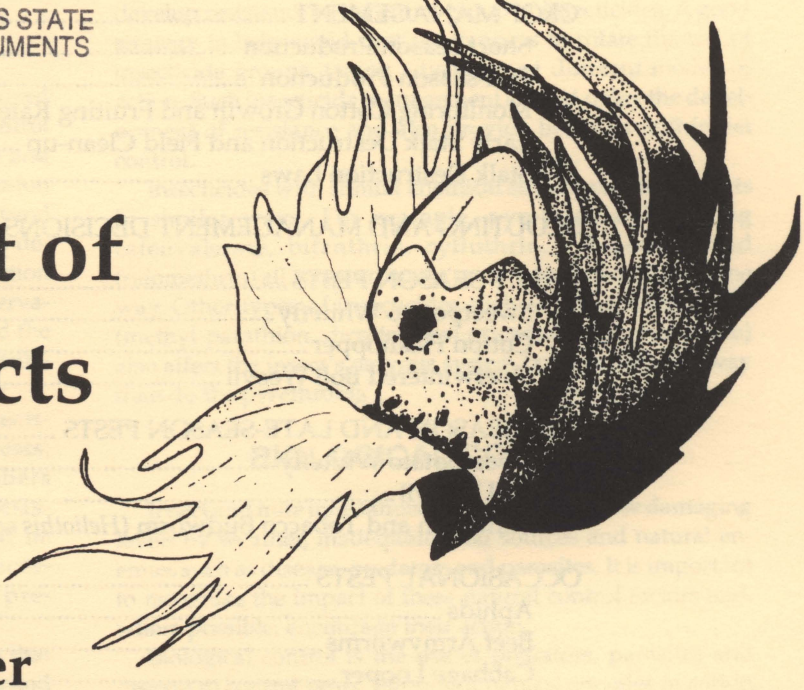
B-1210

Texas Agricultural Extension Service
The Texas A&M University System



Management of Cotton Insects in the Lower Rio Grande Valley 1995-1996

For recommended insecticides refer to B-1210A, "Suggested Insecticides for Managing Cotton Insects in the Lower Rio Grande Valley, 1995."

Texas Agricultural Extension Service • Zerle L. Carpenter, Director • The Texas A&M University System • College Station, Texas

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Management of Cotton Insects in the Lower Rio Grande Valley

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A committee of state and federal research personnel and Extension specialists meets annually to review cotton pest management research and management guidelines. These guidelines are directed toward maximizing profits for the Texas cotton producer by optimizing inputs and production.

PEST MANAGEMENT PRINCIPLES

The term "pest management" applies to a philosophy used in the design of insect, mite, disease and weed pest control programs. It encourages the use of the most compatible and ecologically sound combination of available pest suppression techniques. These management techniques include: cultural control, such as manipulation of planting dates and stalk destruction; crop management practices such as variety selection and timing of irrigation; biological control, involving conservation of existing natural enemies; host plant resistance; and the wise use of selective insecticides and rates to keep pest populations below economically damaging levels.

Major factors to be considered when using insecticides include protecting natural enemies of cotton pests, possible resurgence of primary pests, increased numbers of secondary pests following applications and pest resistance to insecticides. Therefore, insecticides should be applied at the proper rates and used only when necessary, as determined by frequent field inspections, to prevent economic losses from pests.

The pest management concept rests on the assumption that pests will be present to some degree in a production system, and that at some levels they may not cause significant losses in production. The first line of defense against pests is prevention through the use of good agronomic practices or cultural methods which are unfavorable for the development of pest problems (discussed below). Properly selected control measures should be taken only when pest populations reach levels at which crop damage suffered could result in losses greater than the cost of the treatment. This potentially injurious pest population or plant damage level, determined through regular field scouting activities, is called an **economic threshold or action level.** Precise timing and execution of each production operation is essential. In short, pest management strives to optimize rather than maximize pest control efforts.

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INSECTICIDE RESISTANCE MANAGEMENT

Experience has shown that reliance on a single group of insecticides that act in the same way may cause pests to develop resistance to the entire group of insecticides. A good strategy to help avoid pest resistance is to rotate the use of insecticide groups, taking advantage of different modes of action. Such insecticide management should delay the development of resistance and also provide better overall insect control.

Insecticides with similar chemical structures affect insects in similar ways. For example, pyrethroids (including esfenvalerate, bifenthrin, cyfluthrin, cyhalothrin and tralomethrin) all act on an insect's nervous system in the same way. Other types of insecticides such as organophosphates (methyl parathion, dicrotophos) or carbamates (thiodicarb) also affect the insect's nervous system but in a different way than do the pyrethroids.

BIOLOGICAL CONTROL

Insect and mite infestations are often held below damaging levels by weather, inadequate food sources and natural enemies such as disease, predators and parasites. It is important to recognize the impact of these natural control factors and, where possible, encourage their action.

Biological control is the use of predators, parasites and disease to control pests. Important natural enemies in cotton include minute pirate bugs, damsel bugs, big-eyed bugs, assassin bugs, lady beetles, lacewing larvae, syrphid fly larvae, spiders, ground beetles and a variety of tiny wasps that parasitize the eggs, larvae and pupae of many cotton pests.

Biological control includes the conservation, importation and augmentation of natural enemies. It is an environmentally safe method of pest control and is a component of integrated pest management programs in cotton. The Texas A&M University System is fully committed to the development of pest management tactics which use biological control.

Existing populations of natural enemies are conserved by avoiding the use of insecticides until they are needed to prevent the development of economically damaging pest infestations. Insecticide impact can also be minimized by using insecticides that are more toxic to the target pest than to the natural enemy. Classical biological control is the importation of natural enemies from other countries. This method has been effective where an exotic pest has entered Texas without its incumbent natural enemies, or to augment existing natural enemies of native pests.

Augmentation involves the purchase and release of natural enemies on a periodic basis. The most notable commercially available natural enemies include the egg parasite, *Trichogramma*, and the predators, lady beetles and lacewings. Although the control of both bollworms and tobacco budworms by the release of commercially reared *Trichogramma* wasps is theoretically possible, researchers have not been able to consistently achieve the level of parasitism necessary to reduce infestations below economically damaging levels. Multiple *Trichogramma* releases at high rates ranging from 50,000 to 150,000 parasitized eggs per acre were utilized in these studies. There are currently no economic thresholds established for augmentative releases of *Trichogramma* for bollworm/budworm control in cotton. Furthermore, parasite mortality from insecticides used to control other pests in or around parasite release areas would be a major factor adversely affecting the success of augmentative releases.

Research studies have shown that releasing large numbers of lacewing larvae (30,000 and more per acre) can reduce bollworm infestations below damaging levels. However, these release rates are currently cost prohibitive because of high production costs for rearing lacewings. The release of lacewing eggs has been less successful and there is little information on the efficacy of releasing adult lacewings in cotton. There is even less information pertaining to the utility of releasing either lady beetles or lacewings for the control of economically damaging infestations of aphids.

Because definitive information on the application of augmentation (when to apply, what density should be applied, etc.) is lacking, entomologists with the Texas Agricultural Extension Service can not provide guidelines for the application of augmentation as a management tool in cotton.

CROP MANAGEMENT

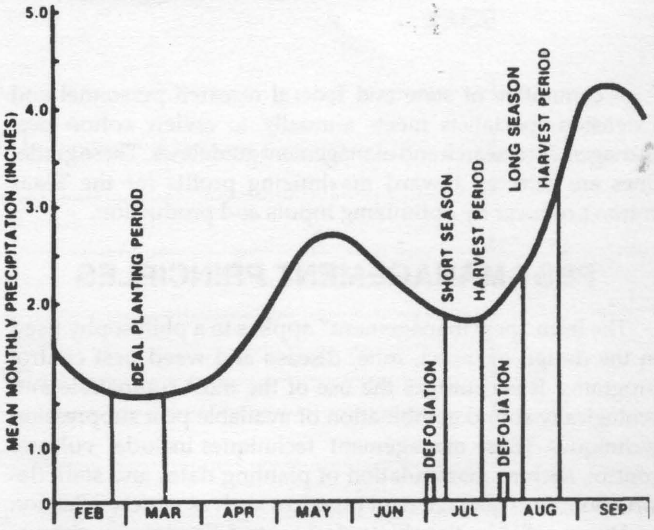
Currently, two major types of cotton production are practiced in the Lower Rio Grande Valley:

Short-season Production

This production system relies chiefly on cultural techniques including proper varietal selection, early planting and efficiency of fertilization and irrigation. These practices shorten the production season and the time that cotton is vulnerable to insect attack. By permitting an earlier harvest this system also greatly reduces the time of vulnerability to damage by adverse, preharvest weather. Short-season cotton varieties usually require 130 to 140 days from planting to harvest if grown under optimal nitrogen and water conditions. These varieties fruit and mature more rapidly than traditional full-season varieties. Thorough postharvest stalk destruction also should be practiced to reduce overwintering boll weevil populations.

The first 30 days of blooming are critical for an optimum, early boll set. The earliness factor in short-season production can be completely lost where damaging populations of insects occur as the first squares are formed. Heavy loss of early squares to overwintered weevils also may detract from short-season production. The boll weevil and the bollworm/tobacco budworm complex should be controlled with insecticides when they occur in damaging numbers. Because of the early maturity and quick fruiting of short-season cotton, field scouting should be intensified to determine pest population levels and damage as well as beneficial insect abundance. Plant growth and fruiting rates also should be monitored to allow early detection of potential problems.

Figure 1. Mean monthly precipitation for the Lower Rio Grande Valley showing the short-season harvest period and the long-season harvest period (N. L. Namken and M. D. Heilman, USDA, Weslaco, TX).



Full-season Production

The full-season production system has been practiced in the Lower Rio Grande Valley for many years. This system uses slower fruiting, indeterminate, full-season varieties grown with higher nitrogen inputs (greater than 30 pounds per acre) and abundant irrigation. The result is a long-season production period of 140 to 160 days from planting to harvest. This system requires higher inputs and has proven to be a profitable method of cotton production in past years. However, production costs have increased greatly in recent years in the Lower Rio Grande Valley. Increasing nitrogen fertilizer and amounts of irrigation water adds extra expense, prolongs the fruit development and delays maturation. These factors expose the cotton to high populations of late-season pests such as the boll weevil, cotton bollworm and tobacco budworm. A major production cost is the multiple applications of insecticides to protect the crop throughout the longer fruiting period. Consequently, high yields must be obtained to offset these high production costs. The probability of crop loss from delayed harvest because of adverse fall weather conditions is greater under this production system.

Full-season cotton varieties can be grown under a short-season production regime where soil types and rainfall allow. Early planting in combination with reduced nitrogen (30 pounds or less) and water levels, where applicable, result in a somewhat shorter production period. Nitrogen required for cotton production depends on the previous crop planted, nitrogen recycling, fall precipitation and soil types.

Monitoring Cotton Growth and Fruiting Rate

Early fruiting is desirable and facilitates early crop maturity. Frequent monitoring gives a good indication of crop set. Often, problem fields can be detected early if growth and fruiting habits are accurately monitored. The cause of a problem may not be immediately evident; however, early detection of problems is critical to minimizing losses. Frequent boll counts allow pest management decisions to be based upon a realistic projected yield estimate in relation to dollar inputs.

Cotton square and/or boll counts can be made by marking off a 10-foot segment of row, counting all squares and/or bolls in that distance, and using Table 2 to calculate the yield estimate on a per-acre basis. Select the appropriate column for your row spacing and read the yield estimate opposite the number of bolls counted.

Generally, 140,000 to 180,000 bolls per acre on a field count were required to produce a one-bale yield of cotton lint based on a 27-variety average in 1979. The two figures in the yield estimate represent varieties with small and large boll sizes. Several boll counts taken at random in a field will give a more accurate estimate of boll set and yield potential than one count alone.

Early Stalk Destruction and Field Clean-up

Early harvest and stalk destruction are among the most effective cultural and mechanical practices for managing overwintering boll weevils if done on an areawide basis. These practices reduce habitat and food available to the boll weevil, pink bollworm, bollworm and tobacco budworm. Shred cotton at the earliest possible date and do not allow stubble, regrowth or volunteer seedlings to remain within fields or surrounding field margins or drainage system banks. Particular attention should be given to the destruction of green or cracked bolls and other plant debris left at the ends of rows following stripper harvest. It is illegal to leave cotton in fields during the fall and winter months in the Rio Grande Valley and some counties to the north. This cotton provides the boll weevil with a host plant on which reproduction occurs throughout the year. Weevil infestations which are allowed to develop during the winter may be extremely difficult to control during the following season. If a thorough stalk destruction program is not carried out, the benefits of the pest management program can be reduced significantly.

The addition of 0.5 lb. methyl parathion or 0.25 lb. azinphosmethyl (Guthion®) to phosphate-type defoliants has proven effective in reducing potential overwintered boll weevils. Do not add methyl parathion or azinphosmethyl to chlorate-type defoliants because of the potential fire hazard. The use of insecticides at defoliation will be effective only if stalks are destroyed promptly after harvest. If 3 to 4 weeks elapse between defoliation and stalk plow-up, the money spent on insecticides at defoliation will provide less benefit in boll weevil management. Weevils will continue to emerge, feed, reproduce and move from defoliated cotton fields following harvest.

Stalk Destruction Laws

Upon request and petition of Texas Cotton Producers, the Texas Legislature passed the Boll Weevil Control Law and the Pink Bollworm Quarantine Law in an effort to combat the two destructive cotton pests. These two laws, which are enforced by the Texas Department of Agriculture, require 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

Table 1. Growth and fruiting rate of the cotton plant.

Development period	Calendar days		Accumulated heat units from planting*	
	Avg.	Range	Avg.	Range
Planting to emergence	7	5 to 10	109	59 to 159
Emergence of:				
first true leaf	8	7 to 9	166	127 to 205
sixth true leaf	25	23 to 27	463	321 to 608
pinhead square	29	27 to 30	517	378 to 663
1/3-grown square	43	35 to 48	752	508 to 996
Square initiation to:				
bloom	23	20 to 25	924	719 to 1129
Bloom to:				
peak bloom	18	14 to 21	1280	977 to 1582
full-grown boll	23	20 to 25	1383	1091 to 1674
open boll	47	40 to 55	1939	1857 to 2021
Fully matured two-bale/acre crop				2500 to 2900
Boll development:				
Fiber length established:	First 21 to 30 days			
Fiber micronaire and strength determined:	Second 20 to 60 days			

*Calculated by the formula:

$$DD\text{-}60 = \frac{\text{High daily temperature} + \text{low daily temperature}}{2} - 60$$

For each day in which the result is a positive number, heat units are accumulated. For example, if the high for the day is 90 and the low is 60, then 90+60=150/2=75-60=15; so 15 heat units would be accumulated for the day. This total would be added to those accumulated each day since planting to get accumulated heat units.

Table 2. Cotton yield estimate chart (bales lint per acre).

Bolls per 10 feet of row	Row spacing in inches: 10	20	30	38	40
20	0.58-0.75	0.30-0.38			
30	0.87-1.1	0.44-0.56			
40	1.2 -1.5	0.58-0.75	0.39-0.50	0.31-0.39	0.31-0.40
50	1.4 -1.9	0.72-0.93	0.46-0.60	0.36-0.60	0.36-0.47
60	1.7 -2.2	0.88-1.1	0.59-0.75	0.47-0.59	0.47-0.56
70	2.0 -2.6	1.0 -1.3	0.68-0.87	0.53-0.69	0.51-0.65
80		1.2 -1.5	0.77-1.0	0.61-0.79	0.58-0.75
90		1.3 -1.7	0.87-1.1	0.68-0.88	0.65-0.84
100		1.4 -1.9	0.97-1.2	0.76-0.98	0.72-0.93
110		1.6 -2.0	1.1 -1.4	0.84-1.1	0.80-1.0
120		1.8 -2.3	1.2 -1.5	0.92-1.2	0.88-1.1
140			1.4 -1.7	1.1 -1.4	1.0 -1.3
160			1.5 -2.0	1.2 -1.6	1.2 -1.6
180				1.4 -1.8	1.4 -1.7
200				1.5 -2.0	1.5 -1.9

Prepared by Travis Miller, Extension agronomist, and Jesse Cocke, Jr., Extension entomologist.

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 don't cause major economic damage. Boll weevil population control through stalk destruction efforts has been significant but progress has been slower. Strict adherence to the established deadlines is critical to success of boll weevil management.

SCOUTING AND MANAGEMENT DECISIONS

Regular field scouting is a vital part of any pest management program because it is the only way reliable information can be obtained to determine if and when pest numbers reach the economic threshold. Scouting involves more than just "checking bugs." It determines the insect density and damage level through the use of standardized, repeatable sampling methods. It is also a reliable way to monitor plant growth, fruiting, beneficial insect activity, weeds, diseases and the effects of pest suppression practices.

Control measures are needed when a pest population reaches a level at which further increases would result in excessive yield or quality losses. This level is known as the "economic threshold" or treatment level. The relationship between pest level, amount of damage and ability of the cotton plant to compensate for damage is greatly influenced by crop phenology and seasonal weather. The economic threshold is not constant but varies with factors such as price of cotton, cost of control and stage of plant development.

Field inspections should be made every 3 to 7 days using the scouting procedures described in this guide. When a cotton field is properly scouted, accurate and timely decisions can be made to optimize control efforts while minimizing risk.

The following general discussion briefly reviews the insect pests of cotton (for more detail see B-933,"Identification, Biology and Sampling of Cotton Insects"). The insect pests are discussed as they normally would occur throughout the cotton production season.

EARLY-SEASON PESTS

Early-season is the first few weeks of the season from plant emergence to first 1/3-grown square (see drawing below). Major early-season pests include: overwintered boll weevils, fleahoppers and sometimes sweetpotato whiteflies.

Cotton Square Diameter

1/16-Inch **3/16-Inch** **1/4-Inch**

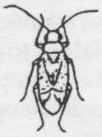
Pinhead **Matchhead** **1/3-grown**

Scouting and management of early-season insect pests are extremely important, particularly in a short-season production system. Loss of early squares may prolong the length of the growing season required to get adequate fruit set.

Sweetpotato Whitefly

Refer to the latest Sweetpotato Whitefly Task Force Suggestons for management information on sweetpotato whiteflies. These are available at the county Extension agent's office.

Cotton Fleahopper



Adult fleahoppers are about 1/8-inch long and pale green. Nymphs resemble adults but lack wings and are light green. They move very rapidly when disturbed. Adults move into cotton from host weeds when cotton begins to square. Both adults and nymphs suck sap from the tender portions of the plant, including small squares. Squares are susceptible to damage from the pinhead size through the 1/3-grown stage.

Management and decision making. After cotton begins producing the first small squares (4- to 6-leaf stage), examine the main stem terminal buds (about 3 to 4 inches of plant top) of 25 randomly selected plants at each of four or more locations across the field. **During the first 3 weeks of squaring, 15 to 25 cotton fleahoppers (nymphs and adults) per 100 terminals may cause economic damage.** As plants increase in size and fruit load, larger populations of fleahoppers may be tolerated without economic yield reduction. Care should be taken not to apply insecticides early in the blooming period as this will result in destruction of beneficial insects, possibly inducing an outbreak of bollworm and tobacco budworm.

Overwintered Boll Weevil

The adult weevil is about 1/4-inch long, grayish brown and has a prolonged snout which bears chewing mouthparts at its tip. The presence of two distinct spurs on the lower part of the first segment of the front leg will distinguish the boll weevil from other weevils with which it might be confused.

Overwintered boll weevils emerge from winter hibernation and enter cotton early in the season. They occur in very low numbers and females do not lay eggs until first squares are about 1/4-inch in diameter (1/3-grown). Insecticides applied at this time (see control suggestions) will help suppress boll weevil population buildup until after peak bloom. This allows the plant to set a large number of bolls early, while having little adverse effect on mid- and late-season beneficial insects.

Management and decision making. The value of making automatic insecticide applications for overwintered weevils has not been demonstrated in all areas of the Valley. **Research has shown that 40 overwintered boll weevils per acre can produce a damaging first generation population.** The first generation of boll weevils emerges and becomes active during the early fruiting period.

If weevils are noticed and the field has a history of heavy weevil infestation, early-season control applications may be economically feasible. The first application should be applied no earlier than 1/3-grown squares. The second application should be applied 3 to 5 days later if weevils continue moving into the field. When two early-season applications of insecticides were made in research and field tests, damaging boll weevil levels were delayed 10 to 12 days in fields where weevils were heavy. However, in other areas where similar spray tests were conducted, subsequent damaging weevil levels were not delayed because of unknown factors. These applications should not be made in fields where population buildup in past years has not occurred and weevils are not found. Avoid making the final overwintered boll weevil insecticide application within 10 days of bloom to allow beneficial insect and spider populations time to reestablish in anticipation of bollworm infestations.

MID-SEASON AND LATE-SEASON PESTS

Mid-season is the 6-week fruiting period following the appearance of the first 1/3-grown squares. Proper crop management and frequent field inspection of pests and beneficials will eliminate unnecessary insecticide applications during this period. The major concern during this period is ensuring adequate fruit set and preserving beneficial insect populations.

Late-season is the remainder of the production season when the major concern is boll protection. Monitoring boll set may aid in making spray decisions in the late-season period. Boll protection is of primary concern as long as bolls which will be harvested are immature.

Sweetpotato Whitefly

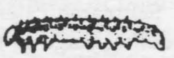
Refer to the latest Sweetpotato Whitefly Task Force Suggestions for management information on sweetpotato whiteflies. These are available at the county Extension agent's office.

Boll Weevil

Management and decision making. As boll weevils move into the edges of fields from overwintering sites, insecticide treatments may be effectively limited to treating along brush lines or corners where boll weevils are concentrating. By treating only those "hot spots," whole fields are not "sterilized" and beneficial insects can move back into these treated areas more quickly.

Randomly inspect 100 1/3-grown squares at weekly intervals from four or more representative locations in the field and from various portions of the plant. **If boll weevil-damaged square levels reach 15 to 25 percent from the time of squaring to peak bloom, the economic threshold level has been reached and an insecticide application is necessary.** Weevil populations may require repeated treatments at 5-day intervals. Under extremely heavy populations, it may be necessary to shorten application intervals to 3 days. If the proper cultural considerations have been made under the short-season production system, mid- to late-season insecticide applications may not be necessary.

Bollworm and Tobacco Budworm



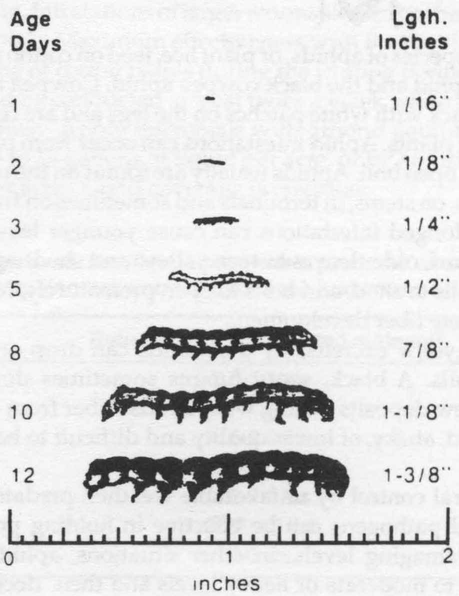
Bollworm and tobacco budworm larvae are similar in appearance and cause similar damage. Full grown larvae are about 1 1/2 inches long and vary in color from pale green to pink or brownish to black, with longitudinal stripes along the back.

Tobacco budworm and bollworm moths are attracted to and lay eggs in cotton that is producing an abundance of new growth. Moths usually lay eggs singly on the top of young, tender terminal leaves in the upper 1/3 of the plant. Eggs are pearly white to cream colored and about half the size of a pinhead. These should not be confused with looper eggs which are flatter and usually laid singly on the undersides of leaves. Eggs hatch in 3 to 4 days, turning light brown before hatching. Young worms usually feed for a day or two on tender leaves, leafbuds and small squares in the plant terminal before moving down the plant to attack larger squares and bolls. When small worms are in the upper 1/3 of the plant they are most vulnerable to natural mortality and to insecticides.

Sometimes moths deposit eggs on squares, bolls, stems and, in general, on lower portions of the plant. This may occur when cotton plants are stressed and have little new growth or during periods of high temperatures and low humidity. Detection and control of eggs and small worms are more difficult when eggs are deposited in these locations.

Budworms are less susceptible to certain insecticides than bollworms, but are less numerous than bollworms until mid-July. Once applications of certain insecticides are used to control bollworms and budworms, the percentage of budworms in the population increases with each additional application due to selection pressure. Aphid and other secondary pest infestations may increase following bollworm/budworm sprays, especially when pyrethroids are used.

Figure 2. Actual size of Heliothis larvae of known age (reared 85° F).



Management and decision making. A major objective of a well-planned IPM program is to avoid having to treat for bollworm and tobacco budworm. Naturally occurring parasites, predators and, to a certain extent, weather conditions often suppress bollworm and budworm populations.

Examine 100 green squares for worms and worm damage, and 100 plant terminals for eggs and small worms. Examine a few plants in each field for eggs, worms and worm damage on lower leaves, stems and fruiting forms.

Prior to initial chemical application. Fields should be scouted at least once a week. Fields should be divided into four quadrants and 25 green squares (1/2-grown or larger) should be selected at random in each quadrant. If fields are larger than 100 acres, additional scouting sites should be added to the sample.

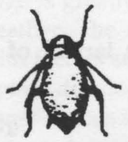
Before bloom the economic threshold is reached when worms are present and 15 to 25 percent of the green squares are worm-damaged.

After bolls are present the economic threshold has been reached when worms are present and 8 to 10 percent of the green squares have been worm-damaged. When sampling, avoid selecting flared or yellowed squares.

After initiation of insecticide applications. The fields should be checked closely 2 to 3 days following the first application. **The economic level has been reached when bollworm eggs and 6 to 10 young worms are found per 100 terminals (3,000 to 4,000 young worms/acre) and 5 percent of the squares and small bolls have been injured by small bollworms and budworms.** If control has not been obtained, another application will be necessary immediately.

OCCASIONAL PESTS

Aphids



Two species of aphids, or plant lice, feed on cotton plants: the cotton aphid and the black cowpea aphid. Cowpea aphids are shiny black with white patches on the legs and are common on seedling plants. Aphid infestations can occur from plant emergence to open boll. Aphids usually are found on the undersides of leaves, on stems, in terminals and sometimes on fruit. Heavy and prolonged infestations can cause younger leaves to curl downward, older leaves to turn yellow and shed, squares and small bolls to shed, and bolls to open prematurely, resulting in incomplete fiber development.

Honeydew excreted by the aphids can drop on fibers of open bolls. A black, sooty fungus sometimes develops on honeydew deposits during wet periods. Fiber from such bolls is stained, sticky, of lower quality and difficult to harvest and gin.

Natural control by unfavorable weather, predators, parasites and pathogens can be effective in holding populations below damaging levels. In other situations, aphid numbers increase to moderate or heavy levels and then decline for no apparent reason.

Management and decision making. Insecticide treatment may be necessary in those instances when infestations are heavy in large areas of the field and natural control has not been sufficient to limit aphid buildup.

Beet Armyworms

Beet armyworm eggs are laid on both leaf surfaces in masses covered by a whitish, velvety material. Young beet armyworms "web up" and feed together on leaves, but eventually disperse and become more solitary in their feeding habits. Early-season infestations feed on leaves and terminal areas. Occasionally they destroy the plant terminal, causing extensive lateral branch development and delayed maturity. Larvae skeletonize leaves rather than chewing large holes in them. Sometimes damaging infestations will develop late in the season when they also feed on terminals, squares, blooms and bolls. When beet armyworms begin to damage fruit, control may be justified. Infestations may be spotty within a field and careful scouting is necessary to determine the need for, and field area requiring, control. Beet armyworms larger than 1/2 inch in length may be difficult to control.

Management and decision making. Scout the field by using the methods described for bollworm and tobacco budworm. When beet armyworms are feeding on fruit forms, then the thresholds should be the same as with bollworm and tobacco budworm.

Cabbage Looper

Cabbage looper eggs are laid singly, mainly on the lower surfaces of the leaves. Their feeding damage is characterized by leaf ragging or large holes in the leaves. Looper larvae often are killed by disease before economic foliage loss occurs.

Management and decision making. No economic threshold has been established for this pest. Insecticide treatments generally are not recommended.

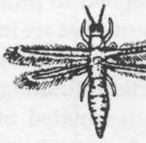
Cutworms

Cutworms may damage cotton during the seedling stage, and control will be necessary if stands are threatened. The economic threshold is a matter of judgment. Keep fields as weed-free as possible 3 weeks before planting to minimize cutworm problems. Plow under cover crops at least 3 weeks before planting. Insecticide sprays or baits are recommended for band application over the drill. If the ground is dry, cloddy or crusty at the time of treatment, control may not be as effective as in moist soil.

Saltmarsh Caterpillars

Saltmarsh caterpillars may attack cotton plants from the seedling stage to the fully mature crop stage. Generally, the larval stages will migrate into a cotton field from surrounding vegetation such as wild sunflowers. Some adults may emerge from within the cotton field and lay eggs in large (1 to 2 inches in diameter) clusters of cream colored masses on individual leaves. The young caterpillars will disperse from their places of hatching and spread out across the field. Some individual fields may be severely defoliated. But usually only margins of fields are attacked and little economic damage is done. Spraying for large infestations of saltmarsh caterpillars is best conducted only when the larvae are very small and more easily controlled. Once larvae reach the 1- to 2-inch stage, they are much more difficult to control. No established thresholds exist for saltmarsh caterpillars. Producers should use their best judgment about the extent of actual crop damage when determining if control is necessary.

Thrips



Throughout most of the southern, eastern and Blackland areas thrips are minor pests, and controlling them has not been shown to increase yields. Under cool, wet conditions heavy infestations might delay fruiting and maturing because of slowed plant growth and increased thrips damage. Generally, about the time thrips reach damaging numbers, favorable growing conditions negate the need for control. Inspect cotton from the cotyledons to the 4-leaf stage. If thrips are present and leaf buds are curled, spray treatment may be justified.

Thrips also can be controlled by applying systemics as seed-planterbox treatments or as granules in the seed furrow. Disulfoton (Di-Syston®) and phorate (Thimet®) seed treatments will effectively control thrips for 2 to 3 weeks following plant emergence. Disulfoton, phorate and aldicarb (Temik®) granules applied in the seed furrow will control these pests for 4 to 8 weeks following planting; however, at the higher labeled rates they sometimes result in greater numbers of bollworms and tobacco budworms later in the season.

Spider Mites

Spider mites infest the undersides of leaves; they remove the sap from the plant and cause the leaves to discolor. They may also infest bracts of squares and bolls, causing the bracts to desiccate and squares or small bolls to shed. Severe infestations can defoliate the cotton plant. Mite infestations most often occur in limited areas of fields and in field margins. Increases in spider mite populations usually follow multiple applications of insecticides for other pests, since these insecticides destroy naturally occurring spider mite predators. Mites also may be moved by high winds or equipment from nearby crops which already have heavy infestations.

Management and decision making. Treat when mites begin to cause noticeable leaf damage. Spot treatment of fields is encouraged when infestations are restricted to small areas. Thorough coverage of the plant canopy with the miticide is essential to achieve good mite control. This may require high gallonage sprays (> 50 GPA) delivered by ground applicators. The spray should be directed into the canopy with drop nozzles.

OVICIDES

These insecticides are effective at reducing numbers of bollworm and tobacco budworm eggs. Because large numbers of eggs often fail to produce economically damaging worm infestations, ***insecticidal control of eggs alone is not recommended.*** Environmental factors such as hot, dry weather can significantly reduce field levels of eggs. Some other important natural control factors include predacious insects and spiders and parasitic wasps. Natural egg control can vary greatly between fields and with time of the season. Often, high numbers of sterile eggs are found late in the growing season. These eggs fail to hatch and no larvae are found. If larval infestations exceed suggested treatment levels and large numbers of eggs are present, the addition of an ovicide to the larvicide may be justified to enhance overall control.

MICROBIAL INSECTICIDES

Microbial products which are natural pathogens of the bollworm and the tobacco budworm are commercially available as preparations of *Bacillus thuringiensis* (B.t.). Field studies indicate that microbials are best suited for square protection. They are slow acting and should be used only against infestations of worms during the squaring period through the first 10 days of blooming. They are not suggested for use after that point.

Microbials are effective against worm numbers of up to 12 per 100 plants (6,000 per acre). They do not destroy beneficial arthropods (predators and parasites), a characteristic which sets them apart from conventional insecticides. When beneficial arthropod populations are absent, other insecticides provide more consistent control.

Treat fields in which most of the larvae are not more than 3/8-inch long. Infestations of larger worms should not be treated with microbials. Maximum effectiveness with *B.t.* requires precise sampling of cotton plants during the fruiting period. Sampling should be conducted at least twice a week while squares are developing. Apply microbials with ground equipment at the rate of 5 to 15 gallons of liquid per acre, or by air using 2 to 5 gallons per acre. Good coverage is essential.

Table 3. Registered *Bacillus thuringiensis* products and labeled rates for controlling bollworm and tobacco budworm.

Product	Rate per acre (formulated material)
Biocot XLP	0.5-3.5 pts.
Condor	0.5-1.67 qts.
Dipel 2X	0.5-2.0 lbs.
Dipel ES	1.0-2.5 pts.
Design	1.0-2.0 lbs.
Javelin	0.25-1.5 lbs.
MVP	2.0 qts.

PROTECTING BEES FROM INSECTICIDES

Pollination is extremely important in producing many seed crops such as alfalfa, clover and vetch. Honey bee pollination also is critical in the production of cucurbits throughout the state, and supplements native pollinators. The role of honey bees and wild pollinators in contributing to increased yield and fiber length of cotton is unclear. The importance of insect pollinators in the production of hybrid cottons is well recognized, however.

Where pollinating insects are required for flower fertilization, the crop producer, insecticide applicator and beekeeper should cooperate closely to minimize bee losses. The following guidelines will reduce bee losses:

1. Apply insecticides, if practical, before bees are moved into fields or adjacent crops for pollination. When bees are in the vicinity, evening applications after bees have left the field are less hazardous than early morning applications.
2. Where insecticides are needed, consider their toxicity. "Highly toxic" insecticides should be applied only in late evening or early morning when bees are not foraging. Insecticides categorized as "Moderately toxic" or "Relatively nontoxic" should be applied in late evening or early morning when bees are not foraging.
3. To prevent heavy losses of bees, don't spray any insecticide directly on colonies and avoid insecticide drifting. Bees often cluster on the fronts of their hives on hot evenings. Pesticide drift or direct spray at this time generally results in high levels of mortality.

POLICY STATEMENT FOR MAKING PEST MANAGEMENT SUGGESTIONS

The information and suggestions included in this publication reflect the opinions of Extension entomologists based on field tests or use experience. Our management suggestions are a product of research and are believed to be reliable. However, it is impossible to eliminate all risks. Conditions or circumstances which are unforeseen or unexpected may result in less than satisfactory results even when these suggestions are used. 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 appropriate 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 from his property to that of others. Always read and follow carefully the instructions on the container label.

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

ENDANGERED SPECIES REGULATIONS

The Endangered Species Act is designed to protect and to assist in the recovery of animals and plants that are in danger of becoming extinct. In response to the Endangered Species Act, many pesticide labels now carry restrictions limiting the use of products or application methods in designated biologically sensitive areas. These restrictions are subject to change. Refer to the Environmental Hazards or Endangered Species discussion sections of product labels and/or call your local county Extension agent or Fish and Wildlife Service personnel to determine what restrictions apply to your area. Regardless of the law, pesticide users can be good neighbors by being aware of how their actions may affect people and the natural environment.

WORKER PROTECTION STANDARD

The Worker Protection Standard (WPS) is a set of new federal regulations that applies to all pesticides used in agricultural plant production. If you employ any person to produce a plant or plant product for sale and apply any type of pesticide to that crop, WPS applies to you. Beginning January 1, 1995, you must comply with all WPS regulations. The WPS requires you to protect your employees from pesticide exposure. It requires you to provide three basic types of protection to your employees: you must inform employees about exposure, protect employees from exposure, and mitigate pesticide exposures that employees might receive. In 1995 all agricultural pesticides will bear a Worker Protection Standard statement on the label. It will appear in the "DIRECTIONS FOR USE" part of the label. For more detailed information, consult EPA publication 735-B-93-001 (GPO #055-000-0442-1) *The Worker Protection Standard for Agricultural Pesticides -- How to Comply: What Employers Need to Know*, or call Texas Department of Agriculture, Pesticide Worker Protection Program, (512) 463-7717.

ADDITIONAL REFERENCES

Number	Title
B-933	Identification, Biology and Sampling of Cotton Insects ($5.00)
B-1204	Management of Cotton Insects in the Southern, Eastern and Blackland Areas of Texas
B-1204A	Suggested Insecticides for Management of Cotton Insects in the Southern, Eastern and Blackland Areas of Texas
B-1209	Management of Cotton Insects in the High Plains, Rolling Plains and Trans Pecos Areas of Texas
B-1209A	Suggested Insecticides for Management of Cotton Insects in the High Plains, Rolling Plains and Trans Pecos Areas of Texas
B-1210A	Suggested Insecticides for Management of Cotton Insects in the Lower Rio Grande Valley of Texas
B-1593	Cotton Harvest-Aid Chemicals

The publications above can be obtained through your county Extension office or ordered from the Texas Agricultural Extension Service, Distribution and Supply, P. O. Box 1209, Bryan, Texas 77806.

The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied.

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B-1210A

Texas Agricultural Extension Service
The Texas A&M University System

Suggested Insecticides for

Management of Cotton Insects

in the Lower Rio Grande Valley

1996

This insert is to be used with B-1210, "Management of Cotton Insects in the Lower Rio Grande Valley, 1995-1996."

Texas Agricultural Extension Service • Zerle L. Carpenter, Director • The Texas A&M University System • College Station, Texas

Suggested Insecticides for Management of Cotton Insects
in the Lower Rio Grande Valley

John W. Norman, Jr. and Alton N. Sparks, Jr.*

A committee of state and federal research scientists and Extension specialists meets annually to review cotton pest management research and management guidelines. Guidelines are revised at this meeting to reflect the latest proven techniques for maximizing profits for the Texas cotton producer by optimizing inputs and production.

Management of Cotton Pests

The proper management of cotton pests is dependent upon the use of pest management principles. Pest management does not rely solely on insecticides. Therefore, the USER of this insert is strongly encouraged to refer to B-1210 for discussion of pest biology, scouting techniques, economic thresholds, insecticide resistance management, conservation of existing natural control agents, overall crop management practices which do not promote pest problems, ovicide use, microbial insecticide use, and guidelines for protecting bees from insecticides. If the insecticide recommendations in this insert are followed without regard to the other management techniques listed in B-1210, there is a risk of misusing insecticides, resulting in adverse economic and environmental consequences.

Policy Statement for Making Insecticide Use Recommendations

This is not a complete listing of all products or their uses registered for cotton. The insecticides and their suggested use patterns included in this publication reflect a consensus of opinion of Extension entomologists based on field tests. The data from these field tests met the minimum requirements as outlined in the Guidlines 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.

Endangered Species Regulations

The Endangered Species Act is designed to protect and to assist in the recovery of animals and plants that are in danger of becoming extinct. In response to the Endangered Species Act, many pesticide labels now carry restrictions limiting the use of products or application methods in designated biologically sensitive areas. These restrictions are subject to change. Refer to the Environmental Hazards or Endangered Species discussion sections of product labels and/or call your local county Extension agent or Fish and Wildlife Service personnel to determine what restrictions apply to your area. Regardless of the law, pesticide users can be good neighbors by being aware of how their actions may affect people and the natural environment.

Worker Protection Standard

The Worker Protection Standard (WPS) is a set of new federal regulations that applies to all pesticides used in agricultural plant production. If you employ any person to produce a plant or plant product for sale and apply any type of pesticide to that crop, WPS applies to you. Beginning January 1, 1995, you must comply with all WPS regulations. The WPS requires you to protect your employees from pesticide exposure. It requires you to provide three basic types of protection to your employees: you must inform employees about exposure, protect employees from exposure, and mitigate pesticide exposures that employees might receive. After 1995 all agricultural pesticides will bear a Worker Protection Standard statement on the label. It will appear in the "DIRECTIONS FOR USE" part of the label. For more detailed information consult EPA publication 735-B-93-001 (GPO #055-000-0442-1) *The Worker Protection Standard for Agricultural Pesticides -- How to Comply: What Employers Need to Know*, or call Texas Department of Agriculture, Pesticide Worker Protection Program, (512) 463-7717.

**Extension Agent-Entomology and Extension Entomologist, The Texas A&M University System.*

Table 1. Insecticide suggestion table.

Pest	Insecticides (listed alphabetically)	Insecticide class[1]	Pounds active ingredient per acre[2]	Formulated amount per acre	Precaution status[3]	Re-entry interval (hrs)[4]	Honeybee hazard[5]
Cutworms	Carbaryl	C					
	(Sevin® 5% bait)		1.5	30 lbs	C	*	H
	Chlorpyrifos	OP					
	(Lorsban® 4E)		0.75-1.0	1.5-2 pts	W	24	H
	Cyhalothrin	SP					
	(Karate® 1.0E)		0.02-0.03	2.56-3.84 oz	D	24	H
	Cypermethrin	SP					
	(Ammo® 2.5E)		0.04-0.1	2-5 oz	C	12	H
	Esfenvalerate***	SP					
	(Asana XL® 0.66E)		0.03-0.05	5.8-9.6 oz	W	12	H
	Methyl Parathion (4E)	OP	1.0	32 oz	D	48**	H
	Methyl Parathion (7.5E)		1.0	17 oz	D	48**	H
	Permethrin	SP					
	(Ambush® 2.0E)		0.1-0.2	6.4-12.8 oz	W	12	H
	(Pounce® 3.2E)		0.1-0.2	4-8 oz	W	12	H
	(Ambush® 25W)		0.1-0.2	6.4-12.8 oz	W	12	H
	(Pounce® 25WP)		0.1-0.2	6.4-12.8	W	12	H
Fleahoppers	Acephate	OP					
	(Orthene® 90 S)		0.188-0.25	3.34-4.44 oz	C	24	H
	Carbaryl	C					
	(Sevin®)						
	(80S)		0.5-1.0	0.6-1.25 lbs	C	12	H
	(XLR Plus 4)		0.5-1.0	1-2 pts	C	12	H
	(50W)		0.5-1.0	1-2 lbs	C	12	H
	(4F)		0.5-1.0	1-2 pts	C	12	H
	Chlorpyrifos	OP					
	(Lorsban® 4E)		0.19-0.5	6-16 oz	W	24	H
	Dicrotophos	OP					
	(Bidrin® 8E)		0.05-0.1	0.8-1.6 oz	D	48**	H
	Dimethoate	OP					
	(Cygon® 4E)		0.125-0.25	4-8 oz	W	12	H
	(Dimate® 2.67E)		0.11-0.22	5.3-10.7 oz	W	12	H
	(Dimethoate® 2.67E)		0.11-0.22	5.3-10.7 oz	W	12	H
	Methomyl	C					
	(Lannate® 2.4LV)		0.113-0.225	6-12 oz	D	72	H
	Methyl Parathion (4E)	OP	0.1	3.2 oz	D	48**	H
	Methyl Parathion (7.5E)	OP	0.1	1.7 oz	D	48**	H
	Oxamyl	C					
	(Vydate® 2.0L)		0.25	16 oz	D	48	H
	(Vydate® 3.76C-LV)		0.25	8.5 oz	D	48	H
	Oxydemetonmethyl	OP					
	(Metasystox-R® 2E)		0.25	16 oz	W	48**	M
Cotton Aphids §§	Acephate	OP					
	(Orthene® 90S)		0.5-1.0	8.89-17.78 oz	C	24	H
	Chlorpyrifos	OP					
	(Lorsban® 4E)		0.25-1.0	8-32 oz	W	24	H
	Dicrotophos	OP					
	(Bidrin 8E)		0.25-0.5	4-8 oz	D	48**	H
	Dicrotophos	OP + T					
	(Bidrin 8E) +		0.25-0.5 +	4-8 oz +	D + W	48**	H
	Amitraz						
	(Ovasyn 1.5E)		0.125-0.25	0.67-1.33 pts			
	Dicrotophos	OP + OP					
	(Bidrin 8E) +		0.25-0.5 +	4-8 oz +	D + W	48**	H
	Profenofos						
	(Curacron 8E)		0.125-0.25	2-4 oz			
	Dimethoate	OP					
	(Cygon® 4E)		0.125-0.25	4-8 oz	W	12	H
	(Dimate® 2.67E)		0.11-0.22	5.3-10.7 oz	W	12	H
	(Dimethoate® 2.67E)		0.11-0.22	5.3-10.7 oz	W	12	H
	Disulfoton	OP					
	(Di-Syston® 8E)		0.1-0.2	1.6-3.2 oz	D	48**	H

*Refer to federal label for specific field re-entry instructions.

(continued)

**Re-entry interval is 72 hours in areas where the average annual rainfall is less than 25 inches.

§§Difficulty in controlling cotton aphids has been encountered in some areas of Texas. Poor or erratic control can be expected in the High Plains, Trans Pecos, Rolling Plains and Wintergarden areas. Resistance exists to most registered materials and continued excessive use of certain insecticides is apt to expand the resistance problem. Where resistance exists in an area, the initial insecticide application should be made at the higher labeled rate. Poorest control has occurred during periods of rapid population growth. Contact the county Extension agent in your area for the latest information on aphid control.

Table 1. Insecticide suggestion table. ***(Continued)***

Pest	Insecticides (listed alphabetically)	Insecticide class[1]	Pounds active ingredient per acre[2]	Formulated amount per acre	Precaution status[3]	Re-entry interval (hrs)[4]	Honeybee hazard[5]
	Methomyl	OP					
	(Lannate® 2.4LV)		0.225	12 oz	D	72	H
	Methyl Parathion (4E)	OP	0.25-.0375	8-12 oz	D	48**	H
	Methyl Parathion (7.5E)	OP	0.25-0.375	4.3-6.4 oz	D	48**	H
	Oxydemetonmethyl	OP					
	(Metasystox-R® 2E)		0.125-0.25	0.5-1.0 pt	W	48**	M
	Parathion (8E)	OP	0.25-0.375	4 oz	D	7 days	H
	Parathion (4E)		0.25-0.375	8-12 oz	D	7 days	H
	Profenofos	OP					
	(Curacron® 8E)		0.5	8 oz	W	12	H
Spider Mites	Avermectin B_1						
	(Zephyr 0.15E)		0.01-0.02	8-16 oz	W	48	H
	Dicofol	CH					
	(Kelthane® MF)		1.0-2.0	1-2 qts	C	12	R
	Parathion (8E)	OP	0.25	4 oz	D	7 days	H
	Parathion (4E)	OP	0.25	8 oz	D	7 days	H
	Profenofos	OP					
	(Curacron® 8E)		0.5-0.75	8-12 oz	W	12	H
	Propargite	CD					
	(Comite® 6.55E)		0.8-1.6	1-2 pts	D	24	R
Boll Weevils (Overwintered)	Azinphosmethyl	OP					
	(Guthion® 2L)		0.25	1 pt	D	48**	H
	(Guthion® 3F)		0.25	0.67 pt	D	48**	H
	Carbaryl	C					
	(Sevin®)						
	(80S)		1-2	1.25-2.5 lbs	C	12	H
	(XLR Plus)		1-2	1-2 qts	C	12	H
	(50W)		1-2	2-4 lbs	C	12	H
	(4F)		1-2	1-2 qts	C	12	H
	Endosulfan	CD					
	(Phaser® 3E)		0.375-1.5	1-4 pts	D	48	M
	(Thiodan® 3E)		0.375-1.5	1-4 pts	D	48	M
	(Thiodan® 2CO)		0.375-1.5	1.5-6 pts	D	48	M
	Malathion (ULV only)	OP	0.58-0.88	8-12 oz	C	12	H
	Methyl Parathion (4E)	OP	0.25-0.5	8-16 oz	D	48**	H
	Methyl Parathion (7.5E)	OP	0.25-0.5	4.26-8.5 oz	D	48**	H
	Methyl Parathion encapsulated	OP					
	(Penncap M® 2F)		0.25-0.5	1-2 pts	W	48	H
	Oxamyl	C					
	(Vydate® 2L)		0.25	16 oz	D	48	H
	(Vydate® 3.76C-LV)		0.25	8.5 oz	D	48	H
(In-season)	Azinphosmethyl	OP					
	(Guthion® 2L)		0.25	1 pt	D	48**	H
	(Guthion® 3F)		0.25	0.67 pt	D	48**	H
	Endosulfan	CD					
	(Phaser® 3E)		0.375-1.5	1.4 pts	D	48	M
	(Thiodan® 3E)		0.375-1.5	1.4 pts	D	48	M
	(Thiodan® 2CO)		0.375-1.5	1.4 pts	D	48	M
	Malathion 91% (ULV only)	OP	0.87-1.17	12-16 oz	C	12	H
	Methyl Parathion (4E)	OP	0.375-0.5	12-16 oz	D	48**	H
	Methyl Parathion (7.5E)	OP	0.375-0.5	6.4-8.5 oz	D	48**	H
	Methyl Parathion encapsulated	OP					
	(Penncap M® 2F)		0.25	1 pt	W	48	H
	Oxamyl	C					
	(Vydate® 2L)		0.25	16 oz	D	48	H
	(Vydate® 3.76C-LV)		0.25	8.5 oz	D	48	H
Bollworm & Tobacco Budworm Eggs	*(Use only with a larvicide, see B-1210.)*						
	Amitraz	T					
	(Ovasyn 1.5EC)		0.125-0.25	0.67-1.33 pts	W	24	R
	Methomyl	C					
	(Lannate® 2.4LV)		0.113-0.225	6-12 oz	D	72	H
	Profenofos	OP					
	(Curacron® 8E)		0.125-0.25	2-4 oz	W	12	H
	Thiodicarb	C					
	(Larvin® 3.2)		0.125-0.25	5-10 oz	W	12	M

(Continued)

Table 1. Insecticide suggestion table. *(Continued)*

Pest	Insecticides (listed alphabetically)	Insecticide class[1]	Pounds active ingredient per acre[2]	Formulated amount per acre	Precaution status[3]	Re-entry interval (hrs)[4]	Honeybee hazard[5]
Larvae	Acephate	OP					
	(Orthene® 90S)		1	1.11 lb	C	24	H
	Bacillus thuringiensis (See listing in Table 2. See "Microbial Insecticides" section in, B-1210.)						
	Bifenthrin***	SP					
	(Capture® 2E)		0.04-0.1	2.56-6.4 oz	W	12	H
	Cyfluthrin***	SP					
	(Baythroid® 2E)		0.025-0.05	1.6-3.2 oz	D	12	H
	Cyhalothrin***	SP					
	(Karate® 1E)		0.025-0.04	3.2-5.12 oz	D	24	H
	Cypermethrin***	SP					
	(Ammo® 2.5E)		0.04-0.1	2-5 oz	C	12	H
	Esfenvalerate***	SP					
	(Asana XL® 0.66E)		0.03-0.05	5.8-9.6 oz	W	12	H
	Methomyl	C					
	(Lannate® 2.4LV)		0.45	1.5 pts	D	72	H
	Methyl Parathion (4E)	OP	1.25-2.0	2.5-4 pts	D	48**	H
	Methyl Parathion (7.5E)	OP	1.25-2.0	1.33-2.13 pts	D	48**	H
	Permethrin***	SP					
	(Ambush® 2.0E)		0.1-0.2	6.4-12.8 oz	W	12	H
	(Pounce® 3.2E)		0.1-0.2	4-8 oz	C	12	H
	Profenofos	OP					
	(Curacron® 8E)		0.5-1.0	8-16 oz	W	12	H
	Sulprofos	OP					
	(Bolstar® 6E)		0.5-1.5	10.7-32 oz	C	48**	H
	Thiodicarb	C					
	(Larvin® 3.2F)		0.6-0.9	1.5-2.25 pts	W	12	H
	Tralomethrin***	SP					
	(Scout X-tra 0.9E)		0.018-0.024	2.56-3.37 oz	D	24	H
	Zeta cypermethrin***	SP					
	(Fury 1.5E)		0.033-0.045	2.82-3.83 oz	W	12	H

***The synthetic pyrethroid insecticides (examples include fenvalerate, bifenthrin, esfenvalerate, cyfluthrin, cyhalothrin, permethrin, tralomethrin, flucythrinate and cypermethrin) recommended for control of bollworms and/or tobacco budworms also will provide boll weevil control. However, application intervals similar to those recommended for the traditional phosphate insecticides (3 to 5 days under heavy pressure) are necessary to provide adequate control. When treatments are to be made for a bollworm or budworm-boll weevil complex, a suggested treatment regime is to use a pyrethroid followed 3 to 5 days later by a phosphate boll weevil insecticide.

Since pyrethroids are not more effective than phosphates for boll weevil control, but are more effective for bollworm-budworm control, they should be saved for bollworm-budworm management.

We do not recommend using pyrethroids for boll weevil control alone or for early season pests because increased use may enhance the opportunity for insects to develop resistance to pyrethroids.

Bifenthrin suppresses spider mites when used for control of bollworms and tobacco budworms.

The use of synthetic pyrethroid insecticides may increase cotton aphid numbers.

Pest	Insecticides (listed alphabetically)	Insecticide class[1]	Pounds active ingredient per acre[2]	Formulated amount per acre	Precaution status[3]	Re-entry interval (hrs)[4]	Honeybee hazard[5]
Beet Armyworms	Chlorpyrifos	OP					
	(Lorsban® 4E)		1	2 pts	W	24	H
	Diflubenzuron	IGR					
	(Dimilin® 2F)		0.0625-0.125	4-8 oz	C	12	R
	Methomyl	C					
	(Lannate® 2.4LV)		0.45	1.5 pts	D	72	H
	Profenofos	OP					
	(Curacron ® 8E)		0.75-1.0	12-16 oz	W	12	H
	Sulprofos	OP					
	(Bolstar® 6E)		0.75-1.5	1-2 pts	C	48**	H
	Thiodicarb	C					
	(Larvin® 3.2F)		0.6-0.9	1.5-2.25 pts	W	12	M

[1] C=carbamate; OP=organophosphate; SP=synthetic pyrethroid; CD=cyclodiene; CH=chloronated hydrocarbon; T=triazapentadiene; IGR=insect growth regulator.
[2] Refer to Tables 2&3 for converting pounds active ingredient per gallon to acres per gallon.
[3] C=Caution; W=Warning; D-Danger
[4] Time after application before re-entering fields without protective clothing. The wearing of protective clothing as described on the label may shorten the re-entry interval. In general, no insecticide label will have the statement "allow spray to dry" or "allow dust to settle" as a re-entry interval. However, there may be limited instances where EPA could grant a shorter re-entry interval than the minimum of 12 hours following application. Re-entry intervals are determined by the product's federal label or by Texas Department of Agriculture regulations and are subject to change.
[5] H=highly toxic; M=moderately toxic; R=relatively non-toxic

Table 2. Registered *Bacillus thuringiensis* products and labeled rates for controlling bollworm and tobacco budworm.

Product	Rate per acre (formulated material)
Biocot XL	0.33-2.33 pts
Biocot XLP	0.5-3.5 pts
Condor	0.5-1.67 qts
Dipel 2X	0.5-2.0 lbs
Dipel ES	1.0-2.5 pts
Dipel ES-NT	1.0-2.5 pts
Design	1.0-2.0 lbs
Javelin	0.25-1.5 lbs
MVP II	2.0-4.0 pts

Table 3. Converting pounds active ingredient per gallon to acres per gallon.

Pounds active ingredient needed per acre	Pounds active ingredient per gallon																	
	0.15	0.30	0.66	0.90	1.00	1.80	2.00	2.40	2.50	2.67	3.00	3.20	4.00	6.00	6.55	7.50	8.00	9.33
	Acres per gallon*																	
0.01	15.0	30.0	66.0	90.0	100.0	180.0	200.0	240.0	250.0	267.0	300.0	320.0	400.0	600.0	655.0	750.0	800.0	933.0
0.015	10.0	20.0	44.0	60.0	66.7	120.0	133.3	160.0	166.7	178.0	200.0	213.3	266.7	400.0	436.7	500.0	533.3	622.0
0.019	7.9	15.8	34.7	47.4	52.6	94.7	105.3	126.3	131.6	140.5	157.9	168.4	210.5	315.8	344.7	394.7	421.1	491.1
0.02	7.5	15.0	33.0	45.0	50.0	90.0	100.0	120.0	125.0	133.5	150.0	160.0	200.0	300.0	327.5	375.0	400.0	466.5
0.025	6.0	12.0	26.4	36.0	40.0	72.0	80.0	96.0	100.0	106.8	120.0	128.0	160.0	240.0	262.0	300.0	320.0	373.2
0.03	5.0	10.0	22.0	30.0	33.3	60.0	66.7	80.0	83.3	89.0	100.0	106.7	133.3	200.0	218.3	250.0	266.7	311.0
0.04	3.8	7.5	16.5	22.2	25.0	45.0	50.0	60.0	62.5	66.8	75.0	80.0	100.0	150.0	163.8	187.5	200.0	233.3
0.05	3.0	6.0	13.2	18.0	20.0	36.0	40.0	48.0	50.0	53.4	60.0	64.0	80.0	120.0	131.0	150.0	160.0	186.6
0.0625	2.4	4.8	10.6	14.4	16.0	28.8	32.0	38.4	40.0	42.7	48.0	51.2	64.0	96.0	104.8	120.0	128.0	149.3
0.08	1.9	3.8	8.3	11.3	12.5	22.5	25.0	30.0	31.3	33.4	37.5	40.0	50.0	75.0	81.9	93.8	100.0	116.6
0.1	1.5	3.0	6.6	9.0	10.0	18.0	20.0	24.0	25.0	26.7	30.0	32.0	40.0	60.0	65.5	75.0	80.0	93.3
0.11	1.4	2.7	6.0	8.2	9.1	16.4	18.2	21.8	22.7	24.3	27.3	29.1	36.4	54.5	59.5	68.2	72.7	84.8
0.113	1.3	2.7	5.8	7.9	8.8	15.9	17.7	21.2	22.1	23.6	26.5	28.3	35.4	53.1	58.0	66.4	70.8	82.6
0.125	1.2	2.4	5.3	7.2	8.0	14.4	16.0	19.2	20.0	21.4	24.0	25.6	32.0	48.0	52.4	60.0	64.0	74.6
0.17	0.9	1.8	3.9	5.3	5.9	10.6	11.8	14.1	14.7	15.7	17.6	18.8	23.5	35.3	38.5	44.1	47.1	54.9
0.19	0.8	1.6	3.5	4.7	5.3	9.5	10.5	12.6	13.2	14.1	15.8	16.8	21.1	31.6	34.5	39.5	42.1	49.1
0.2	0.7	1.5	3.3	4.5	5.0	9.0	10.0	12.0	12.5	13.4	15.0	16.0	20.0	30.0	32.8	37.5	40.0	48.7
0.22	0.7	1.4	3.0	4.1	4.5	8.2	9.1	10.9	11.4	12.1	13.6	14.5	18.2	27.3	29.8	34.1	36.4	42.4
0.225	0.6	1.3	2.9	4.0	4.4	8.0	8.9	10.7	11.1	11.9	13.3	14.2	17.8	26.7	29.1	33.3	35.6	41.5
0.25	0.6	1.2	2.6	3.6	4.0	7.2	8.0	9.6	10.0	10.7	12.0	12.8	16.0	24.0	26.2	30.0	32.0	37.3
0.33	0.4	0.9	2.0	2.7	3.0	5.5	6.1	7.3	7.6	8.1	9.1	9.7	12.1	18.2	19.8	22.7	24.2	28.3
0.37	0.4	0.8	1.8	2.5	2.7	4.9	5.4	6.5	6.8	7.2	8.1	8.6	10.8	16.2	17.7	20.3	21.6	25.2
0.375	0.4	0.8	1.8	2.4	2.7	4.8	5.3	6.4	8.7	7.1	8.0	8.5	10.7	16.0	17.5	20.0	21.3	24.9
0.45	0.3	0.7	1.5	2.0	2.2	4.0	4.4	5.3	5.6	5.9	6.7	7.1	8.9	13.3	14.6	16.7	17.8	20.7
0.5	0.3	0.6	1.3	1.8	2.0	3.6	4.0	4.8	5.0	5.3	6.0	6.4	8.0	12.0	13.1	15.0	16.0	18.7
0.55	0.3	0.5	1.2	1.6	1.8	3.3	3.6	4.4	4.5	4.9	5.5	5.8	7.3	10.9	11.9	13.6	14.5	17.0
0.58	0.3	0.5	1.1	1.5	1.7	3.1	3.4	4.1	4.3	4.6	5.2	5.5	6.9	10.3	11.3	12.9	13.8	16.1
0.6	0.2	0.5	1.1	1.5	1.7	3.0	3.3	4.0	4.2	4.5	5.0	5.3	6.7	10.0	10.9	12.5	13.3	15.6
0.675	0.2	0.4	1.0	1.4	1.5	2.7	3.0	3.6	3.7	4.0	4.4	4.7	5.9	8.9	9.7	11.1	11.9	13.8
0.75	0.2	0.4	0.9	1.2	1.3	2.4	2.7	3.2	3.3	3.6	4.0	4.3	5.3	8.0	8.7	10.0	10.7	12.4
0.8	0.2	0.4	0.8	1.2	1.3	2.3	2.5	3.0	3.1	3.3	3.8	4.0	5.0	7.5	8.2	9.4	10.0	11.7
0.88	0.2	0.3	0.8	1.0	1.1	2.0	2.3	2.7	2.8	3.0	3.4	3.6	4.5	6.8	7.4	8.5	9.1	10.6
0.9	0.2	0.3	0.7	1.0	1.1	2.0	2.2	2.7	2.8	3.0	3.3	3.6	4.4	6.7	7.3	8.3	8.9	10.4
1	0.1	0.3	0.7	0.9	1.0	1.8	2.0	2.4	2.5	2.7	3.0	3.2	4.0	6.0	6.6	7.5	8.0	9.3
1.17	0.1	0.3	0.6	0.8	0.9	1.5	1.7	2.1	2.1	2.3	2.6	2.7	3.4	5.1	5.8	6.4	6.8	8.0
1.25	0.1	0.2	0.5	0.7	0.8	1.4	1.6	1.9	2.0	2.1	2.4	2.6	3.2	4.8	5.2	6.0	6.4	7.5
1.5	0.1	0.2	0.4	0.6	0.7	1.2	1.3	1.6	1.7	1.8	2.0	2.1	2.7	4.0	4.4	5.0	5.3	6.2
1.6	0.1	0.2	0.4	0.5	0.6	1.1	1.3	1.5	1.6	1.7	1.9	2.0	2.5	3.8	4.1	4.7	5.0	5.8
2	0.1	0.2	0.3	0.5	0.5	0.9	1.0	1.2	1.3	1.3	1.5	1.6	2.0	3.0	3.3	3.8	4.0	4.7

*See Table 1 for specific rates of insecticides for each insect or mite pest.

Table 4. Converting percent active ingredient of dry insecticides to formulated insecticide per acre.

Pounds active **ingredient needed per acre**	Percent active ingredient					
	5	**15**	**20**	**50**	**80**	**90**
	Pounds formulation per acre*					
0.09	1.80	0.60	0.45	0.18	0.11	0.10
0.188	3.76	1.25	0.04	0.38	0.24	0.21
0.25	5.00	1.67	1.25	0.50	0.31	0.28
0.3	6.00	2.00	1.50	0.60	0.38	0.33
0.45	9.00	3.00	2.25	0.90	0.56	0.50
0.5	10.00	3.33	2.50	1.00	0.63	0.56
0.6	12.00	4.00	3.00	1.20	0.75	0.67
0.75	15.00	5.00	3.75	1.50	0.94	0.83
1.0	20.00	6.67	5.00	2.00	1.25	1.11
1.25	25.00	8.33	6.25	2.50	1.56	1.39
1.33	26.60	8.87	6.65	2.66	1.66	1.48
1.5	30.00	10.00	7.50	3.00	1.88	1.67
1.6	32.00	10.67	8.00	3.20	2.00	1.78
2.0	40.00	13.33	10.00	4.00	2.50	2.22
2.4	48.00	16.00	12.00	4.80	3.00	2.67

*See Table 1 for specific rates of insecticides for each insect or mite pest.

The information herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied.

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