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Texas Agricultural Extension Service
The Texas A&M University System

Managing Insect and Mite Pests of Corn

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

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Managing Insect and Mite Pests of Texas Corn

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Corn is subject to insect attack throughout the growing season. Some insects may reach damaging levels in spite of natural predators and parasites and may require chemical control. However, plant damage is not always directly related to insect numbers. Other factors such as plant vigor, stage of growth, 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. Wise use of insecticides requires that producers inspect their crops frequently to determine if damaging numbers of insect or mite pests are present. Methods of determining insect numbers and guides for determining the need for pesticides are given in this publication. Seed corn production fields and sweet corn are more susceptible to insect damage than field corn. Increased susceptibility to insect attack and higher value often require that certain pests be controlled at lower levels than in field corn.

A few insect and mite pests attacking corn in Texas show some resistance to once-effective pesticides. 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. The present status of resistance in specific pests is discussed in this publication.

NOTE: 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. Insect control recommendations in this bulletin primarily refer to insect and mite control on field corn.

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 and use experience. Our management suggestions are a product of research and are believed to be reliable. However, it is impossible to eliminate all risk. 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 risks. Such risks 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 for 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.

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

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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.

BIOLOGICAL CONTROL

Insect and mite populations are often held below damaging levels by weather, inadequate food and natural enemies (including 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 living organisms such as parasites, predators and disease to control pests. Important natural enemies in corn include minute pirate bugs, spiders, predatory mites and thrips, and a variety of tiny wasps which parasitize insect pests.

Biological control includes the conservation, augmentation and importation of natural enemies. Existing populations of natural enemies can be conserved by minimizing insecticide applications and using insecticides that are more toxic to the target pest than to the natural enemy. Augmentation involves the purchase and release of natural enemies on a periodic basis. Classical biological control, the third type, is the importation of natural enemies from other countries.

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 by these soil pests. The continued growth of corn on the same land year after year increases damage by certain soil insects. For example, losses from corn rootworms may be reduced or in some cases eliminated by a crop rotation scheme including soybeans or other crops that are not fed upon 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, corn following sorghum in parts of south central Texas has been damaged by the Mexican corn rootworm. Another cultural practice that reduces soil insect pests is to maintain weed-free fields throughout the year, since weeds serve as 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 treatment methods are available. One method may be more effective for a particular soil pest than another.

Seed Treatment

Seed treatment in the past was done by the seed company; however, because of restrictions on chemicals used on seeds, many commercial seed companies are not treating seeds. Direct seed treatment or planter box treatments have been used by growers where commercially treated seeds are not available.

Light populations of wireworms, seedcorn maggots, seedcorn beetles and southern corn rootworms may be effectively controlled by treating seeds with products containing lindane or lindane plus diazinon. When treating the seeds, the insecticide should coat each seed evenly. Use a concrete mixer, commercial or homemade seed treater to treat seeds. Sprinkle 1 pint of water on each 100 pounds of seed and mix this to coat the seed with moisture. Slowly add the correct amount of insecticide while mixing the seed, and mix thoroughly until the insecticide is evenly distributed on all seeds. Treated seeds should be planted within 20 days of treatment, since 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 wireworms, seed-feeding ants, seedcorn beetles and seedcorn maggots when their population levels are low. Use this soil insect control technique as directed on the insecticide label.

Insecticides such as malathion, pirimophosmethyl 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 for controlling some soil pests must be applied before the crop is planted or at planting time. Granular or liquid formulations may be used. The formulation used usually depends on the producer's equipment and the target insect. Granular forms of insecticide are generally safer and more convenient. With the soil treatment method there are three application techniques: (1) the preplant broadcast, (2) row 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 infestations of white grubs. Unfortunately, the broadcast applications require more insecticide and are more expensive than row band or in-furrow treatments and, therefore, are usually not 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.

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 after or during bed formation, since 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 or in-furrow techniques. The technique of choice will depend on the pest and how a particular insecticide is labeled. Some insecticides (carbofuran, chlorpyrifos, terbufos) 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. Depending upon the insecticide, these pests will be suppressed for 2 to 4 weeks.

Mount 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 that the treatment band is about 6 to 8 inches wide and so that the seed furrow and covering soil are treated. Incorporation of 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, since doing so usually results in poor seed germination. Poor control usually results from in-furrow application where white grub populations are high.

White Grubs and Cutworms

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

If white grub numbers exceed two per square foot, broadcast insecticide. On the same day as treatment, incorporate the insecticide into the top 2 to 4 inches of soil using a disc, field cultivator or equivalent equipment. If white grubs average approximately one per square foot, adequate suppression can be achieved with a planting time in-furrow or band treatment. For surface cutworms, incorporation of insecticide into the top 1 to 2 inches of soil is best. See page 6 for cutworm control on seedling corn.

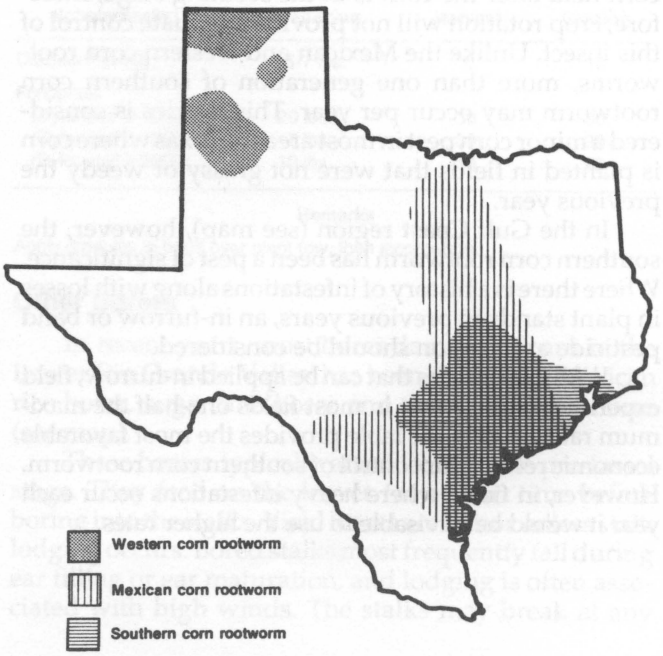
Wireworms, Seedcorn Maggots and Seedcorn Beetles

Seed treatment with products containing lindane or lindane plus diazinon is generally effective in controlling these soil pests. See seed treatment procedures on page 4. 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 these pests.

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 to corn year after year in Mexican and western corn rootworm problem areas (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 (listed alphabetically)	Amount per 1,000 feet of row	Amount per acre on 40-inch row spacing
Carbofuran	See remarks	
(Furadan® 4F)	2.5 oz.	1 qt.
Chlorpyrifos		
(Lorsban® 15G)	8 oz.	6.5 lbs.
Fonophos	See remarks	
(Dyfonate® II 10G)	12 oz.	10 lbs.
(Dyfonate® II 15G)	8 oz.	6.5 lbs.
(Dyfonate® II 20G)	6 oz.	5 lbs.
Terbufos		
(Counter® 15G)	8 oz.	6.5 lbs.
(Counter® CR)	6 oz.	4.9 lbs.
Tefluthrin		
(Force® 1.5G)	8-10 oz.	6.5-8.2 lbs.

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 insecticide is incorporated into the soil.

Fonophos. Do not place in direct contact with the seed. Stand reduction may result.

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 insecticides year after year in the same field is not a good practice. Producers are encouraged to rotate organophosphate (chlorpyrifos, fonophos, terbufos) with other (tefluthrin) 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 eggs in the corn field 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), however, the southern corn rootworm has been a pest of significance. 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 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 (listed alphabetically)	Amount per 1,000 feet of row	Amount per 40-inch row spacing
Carbofuran	See remarks	
(Furadan® 4F)	2.5 fl. oz.	2.0 pts.
Chlorpyrifos		
(Lorsban® 15G)	8 oz.	6.5 lbs.
Fonophos	See remarks	
(Dyfonate® II 10G)	12 oz.	10 lbs.
(Dyfonate® II 15G)	8 oz.	6.5 lbs.
(Dyfonate® II 20G)	6 oz.	5 lbs.
Terbufos		
(Counter® 15G)	8 oz.	6.5 lbs.
(Counter® CR)	6 oz.	4.9 lbs.
Tefluthrin		
(Force® 1.5G)	8-10 oz.	6.5-8.2 lbs.

Remarks

Carbofuran. Apply Furadan® 4F at planting directly into the seed furrow.

Fonophos. Do not place in direct contact with the seed. Stand reduction may result.

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, fonophos, terbufos) with other (tefluthrin) 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.

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 cause 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 fields where grass and weeds are a problem.

When cutworms are damaging plant stand, 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 on moist soil.

SUGGESTED INSECTICIDES FOR CONTROLLING CUTWORMS

Insecticides (listed alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Chlorpyrifos (Lorsban® 4E)	2-3 pts.	See remarks 35	14
Esfenvalerate (Asana XL® 0.66)	5.8-9.5 oz.	21	21
Permethrin (Ambush® 25W) (Ambush® 2E) (Pounce® 3.2 EC)	0.4-0.8 lb. 6.4-12.8 oz. 4-8 oz.	See remarks	

Remarks

Chlorpyrifos. It is preferable to apply Lorsban® when soil is moist and cutworms are active on or near the soil surface.

Permethrin. Pre-emergent use--Apply in the time period from 5 days prior to planting up to 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 or air.

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 and after about 24 hours three red bands appear on each egg. Small larvae hatch from the eggs in about five 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 since infestations seldom exceed 5 percent. However, if infestations are great enough to warrant treatment, applications should be made before borers leave the whorl and enter the stalk. Refer to the table on page 10 for recommended insecticides.

European Corn Borer

European corn borers were first discovered in Texas High Plains corn in 1978. Economic 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 moth emergence begins 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 for the presence of larvae. An insecticide application is justified if 50 percent of the plants are found to be infested with an average of at least one live larva per plant. Refer to the table on page 11 for recommended insecticides.

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 may help control the larvae. Insecticides applied at planting for corn rootworms may control other soil pests such as lesser cornstalk borer. Where this insect has been a problem, careful inspection during the seedling stage is important. Base treatments on plant damage and the presence of larvae. Larger corn plants usually are not affected by this insect.

SUGGESTED INSECTICIDES FOR CONTROLLING LESSER CORNSTALK BORER

Insecticides (listed alphabetically)	Amount per acre on 40-inch row spacing	Days from last application to: Harvest	Grazing
Diazinon® (14G)	3.5-7 lbs.	0	10
Fonophos (Dyfonate® II 10G)	20 lbs.	30	30
(Dyfonate® II 15G)	13 lbs.	30	30
(Dyfonate® II 20G)	10 lbs.	30	30

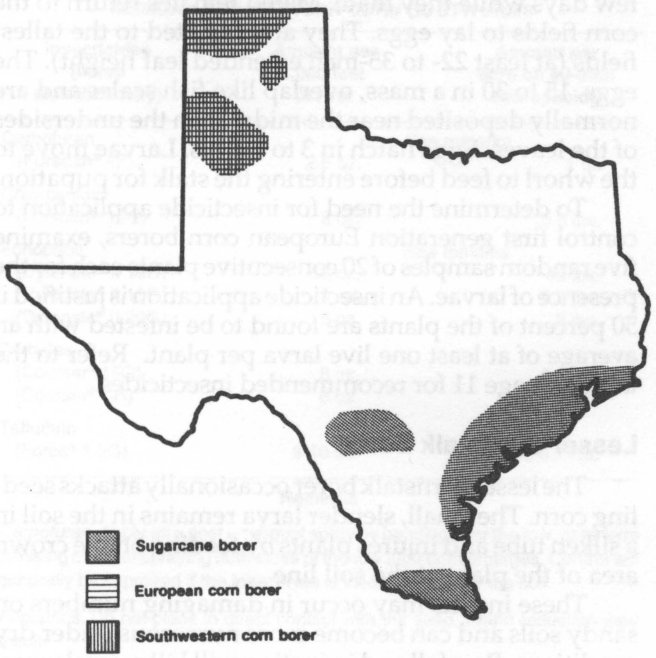
Remarks

Apply granules in band over plant row, then incorporate.

Other Borers

In recent years, most borer damage to corn in the Lower Rio Grande Valley has been due to the Mexican rice borer, 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 in 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, and newly hatched larvae begin to feed in the whorl. Larval feeding will cause the leaves to appear ragged, but *insecticide treatments are seldom recommended.*

Flea Beetles

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

Keeping fields free from weeds is important since fields kept clean the previous season are seldom injured by flea beetles. When sufficient numbers of flea beetles are damaging corn, an application of insecticide may be necessary.

SUGGESTED INSECTICIDES FOR CONTROLLING FLEA BEETLES

Insecticides (listed alphabetically)	Amount per acre	Days from last application to:	
		Harvest	Grazing
Carbaryl			
(Sevin® 80S)	1.25-2.5 lbs.	0	0
(Sevimol® 4 lb.)	1-2 qts.	0	0
(Sevin® XLR Plus)	1-2 qts.	0	0
Methyl parathion			
(7.5 lb.)	0.25 pt.	12	12

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. Viewed from above, the insect appears to have a white "X" or white hour glass 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 high.

Chinch bugs can move into a cornfield in large numbers 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.

In fields with a history of early-season, economically damaging chinch bug populations, the use of 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 the granules. Even when at-plant insecticides are used, young plants should be closely monitored for chinch bugs and feeding damage after germination and particularly during dry periods.

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 the seedlings less than 6 inches high. On taller plants apply insecticides when immature and adult bugs are found on 75 percent of the plants.*

SUGGESTED INSECTICIDES FOR CONTROLLING CHINCH BUGS

Insecticides (listed alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
At-plant:			
Carbofuran (Furadan® 4F)	2 pts. per 13,000 linear ft. of row	See remarks 30	30
Chlorpyrifos (Lorsban® 15G)	8 oz. per 1,000 linear ft. of row	See remarks 35	14
Terbufos (Counter® 15G)	8 oz. per 1,000 linear ft. of row	See remarks 30	30
(Counter® CR)	6 oz. per 1,000 linear ft. of row	30	30
Post-Plant:			
Carbaryl (Sevin® XLR Plus)	1-2 qts.	See remarks 0	0
(Sevin® 80S)	1.25-2.5 lbs.	0	0
(Sevin® 50W)	2-4 lbs.	0	0
Carbofuran (Furadan® 4F)	1-2 pts.	See remarks 30	30
Chlorpyrifos (Lorsban® 4E)	1-2 pts.	See remarks 35	14
Parathion (ethyl) (8 lb.)	0.75 pt.	See remarks 12	12

Remarks

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

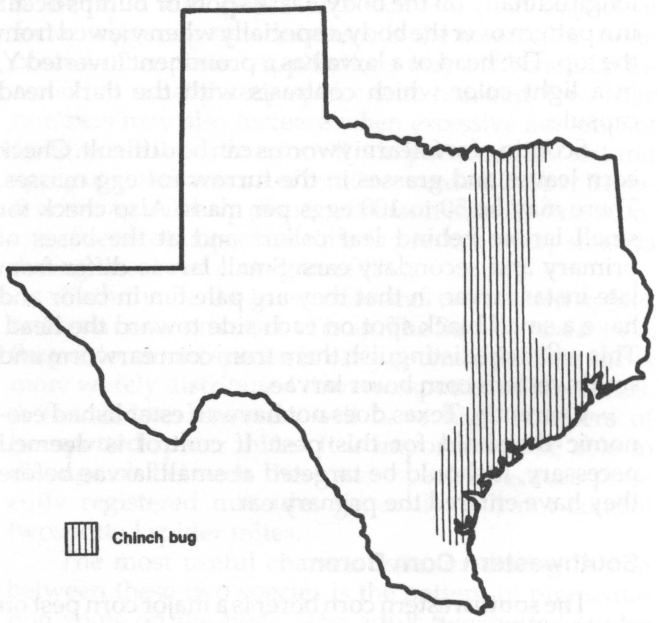
Carbaryl. For optimum control, apply 20 gallons of water per acre by ground and direct spray toward bases of stalks to provide thorough coverage.

Carbofuran. Ground equipment only. Apply Furadan® 4F at planting time directly into the seed furrow or apply as a 7-inch band over the row or inject on each side of the row by mixing with water or liquid fertilizers (see product label for detailed instructions for mixing with liquid fertilizer). For post-plant treatments, use 20 to 30 gallons of water per acre. Direct spray to bases of plants. A maximum of four applications may be made at the 1 pint rate.

Chlorpyrifos. Apply Lorsban® 15G at planting time in-furrow or as a T-band. 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 nozzles directed to 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.

Parathion (ethyl). Aerial application only. Consult label for additional restrictions.



TASSEL TO HARD DOUGH STAGE INSECT CONTROL

Corn Earworm

Corn earworms begin laying eggs on leaves and silks soon after the tassel stage is reached. Eggs are laid on silks as they begin to emerge for pollination. After hatching, larvae tunnel into the silk channel to feed. The silks which 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.

Control of corn earworms 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 have to be applied frequently because untreated silks are exposed daily as silks elongate. Control efforts are usually costly and inconsistent. Control strategies are not suggested at this time 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. When infestations occur from tassel to dough stage they can be very damaging. Larvae feed on ears and ear shanks and behind leaf collars. When infestations are heavy, yield losses can be substantial 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 which 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 will help distinguish them from corn earworm and southwestern corn borer larvae.

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

Southwestern Corn Borer

The southwestern corn borer is a major corn pest on the High Plains (see map page 8). It also occurs in far West Texas and Northeast Texas but 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. First generation larvae mature and pupate in the stalk in July on the High Plains. 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. These leaves are: 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 plant maturity is reached, 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, insulated by a frass plug in the stalk and by the surrounding soil. One of the most effective borer control methods is destruction of this winter habitat to reduce spring moth emergence. A single tandem disc cultivation or shredding will expose larvae to cold and 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 while exposing corn borer larvae. Also, stalk shredding can be performed even when 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, every producer must cooperate by destroying stubble to effectively reduce southwestern corn borer populations area-wide.

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, helps 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 aid in reducing yield losses.

Insecticide treatments usually are 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.

Computer prediction of second generation moth flight and egg lay can be used to plan field scouting to detect infestations. Contact your county agricultural Extension agent for egg-laying predictions in your area.

SUGGESTED INSECTICIDES FOR CONTROLLING SOUTHWESTERN CORN BORER

Insecticides (listed alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Bifenthrin			
(Capture® 2EC)	5.1-6.4 oz.	30	30
Carbaryl			
(Sevin® 80S)	1.25-2.5 lbs.	0	0
(Sevimol® 4 lb.)	1.5 qts.	0	0
(Sevin® XLR Plus)	1-2 qts.	0	0
Carbofuran		See remarks	
(Furadan® 4F)	1.2 pts.	30	30
Chlorpyrifos			
(Lorsban® 4E)	1.5-2 pts.	35	14
(Lorsban® 15G)	5-6.5 lbs.	35	14
Diazinon			
(14G)	7-14 lbs.	0	10
Esfenvalerate			
(Asana XL® 0.66)	5.8-9.6 oz.	21	21
Permethrin		See remarks	
(Ambush® 25W)	0.4-0.8 lb.		
(Ambush® 2E)	6.4-12.8 oz.		
(Pounce® 3.2EC)	4-8 oz.		

Remarks

Carbofuran 4F. Use a maximum of four applications at the 1 pint/acre rate. Use a maximum of two applications at 2 pints/acre rate. Do not enter treated fields within 14 days of application unless full protective equipment is worn.

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

European Corn Borer

Yield losses from second generation European corn borer are usually higher than yield losses from the first generation. First generation moths that emerge in midsummer 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 the 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 to the ear sheath and collar tissue. Yield losses result from physiological damage caused by larval tunneling, ear droppage and direct kernel feeding.

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

SUGGESTED INSECTICIDES FOR CONTROLLING EUROPEAN CORN BORER

Insecticides (listed alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Bacillus thuringiensis			
(Dipel® 10G)	10 lbs.	0	0
(Dipel® ES)	1.5-2.5 pts.	0	0
Bifenthrin			
(Capture® 2EC)	5.1-6.4 oz.	30	30
Carbofuran		See remarks	
(Furadan® 4F)	1.5-2 pts.	30	30
Chlorpyrifos			
(Lorsban® 15G)	5-6.5 lbs.	35	14
(Lorsban® 4E)	1.5-2 pts.	35	14
Esfenvalerate			
(Asana XL® 0.66 EC)	7.8-9.6 oz.	21	21
Fonofos		See remarks	
(Dyfonate® II 10G)	10 lbs.	30	30
(Dyfonate® II 15G)	6.5 lbs.	30	30
(Dyfonate® II 20G)	5 lbs.	30	30
Permethrin		See remarks	
(Ambush® 2E)	6.4-12.8 oz.		
(Pounce® 3.2 EC)	4-8 oz.		

Remarks

Fonofos. Broadcast rates for over the whorl applications.

Furadan® 4F. Use a maximum of four applications at the 1 pint/acre rate. Use a maximum of two applications at 1 1/2 to 2 pints/acre. Do not enter treated fields within 14 days of application unless full protective equipment is worn.

Permethrin. Apply prior to the brown silk stage.

Spider Mites

Economic infestations of spider mites primarily occur on corn in the Texas High Plains and the Rio Grande Valley. High numbers of spider mites may occur on corn after tassels appear. Mites first appear on the lower leaves, but 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 rapid mite population increases. An important factor triggering mite increases is the insecticide use to control other pests. Applications 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 is more widely distributed than twospotted spider mites. A few fields, however, will have high numbers of twospotted spider mites. It is important to be able to distinguish between these two species because presently registered miticides generally will not control twospotted spider mites.

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.

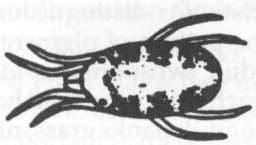
To decide whether or not Banks grass mites and/or twospotted spider mites should be controlled, the per acre control cost (miticide plus application costs) and the expected value of the crop (yield X value) should be estimated. A two-step sampling process is necessary. A leaf is infested if a mite colony of any size is on the leaf. The field can be quickly checked to determine the percent of the plant infested by mites. This is accomplished by dividing the number of mite-infested green leaves 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.

ECONOMIC INJURY LEVEL FOR THE BANKS GRASS MITE AND/OR TWOSPOTTED SPIDER MITES ON CORN, BASED ON THE PERCENTAGE OF INFESTED LEAVES PER PLANT / PERCENTAGE OF LEAF AREA DAMAGED

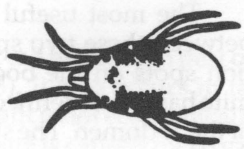
Control cost ($) per acre	Market value ($) per acre 200	250	300	350	400	450	500	550	600	650	700
5	15/8	12/6	10/5	8/5	7/4	7/3	6/3	5/6	5/3	5/2	4/2
10	29/16	24/13	20/10	17/9	15/8	13/7	12/6	11/6	10/5	9/5	8/4
15	44/23	35/19	29/16	25/13	22/12	20/10	18/9	16/9	15/8	14/7	13/7
20	59/31	47/25	39/21	34/18	29/16	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

Mite damage is any light colored (chlorotic) areas on the plant that result from mite feeding. Remember to look at all leaves on the plant to estimate how much of the total leaf area is damaged by mite feeding. Do not base your

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 your crop on the preceding table, it is time to spray. If the miticide chosen will not provide maximum control for approximately 1 week after application, spray the field immediately. 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. This economic injury level may be used to make control decisions on field or food corn prior to the full dent growth stage. Mite feeding after full dent will not cause yield loss, but may contribute to premature plant lodging if mite feeding damage is severe and the crop is stressed. Mite feeding will not slow dry-down of the grain. Research has shown that canopy penetration of miticides is increased with the addition of oil.



Banks grass mite



Twospotted spider mite

SUGGESTED MITICIDES FOR CONTROLLING SPIDER MITES

Miticides (listed alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Bifenthrin (Capture® 2EC)	5.1-6.4 oz.	30	30
Diazinon® (4 lb.)	1 pt.	0	0
Dimethoate		See remarks	
(Cygon® 4 lb.)	0.66-1 pt.	14	14
(Dimethoate 2.67 lb.)	1-1.5 pts.	42	14
(Dimethoate 4 lb.)	0.66-1 pt.	14	14
Disulfoton (DiSyston® 8 lb.)	1 pt.	28	28
Phorate		See remarks	
(Rampart® 10G)	10 lbs.	30	30
(Thimet® 15% G)	6.7 lbs.	30	30
(Thimet® 20% G)	5 lbs.	30	30
Propargite (Comite® II 6 lb.)	2.25 pts.	See remarks 30	
Sulfur (6 lb. flowable)	1 gal.	See remarks 0	0

Remarks

Dimethoate. Make no more than three applications per year. Not labeled for Trans-Pecos area of Texas.

Disulfoton. Do not apply more than twice per season. Resistance to disulfoton has been identified on the Texas High Plains.

Phorate. One application per season. Do not apply under prolonged drought conditions. Aerial application of Thimet® is being discontinued. Check product label for application instructions.

Propargite. Use a minimum of 20 gallons of spray solution if applying by ground and a minimum of 5 gallons of spray solution if applying by air. Refer to Texas Special Local Need registration for additional application information.

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

Adult Rootworm Beetle

Adult rootworm beetles feed on leaves, pollen and tassels, but prefer silks. When adults are numerous (8 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 occurs, or if 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 beneficial insects in the field. Spider mites can be very damaging to corn and are difficult to control. Insecticide treatments for adult beetle control should only be used when necessary.

SUGGESTED INSECTICIDES FOR CONTROLLING MEXICAN AND WESTERN CORN ROOTWORM BEETLES

Insecticides (listed alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Carbaryl			
(Sevin® 80S)	1.5 lbs.	0	0
(Sevimol® 4 lb.)	1-2 qts.	0	0
(Sevin® XLR Plus)	1-2 qts.	0	0
Diazinon		See remarks	
(4 lb.)	0.5-1 pt.	0	0
Malathion (5 lb.)	1.5 pts.	5	5
Methyl parathion			
(4 lb.)	0.5 pt.	12	12
(7.5 lb.)	0.25 pt.	12	12
Parathion (ethyl)		See remarks	
(8 lb.)	4 oz.	12	12

Remarks

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

Diazinon. Temporary spotting of leaves may occur following application. Forage may be fed to dairy and beef cattle and sheep.

Parathion (ethyl). Aerial application only. Consult label for additional restrictions.

True Armyworm

True armyworms occasionally cause heavy damage to corn in the High Plains, and they also may occur in other areas of Texas. True armyworm activity is usually heaviest in fields with watergrass and johnsongrass in the furrows, or 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 ARMYWORM

Insecticides (listed alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Carbaryl			
(Sevin® 80S)	2 lbs.	0	0
(Sevimol® 4 lb.)	1-2 qts.	0	0
(Sevin® XLR Plus)	1-2 qts.	0	0
Methomyl		See remarks	
(Lannate® 90% SP)	0.25-0.5 lb.		3
(Lannate® LV)	0.75-1.5 pts.		3
Methyl parathion			
(4 lb.)	0.5 pt.	12	12
(7.5 lb.)	0.25 pt.	12	12
Parathion (ethyl)		See remarks	
(8 lb.)	0.25 pt.	12	12

Remarks

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

Methomyl. Preharvest intervals for field and sweet corn are 21 and 0 days, respectively.

Parathion (ethyl). Aerial application only. Consult label for additional restrictions.

Western Bean Cutworm

Economic damage from western bean cutworm is restricted 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 at hatching time. At hatching time the young cutworms will feed on the egg shell and then move to one of two sites on the corn, depending on stage of corn development. If the corn has not tasseled, the young cutworms will feed in the whorl on the developing tassel. If the corn has tasseled, the young cutworms will move to the developing ear and feed on the silk. As the larvae mature, they begin feeding on the 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 (listed alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Bifenthrim			
(Capture® 2EC)	5.1-6.4 oz.	30	30
Carbaryl			
(Sevin® 80S)	2.5 lbs.	0	0
(Sevimol® 4 lb.)	2 qts.	0	0
(Sevin XLR® 4 lb.)	2 qts.	0	0
(Sevin 4-Oil®)	2 qts.	0	0
Methyl parathion			
(Penncap-M® 2 lb. encapsulated)	3-4 pts.	12	12

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 (listed alphabetically)	Amount per acre	Days from last application to: Harvest	Grazing
Carbaryl			
(Sevimol®)	0.5-1.5 qts.	0	0
(Sevin 4-Oil®)	0.5-1.5 qts.	0	0
(20% Bait)	5-10 lbs.	0	0
(Sevin® 50W)	1.3 lbs.	0	0
(Sevin® 80S)	0.66-1.875 lbs.	0	0
(Sevin® XLR Plus)	0.5-1.5 qts.	0	0
Diazinon®			
(AG 500)	1 pt.	0	0
Malathion			
(ULV)	8 oz.	5	5
(57%)	1-1.5 pts.	5	5

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 that they meet or overlap. Spray applications are more effective and drift is reduced when wind velocity does not exceed 10 miles per hour. Avoid spraying when plants are wet. Nozzle size and number, ground speed and pressure influence the rate of spray solution output per acre; therefore, calibrate the sprayer carefully and often to ensure application of recommended insecticide amounts. One nozzle per row usually is adequate for young row crops, but two or three nozzles per row may be desirable on larger plants to obtain adequate coverage.

Certain insecticides and miticides applied with the irrigation water through center pivot and stationary irrigation systems effectively control some corn pests. 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.

Certain safety features and practices are necessary for safe and effective chemigation. Prevention of ground water contamination is of key importance. *Chemigation of some insecticides is prohibited* because of their high mammalian toxicity or lack of effectiveness 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, permethrin (Ambush® and Pounce®), fenvalerate (Pydrin®, Asana XL®), chlorpyrifos (Lorsban®), methyl parathion (Penncap-M®), carbaryl (Sevin®), propargite (Comite®) and *Bacillus thuringiensis* (Dipel ES®) are registered for chemigation in 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 may also provide instructions for mixing, diluting and agitating the product, and state the quantity of irrigation water to be applied during chemigation. Certain adjuvants 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 of pesticide 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 result in underapplication, which reduces insecticide effectiveness, or in overapplication, which increases costs and crop and environmental contamination. Refer to the Texas Agricultural Extension Service publication, B-1652 *Chemigation Workbook*, 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. When 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.

1. If practical, apply insecticides before bees are moved into fields for pollination.
2. Where insecticides are needed, use materials least toxic to bees.
3. 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.
4. Use spray or granular formulations rather than dusts.
5. When necessary to use an insecticide in groups 1 or 2 in the following list, notify the beekeeper so that he or she can make necessary arrangements to protect the bees.
6. 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®) Diazinon Dimethoate Esfenvalerate (Asana® XL) Malathion (wettable powder or ULV) Methomyl (Lannate®) Methyl parathion (EC, Penncap-M®) Parathion Permethrin (Ambush®, Pounce®)	This group includes materials that kill bees on contact during application or for several days following application. Remove bees from the area if these 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 Disulfoton (DiSyston®) Malathion (EC) Phorate (Thimet®)	Apply in late evening.
Group 3. Relatively Non-Toxic Ethion Sulfur Propargite (Comite®)	Apply in late evening or early morning when bees are not foraging.

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