head when young. Sharp-eyed scouts can find these threadlike young worms when they are no more than 1/16 of an inch long. As the worms grow they develop distinctive pink bands. Nearing the pupal stage the worms reach 1/2 inch in length. Larva and moth shown here are greatly enlarged.

### Pupae

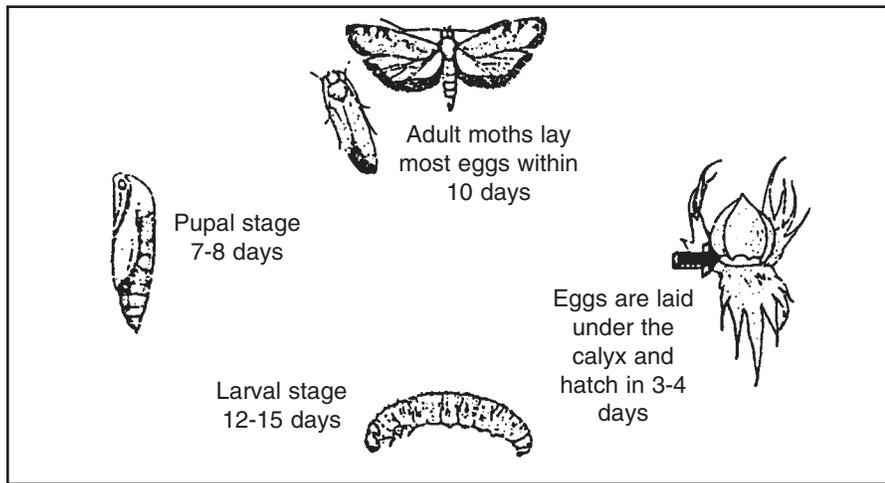
When mature, the larvae cut out of the bloom or boll and drop to the ground. Most larvae encase themselves in a cocoon or hibernaculum constructed of silken fibers, soil particles and plant matter. The cocoon is formed at or near the soil surface, often in cracks in the soil. With or without the silken cocoon, the larvae at this stage change into pupae. Pupae are about 3/8 inch long, shiny brown and can be found in the top 2 inches of soil.

## Life Cycle/Biology

### Adult

The adult pink bollworm female emerges from the pupal stage, feeds briefly, mates and begins laying eggs. Egg laying begins about 2 days after emergence. Over her 10- to 14-day life span, a female will lay 200 or more

\*Associate Professor and Extension Entomologist, Texas Agricultural Extension Service, The Texas A&M University System.



*Pink Bollworm Life Cycle*

eggs. The moth is active at night and rests under clods or in soil cracks during the day. Most adult movement is short range, but long range movement is not uncommon among a small fraction of the population. Long range movement occurs predominantly in early spring and late fall.

### Eggs

Eggs are placed singly or more commonly in groups of 5 to 10. Early in the season, eggs are laid on leaves, stems, terminals and squares. Larvae usually enter squares which are more than 10 days old. By mid-season and throughout the remainder of the season, eggs are laid on young, soft bolls, 10 to 24 days of age. Eggs are placed mainly beneath the calyx at the base of the bolls. Eggs hatch in 3-4 days.

### Larvae

The pink bollworm larva emerges from the egg and quickly eats its way into squares or bolls. To be successful, a newly hatched larva must have entered the cotton fruit within 30 minutes to 1 hour from when it hatched from the egg. Mortality from predation is high at this stage.

A rosetted bloom results when a pink bollworm infests a square. As the infested square forms a

bloom, the mature pink bollworm larvae ties the flower petals together with silken threads, preventing the bloom from opening completely. In squares and blooms, pink bollworm larvae feed primarily on pollen, but also on immature seeds. About 50 percent of infested fruit are shed as a result of this feeding.

Most of the economic damage from pink bollworm results from larvae feeding on bolls. Larvae tunnel through the boll walls and feed on the developing seeds. Bolls between 10 and 24 days post bloom are most susceptible to infestation. After entering a boll, the larvae feed for 12 to 15 days. When larval development is complete, mature worms cut small holes through the wall of infested bolls and fall to the ground. Larvae then pupate at or near the soil surface, often in cracks in the soil.

### Pupae

Pupae do not feed. During the pupal stage, pink bollworm changes from the feeding stage (larva) to the flying, sexual stage (moth). The pupal stage lasts about 7-8 days, after which the adult moth emerges.

The complete life cycle is about 30 days. Four to five generations are normally produced per year.

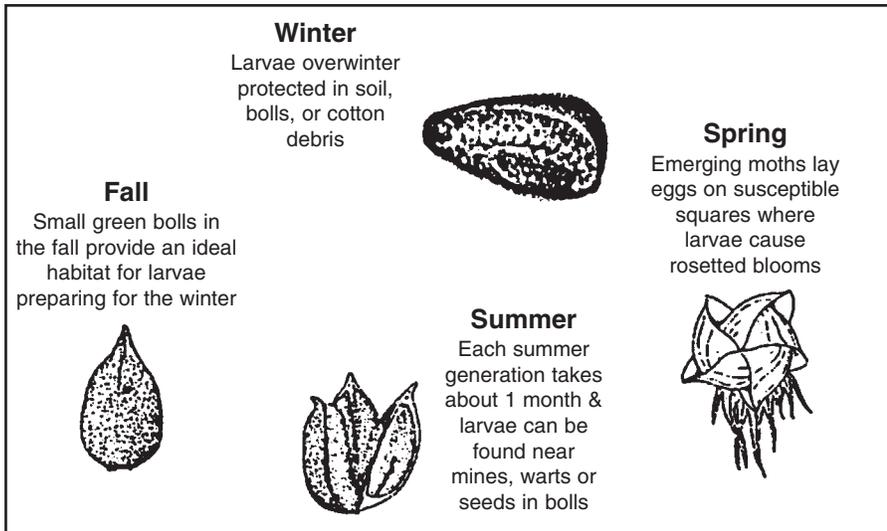
## Winter Survival

The pink bollworm spends the winter as a mature (fourth instar) larva in hibernation or diapause. The worms diapause inside a loosely spun silken web within bolls, in the seed, or in the soil in the field. Almost all overwintering occurs in the field, but overwintering can occur anywhere in cotton debris. Only a small part of the overwintering population survives to infest cotton the following year. Many die during the winter or emerge and die before the matchhead-sized squares they need for reproduction are present on the plant. Moths which emerge too early in the spring to find squares on which to lay eggs do not contribute to the population. This is called suicidal emergence.

## Season-Long Pink Bollworm Management

### Spring Management

Suicidal emergence is one of the major mortality factors for the pink bollworm. Delaying planting until soils are warm improves seedling health and vigor, and allows for higher pink bollworm suicidal emergence. Earliest planted fields in an area, as a rule, become the most heavily infested fields. Late in the season large numbers of pink bollworm moths frequently move out of early planted (mature) cotton fields and into late planted (immature) cotton fields. Therefore, it is important not to plant too late. Late plantings provide abundant fruit in September and October for pink bollworm increases. Grower agreement on a "planting window" is an important cultural pink bollworm management tool. A compact "planting window" normally results in a compact season. Pink bollworm populations are limited by a compact season since fewer generations can



*Pink Bollworm Seasonal Cycle*

develop. Soil thermometers, crop models and heat unit models can help growers decide on the best planting window for an area.

Winter and spring irrigations cause pink bollworms to emerge early. This lowers the number which are available to infest the crop. Pre-plant irrigation is a better practice from a pink bollworm management standpoint than dry planting and watering-up cotton.

Pinhead square stage insecticide or mating disruption pheromone treatments should be made if pheromone traps catch an average of 5 moths or more per trap per night from pinhead square to matchhead square. Treatments should be initiated at or after 850 Heat Units (on the 55-86 model) and terminated at 95 percent emergence, or 1950 Heat Units. It is important to consider the impact of insecticide treatments on the natural enemy complex. Pinhead square applications should be completed by the 1/3 grown square stage (pencil eraser sized squares) to allow parasite and predator population to rebuild before bloom.

Early maturing varieties and a uniform plant population of 3 to 5 plants per foot of row promote early crop maturity. This allows the crop to escape large late season pink bollworm populations.

Earliness can also be enhanced by avoiding excessive nitrogen fertilization. Fertilization for realistic crop yield goals will reduce the likelihood of producing a late maturing, heavily pink bollworm-infested crop.

## Mid-Season Management

Rosetted bloom counts are useful in determining infestation levels, but treatments should not be based on bloom infestation. Treatment, if needed, should be timed for moth flights which occur after the larvae from rosetted blooms have emerged as adults.

In mid-season pink bollworm populations must be monitored carefully. Pheromone traps can be used, but should not be relied on totally. Reliable thresholds for pheromone traps have been elusive. Traps have not been especially effective in timing first summer treatment. Infested boll counts are more appropriate for making that decision. High trap catches generally mean you have high pink bollworm activity, but low trap catches don't always mean you have low pink bollworm activity. Traps are generally a good tool for determining when fields may need retreatment, however. Traps are useful in determining when mating dis-

ruption products should be reapplied. Reliance on traps as the only pink bollworm monitoring procedure should be avoided.

Insecticide or pheromone treatment decisions should be based primarily on boll sampling and percent boll infestation. Collect and examine 40 to 50 small bolls per field. Newly set bolls about the size of a quarter should be pulled from the plant and carefully cut and examined for pink bollworms. Newly infested bolls have a small clear bump or wart on the inside of the bur wall at the site where the larva entered the boll. The developing lint surrounding the wart is depressed or sunken in to accommodate the wart. The tiny, threadlike white worm can be found in the depressed area. The black head and movement of the larvae will make them easier to spot. Sampling bolls this size indicates the current status of the infestation. Bolls which have been infested for several days are much easier to spot. The larvae are larger, fecal material is easily seen, and the feeding damage is more extensive.

Insecticide or pheromone treatments should be considered when boll counts indicate 10 to 15 percent of upland bolls or 5 to 10 percent of pima bolls have been infested during the first 6 weeks of bollset.

In upland cotton, insecticide applications can be terminated when the last bolls you expect to harvest are "rock-hard" (30 days old).

In pima cotton, continue treatments until 70 percent of the bolls are open.

## Late Season Management

Irrigations should be terminated by August 25. The percentage of pink bollworm larvae in diapause (the overwintering form) increases from about 15 percent to about 90 percent between September 15 and October 15. If

irrigations are terminated by late August only a limited, poor quality food supply will be available for diapausing larvae in late September and October most years.

Harvest aid chemicals can be used to manage pink bollworm populations. Certain boll openers and defoliant cause immature fruit forms to fall from the plant, thereby limiting the pink bollworm food supply.

Other harvest aids may not cause fruit shed but may drop the leaves. Defoliated and desiccated plants are less attractive to pink bollworm.

Early thorough and complete harvest is critical in pink bollworm management. Early thorough harvest removes pink bollworms in mature bolls from the field and they are killed in the ginning process. Spilled seed cot-

ton should be picked up and ginned. Late harvest allows diapausing larvae to cut out of the bolls to overwinter in the soil.

Spindle picking leaves green bolls on the plant. The unharvested green bolls provide food for pink bollworms and a place for them to overwinter. Stripper harvesting removes the green bolls from the plants. If green bolls are piled and left on the turn-rows they form an excellent place for pink bollworm overwintering. The outer bolls on the pile pop open forming an insulating blanket for the interior bolls. Boll piles should be either picked up and ginned, or burned. If green boll piles cannot be ginned or burned, the next best option is to tie open green boll boxes and scatter green bolls in the field as you strip. This exposes the bolls to greater temperature changes and to field tillage operations.

Early thorough stalk destruction and plow-down is the single most critical part of a good pink bollworm management plan. As soon as a field is harvested, stalks should be shredded. Flail shredders are somewhat more effective in pink bollworm control than rotary shredders. As soon as the shredding operation is complete the field should be plowed. A turning plow which buries surface residue 6 inches or deeper is best for pink bollworm control. A light disking which covers residue only 1 to 2 inches normally improves the survival of pink bollworms.

Cropping systems which include fall or winter irrigations of cotton fields greatly increase pink bollworm mortality and stimulate early (suicidal) emergence of the adult moths.

<b>Suggested Products for Pink Bollworm Control</b>		
<b>Products (Listed Alphabetically) Active Ingredient</b>	<b>Rate Concentrate Per Acre</b>	<b>Use Restrictions</b>
Azinphosmethyl Guthion 3 lb	1 1/3 pt	Do not apply within one day of harvest or graze treated fields.
Bifenthrin Capture 2 lb	3.8 - 6.4 oz	Do not use more than 10 applications of any pyrethroid per season. Do not use near lakes, streams, rivers or wet lands (25 ft by ground; 75 ft by air). Do not graze.
Carbaryl Sevin 4F Sevin 80S Sevin 50W Sevin XLR Plus	1 1/2 - 2 1/2 qts 1 7/8 - 3 lbs 3-5 lbs 1 1/2 - 2 1/2 qts	
Chlorpyrifos Lorsban 4 lb	1 1/2 - 2 pts	
Cyfluthrin Baythroid 2 lb	1.6 - 3.2 oz	Do not use more than 10 applications of any pyrethroid per season. Do not use near lakes, streams, rivers or wet lands (25 ft by ground; 75 ft by air). Do not graze.
Cyhalothrin Karate 1 lb	2.56 - 3.84 oz	Do not use more than 10 applications of any pyrethroid per season. Do not use near lakes, streams, rivers or wet lands (25 ft by ground; 75 ft by air). Do not graze.
Cypermethrin Ammo 2.5 lb	2-5 oz	Do not use more than 10 applications of any pyrethroid per season. Do not use near lakes, streams, rivers or wet lands (25 ft by ground; 75 ft by air). Do not graze.

<b>Suggested Products for Pink Bollworm Control</b> <i>(continued)</i>		
<b>Products (Listed Alphabetically) Active Ingredient</b>	<b>Rate Concentrate Per Acre</b>	<b>Use Restrictions</b>
Esfenvalerate Asana XL	2.9 - 5.8 oz	Do not use more than 10 applications of any pyrethroid per season. Do not use near lakes, streams, rivers or wet lands (25 ft by ground; 75 ft by air). Do not graze.
Gosypylure Checkmate PBW NoMate PBW Fibers NoMate PBW MEC	5-8 grams 5-15 grams 1/3 - 5/6 oz	
Methyl Parathion PennCap M 2lb	2-4 pt	
Permethrin Ambush 2 lb Pounce 3.2 lb	6.4 - 12.8 oz 4-8 oz	Do not use more than 10 applications of any pyrethroid per season. Do not use near lakes, streams, rivers or wet lands (25 ft by ground; 75 ft by air). Do not graze.
Tralomethrin Scout X-TRA 0.9 lb	2.56 - 3.33 oz	Do not use more than 10 applications of any pyrethroid per season. Do not use near lakes, streams, rivers or wet lands (25 ft by ground; 75 ft by air). Do not graze.
Zeta-Cypermethrin Fury 1.5 lb	2.82 - 3.83 oz	Do not use more than 10 applications of any pyrethroid per season. Do not use near lakes, streams, rivers or wet lands (25 ft by ground; 75 ft by air). Do not graze.

## **Policy Statement for Making Insecticide Use Recommendations**

This is not a complete listing of all products registered for cotton and their uses. The insecticides and their suggested use patterns included in this publication reflect a consensus of opinion of Research and Extension entomologists based on field tests. The data from these field tests met the minimum requirements as outlined in the Guidelines for the Annual Entomology Research Review and Extension Guide Revision Conference. Products listed must conform to our performance standards and avoid undue environmental consequences.

Suggested insecticide use rates have exhibited sufficient efficacy in tests to be effective in providing adequate control in field situations. However, it is impossible to eliminate all risks. Conditions or circumstances which are unforeseen or unexpected may result in less than satisfactory results. The Texas Agricultural Extension Service will not assume responsibility for such risks. Such responsibility shall be assumed by the user of this publication.

Suggested pesticides must be registered and labeled for use by the Environmental Protection Agency and the Texas Department of Agriculture. The status of pesticide label clearances is subject to change and may have changed since this publication was printed. County

Extension agents and specialists are advised of changes as they occur.

The **USER** is always responsible for the effects of pesticide residues on his livestock and crops as well as problems that could arise from drift or movement of the pesticide. Always read and follow carefully the instructions on the container label. Pay particular attention to those practices which insure worker safety.

For additional information, contact your county Extension staff or write the Extension Entomologist, Entomology Department, Texas A&M University, College Station, TX 77843; or call (409) 845-7026.

In all of the zones, fields must be free of fruiting cotton plants from the stalk destruction deadline date to beginning of the next planting period. See cultural control map.

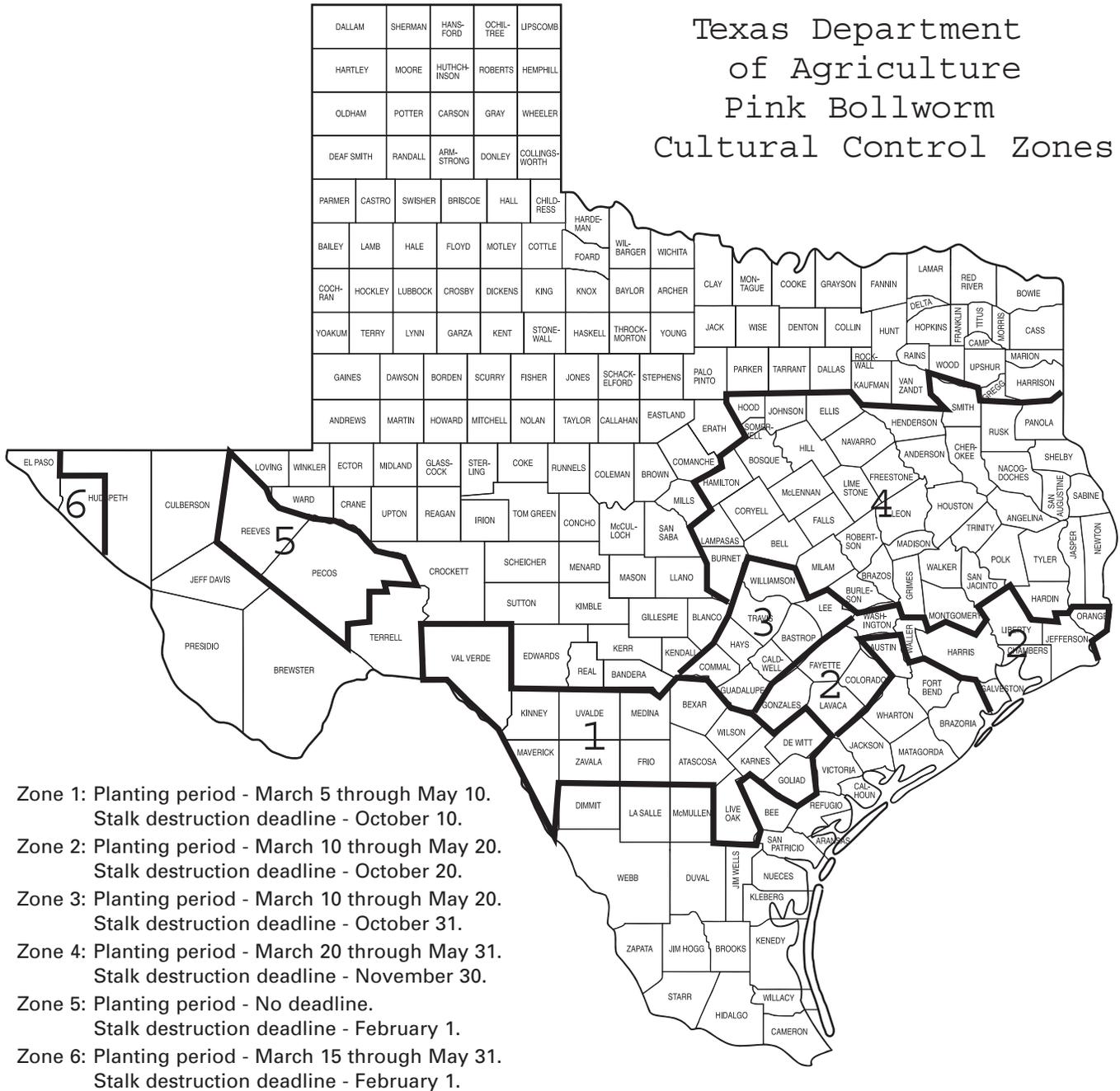
Although cultural control requirements apply in many

Texas counties, as shown on the map, pink bollworms also occur in nearly all cotton-growing counties of the state not included in the control areas. To reduce pink bollworm populations and damage, carry out the cultural practices recommended in this leaflet.

Consult your local, state or federal inspector for more detailed information or regulations.

The general infestation of pink bollworms calls for uniform action and complete cooperation of everyone growing or handling cotton.

## Texas Department of Agriculture Pink Bollworm Cultural Control Zones



- Zone 1: Planting period - March 5 through May 10.  
Stalk destruction deadline - October 10.
- Zone 2: Planting period - March 10 through May 20.  
Stalk destruction deadline - October 20.
- Zone 3: Planting period - March 10 through May 20.  
Stalk destruction deadline - October 31.
- Zone 4: Planting period - March 20 through May 31.  
Stalk destruction deadline - November 30.
- Zone 5: Planting period - No deadline.  
Stalk destruction deadline - February 1.
- Zone 6: Planting period - March 15 through May 31.  
Stalk destruction deadline - February 1.

## **Texas Department of Agriculture Pink Bollworm Regulatory Requirements**

The pink bollworm is a public nuisance and a menace to the cotton industry, and its eradication is a public necessity. The state shall employ all constitutional methods to control and eradicate the pink bollworm that scientific research demonstrates to be successful, including:

1. inspection of host plants in the field or host plant products where stored;
2. quarantine and fumigation of host plants and host plant products found to be contaminated;
3. supervision of the growing of host plants in areas known to be contaminated;
4. destruction of infested fields of host plants or of infested host plant products; and
5. prevention of planting of host plants in areas where infestation has been found.

Cultural controls: Planting periods and final deadline dates for stalk destruction are given for each of the zones in which they are mandatory. Pink Bollworm regulation 5.179 (c) for compliance with stalk destruction deadline states:

“The owner of the land in question and the tenant, if any, leasing such land to grow cotton shall be jointly and/or severally responsible for conducting cotton production within the limitation of these regulations and any fraction of the law as incorporated in these regulations as part of the Pink Bollworm law shall apply against both the owner, or his duly authorized agent, and tenant involved.”

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