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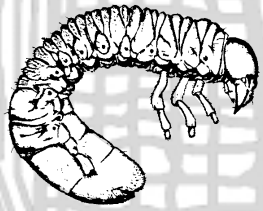
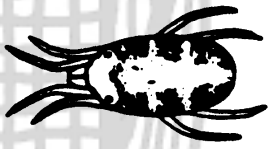
Managing Insect and Mite Pests of Texas Corn





Contents

Managing Insect and Mite Pests of Texas Corn

Patrick Porter, Gregory B. Cronholm, Roy D. Parker, Noel Troxclair, Carl D. Patrick,[1] Pat Morrison,[2] and Thomas L. Archer[3]

Introduction

Corn is subject to insect attack throughout the growing season. Despite natural predators and parasites, some insects may reach damaging levels and may require chemical control. However, plant damage is not always directly related to insect numbers. Other factors such as plant vigor, growth stage, moisture conditions, time of year, parasite and predator abundance and crop rotation are equally important. Therefore, chemical treatments should be based on careful evaluation of economic and natural control factors.

The wise use of insecticides requires that producers inspect their crops frequently to determine if damaging numbers of insect or mite pests are present. This publication provides methods of determining insect numbers and guides for determining the need for pesticides. *Because seed production corn and sweet corn are more susceptible to insect damage and are also more economically valuable than field corn, producers may need to control pests in seed and sweet corn even when fewer pests are present.* Recommendations in this bulletin primarily refer to insect and mite control on field corn.

A few insect and mite pests attacking corn in Texas show resistance to pesticides that once were effective. Generally, the more extensively a pesticide is used, the more rapidly resistance develops. Therefore, pesticides should be used only when needed. The actual need can be determined only by frequent inspections of the crop to determine pest numbers.

This guide discusses insect and mite pests in the approximate seasonal order that they damage corn—pre-emergence, seedling to tassel and tassel to hard dough.

Policy Statement for Making Pest Management Suggestions

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

Suggested insecticide use rates have shown sufficient effectiveness in tests to provide adequate control in field situations. However, it is impossible to eliminate all risks. Unforeseen or unexpected conditions or circumstances may result in less than satisfactory results. Texas Cooperative Extension 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 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.

The USER is always responsible for the effects of pesticide residues on his livestock and crops, as well as for problems that arise from drift or movement of the pesticide. Always read and follow carefully the instructions on the container label.

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Pay particular attention to practices that ensure worker safety.

For additional information, contact your county Extension staff; write the Extension Entomologist, 2475 TAMU, Texas A&M University, College Station, TX 77843-2475; or call (979) 845-7026.

Endangered Species Regulations

The Endangered Species Act was enacted 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 areas designated as biologically sensitive. These restrictions are subject to change. Refer to the Environmental Hazards or Endangered Species discussion sections of product labels and/or call your county Extension agent or Fish and Wildlife Service personnel to determine what restrictions apply in your area. Regardless of the law, pesticide users can be good neighbors by being aware of how their actions may affect people and the environment.

Worker Protection Standard

The Worker Protection Standard (WPS) is a set of federal regulations that applies to producers who employ people to produce a plant or plant product for sale. The WPS affects workers who will apply pesticides (agricultural handlers) or work in an area where pesticides have been applied (agricultural workers). Since 1995, if you are using a pesticide product with labeling that refers to the Worker Protection Standard, you must comply with it. The WPS requires that you provide three basic types of pesticide protection to your employees. You must:

- Inform employees about possible exposure.
- Protect employees from exposure.
- Mitigate pesticide exposures that employees might receive.

All agricultural pesticides bear a WPS statement in the "DIRECTIONS FOR USE" part of the label. For more detailed information, consult EPA publication 735-B-93-001, *The Worker Protection Standard for Agricultural Pesticides — How to Comply: What Employers Need to Know* (GPO #055-000-0442-1), or call the Texas Department of Agriculture, Pesticide Worker Protection Program, (512) 463-7717.

Biological Control

Biological control is the use of living organisms, such as parasites, predators and disease, to control pests. Organisms that control pests are called natural enemies. In corn, natural enemies include minute pirate bugs, spiders, lady beetles, predatory mites and thrips, and a variety of tiny wasps that parasitize insect pests. In addition, weather and inadequate food often hold insect and mite populations below damaging levels. It is important to recognize the effect of these natural control factors and, where possible, encourage their action.

Biological control includes the conservation, augmentation and importation of natural enemies. A producer can conserve existing populations of natural enemies by minimizing insecticide applications and using insecticides that are more toxic to the target pest than to the natural enemy. Augmentation involves purchasing and releasing specimens of the natural enemies. Classical biological control—the third type—involves importing natural enemies from other countries.

Transgenic Corn

Transgenic corn produces some of the insecticidal endotoxins (poisons) found in the bacterium *Bacillus thuringiensis* (Bt). These proteins are highly toxic to certain insect pests but have little or no effect on humans, livestock, most beneficial insects and other nontarget organisms. Because planting Bt corn reduces the need for insecticides, there is less human and environmental exposure to insecticides, and the producer has lower production costs.

Extensive field testing indicates that Bt corn hybrids provide excellent control of first and usually second generation European corn borers, southwestern corn borers and sugarcane borers. Bt corn varieties also may be effective in controlling or suppressing some other lepidopterous (caterpillar) pests, including corn earworm. There are significant differences among the types of Bt corn and their ability to control such pests.

The presence of Bt in corn does not enhance yield; it simply protects the yield against insect damage. Without pests, there is no difference in

the amount of corn produced, compared to the same variety without Bt. However, Bt is often placed in "elite" hybrids, and these may or may not yield more than older hybrids. (See B-6090, "Bt Corn Technology in Texas: A Practical View," Texas Cooperative Extension.)

Subject to EPA approval, transgenic corn for corn rootworm control will be marketed in 2002. While there are several types of rootworm toxins under development, most depend on proteins from *Bacillus thuringiensis*. However, these toxins are different from those that are active against caterpillar pests. Rootworm-active corn will not harm corn borers, and corn borer-active corn will not harm rootworms. Putting toxins from both rootworm-active and lepidoptera-active corn together in the same plant is possible, as is putting two different toxins for rootworms or lepidoptera alone. These would be "stacked gene" hybrids, which will be sold in the future.

Pre-Emergence Insect Control

Soil-Inhabiting Pests

White grubs, corn rootworms, cutworms, wireworms, sod webworms, seedcorn beetles and seedcorn maggots are the most common soil insects attacking corn in Texas. Cultural practices are very important in reducing damage from these soil pests. Growing corn on the same land year after year increases the damage done by certain soil insects. For example, losses from corn rootworms may be reduced or in some cases eliminated by rotating corn with soybeans or other crops that are not attacked by rootworms. In most areas of Texas, corn has been rotated successfully with sorghum without damage from the Mexican corn rootworm and western corn rootworm. However, in parts of South Central Texas, corn following sorghum has been damaged by the Mexican corn rootworm, although this is a rare occurrence. Another cultural practice that reduces soil insect pests is maintaining weed-free fields throughout the year, because weeds are host plants for certain soil insects.

Producers should sample their fields for white grubs, cutworms and wireworms before bed formation. If chemical treatment is necessary, soil or seed treatments are available. One method may be more effective for a particular soil pest than another.

Seed Treatment

In the past, seed treatment was done by the seed companies; however, because of restrictions on chemical use on seeds, many commercial seed companies are no longer treating seeds. If commercially treated seeds are not available, growers can use direct seed treatment or planter box treatments.

Light populations of wireworms, seedcorn maggots, seedcorn beetles and seed-feeding ants may be controlled by treating seeds with products containing lindane or lindane plus diazinon. The insecticide should coat each seed evenly. Use a concrete mixer, commercial seed treater or homemade seed treater. Sprinkle 1 pint of water on each 100 pounds of seed and mix to coat the seed with moisture. Slowly add the correct amount of insecticide while mixing the seed. Mix until the insecticide is evenly distributed on all seeds. Treated seeds should be planted within 20 days of treatment, because long exposure to the chemical will affect germination in some hybrids. Do not use treated seed for human consumption or livestock feed.

Some insecticides are made to be applied to seed in the planter box. This method is effective only against low populations of wireworms, seed-feeding ants, seedcorn beetles and seedworm maggots. Use this soil insect control technique as directed on the insecticide label.

Insecticides such as malathion, pirimophos-methyl (Actellic®) or methoxychlor are often applied to seed to control stored grain pests. These insecticides are not effective for control of soil pests.

Soil Treatment

Insecticide that controls some soil pests must be applied before the crop is planted or at planting time. Granular or liquid formulations may be used depending on the producer's equipment and the target insect. Granular insecticides are generally safer. With the soil treatment method there are three application techniques: (1) preplant broadcast, (2) row band or T-band, and (3) in-furrow at planting.

Preplant insecticide application. A broadcast application generally provides the best protection against soil insects and is the only means of controlling heavy white grub infestations.

Unfortunately, broadcast applications require more insecticide and are more expensive than row band or in-furrow treatments. Therefore, broadcast applications are not usually recommended. However, when broadcast applications are necessary, the insecticide should be applied uniformly to the field and incorporated to a depth of 3 to 5 inches immediately after application. Because of label changes in recent years, fewer products are labeled for preplant broadcast application.

When corn is planted on a bed, special equipment is required to incorporate the insecticide to a depth of 3 to 5 inches. This is called row treatment. Row treatments must be made during or after bed formation. Further cultivation or bed shaping will alter the position of the insecticide in the row. A treated band of soil 7 to 10 inches wide and 3 to 5 inches deep, with seed placed in the center of the treated band, is necessary to obtain the best control.

Insecticide application at planting. Insecticides may be applied to the soil at planting time by the row band, T-band, or in-furrow techniques. The technique of choice will depend on the pest insect and how a particular insecticide is labeled. Some insecticides applied at planting for corn rootworm control will suppress some early season pests, such as chinch bugs, fire ants and flea beetles on seedling plants. These pests will be suppressed for 2 to 4 weeks, depending upon the insecticide used.

Mount the granular application equipment on the planter with the spout just behind the opening plow or disc opener and in front of the covering shovels or press wheel. Adjust the spouts so the treatment band is about 6 to 8 inches wide and the seed furrow and covering soil are treated. Incorporating the insecticide by covering shovels is adequate. Insecticide also can be incorporated with short parallel chains, loop chains, press wheels, finger tines or other suitable devices. Some insecticides are labeled only for band application behind the seed covering devices. *Do not* apply insecticide directly on the seed unless this use is specifically listed on the label, because doing so usually results in poor seed germination. In-furrow application usually gives poor control where white grub populations are high.

White Grubs and Cutworms

White grubs are the larval stage of May and June beetles. The larvae feed on the plant roots. Small plants often are killed, and large plants are stunted and may lodge before harvest. *To determine the need for white grub control before planting, examine 1-square-foot soil sample for each 5 to 10 acres. An average of one white grub per square foot is enough to cause significant stand loss.*

If white grub populations average approximately one per square foot, adequate suppression can often be achieved with an in-furrow or band treatment at planting. For surface cutworms, incorporate insecticide into the top 1 to 2 inches of soil. Refer to the table in this document for cutworm control on seedling corn.

Suggested Insecticides for Controlling White Grubs

Insecticides (alphabetically)	Amount per 1,000 feet of row	Amount per acre on 40-inch row spacing
Chlorpyrifos (Lorsban® 15G)	8.0 oz.	6.5 lb.
Tebupirimfos + cyfluthrin (Aztec® 2.1G)	6.7 oz.	5.5 lb.
Tefluthrin (Force® 3G)	4-5 oz.	3.3-4.1 lb.
Terbufos (Counter® 20CR)	6.0 oz.	4.9 lb.
(Counter® 15G)	8.0 oz.	6.5 lb.

Remarks

Chlorpyrifos: Not labeled for band application. Must be in-furrow or T-band.

Tebupirimfos + cyfluthrin: May not be used in counties adjacent to the Gulf Coast. For applications made within 20 yards of aquatic sites, apply as an in-furrow application only. See Special Local Needs Registration TX-00008. For optimum results, apply as a band or T-band. In-furrow application may provide less control.

Tefluthrin: Apply as an in-furrow treatment.

Terbufos: Read supplemental label for information on potential crop damage if used in combination with some herbicides. Banded or in-furrow application only.

Wireworms, Seedcorn Maggots and Seedcorn Beetles

Seed treatment with products containing lindane or lindane plus diazinon is generally effective in controlling these soil pests. (See the section on seed treatment procedures for more information.) Where large populations of wireworms are present, follow the recommendations listed on appropriate insecticide labels. Producers should check their soil closely during land preparation to

determine the need for seed treatment or soil applications to control such pests.

Suggested Insecticides for Controlling Wireworms

Insecticides (alphabetically)	Amount per 1,000 feet of row	Amount per acre on 40-inch row spacing
Chlorpyrifos		
(Lorsban® 15G)	8.0 oz.	6.5 lb.
Fipronil		
(Regent® 80WG)	0.149 oz.	1.95 oz.
Tebupirimfos + cyfluthrin		
(Aztec® 2.1G)	6.7 oz.	5.5 lb.
Tefluthrin		
(Force® 3G)	4-5 oz.	3.3-4.1 lb.
Terbufos		
(Counter® 20CR)	6.0 oz.	4.9 lb.
(Counter® 15G)	8.0 oz.	6.5 lb.

Remarks

Chlorpyrifos: Not labeled for band application. Must be in-furrow or T-band.

Fipronil: Do not apply on row spacing less than 30 inches. Do not harvest within 90 days of application. Do not plant small grains or other rotational crops within 12 months of application or root crops within 5 months of application.

Tebupirimfos + cyfluthrin: May not be used in counties adjacent to the Gulf Coast. For applications made within 20 yards of aquatic sites, apply as an in-furrow application only. See Special Local Needs Registration TX-00008.

Tefluthrin: Apply as an in-furrow treatment.

Terbufos: Read supplemental label for information on potential crop damage if used in combination with some herbicides.

Mexican and Western Corn Rootworm

Mexican and western corn rootworm beetles lay eggs in the soil during the summer and fall, shortly after silking time. Eggs are usually laid within the corn field in the upper 2 to 8 inches of the soil, where they remain until they hatch the following year. Time of hatching depends to some extent on soil temperature; however, eggs usually begin to hatch about mid-April in South Texas and about mid-May in the High Plains and continue to hatch for several weeks. If corn roots are not available for the newly hatched corn rootworms to feed on, they will die. *There is only one generation per year. Therefore, the best method of controlling these two subspecies is to rotate corn with any other crop.*

Fields planted with corn year after year in areas prone to have Mexican and western corn rootworm problems (see map) generally require a soil insecticide at planting time. In continuous corn production fields, an average of one or more beetles per plant on any sampling date during the growing season indicates a need for a soil insecticide the following spring or a need to consider crop rotation. Damage from corn rootworms usually occurs from mid-April through mid-May in South Texas and during June in the High Plains. Extensive damage to the brace roots and fibrous roots may cause plants to lodge. A "goose necking" appearance occurs when lodged plants continue to grow.

Suggested Insecticides for Controlling Mexican and Western Corn Rootworms

Insecticides (alphabetically)	Amount per 1,000 feet of row	Amount per acre on 40-inch row spacing
Carbofuran	See remarks	See remarks
(Furadan® 4F)	2.5 oz.	1 qt.
Chlorpyrifos		
(Lorsban® 15G)	8.0 oz.	6.5 lb.
(Lorsban® 4E)	2.4 oz.	2 pt.
Tebupirimfos + cyfluthrin		
(Aztec® 2.1G)	6.7 oz.	5.5 lb.
Tefluthrin		
(Force® 3G)	4.0-5.0 oz.	3.3-4.1 lb.
Terbufos		
(Counter® 20CR)	6.0 oz.	4.9 lb.
(Counter® 15G)	8.0 oz.	6.5 lb.

Remarks

Carbofuran: Apply as a post-emergent spray by banding over the row or by side dressing or basal spraying both sides of the row after corn emerges. Control will generally be improved if the treatment is incorporated into the soil. Do not feed forage within 30 days of last application.

Chlorpyrifos: Granules are not labeled for band application. Must be in-furrow or T-band. Liquid formulation must be applied by T-band application only. Applications made using a band width less than 5 to 6 inches may cause phytotoxicity under certain environmental conditions (e.g., cool temperatures, wet conditions and light soils).

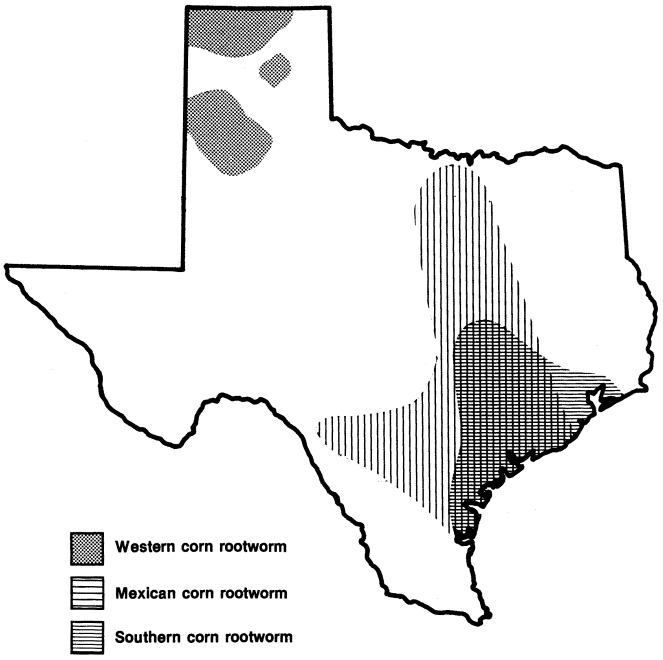
Tebupirimfos + cyfluthrin: May not be used in counties adjacent to the Gulf Coast. For applications made within 20 yards of aquatic sites, apply as an in-furrow application only.

Terbufos: Read supplemental label for information on potential crop damage if used in combination with some herbicides.

PRECAUTION: Certain sulfonylurea herbicides and organophosphate insecticides used in the same crop year on corn may cause severe crop injury. Please read pesticide labels carefully.

IMPORTANT: The use of the same soil insecticides year after year in the same field is not a good practice. Producers are encouraged to rotate organophosphate (chlorpyrifos, terbufos, tebupirimfos) with other (tefluthrin, cyfluthrin, carbofuran) soil insecticides each year for best results.

For all band applications, apply in a 6- to 8-inch band just behind seed drop and in front of covering shovels and press wheel or chain drag. Soil incorporation to a depth of about 1 inch is important.



Southern Corn Rootworm

The southern corn rootworm deposits its eggs in soil after the corn is in the seedling stage. Therefore, crop rotation will not provide adequate control of this insect. Unlike the Mexican and western corn rootworms, more than one generation of southern corn rootworm may occur per year. This species is considered a minor corn pest in most areas of Texas where corn is planted in fields that were not grassy or weedy the previous year.

In the Gulf Coast region (see map above), however, the southern corn rootworm has been a significant pest. Where there is a history of infestations along with losses in plant stands in previous years, an in-furrow or band pesticide application should be considered.

With insecticides that can be applied in-furrow, field experiments show that in most fields one-half the maximum rate listed in the following table provides the most favorable economic returns for control of southern corn rootworm. However, in fields where heavy infestations occur each year, it would be advisable to use the higher rates.

Suggested Insecticides Applied At Planting for Controlling Southern Corn Rootworm

Insecticides (alphabetically)	Amount per 1,000 feet of row	Amount per acre on 40-inch row spacing
Carbofuran (Furadan® 4F)	2.5 oz.	1 qt.
Chlorpyrifos (Lorsban® 15G)	8.0 oz.	6.5 lb.
Tefluthrin (Force® 3G)	4-5 oz.	3.3-4.1 lb.
Terbufos (Counter® 20CR)	6.0 oz.	4.9 lb.
(Counter® 15G)	8.0 oz.	6.5 lb.

Remarks

Carbofuran: Apply at planting directly into the seed furrow. Do not feed forage within 30 days of last application.

Terbufos: Read supplemental label for information on potential crop damage if used in combination with some herbicides.

PRECAUTION: Certain sulfonylurea herbicides and organophosphate insecticides used in the same crop year on corn may result in severe crop injury. Please read pesticide labels carefully.

IMPORTANT: The use of the same soil insecticide year after year in the same field is not a good practice. Producers are encouraged to rotate organophosphate (chlorpyrifos, terbufos) with other (tefluthrin, carbofuran) soil insecticides each year.

For all band applications, apply in a 6- to 8-inch band just behind seed drop and in front of covering shovels and press wheel or chain drag. Soil incorporation to a depth of about 1 inch is important.

Seedling to Tassel Stage Insect Control

Corn Leaf Aphid

Fields in the seedling stage rarely require treatment for corn leaf aphid. Yield losses have occurred only where corn leaf aphids caused stand loss to seedling plants. Pre-tassel and later growth stages can tolerate large numbers of aphids without economic damage.

Soil Cutworms

Cutworms are dingy, grayish-black, smooth "worms" that are the larval stages of several different moths. Cutworms are active at night and damage seedling corn by cutting the stalk just above ground level. Large numbers of cutworms may be found in grassy or weedy areas. Most cutworm species hide in the soil during the day and are not visible on the plants.

When cutworms are damaging plant stands, an application of insecticide by air or ground usually

will give adequate control. Best results are obtained when insecticides are applied in the late afternoon. If the soil is dry, cloddy or crusty at the time of treatment, control may not be as effective as in moist soil.

Suggested Insecticides for Controlling Cutworms

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Chlorpyrifos			
(Lorsban® 4E)	1-2 pt.	35	14
Esfenvalerate			
(Asana® XL 0.66E)	5.8-9.6 oz.	21	21
Permethrin			
(Ambush® 2E)	6.4-12.8 oz.	30	30
(Pounce® 3.2EC	4.0-8.0 oz.	30	no
(Pounce® 1.5G)	6.7-13.3 lb.	30	no
Lambda-cyhalothrin			
(Warrior® CS)	1.92-3.20 oz.	21	See label

Remarks

Chlorpyrifos: It is preferable to apply Lorsban when soil is moist and cutworms are active on or near the soil surface. Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment.

Permethrin: Pre-emergent use—Apply from 5 days prior to planting until the emergence of the crop. Apply as a broadcast spray in a minimum of 20 gallons of finished spray/acre with ground equipment. Foliar use—Apply prior to ear formation by ground.

Southwestern Corn Borer

Southwestern corn borers emerge from corn stubble in the spring to lay eggs on whorl-stage corn. Corn adjacent to or near unplowed stubble typically experiences higher densities of southwestern corn borer larvae feeding in the whorl. Eggs are laid on the upper and lower surfaces of expanded leaves in the whorl. Freshly laid eggs are creamy white; after about 24 hours, three red bands appear on each egg. Small larvae hatch from the eggs in about 5 days and begin feeding in the whorl. The typical rows of holes across the leaf surface associated with whorl feeders become apparent as leaves unfold. Another leaf symptom commonly associated with southwestern corn borer feeding in the whorl is longitudinal, transparent areas on the leaf where young larvae feed only partially through the leaf tissue. After the larva has fed in the whorl, it crawls down the plant and bores into the stalk. Corn borer larvae reach a length of 1 to 1 1/2 inches. They have a regular pattern of raised black dots on a creamy white body.

First generation eggs and larvae are difficult to detect because infestations seldom exceed 5 percent of plants. However, if infestations are great enough to warrant treatment, applications should be made before borers leave the whorl and enter the stalk. For recommended insecticides, refer to the southwestern corn borer table in the "Tassel to Hard Dough Stage" of this guide.

European Corn Borer

European corn borer was first discovered in Texas High Plains corn in 1978. Economically damaging infestations can be found in most corn growing areas of the Texas Panhandle. Borers overwinter as full-grown larvae in corn stalks, corn cobs, weed stems or other corn field debris. Pupation occurs in May, and first generation moths begin to emerge in late spring. Moths are first attracted to dense vegetation around corn and remain there for a few days while they mate. Mated females return to the corn fields to lay eggs. They are attracted to the tallest fields (at least 22- to 35-inch extended leaf height). The eggs, 15 to 30 in a mass, overlap like fish scales and are normally deposited near the midribs on the undersides of the leaves. Eggs hatch in 3 to 7 days. Larvae move to the whorl to feed before entering the stalk for pupation.

To determine the need for insecticide application to control first generation European corn borers, examine five random samples of 20 consecutive plants each. An insecticide application is justified if 50 percent of the plants are infested with an average of at least one live larva per plant. For recommended insecticides, refer to the European corn borer table in the "Tassel to Hard Dough Stage" of this publication.

Lesser Cornstalk Borer

The lesser cornstalk borer occasionally attacks seedling corn. The small, slender larva remains in the soil in a silken tube and injures plants by feeding on the crown area of the plant at the soil line.

These insects may occur in damaging numbers on sandy soils and can become more numerous under dry conditions. Rainfall and irrigation will kill many larvae, so irrigation timing and the amount of water applied at each irrigation will influence control. Insecticides applied at planting for corn rootworms may control other soil pests such as lesser cornstalk borer.

Applications of Terbufos (Counter CR) for corn rootworms have provided suppression of lesser cornstalk borers. Careful inspection during the

seedling stage is important in areas where this insect has been a problem. Base any treatments on the actual plant damage and the presence of larvae. This insect does not usually affect larger corn plants.

Suggested Insecticides for Controlling Lesser Cornstalk Borer

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Chlorpyrifos			
(Lorsban® 15G)	3.3-9.8 lb.	35	14
(Lorsban® 4E)	2-3 pt.	35	14

Remarks

Chlorpyrifos: Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment.

Other Borers

In recent years, most borer damage to corn in the Lower Rio Grande Valley and along the Gulf Coast has been caused by the Mexican rice borer, the sugarcane borer and the neotropical borer (see map).

These borers typically attack corn in the pre-tassel stage. They feed on the leaves for a short time before boring into the stalks. Yield losses are minor unless stalk lodging occurs. Bored stalks most frequently fall during ear filling or ear maturation, and lodging is often associated with high winds. The stalks may break at any point and usually do not break near the soil level as with southwestern corn borer infestations. Control is most successful when fields are scouted closely and treated before larvae bore into stalks.

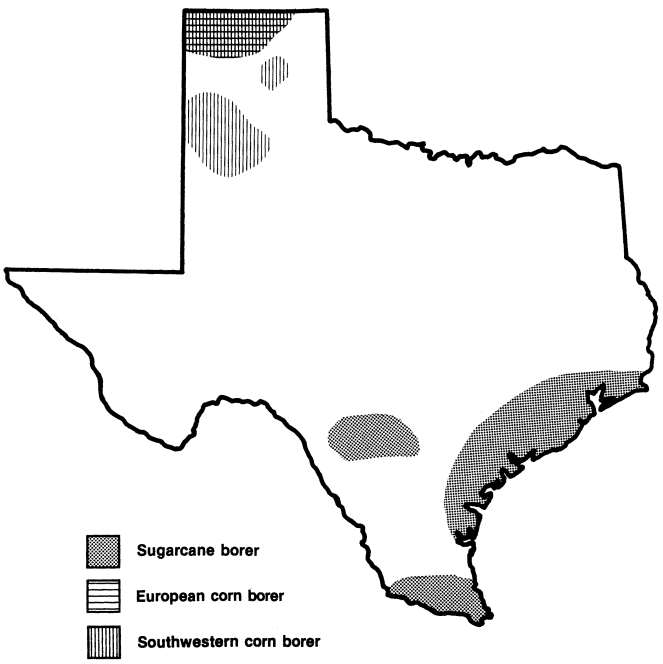
Corn Earworm and Fall Armyworm

Corn earworm and fall armyworm moths deposit eggs on leaves. Newly hatched larvae begin to feed in the whorl. Larval feeding will cause the leaves to appear ragged, but *insecticide treatments are seldom recommended and economical control is seldom achieved.*

Flea Beetles

Flea beetles are very tiny, shiny black or greenish black insects that will jump when disturbed. They range in size from smaller than a pinhead to several times as large. They damage corn plants up to 18 inches tall, primarily by feeding on the leaves. Damaged leaves have a whitened, bleached appearance. Plant growth is retarded as the leaves wilt and hang limp.

Fields kept clean of weeds the previous season seldom suffer significant flea beetle injury. When



sufficient numbers of flea beetles are damaging corn, an application of insecticide may be necessary.

Suggested Insecticides for Controlling Flea Beetles

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Carbaryl			
(Sevin® 80WSP)	1.25-2.5 lb.	48	14
(Sevin® XLR Plus 4 lb.)	1.0-2.0 qt.	48	14
Esfenvalerate			
(Asana® XL 0.66EC)	5.8-9.6 oz.	21	21
Methyl parathion			
(4.0 lb.)	0.50 pt.	12	1

Remarks

Chlorpyrifos: Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment.

Chinch Bug

Adult chinch bugs are about 1/6-inch long with black bodies and reddish-yellow legs. When fully developed, the white wings are marked with a triangular black spot near the middle of the back on the outer wing margin. When viewed from above, the insect appears to have a white "X" or white hourglass on the back.

Adult and immature chinch bugs suck plant juices and cause reddening of the leaves. Damage by chinch bugs normally occurs from seedling emergence until the plants are 18 inches tall. Large numbers of chinch bugs can move into a cornfield by crawling or flying from wild bunch

grasses or small grains. Once in the field, they congregate and feed behind the leaf sheaths of the corn plant.

Suggested Insecticides for Controlling Chinch Bugs

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
At-Plant			
Chlorpyrifos			
(Lorsban® 15G)	6.5 lb.	35	14
(Lorsban® 4E)	1-2 pt.	35	14
Terbufos			
(Counter® 20CR)	4.9 lb.	30	30
(Counter® 15G)	6.5 lb.	30	30
Post-Plant			
Carbaryl			
(Sevin® XLR Plus 4 lb.)	1-2 qt.	48	14
(Sevin® 80WSP)	1.25-2.5 lb.	48	14
Chlorpyrifos			
(Lorsban® 4E)	1-2 pt.	35	14
Lambda-cyhalothrin			
(Warrior® 1CS)	3.84 oz.	21	See label

Remarks

For post-plant application, use only ground application equipment and direct the spray nozzles at the infested portions of the plants. Control is difficult on larger plants.

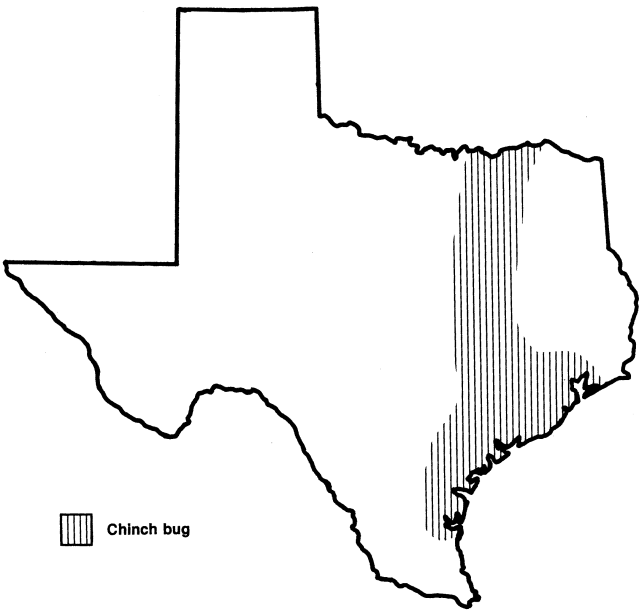
Carbaryl: For optimum control, apply 20 gallons of water per acre by ground and direct the spray towards the bases of stalks to provide thorough coverage.

Chlorpyrifos: Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment. For Lorsban 15G, a T-band is more effective than an in-furrow application. In-furrow applications should be considered as suppression only. Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment. Apply Lorsban 4E with sufficient water to ensure a minimum spray volume of 20 to 40 gallons per acre and 40 psi using ground equipment. On corn less than 6 inches tall, use a 9- to 12-inch band over the row. On corn higher than 5 inches, use drop noz.zles directed at the bases of the plants.

Terbufos: Apply at planting time in-furrow, placing granules directly in the seed furrow behind the planting shoe. For early season control of light to moderate infestations.

In fields with a history of early-season, economically damaging chinch bug populations (see map), at-plant soil-incorporated insecticides can suppress the development of chinch bug populations. Granular formulations may provide 2 to 3 weeks of protection, provided sufficient rainfall is received following application to wash the insecticide off of the granules. Young plants should be closely monitored for chinch bugs and feeding damage after germination, particularly during dry periods, even when at-plant insecticides are used.

Make at least five random checks in the field. *Insecticide should be applied when two or more adult chinch bugs are found on 20 percent of seedlings less than 6 inches high. On taller plants, apply insecticides when immature and adult bugs are present on 75 percent the plants.*



Tassel to Hard Dough Stage Insect Control

Corn Earworm

Corn earworm moths begin laying eggs on leaves and silks soon after tassel emergence and before pollination. After hatching, larvae tunnel into the silk channel to feed. The silks that are fed upon have usually completed pollination; therefore, a loss of pollination is generally not a problem. Later instar larvae can be found feeding on kernels at the tip of the ear. Ear damage is usually minor, although an occasional field may have excessive damage.

Corn earworm control is difficult since egg laying is extended through the silking period and continues after the completion of pollination (brown silk stage). Insecticides used for control must be applied frequently because untreated silks are exposed daily as silks elongate. Control efforts are usually costly and inconsistent. Currently, control strategies are not suggested in commercial field corn.

Fall Armyworm

The fall armyworm is a sporadic pest of corn. It migrates north during the growing season from overwintering sites in south Texas and northern Mexico. Infestations occurring from tassel to dough stage can be very damaging. Larvae feed on ears and ear shanks and behind leaf collars. Heavy infestations may cause substantial yield losses because larvae feed directly on the ear. Additional losses can occur when shank feeding causes ears to drop and when stalks lodge as a result of feeding damage to the nodes.

Fall armyworm larvae range from a light tan to a dark green or black color. Light and dark stripes run longitudinally on the body. Dark spots or bumps occur in a pattern over the body, especially when viewed from the top. The head of a larva has a prominent inverted "Y" in a light color that contrasts with the dark head capsule.

Scouting for fall armyworms can be difficult. Check corn leaves and grasses in the furrow for egg masses. There may be 50 to 100 eggs per mass. Also check for small larvae behind leaf collars and at the bases of primary and secondary ears. Small larvae differ from late instar larvae in that they are pale tan in color and have a small black spot on each side toward the head. This distinguishes them from corn earworm and southwestern corn borer larvae.

Currently, Texas does not have an established economic threshold for this pest. If control is necessary, it should be targeted at small larvae before they enter the primary ear.

Southwestern Corn Borer

The southwestern corn borer is a major corn pest on the High Plains (see map on page 8). Although it also occurs in far West Texas and Northeast Texas, it is not economically important in these regions. Damage is caused by larvae tunneling in the stalk and later girdling the plant, which results in lodging. Moths emerge from corn stubble and weed hosts in the spring to lay first generation eggs on whorl stage corn. On the High Plains, first generation larvae mature and pupate in the stalk in July. Moths begin emerging about mid-July and lay eggs of the second generation.

Second generation eggs are usually laid after tasseling has occurred. About three-fourths of these eggs are laid on the upper surfaces of the middle seven leaves — the ear leaf, two leaves above and four leaves below the ear leaf. Eggs are laid singly or in masses of two to three or more. Eggs overlap like fish scales or shingles. Freshly laid eggs are creamy white. One day later, three red bands appear across each egg. Eggs hatch in about 5 days. Small larvae feed behind leaf collars and ears and beneath the shucks of the primary ear. Older larvae bore into the stalk and continue feeding. Mature corn borer larvae reach 1 to 1 1/2 inches in length. They are dull white and have a regular pattern of raised black dots over the body. As plants reach maturity, larvae prepare for overwintering in the base of the stalk by girdling the plant from 1 to 6 inches above the ground. Wind can easily lodge girdled plants. Lodged plants are difficult to harvest, and yields are reduced.

Southwestern corn borer larvae overwinter in the stalk base or root crown. They are insulated by a frass (excrement) plug in the stalk and by the surrounding soil. One of the most effective borer control methods is to destroy this winter habitat to reduce spring moth emergence. A single tandem disc cultivation or shredding will expose larvae to cold, dry winter conditions while leaving sufficient residue to prevent soil erosion. The shredder must be set to cut stalks at the soil surface to remove the protective frass plug. Shredding is particularly compatible with grazing and minimum tillage operations because it does not bury plant materials, but it does expose corn borer larvae. Also, stalk shredding can be performed even when the soil is frozen. Double disking and deep plowing are effective methods if soil erosion is not a problem. High larval mortality is obtained when cultivation or shredding is performed before mid-January. Timely stubble destruction will reduce local infestations of first generation larvae. However, producers must cooperate by destroying stubble to effectively reduce southwestern corn borer populations throughout an area.

Early planted corn is less susceptible to corn borer plant lodging. A plant population that promotes large, healthy stalks, combined with proper fertilization and adequate irrigation, help prevent lodging of corn borer-infested stalks. Crop rotation, use of early-maturing varieties and an early harvest with equipment designed to pick up lodged stalks help reduce yield losses.

Insecticide treatments are usually directed toward second generation larvae. *Insecticide*

should be applied when 20 to 25 percent of the plants are infested with eggs or newly hatched larvae. Check for egg masses to determine the potential infestation and the correct timing of insecticide application.

Producers can use computer predictions of second generation moth flight and egg lay to plan field scouting to detect infestations. Contact your county Extension agent for egglaying predictions in your area.

Suggested Insecticides for Controlling Southwestern Corn Borer

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Bifenthrin (Capture® 2EC)	2.1-6.4 oz.	30	30
Carbaryl (Sevin® 80WSP)	1.25-2.5 lb.	48	14
(Sevin® XLR Plus 4 lb.)	1.0-2.0 qt.	48	14
Carbofuran (Furadan® 4F)	1.0-2.0 pt.	30	30
Chlorpyrifos (Lorsban® 4E)	1.5-2 pt.	35	14
(Lorsbsan® 15G)	6.5 lb.	35	14
Esfenvalerate (Asana XL® 0.66E)	5.8-9.6 oz.	21	21
Lambda-cyhalothrin (Warrior® 1CS)	2.56-3.84 oz	21	See Label
Permethrin (Ambush® 2E)	6.4-12.8 oz.	30	30
(Pounce® 3.2EC)	4.0-8.0 oz.	30	No
(Pounce® 1.5G)	6.7-13.3 lb.	30	No

Remarks

Research data demonstrate that the use of cabaryl, chlorpyrifos, and pyrethroid (esfenvalerate, lambda-cyhalothrin, permethrin) insecticides can increase mite densities on corn.

Chlorpyrifos: Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment. Lorsban 15G is not labeled for band application. Must be in-furrow or T-band.

Carbofuran: Do not make more than two foliar applications per season or more than one foliar application if Furadan 4F was used as a soil application. Do not use Furadan as a foliar treatment on seed corn. Do not enter treated fields within 14 days of application unless full protective equipment is worn.

Permethrin: Do not apply after silks begin to turn brown.

European Corn Borer

The second generation of European corn borers usually causes higher yield losses than the first generation. Second generation moths that emerge in mid-summer are attracted to dense vegetation around corn fields, primarily for mating. Mated females return to recently tasseled corn to lay eggs. Most of the egg masses will be laid on the undersides of leaves nearest to and including the ear leaf. Eggs are white, and a black dot (the head of the young larva) can be seen just before hatching. Eggs will hatch in 3 to 5 days. After hatching, approximately 75 percent of the small larvae move to the leaf axils, and the remaining 25 percent go to the ear sheath and collar tissue. Yield losses result from damage caused by larval tunneling, ear droppage and direct kernel feeding.

Suggested Insecticides for Controlling European Corn Borer

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Bacillus thuringiensis (Dipel® 10G)	10 lb.	0	0
(Dipel® ES)	1.5-2.5 pt.	0	0
Bifenthrin (Capture® 2EC)	2.1-6.4 oz.	30	30
Carbofuran (Furadan® 4F)	1.5 - 2 pt.	30	30
Chlorpyrifos (Lorsban® 4E)	1.5 - 2 pt.	35	14
(Lorsbsan® 15G)	6.5 lb.	35	14
Esfenvalerate (Asana XL 0.66E)	7.8-9.6 oz.	21	21
Lambda-cyhalothrin (Warrior® 1CS)	2.56-3.84 oz.	21	See Label
Permethrin (Ambush® 2E)	6.4-12.8 oz.	30	30
(Pounce® 3.2EC)	4.0-8.0 oz.	30	No
(Pounce® 1.5G)	6.7-13.3 lb.	30	No
Spinosad (Tracer® 4SC)	2.0-3.0 oz.	28	7

Remarks

Research data demonstrate that the use of cabaryl, chlorpyrifos, and pyrethroid (esfenvalerate, lambda-cyhalothrin, permethrin) insecticides can increase mite densities on corn.

Chlorpyrifos: Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment. Lorsban 15G is not labeled for band application. Must be in-furrow or T-band.

Carbofuran: Do not make more than two foliar applications per season or more than 1 foliar application if Furadan 4F was used as a soil application. Do not use Furadan as a foliar treatment on seed corn. Do not enter treated fields within 14 days of application unless full protective equipment is worn.

Permethrin: Apply prior to the brown silk stage.

Spinosad: Suggested for first generation only.

To determine the need for an insecticide application, examine a minimum of five random samples of 20 consecutive plants each. *An insecticide application is justified if an average of 10 to 20 hatched and unhatched egg masses can be found per 100 plants.* Two applications may be necessary to satisfactorily control European corn borer.

Spider Mites

Infestations of spider mites sufficient to cause economic harm occur primarily on corn in the Texas High Plains and Rio Grande Valley. Large numbers of spider mites may occur on corn after tassels appear. Mites first appear on the lower leaves, but they may move upward until all the leaves (and in extreme cases the entire plant) are killed. Heavy infestations cause extensive webbing on the leaves and may be associated with stalk rot and lodging. Periods of hot, dry weather favor a rapid increase of mite populations. Using insecticide to control other pests is an important factor triggering mite increases. Infestations may kill beneficial insects that usually keep spider mite numbers low. Mite numbers may also increase when excessive amounts of fertilizer are used; therefore, it is important to test soil and apply only the amount of fertilizer needed. Proper irrigation timing will help plants withstand mite feeding damage. The most important time to prevent water stress is during tassel and early grain filling.

Both the Banks grass mite and twospotted spider mite can occur on corn in Texas. The Banks grass mite is the predominant species in early and mid-season, and it is more widely distributed than the twospotted spider mite. A few fields, however, will have high numbers of twospotted spider mites. It is important to distinguish between these two species because presently registered miticides generally will not control twospotted spider mites in tassel-stage corn. The most useful characteristic for distinguishing between these two species is the pattern of pigmentation spots on the body. The adult twospotted spider mite has a well defined spot on each side of the front half of the abdomen. The spots on the adult Banks grass mite extend all the way down both sides of the body, sometimes almost touching at the rear of the body. Additionally, twospotted spider mites produce more webbing than Banks grass mites.

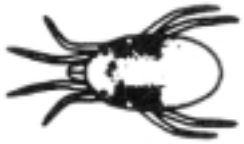
To decide whether or not Banks grass mites and/or twospotted spider mites should be controlled, estimate the per acre control cost (miticide plus application costs) and the expected value of the crop (yield X value). A two-step sampling process is necessary. The field can be quickly checked to determine the percentage of plants infested by mites. Divide the number of mite-infested green leaves (a leaf is infested if a mite colony of any size is on the leaf) by the number of green leaves per plant. If the plant equals or exceeds the percentage of infested leaves needed to cause yield loss, based on the table below, then determine the percentage of the leaf area on the plant that is damaged by mite feeding.

Mite damage is any light colored (chlorotic) areas on the plant that result from mite feeding. Remember to look at all the leaves on a plant to estimate how much of the total leaf area is damaged by mite feeding. Do not base the damage estimate on infested leaves only, or the damage rating will be overestimated. Dead leaves equal 100 percent damage for that leaf. Now, calculate the average percentage of the leaf area damaged. If both the percentage of the leaves infested and the percentage of the leaf area damaged equal or exceed the values for the crop on the table below, it is time to spray. If the miticide to be applied provides rapid control (less than 3 days after application), you can wait up to 1 week before spraying the corn. However, if the miticide will not provide rapid control, spray the field immediately. This economic injury level may be used to make control decisions on field or food corn before the full dent growth stage. Mite feeding after full dent will not cause yield loss, but it may contribute to premature plant lodging if mit feeding damage is severe and the crop is stressed. Mite feeding will not slow dry-down of the grain. Research has shown that adding oil to miticides helps them penetrate the canopy.

Economic Injury Level for the Banks Grass Mite and/or Twospotted Spider Mite on Corn, Based on the Percent-age of Infested leaves Per Plant/ Percentage of Leaf Area Damaged

Control Cost	Market value ($) per acre										
5	15/8	12/6	10/5	8/5	7/4	7/3	6/3	5/6	5/3	5/2	4/2
10	29/16	24/13	20/10	17/9	15/8	13/7	12/6	11/6	10/5	9/5	8/4
15	44/23	35/19	29/16	25/13	22/12	20/10	18/9	16/9	15/8	14/7	13/7
20	59/31	47/25	39/21	34/18	29/16	26/14	24/13	21/11	20/10	18/10	17/9
25	74/39	59/31	49/26	42/22	37/20	33/17	29/16	27/14	25/13	23/12	21/11

Banks grass mite



Twospotted spider mite

Suggested Miticides for Controlling Twospotted Spider Mites

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Propargite (Comite® II 6 lb.)	2.25-3.38 pt.	See remarks 30	See label
Sulfur (6 lb. flowable)	4 qt.	0	0

Remarks

Propargite: Ground application must use a minimum of 20 gallons of water per acre. A minimum of 5 gallons of water per acre are required for aerial application. Only one application can be made per year. Do not plant small grains in rotation within 82 days after application.

Sulfur: This is the only material that has been partially effective in the Trans-Pecos area of Texas. Thorough plant coverage is required.

Suggested Miticides for Controlling Banks Grass Mites

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Bifenthrin (Capture® 2EC)	5.12-6.4 oz.	30	30
Carbofuran + Dimethoate (Furadan® 4F) + Dimethoate (see formulations listed below)	2 pt Furadan + dimethoate as listed below	30	See label
Dimethoate			
(Dimethoate 4 EC)	0.67-1 pt.	14	14
(Dimethoate 5 lb.)	8.4-12.8 oz.	14	14
(Dimethoate 400)	0.67-1 pt.	14	14
Propargite (Comite II 6 lb.)	2.25-3.38 pt.	See remarks 30	See label
Sulfur (6 lb. flowable)	4 qt.	0	0

Remarks

Bifenthrin: ULV applications are prohibited. Often used in combination with dimethoate.

Carbofuran: Do not make more than two foliar applications per season or more than one foliar application if Furadan 4F was used as a soil application. Do not use Furadan as a foliar treatment on seed corn. Do not enter treated fields within 14 days of application unless full protective equipment is worn.

Dimethoate: Not labeled for Trans-Pecos area of Texas. This product has often been used in combination with pyrethroids for the control of mites. There is no demonstrated advantage to mixing dimethoate with Propargite. Heavy infestations may require an alternate chemical.

Propargite: Ground application must use a minimum of 20 gallons of water per acre. A minimum of 5 gallons of water per acre are required for aerial application. Only one application can be made per year. Do not plant small grains in rotation within 82 days after application.

Sulfur: This is the only material that has been partially effective in the Trans-Pecos area of Texas. Thorough plant coverage is required.

Adult Corn Rootworm Beetle

Adult rootworm beetles feed on leaves, pollen and tassels, *but they prefer silks. When adults are numerous (eight to 10 per plant) during the green silk stage and the silks are chewed back to within*

1/2 inch of the shuck, poorly filled ears may result from poor pollination. When this or excessive leaf damage occurs, it is profitable to control the beetles.

Controlling adult beetles usually will reduce the number of eggs laid in the field. However, insecticides can cause an outbreak of spider mites by destroying natural enemies. Spider mites can be very damaging to corn and are difficult to control. Insecticide treatments for adult beetle control should be used only when necessary.

In addition to conventional insecticides, there are baits containing reduced rates of insecticides labeled for control of adult corn rootworms. These baits attract only corn rootworm beetles and do not destroy beneficial insects and predatory mites. Therefore, there is less risk of a spider mite outbreak following application than with many other conventional insecticides. These baits have been most effective when all the corn producers in an area cooperate to treat their fields and thus reduce rootworm numbers across a large area. An effective program requires an organized field scouting program, accurate timing of treatments and proper application of the baits.

Suggested Insecticides for Controlling Mexican and Western Corn Rootworm Beetles

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Carbaryl			
(Sevin® 80WSP)	1.25-2.5 lb.	48	14
(Sevin® XLR Plus 4 lb.)	1.0-2.0 qt.	48	14
Malathion			
(Atrapo® ULV 9.9 lb.)	4.0 oz.	5	See label
(Fyfanon® ULV 9.9 lb.)	4.0 oz.	5	5
Methyl parathion			
(Penncap-M® 2F)	1.0-2.0 pt.	12	12
(Methyl parathion 4.0E)	0.5 pt.	12	12

Remarks

Research demonstrates that the use of cabaryl, chlorpyrifos and pyrethroid (esfenvalerate, lambda-cyhalothrin, bifenthrin, permethrin) insecticides can increase mite densities on corn. Ethyl and methyl parathion are also associated with mite increase on corn.

Note: Application of the insecticides listed above during pollen shed will destroy foraging honey bees.

Chlorpyrifos: Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment.

Methyl parathion: Do not apply during pollen shed if bees are foraging in the area.

True Armyworm

True armyworms occasionally cause heavy damage to corn in the High Plains, and they may occur in other areas of Texas as well. True armyworm activity is usually heaviest in fields with junglerice (watergrass) and johnsongrass in the furrows or in fields that have hail-damaged leaves. True armyworms may go unnoticed as populations build up on the weeds in the furrows. Then, when the weeds are consumed and larvae increase in size, they begin feeding on corn leaves. Large larvae can defoliate corn plants rapidly. When defoliation is excessive, yield reductions will occur, and premature drying of the stalk may lead to lodging problems. *Chemical treatments should be applied when an average of three leaves per plant are destroyed by larval feeding.*

Suggested Insecticides for Controlling True Armyworms

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Carbaryl			
(Sevin® 80WSP)	1.25-2.5 lb.	48	14
(Sevin® XLR Plus 4 lb.)	1.0-2.0 qt.	48	14
Chlorpyrifos			
(Lorsban® 4E)	1-2 pt.	35	14
Esfenvalerate			
(Asana® XL 0.66E)	5.8-9.6 oz.	21	21
Methomyl:			
(Lannate® 90SP)	0.25-0.5 lb.	21	See label
(Lannate® 2.4LV)	0.75-1.5 pt.	21	See label
Methyl parathion			
(Penncap-M® 2F)	2.0-3.0 pt.	12	12
(Methyl parathion 4E)	0.5 pt.	12	12
Malathion			
(Atrapa® ULV 9.9 lb.)	4.0 oz.	5	See label
(Fyfanon® 9.9 lb.)	4.0 oz.	5	5
Permethrin			
(Ambush® 2E)	6.4-12.8 oz.	30	30
(Pounce® 3.2EC)	4.0-8.0 oz.	30	no

Remarks

Research demonstrates that the use of carbaryl, chlorpyrifos and pyrethroid (esfenvalerate and permethrin) insecticides can increase mite densities on corn. Ethyl parathion and methyl parathion are also associated with mite increase on corn.

Note: Application of the insecticides listed above during pollen shed will destroy foraging honey bees.

Chlorpyrifos: Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment.

Methyl parathion: Do not apply during pollen shed if bees are foraging in the area.

Western Bean Cutworm

Economic damage from western bean cutworm is limited to the extreme northwest corner of the Texas Panhandle. Moth activity begins in early July, with egg lay following shortly thereafter. Eggs are laid on the upper surfaces of the corn leaves in masses of 5 to 200. They turn from a pearly white at egg lay to bluish-black by hatching time. At hatching the young cutworms feed on the egg shell and then move to one of two sites on the corn, depending on the stage of corn development. If the corn has not tasseled, young cutworms will feed in the whorl on the developing tassel. If the corn has tasseled, the young cutworms move to the developing ear and feed on the silk. As the larvae mature, they begin feeding on developing grain. *Insecticide treatments should be made when 14 percent of the plants are infested with eggs or larvae and corn is 95 percent tasseled.*

Suggested Insecticides for Controlling Western Bean Cutworm

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Bifenthrin (Capture® 2EC)	2.1-6.4 oz.	30	30
Carbaryl (Sevin® 80WSP)	2.5 lb.	48	14
(Sevin® XLR Plus 4 lb.)	2.0 qt.	48	14
Esfenvalerate (Asana® XL 0.66E)	2.9-5.8 oz.	21	21
Lambda-cyhalothrin (Warrior® 2CS)	1.92-3.2 oz.	21	See label
Methyl parathion (Penncap-M® 2F)	3.0-4.0 pt.	12	12

Remarks

Chlorpyrifos: Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment.

Methyl parathion (Penncap-M®): Do not apply during pollen shed if bees are foraging in the area.

Grasshoppers

Grasshoppers occasionally cause damage to corn. Damaging infestations need to be controlled early while grasshoppers are small and still in crop border areas. *Ten or more nymphs per square yard in crop margins warrant control measures.*

Suggested Insecticides for Controlling Grasshoppers

Insecticides (alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Bifenthrin (Capture® 2EC)	2.1-6.4 oz.	30	30
Carbofuran (Furadan® 4F) Sec. 24C	0.25-0.5 pt.	30	30
Chlorpyrifos (Lorsban® 4E)	0.5-1.0 pt.	35	14
Esfenvalerate (Asana® XL 0.66E)	5.8-9.6 oz.	21	21
Lambda-cyhalothrin (Warrior® 2SC)	2.56-3.84 oz.	21	See label

Remarks

Carbofuran: Do not make more than two foliar applications per season or more than one foliar application if Furadan 4F was used as a soil application. Do not use Furadan as a foliar treatment on seed corn. Do not enter treated fields within 14 days of application unless full protective equipment is worn.

Chlorpyrifos: Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment.

Sap Beetles

Corn sap beetles or picnic beetles are attracted to decaying vegetable matter and often invade corn ears damaged by insects. These are small (1/3-inch) black or brown beetles, which may have orange to yellow spots on their wing covers. These secondary invaders are not attracted to healthy ears, but feed on decaying plant tissue and the associated micro-organisms.

Insecticide Application Methods

Ground machines or aircraft may be used to apply most insecticides. For best aerial application results, flag the swaths so they meet or overlap. Spray applications are more effective and drift is reduced when wind velocity is not more than 10 miles per hour. Avoid spraying when plants are wet. Nozzle size and number, ground speed and pressure affect the rate of spray solution output per acre; therefore, calibrate the sprayer carefully and often to ensure that the recommended amount of insecticide is applied. One nozzle per row is usually adequate for young row crops, but two or three nozzles per row may be desirable on larger plants for adequate coverage.

Certain insecticides and miticides can be applied in irrigation water (chemigation) through center pivot and stationary irrigation systems. Chemigation can reduce application costs and, in

some cases, requires less insecticide because of improved crop coverage as compared to conventional application methods. Chemigation requires an initial investment in chemical injection equipment and additional management time.

Safe and effective chemigation requires certain safety features and practices. Preventing the contamination of ground water is critical. Chemigation of some insecticides is prohibited because they are highly toxic to mammals or ineffective when applied in irrigation water. Refer to the pesticide label to determine if chemigation is prohibited or if it is an approved application method. Currently, bifenthrin (Capture®), carbaryl (Sevin®), chlorpyrifos (Lorsban®), dimethoate, permethrin (Ambush® and Pounce®), esfenvalerate (Asana® XL), Lambda-cyhalothrin (Warrior®), methyl parathion (Penncap-M®) and spinosad (Tracer®) are registered for chemigation of corn in Texas. If approved for chemigation, the label will identify specific safety equipment and procedures that are required by federal law if the product is applied in this way. Refer to the product label for specific instructions and restrictions regarding chemigation.

The label also may provide instructions for mixing, diluting and agitating the product and state the quantity of irrigation water to be applied during chemigation. Certain additives may be recommended to increase pesticide efficacy by reducing washoff. Irrigation systems with nozzles positioned above the crop canopy should not be used for chemigation during windy weather because of the danger that pesticides may drift from the treated field. Also, endguns should be shut off during chemigation. Personal safety equipment should be worn during mixing and loading of the insecticide. Avoid contamination of the site with spilled pesticide, and properly dispose of pesticide containers.

The pesticide injection pump unit must be carefully maintained and calibrated to uniformly apply the insecticide at the desired rate in the irrigation water. Inaccurate calibration can cause under-application, which reduces insecticide effectiveness, or over-application, which increases costs and crop and environmental contamination. Refer to the Texas Cooperative Extension publication, "Chemigation Workbook" (B-1652), available from your county Extension office, for additional information on calibration and chemigation.

Protecting Bees and Other Pollinators from Insecticides

Pollination is extremely important in producing many seed crops. This is particularly true for legumes such as alfalfa, clovers and vetch. Most grass-type plants are wind or self-pollinated and do not require insect pollinators. Where pollen-collecting insects are required for flower fertilization, the producer, insecticide applicator and beekeeper should cooperate closely to minimize bee losses. The following guidelines will reduce bee losses:

- If practical, apply insecticides before bees are moved into fields for pollination.
- Where insecticides are needed, use materials least toxic to bees.
- Make all applications when bees are away from the field. Evening or early morning treatments between the hours of 7 p.m. and 6 a.m. generally are most satisfactory. Evening applications after bees have left the field are less hazardous than early morning applications.
- Use spray or granular formulations rather than dusts.
- When possible, use an insecticide in groups 2 or 3 in the following list. Notify the beekeeper so that he or she can make necessary arrangements to protect the bees.
- Avoid drifting or spraying any insecticide directly on colonies. Heavy losses generally occur in these situations. On hot evenings, bees often cluster on the fronts of the hives. Pesticide drift or direct spray at this time results in heavy bee kill.

Honey Bee Hazards

Insecticides	Remarks
Group 1. Highly Toxic Carbaryl (Sevin®) Carbofuran(Furadan®) Chlorpyrifos (Lorsban®) Dimethoate Esfenvalerate (Asana® XL) Lambda-cyhalothrin (Warrior®) Malathion (wettable powder or ULV) Methomyl (Lannate®) Methyl parathion (EC, Penncap-M®) Parathion Permethrin (Ambush®, Pounce®) Spinosad (Tracer®)	This group includes substances that kill bees on contact during application and for several days following application. Remove bees from the area if these products are used on plants being visited by the bees (with some exceptions). Malathion occasionally causes heavy bee losses, particularly during periods of extremely high temperatures. Apply malathion in the evening after all the bees have completed foraging. Avoid ultra-low-volume malathion after blooms appear.
Group 2. Moderately Toxic Bifenthrin (Capture®) Disulfoton (Di-Syston®) Malathion (EC) Phorate (Thimet®)	Apply in late evening.
Group 3. Relatively Non-Toxic Dipel® Sulfur Propargite (Comite)	Apply in late evening or early morning when bees are not foraging.

Appendix I
Insect and Mite Pests

corn leaf aphid

aphid mummies

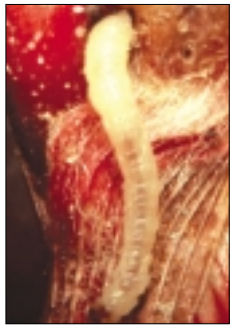
corn earworm adult

corn earworm larva

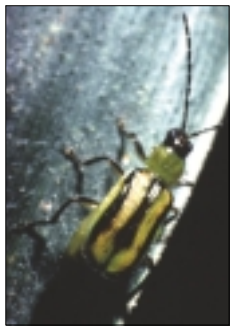
chinch bugs

Mexican corn rootworm adult

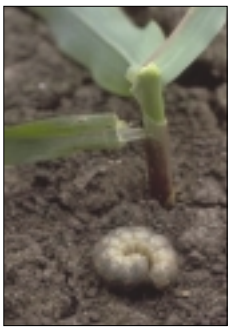
southern corn rootworm adult



corn rootworm larva



western corn rootworm adult

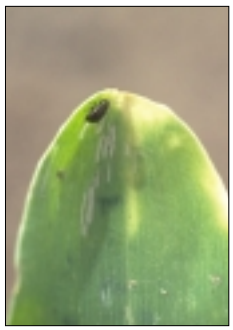


cutworm

European corn borer larva

fall armyworm adult

fall armyworm larva

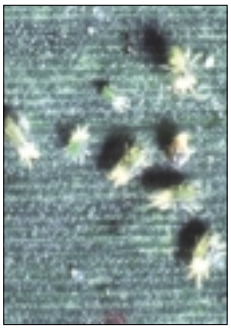


flea beetle

lesser cornstalk borer larva

Mexican rice borer larva

Appendix I (cont.)
Insect and Mite Pests



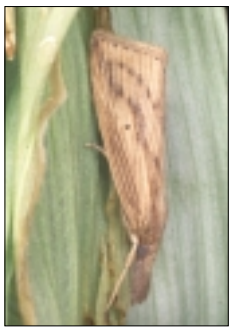
Banks grass mites

Banks grass mite colony

neotropical borer adult

neotropical borer larva

sap beetle



sugarcane borer adult

sugarcane borer larva

southwestern corn borer adult

southwestern corn borer girdle

southwestern corn borer larva

white grubs

wireworm larva

false wireworm

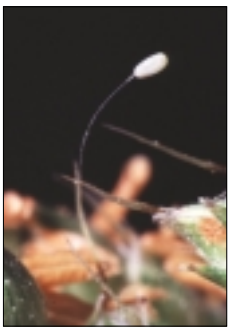
yellowstriped armyworm

western bean cutworm egg mass

western bean cutworm larva

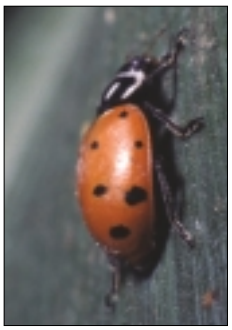
Appendix II
Beneficial Arthropods

bigeyed bug



green lacewing egg

green lacewing larva



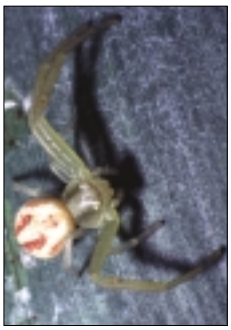
lady beetle adult

lady beetle larva

lady beetle pupa

orius adult

orius nymph



crab spider

syrphid fly larva

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2.5M, Revised