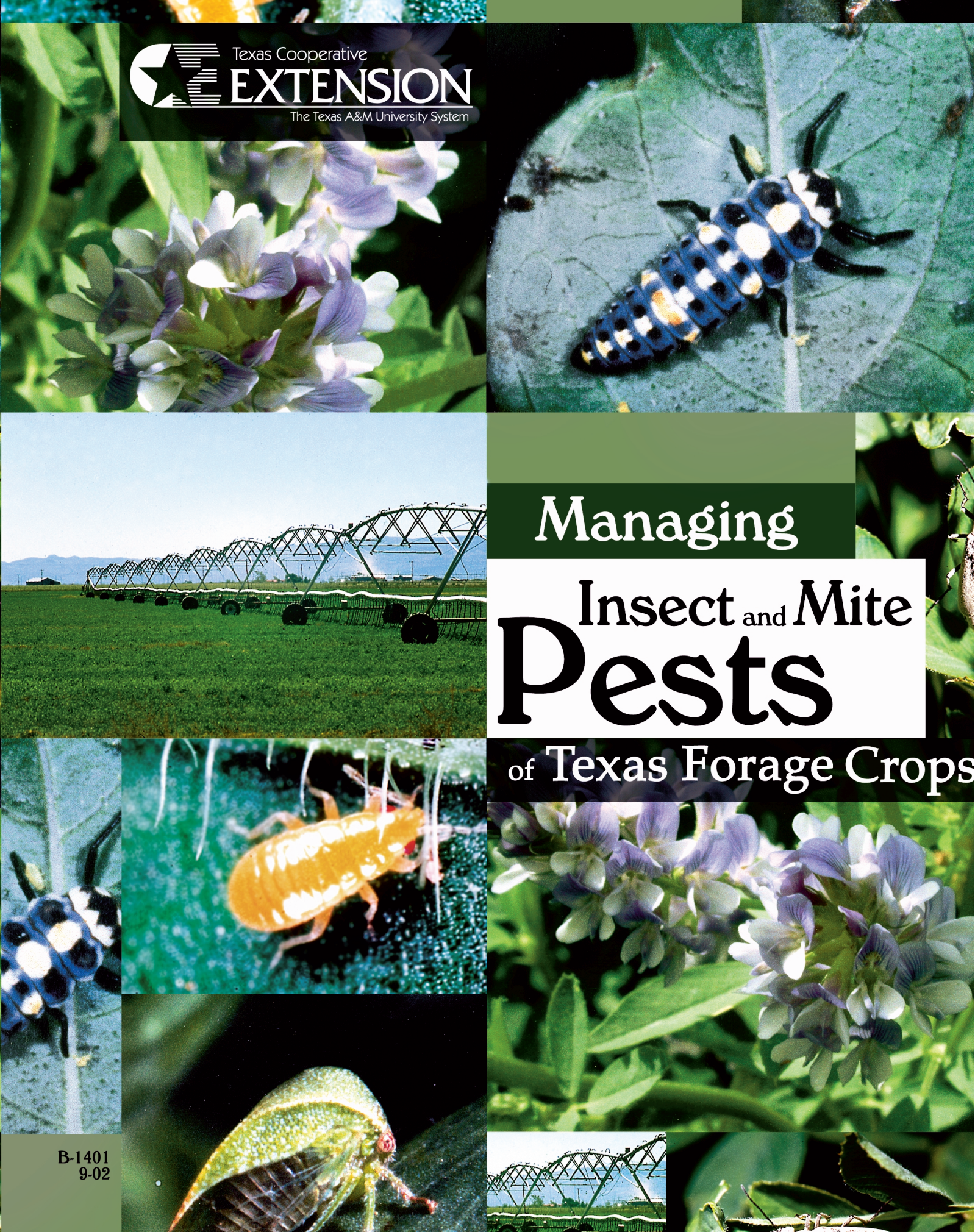


Texas Cooperative
EXTENSION
The Texas A&M University System

Managing Insect and Mite Pests of Texas Forage Crops

B-1401
9-02

Table of Contents

Managing Insect and Mite Pests of Texas Forage Crops

Mark A. Muegge and James V. Robinson*

When planning an integrated pest management (IPM) program, the producer should consider the effective use of cultural control, natural enemies, resistant crop seed, accurate field scouting and chemical control. IPM programs use all available options to keep pest numbers below levels that cause economic crop damage.

Although non-chemical management tools provide the first line of defense, chemicals are an important part of the pest management system. Major factors to be considered when using insecticides include:

- Protection of natural enemies of crop pests
- Resurgence of secondary pests following application
- Insect resistance to insecticides
- Effects on livestock, humans and other non-target organisms

This publication is the result of an annual review of pest management research by a committee of state and federal research personnel and Extension specialists. Insect management practices are directed toward the most effective, safest and most profitable means of minimizing crop loss from insect pests.

- The effectiveness of the product against the target pest
- Cost of the product.

Best management practices call for use of insecticides at the proper rates and only when field counts indicate economic losses will occur if insecticides are not used. Remember to read all pesticides labels carefully. Specific products or rates may not be labeled for all pests or crops given in the tables.

Insecticide Application

Ground equipment or aircraft may be used to apply most insecticides. For best results with aerial applications, flag the swath to overlap. Spray applications are most effective and drift hazards minimized when wind velocity does not exceed 10 miles per hour.

Ground speed, application pressure and nozzle size, number and condition influence the rate of insecticide applied per acre. The sprayer should be carefully calibrated to ensure proper application of approved label rates. Plant coverage is essential for optimum insect or mite control. Use of excess insecticide may result in residue accumulation, injury to the plants or livestock and an increase in the cost of production. Low use rates may result in poor control.

*Extension entomologists, Texas Cooperative Extension, The Texas A&M University System

POLICY STATEMENT FOR MAKING PEST MANAGEMENT SUGGESTIONS

This is not a complete listing of all products registered for forage crops or their uses. The insecticides and their suggested use patterns included in this publication reflect a consensus of opinion of Extension entomologists based on field tests. The data from these field tests met the minimum requirements as outlined in the Guidelines for the Annual Entomology Research Review and Extension Guide Revision Conference. Products listed must conform to our performance standards and avoid undue environmental consequences. Suggested insecticide use rates have exhibited sufficient efficacy in tests to be effective in providing adequate control in field situations. However, it is impossible to eliminate all risks. Conditions or circumstances that are unforeseen or unexpected 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 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. The USER is always responsible for the effects of pesticide residues on his livestock and crops as well as problems that could arise from drift or movement of the pesticide. Always read and follow carefully the instructions on the container label. Pay particular attention to those practices that ensure worker safety. For additional information, contact your county Extension staff or write the Extension Entomologist, Department of Entomology, Texas A&M University, College Station, TX 77843; or call (979) 845-7026.

Insect Resistance Management

Research results have shown that repeated use of a single class of pesticides will select for resistant pests. Reduce this occurrence by using non-pesticide alternatives. When insecticides must be used, rotate insecticide classes, taking advantage of different modes of action. This strategy will reduce selection for resistant pests.

Insecticides can be grouped into classes by how they cause pest mortality. For example, pyrethroids (including esfenvalerate and permethrin) act on an insect's nervous system in the same way, thus all insecticides that act in this way can be placed into one class. Other insecticide classes, such as organophosphates (methyl parathion, chlorpyrifos, dimethoate, malathion and acephate) and carbamates (methomyl and carbaryl), affect the pest's nervous system but in a different way from pyrethroids. See Table 1 for the different classes and trade names of insecticides.

Biological Control

Weather, inadequate food sources and natural enemies often keep pest infestations below economically damaging levels. Natural enemies include fungal, bacterial and viral disease-causing organisms and predatory and parasitic arthropods. It is important to understand the impact of natural enemies and, where possible, encourage their action.

Biological control uses natural enemies to control arthropod pests. Important natural enemies commonly found in forage crops include minute pirate bugs, damsel bugs, big-eyed bugs, assassin bugs, lady beetles, lacewing larvae, syrphid fly larvae, spiders, ground beetles and a variety of tiny wasps that parasitize the eggs, larvae and pupae of many forage crop pests.

Methods that improve biological control include conservation, importation and augmentation of natural enemies. Biological control, an environmentally sound method of pest control, is an important component of IPM. The Texas A&M University System is fully committed to the development of pest management tactics that use biological control.

Conservation of natural enemies is the simplest and generally most cost-effective method of biological control available to forage producers. Avoiding pesticide application, when possible, strip or spot pesticide application and the use of pesticides that are less harmful to natural enemies will help conserve existing natural enemy populations.

Importation of natural enemies, better known as "classical biological control," involves importing natural enemies from other countries to manage accidental introductions of exotic arthropod pests. Classical biological control has proven effective for managing many exotic arthropod pests.

Augmentation is a biological control method that involves the release of natural enemies to increase their ability to control the target pest. Common commercially available natural enemies include parasitic wasps, lady beetles and lacewings. Although augmentation has proven effective for managing some arthropod pests in greenhouses and other closed systems, it can be unpredictable and costly. Because definitive information on augmentation (when to apply, what density to apply, etc.) is lacking, entomologists with Texas Cooperative Extension cannot provide guidelines for augmentation as a management tool for forage crops.

Endangered Species Regulations

The Endangered Species Act is designed to protect and assist 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 county Extension agent or Fish and Wildlife Service personnel to determine what restrictions apply in your area. Regardless of the law, pesticide users must 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 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. The WPS requires you to protect your employees from pesticide exposure. It requires you to provide three basic types of protection:

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

All agricultural pesticides include 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.

Protection of Bees and Other Pollinators from Insecticides

Pollination is extremely important in the production of many seed crops. This is especially true of legumes such as alfalfa, clover and vetch. Most grassy plants are wind- or self-pollinated and do not require the assistance of insect pollinators. Where pollen-collecting insects are required for seed production, the producer, insecticide applicator and beekeeper should cooperate closely to minimize bee mortality. See Table 1 for pesticides ranked by relative hazard to honeybees. The following guidelines will prevent or reduce bee mortality:

- Apply insecticides before bees are moved into the fields.
- Use insecticides only when pest infestations exceed Treatment Threshold. Then, use materials least toxic to bees.

Table 1. Insecticides grouped according to relative hazards to honeybees

Insecticides	Remarks
Group 1. Highly Toxic carbaryl (Sevin® 80S, Sevin® XLR Plus) carbofuran (Furadan®) chlorpyrifos (Lorsban®) cypermethrin (Fury®, Mustang®) dimethoate (Dimethoate®) ethyl methyl parathion malathion (malathion 5 EC and 8 EC) methomyl (Lannate®) methyl parathion permethrin (Ambush®, Pounce®) phosmet (Imidan®) lambda-cyhalothrin (Warrior®) permethrin (Ambush®, Pounce® 3.2EC)	This group includes materials that kill bees on contact during application or for several days afterward. With some exceptions, bees should be removed from the area if these materials are used on plants being visited by the bees. If bees cannot be removed, applications should be made in the evening after bees have completed foraging. Avoid ultra low-volume malathion applications after blooms appear. Foliar applications of granular formulations pose an intermediate hazard but should not be applied when bees are working in the field. Soil-applied granular insecticides pose little hazard.
Group 2. Moderately Toxic disulfoton (Di-Syston®) malathion (EC) phorate (Thimet®)	Do not apply when bees are working in the field. Apply late in evening.
Group 3. Relatively Non-Toxic Bacillus thuringiensis (Agree®, Dipel®, Javelin®) hydramethylnon (Amdro®) (S)-Methoprene (Extinguish®)	These materials are least toxic to bees. Apply in late evening when bees are not foraging.

- Make all applications late in the evening (6-7 p.m.) when bees are not in the field. EVENING APPLICATIONS AFTER BEES HAVE LEFT THE FIELD ARE LESS HAZARDOUS THAN EARLY MORNING APPLICATIONS.
- Use spray or granular formulations rather than dust.
- Where it is necessary to use one of the insecticides in Groups 1 or 2 given in Table 1, notify the beekeeper so that he can make necessary arrangements to protect the bees.
- Minimize pesticide drift or spraying an insecticide directly on bee colonies. Heavy losses generally occur in these situations. On hot evenings, bees often cluster on the fronts of the hives. Pesticide drift at this time generally results in heavy bee mortality.

Phytotoxicity Precautions

Some insecticides discolor the foliage of certain forage sorghum varieties. Stunting and foliage burn have resulted from the use of specific chemicals on certain sorghum hybrids. Before application, growers should closely check the pesticide label and contact the manufacturer and the seed company about possible phytotoxic effects.

Alfalfa and Çlover Pests

A large variety of insects are found in alfalfa and clover. Some are only visitors or may be feeding on other plants in the alfalfa or clover fields. Others are present in small numbers but do not cause economic damage. Many are beneficial. Beneficial insects include the insect pollinators, parasites and predators. However, several insect pests are injurious. These pests feed on the leaves, stems, crowns, seed pods and flowers, resulting in economic loss.

Resistant Cultivars

One of the best ways to avoid insect-related losses to hay and forage crops is to plant cultivars that are resistant to insect damage. Many cultivars are available that are resistant to both insects and disease. When selecting an alfalfa cultivar for use on your farm, be sure to select from the fall dormancy group appropriate for your area. If you are unsure which fall dormancy group to select, contact your county Extension agent or talk to a reputable seed salesman in your area.

Field Scouting

Check fields of alfalfa or clover grown for hay or grazing weekly during the growing season for insect activity. It is important to sample as much of the field as possible (at least four or

five spots in each field). Populations of pests can vary across fields, and your results may be inaccurate if only a small part of the field is checked. Sample away from field edges. Fields should be sampled when the hay is dry, so that insects can easily be found.

Sweep Net Sampling

A standard 15-inch diameter sweep net is the basic sampling tool for many insect pests, including aphids, plant bugs and caterpillars. A sampling unit consists of 10 consecutive (180 degree) sweeps taken while walking through a field. The net is swung from side to side with each step. The net should be held so that the lower half of the opening (7 to 8 inches) is drawn through the foliage. Some foliage and stems should be found in the sample. If not, the net is not being swung hard enough and/or deep enough. Samples may differ somewhat among individuals according to their reach.

Five samples (each consisting of 10 sweeps), one taken in each quadrant of the field and one near the center of the field, provide a good estimate of insect numbers. Samples should be taken 30 to 50 feet from the field margin.

Often aphids are too abundant to count individually but can be estimated in 10s or 100s.

Sucking Pests

See Tables 2-4 for treatment thresholds and pesticide recommendations on all sucking pests.

Pea Aphid

Pea aphids are the most commonly seen aphids in Texas alfalfa and clover crops. The adults are bright green, long legged and about 1/8 inch long. Adults may be winged or wingless. In spring and summer all aphids are female, and each gives birth to 50 to 100 young over a 10- to 12-day period. Up to 20 generations may occur per year. When not held in check by weather, predators, parasites or diseases, pea aphid populations can increase dramatically. Pea aphids generally cause the greatest amount of damage in the spring.

Resistant cultivars are very helpful in reducing pea aphid damage. Use of an insecticide is justified when aphid populations reach the Treatment Threshold level (Table 2).

Pea aphids prefer to congregate in dense colonies along the stems, terminal shoots and leaves. Heavy infestations cause plants to wilt and yellow. Honeydew is usually not abundant on infested plants.

Spotted Alfalfa Aphid

The spotted alfalfa aphid is small (1/16 inch long) and grayish-yellow with four to six rows of raised dark spots on the back. This aphid is usually found on the undersides of the lower leaves. However, as the population increases, aphids can be found on all parts of the plant. Spotted alfalfa aphids secrete large amounts honeydew, which interferes with cutting and baling and degrades hay quality. Spotted alfalfa aphids fall from alfalfa plants when disturbed.

As with pea aphids, spotted alfalfa aphids are all female. Each female produces 100 offspring, and up to 20 generations may be produced per year. Winged females may travel up to 70 miles with the wind. Infestations can increase rapidly under favorable conditions. However, rain and high humidity often reduce an infestation or create conditions unfavorable for survival.

The spotted alfalfa aphid causes a toxic reaction in plants as it feeds. This reaction results in plant injury and even death of seedling alfalfa. On established stands, growth is severely stunted and yellow or chlorotic areas appear on the leaves. Veins of newly formed leaves often become discolored, a symptom known as "veinbanding."

Resistant cultivars offer varying degrees of protection from yield and stand losses from the spotted alfalfa aphid. Insecticide use is justified when Treatment Threshold are reached (Table 2).

Blue Alfalfa Aphid

The blue alfalfa aphid was detected in alfalfa fields in West Texas in 1978, but as of this printing has been of little economic importance. The pest closely resembles the pea aphid but can be easily distinguished from the pea aphid by examining the antennae. The antennae of the blue aphid are uniformly dark, while the pea aphid possesses dark bands at each antennal segment. The blue aphid generally congregates in clusters on the terminal growth, while the pea aphid may be found over the entire plant. Blue aphid populations tend to build up in the early spring, but decline when temperatures exceed 85 degrees F. Severe stunting of plants and deformation of leaves may result from blue aphid feeding on new alfalfa regrowth less than 6 inches tall and when temperatures are below 75 degrees F. Leaf yellowing occurs as plants die. Insecticide use is justified when Treatment Threshold are reached (Table 2).

Several alfalfa cultivars are resistant to this pest.

Cowpea Aphid

Cowpea aphids are easily distinguished from all other aphids found in alfalfa by their dark blue-black color. Adults are shiny, while nymphs are dull. The legs of adults and nymphs are off-white with black tips.

Although commonly found infesting Texas alfalfa, this species generally does not cause economic damage. Under favorable conditions, however, cowpea aphid populations can increase significantly, resulting in economic loss. This occurs most commonly when alfalfa is dormant. When alfalfa breaks dormancy, heavily infested plants fail to grow and occasionally will wilt and die. As with spotted alfalfa aphids, this species produces a considerable amount of honeydew, which impairs cutting and baling and reduces hay quality.

Resistant cultivars are currently not available for management of this pest. Furthermore, sampling methods and Treatment Threshold have not been established for cowpea aphids in alfalfa. Nevertheless, dormant alfalfa should be monitored in spring for presence of cowpea aphids. Once alfalfa breaks dormancy, monitor fields for normal growth. Consider control measures if plants are growing slowly and cowpea aphids are present.

Table 2. Treatment threshold for aphid control

Insect	Hay height (inches)	No. aphids per stem	No. aphids per sweep
Pea Aphid	<10 >10	50 100	200** 300-400**
Spotted Alfalfa Aphid	<10 >10	20 40	100-200 ** 200-400 **
Blue Alfalfa Aphid*	<10 >10	20 40-50	50 200**

*Treat for blue alfalfa aphid if aphids are present in numbers approaching the thresholds and plants have taken on a stunted, blue-green appearance.
**Sweep sampling is generally not appropriate on short hay.

Table 3. Insecticides labeled for aphid control on alfalfa and clover* (Pea, Cowpea, Spotted Alfalfa, Yellow Clover and Blue Alfalfa Aphids)

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to:	
		Harvest	Grazing
cyfluthrin (Baythroid® 2E)	1.6 - 2.8 oz.	see remarks 7	see remarks 7
carbofuran (Furadan® 4F)	1/2 - 2 pt.	see remarks 7-28	see remarks 7-28
chlorpyrifos (Lorsban® 4lb)	1/2 pt	see remarks 7	see remarks 7
cypermethrin (Fury®) (Mustang®)	 2.4 - 4.3 oz. 2.4 - 4.3 oz.	see remarks 3 3	see remarks 3 3
dimethoate (Dimethoate 4 lb) (Dimethoate 2.67 lb)	 1/2 - 1 pt 3/4 - 1 1/2 pt	see remarks 10 10	see remarks 10 10
lambda-cyhalothrin (Warrior®)	2.56 -3.84 oz.	1	7
malathion (Malathion 5 EC) (Malathion 8 EC)	 1 - 2 pt 1 - 2 pt	 0 0-7	 0 0-7
methomyl (Lannate® SP) (Lannate® LV)	 1/2 - 1 lb. 1 1/2 - 3 pt.	 0 0	 7 7
methyl parathion (Methyl parathion 4E) (Declare® 4lb)	 1/2 - 1 pt.	 15	 15
parathion (Parathion 8EC)	1/4 - 1/2 pt.	15	15
permethrin (Ambush®) (Pounce® 3.2EC)	 3.2 - 12.8 oz. 2 - 8 oz.	see remarks 0-14 0-14	see remarks – –

*When weevil control is desired with the same application, see section on weevil control.

Remarks

carbofuran	Harvest and grazing intervals are rate-dependent. Rates of 1/2, 1 and 2 pints per acre require 7-, 14- and 28-day harvest and grazing intervals respectively.
chlorpyrifos	Do not make more than four applications per year or apply more than once per crop cutting. Not labeled for use on clover.
cyfluthrin	Baythroid is not labeled for alfalfa grown for seed. High aphid infestations my not be adequately controlled.
cypermethrin	Control may be variable depending on species present.
dimethoate	Make only one application per cutting. Do not apply if the crop or weeds in treatment area are in bloom. Not labeled for use on clover.
malathion	When alfalfa is in bloom, spray only in early morning or late evening to avoid bee kill. A 0-day harvest interval exists for Malathion 8 EC when applied at rates up to 1 pt../acre. Higher rates require a 7-day harvest interval.
permethrin	Do not apply more than 12.8 oz. Ambush or 8 oz. Pounce per acre per cutting. When alfalfa is in bloom, spray only in early morning or late evening to avoid bee-kill. A 0-day harvest interval exists for Ambush and Pounce when applied at rates up to 6.4 and 4oz./acre, respectively. Higher rates require a 14-day harvest interval

Three-cornered Alfalfa Hopper (TCAH)

Three-cornered alfalfa hoppers are commonly found in alfalfa and clover fields. Adults and nymphs suck plant juices by puncturing stems either randomly or in a circle that completely girdles a stem. Girdling is done primarily by the nymphs. Girdled stems become stunted and weakened just above the soil surface.

In most of Texas, TCAH rarely reach densities that cause economic damage. However, girdling, caused primarily by the immature TCAH, damages the vascular tissue of the stems and can result in a condition that mimics boron deficiency. Leaves on affected stems turn red underneath and light yellow-green on top. Individual damaged stems that develop these symptoms usually die. Because TCAH produce several generations per year, populations tend to be highest from late summer to early fall. Check crowns closely near the soil surface for TCAH nymphs and damaged stems. Check several locations in each field. Consider treatment when 10 percent of the lateral stems are girdled and stem death is apparent. An average of about three TCAH per plant would be necessary to cause this amount of damage.

Table 4. Insecticides labeled for three-cornered alfalfa hopper and leafhopper control in alfalfa and clover

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		see remarks	see remarks
(Sevin® 4F)	1 qt	7	7
(Sevin® 80S)	1/4 lb.	7	7
(Sevin® XLR Plus)	1 qt.	7	7
carbofuran	see remarks	see remarks	see remarks
(Furadan® 4F)	1 - 2 pt	14-28	14-28
chlorpyrifos	see remarks	see remarks	see remarks
(Lorsban® 4EC)	0.5 - 2 pt	7-21	7-21
cyfluthrin		see remarks	see remarks
(Baythroid® 2E)	0.8 - 2.8 oz.	7	–
cypermethrin			
(Fury®)	2.4 - 4.3 oz.	3	3
(Mustang®)	2.4 - 4.3 oz.	3	3
dimethoate		see remarks	see remarks
(Dimethoate)	6.4 - 12.8 oz.	10	10
(Dimethoate 400)	1/2 - 1 pt	10	10
(Dimethoate 2.67 EC)	3/4 - 1 1/2 pt	10	10
guthion		see remarks	
(Guthion® Solupak)	1/2 - 1 lb	14-16	
lambda-cyhalothrin			
(Warrior®)	2.56 - 3.84 oz.	1	7
malathion		see remarks	see remarks
(Malathion 5EC)	1 1/2 - 2 pt.	0	0
(Malathion 8EC)	1 1/4 - 1 1/2 pt.	0	0
methoxychlor			
(Methoxychlor 2EC)	1 - 2 qt.	7	
methyl parathion	see remarks		
(Declare®)	1 - 2 pt.	15	15
(Penncap-M)	2 - 3 pt.	15	15
parathion			
(Parathion 8EC)	1/4 - 1/2 pt	15	15

Remarks

carbaryl	Apply once per cutting.
malathion	Do not apply to clover or alfalfa in bloom. Do not apply to seed clover or alfalfa. Labeled only for potato leafhopper.
carbofuran	Labeled for leafhoppers only. Do not apply more than twice per season.Do not apply when bees are present. Application rate determines harvest and grazing interval: 14 days at 1pt.; 28 days at 2 pt...
chlorpyrifos	Labeled for leafhoppers only. Application rate determines harvest and grazing interval: 7 days at 0.5 pt.; 14 days at 1 pt.; 21 days at 2 pt...
cyfluthrin	Baythroid is not labeled for alfalfa grown for seed. Baythroid is labeled only for potato and aster leafhoppers.
dimethoate	Dimethoate is highly toxic to bees. Do not apply to alfalfa in bloom.Dimethoate 400 is labeled for seed alfalfa only. Do not allow grazing within 20 days of application if Dimethoate 2.67 EC is used in seed alfalfa.
guthion	Not labeled for use on alfalfa grown for seed. At rates up to 3/4 lbs. the harvest interval is 14 days, rates greater than 3/4 lbs. require a 16-day harvest interval.
methyl parathion	Labeled for leafhoppers only.

In seed alfalfa and clover crops sample for TCAH adults with a sweep net. The treatment threshold is reached when sweep net counts average 150 or more per 100 sweeps.

Leafhoppers

Leafhopper populations, like three-cornered alfalfa hopper populations, tend to be highest from late summer on. Several species of leafhoppers feed on alfalfa. Leafhoppers are wedge shaped and range in size from 1/8" to 3/8" long. Most species are various shades of green or brown. Immature leafhoppers are easily distinguished from similar appearing insects such as aphids and immature tarnished plant bugs by their curious behavior of quickly moving sideways or backward when disturbed. Adult leafhoppers also move in this fashion but generally fly when disturbed.

Leafhoppers in the genus Empoasca are of most concern in alfalfa. Empoasca leafhoppers are generally bright green and about 1/8" long. Leafhoppers feed by sucking plant juices. When populations are high, feeding may cause stunted growth and yellowing of the leaves. The most characteristic symptom of leafhopper feeding is a yellow to red leaf-tip discoloration.

Base treatment decisions on the presence of leafhoppers and feeding symptoms, days to harvest and yield potential. Treatment should be considered if five or more leafhoppers are found per sweep net sample and if the crop is two or more weeks from harvest. If less than 10 days from harvest, consider treatment when 10 or more leafhoppers are found per sweep. Monitor field margins because leafhopper populations generally increase from the field margin first. If field margins possess high leafhopper populations, margin or spot treatments may provide adequate control.

Thrips

Thrips feed on alfalfa blooms, buds and leaves. When populations are large, leaves become distorted and silvered and blooms turn a mottled brown. Thrip damage to alfalfa grown for hay or forage is generally minimal. Using insecticides for thrips control has never been shown to be economically advantageous.

Chewing Pests

Alfalfa Weevil

The alfalfa weevil is primarily a pest of alfalfa but may also attack several species of clover. The first and second alfalfa cuttings are most heavily damaged. Upon hatching, larvae feed on leaf buds at the tip of the plant. Older larvae feed mostly on open leaflets, but they also feed on the terminal buds. Foliage is skeletonized by alfalfa weevil larvae and from a distance, fields appear grayish to white.

Adult weevils lay eggs in groups from 1 to 40 per stem inside alfalfa stems in late fall, winter and early spring. Each female lays 600 to 800 eggs. Activity ceases on cold days during winter. Fall-laid eggs hatch in early spring; spring-laid eggs hatch after being exposed to a few weeks of warm temperatures. Eggs hatch into small, light green, black-headed larvae that move out of the stem and to the terminal, where they feed on leaf buds and unfolded leaflets. Mature larvae are darker green with a single white stripe down their backs. Larvae feed for about 3 to 4 weeks on the terminal and upper leaves. The damage caused by larvae increases with larval growth, with the most severe damage being done by large larvae. The damage stunts the plant. Large populations may remove virtually all the leaf tissue on the first cutting and cause delayed, low yielding second cuttings.

In fields where infestations arise from both fall- and spring-laid eggs, feeding damage is extended over a period of 6 to 8 weeks. The amount of crop damage done by alfalfa weevil larvae at any time depends on:

- The size of the alfalfa plant
- The size of the larvae
- The number of larvae per alfalfa stem.

When larvae are mature, they spin spherical cocoons about 1/4 inch in diameter either on the plants or within the curl of fallen dead leaves. They pupate within these cocoons and emerge as adults in 1 to 2 weeks. After emergence, most young adults leave the alfalfa field to go to nearby protected areas for a summer resting period, returning to the fields again in the fall.

Crop protection practices that encourage dense, vigorous plant growth will reduce weevil damage. The first crop should be cut as cleanly and closely as possible when most of the plants are in the bud stage. This deprives larvae of food and shelter. Exposing the larvae to the hot soil surface when the crop is cut causes extensive mortality. When infested alfalfa is cut, the stubble under the windrows is subject to excessive damage. Scout for alfalfa weevil damage to regrowth, especially in the strips under the windrows. Grazing

Table 5. Treatment threshold level for alfalfa weevil

Plant height (inches)	Larvae per terminal	Larvae per sq. ft.	Percent damaged terminals[1]	Larvae per sweep
2-6	1	—	30-40	—
7-14	1.5	—	25-30	20
Near cutting[2]	2.0	—	50	40-50
Stubble[3] (after cutting)	1	16	—	—

[1]And an average of 1 or more medium or large larvae per stem.

[2]In alfalfa within 1 to 2 weeks of cutting, it may be advisable to cut early rather then apply an insecticide

[3]Stubble treatment may be advisable if cloudy conditions and mild temperatures allow good weevil survival on stubble under windrows.

during the winter will aid in destruction of fall-laid eggs and remove egg-laying sites for winter egg laying.

Close field inspections are necessary to determine when the alfalfa weevil Treatment Threshold level has been reached. The Treatment Threshold level (Table 5) should be based on plant size, plant damage and number of weevil larvae. When conditions approaching the Treatment Threshold level are found, consider cutting or insecticide treatment. If weevil populations are above the Treatment Threshold and larvae are small, sprays can be delayed until the oldest larvae are half grown to allow as much egg hatch as possible. Take care to allow passage of the label-specified time between spraying and cutting or grazing (Table 6). This minimizes the chances of having to spray a cutting twice and allows for treatment of the

Table 6. Insecticides labeled for alfalfa weevil control on alfalfa

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		see remarks	see remarks
(Sevin® 80S)	1 7/8 lb.	7	7
(Sevin® XLR Plus)	1 1/2 qt.	7	7
(Sevin® 4F)	1 1/2 qt.	7	7
carbofuran		see remarks	see remarks
(Furadan® 4lb)	1 - 2 pt	14-28	14-28
chlorpyrifos		see remarks	see remarks
(Lorsban® 4E)	1 - 2 pt.	14-21	14-21
cyfluthrin		see remarks	see remarks
(Baythroid® 2E)	1.6 - 2.8 oz.	7	–
cypermethrin			
(Fury®)	2.4 - 4.3 oz.	3	3
(Mustang®)	2.4 - 4.3 oz.	3	3
ethyl methyl parathion		see remarks	see remarks
(Ethyl Methyl Parathion 6-3EC)	1/4 - 1/2 pt.	15	15
lambda-cyhalothrin			
(Warrior®)	2.56 - 3.84 oz.	1	7
malathion			
(Malathion 5 EC)	1 1/2 - 2 pt.	0	0
(Malathion 8 EC)	1 1/4 - 1 1/2 pt.	0	0
methomyl			
(Lannate® SP)	1 lb.	0	7
(Lannatev LV)	3 pt.	0	7
methyl parathion			
(Methyl parathion 4E)	1/2 - 1 pt.	15	15
(Declare® 4lb)	1/2 - 1 pt.	15	15
(Penncap-M)	2 - 3 pt.	15	15
parathion			
(Parathion 8EC)	1/4 - 1/2 pt.	15	15
permethrin		see remarks	
(Ambushv)	6.4 - 12.8 oz.	0-14	–
(Ambush® 25W)		6.4 - 12.8 oz.	0-14 .....–
(Pounce®)	4 - 8 oz.	0-14	–
phosmet		see remarks	see remarks
(Imidanv 70WP)	1/3 lb.	7	7

Remarks

carbaryl	Not effective against aphids.
carbofuran	Do not apply more than twice per season or once per cutting. Apply no more than 1 pt. per acre on second application. No labeled for use on clover. Apply only to pure stands of alfalfa. Not effective against aphids. Do not cut or graze within 14 days after using 1 pt. of Furadan or within28 days of using 2 pt. of Furadan.
chlorpyrifos	Do not make more than four applications per year or apply more than once per crop cutting. Do not graze within 14 daysafter application of 1 pt. per acre or within 21 days after application rates above 1 pt. per acre.
cyfluthrin	Baythroid is not labeled for alfalfa grown for seed.
malathion	Do not apply when plants are in bloom. Do not use on seed alfalfa. For alfalfa weevil larvae only.
permethrin	Do not apply more than 12.8 oz. Ambush or 8 oz. Pounce per acre per cutting. When alfalfa is in bloom, spray only in early morning or late evening to avoid bee kill. A 0-day harvest interval exists for Ambush and Pounce when applied at rates up to 6.4 and 4oz./acre, respectively. Higher rates require a 14-day harvest interval. Lower rates of permethrin are not highly effective on heavy weevil pressure.
phosmet	Do not apply more than once per cutting. Not effective against aphids.

maximum number of larvae without exposing the crop to excessive damage.

Sampling can be accomplished by several methods. Under situations where the alfalfa weevil is a serious annual pest of alfalfa, the stem sampling (beat bucket) method is best. With this method, 30 stems are collected at random throughout a field. (An additional 30 stems may be needed on fields larger than 30 acres.) The 30-stem sample is beaten vigorously in a 2- to 3-gallon bucket for 10 to 20 seconds. This shakes out large- and medium-sized larvae, which can then be easily counted.

Percent damaged terminals can be useful. When using this method, be sure larvae are still present before spraying a field. In fields in which spring regrowth is very short or following cutting, counting the number of larvae per square foot is a good way to sample alfalfa weevil populations. In areas with only sporadic and occasionally severe alfalfa weevil damage, a sweep net can be used to quickly and effectively monitor weevil populations.

See Tables 5-6 for Treatment Threshold and insecticide recommendations.

Clover Head Weevil

The most important pest of Texas crimson clover is the clover head weevil. It was first observed in Texas during the spring of 1965 in light, scattered infestations. It now occurs in all eastern and northeastern counties where crimson clover is grown. Crimson clover is an annual crop. Producers who depend on crimson clover reseeding itself are subject to weakened stands in years following head weevil outbreaks. This weevil prefers clovers, particularly crimson, alsike and red. However, the adults have been observed on alfalfa, black medic and snap beans.

Adults become active in early spring and begin laying eggs in late March or early April. Each female deposits 200 to 300 eggs in stalks or leaf stems of host plants during a 2- to 6-week period. Eggs hatch in 5 to 8 days, and emerging larvae feed primarily in the florets. Larval populations normally peak about April 15 to May 1. Full-grown larvae are about 1/2 inch long, legless and vary from light green to yellowish. Mature larvae spin a silken cocoon in the floral head of host plants where they spend several days before pupating. The pupal stage lasts 3 to 6 days; the life cycle requires 22 to 28 days from egg to adult. Adults are inactive during the remainder of the summer. They hibernate in ground trash and bunch grasses in or near clover fields. The principal damage is caused by larvae feeding on developing flowers and seed pods or from adults feeding on stems. This often results in lodging of the flowers.

The decision to take action depends on the history or damage in the field in previous years plus the presence of weevils at the beginning of the bloom period. Apply treatment when clover has reached a 25 to 50 percent bloom stage. If a second application is required, apply 7 to 10 days after the first.

See Table 7 for insecticide recommendations.

Grasshopper

Grasshoppers are usually most damaging in dry years. These pests generally migrate into the field from adjoining fence rows, ditch banks, field margins or native pastures. Grasshopper nymphs and adults are foliage feeders and can cause extensive forage loss when populations are large. Grasshoppers may devour all plant parts except stems. However, extensive damage is not common.

A few grasshopper species hatch in fields, but most species hatch outside fields in weedy ditches or other non-crop areas. For grasshopper populations that develop outside fields, grasshopper control should be initiated before the pests move out of hatching areas and into the field.

Eliminate weedy field margins (roadsides and fence rows) to aid in reducing grasshopper numbers. These areas are favored habitat for egg laying and early nymphal feeding in many species.

Chemical treatment of fields and field margins is suggested in early summer where grasshopper nymphs are abundant. The Treatment Threshold level for field infestations is an average of 10 or more grasshoppers per square yard. Spot and/or border treatments can be effective.

See Table 8 for insecticide recommendations.

Table 7. Insecticides labeled for clover head weevil control on alfalfa and clover

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to:	
		Harvest	Grazing
carbaryl		see remarks	see remarks
(Sevin® 80S)	1 1/4 - 1 5/8 lb.	7	7
(Sevin® 80WSP)	1 1/4 - 1 5/8 lb.	7	7
(Sevin® XLR Plus)	1 - 1 1/2 qt.	7	7
(Sevin® 4F)	1 - 1 1/2 qt.	7	7
methyl parathion			
(Methyl parathion 4E)	1/2 - 1 pt.	15	15
(Pencap-M®)	1pt.	15	15
(Declare®)	1pt.	15	15

Table 8. Insecticides labeled for grasshopper control on alfalfa

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
carbofuran		see remarks	see remarks
(Furadan® 4lb)	1/4 - 1/2 pt.	7-14	7-14
chlorpyrifos		see remarks	see remarks
(Lorsban® 4E)	1/2 - 1 pt.	7-14	7-14
cyfluthrin		see remarks	see remarks
(Baythroid® 2E)	2 - 2.8 oz.	7	–
cypermethrin		–	–
(Fury®)	3.0 - 4.3 oz.	3	3.....
(Mustang®)	3.0 - 4.3 oz.	3	3
dimethoate		see remarks	see remarks
(Dimethoate 400)	1/2 - 1 pt.	10	10
(Dimethoate 2.67 lb)	3/4 - 1 1/2 pt.	10	10
guthion		see remarks	
(Guthion® Solupak)	1 lb.	16	–
lambda-cyhalothrin			
(Warrior®)	2.56 - 3.84 oz.	1	7
malathion		see remarks	see remarks
(Malathion 5EC)	1 1/2 - 2 pt.	0	0
(Malathion 8EC)	1 1/4 - 1´ pt.	0	0
methyl parathion			
(Methyl parathion 4E)	1 pt	15	15
(Penncap-M)	1 pt	15	15
(Declare 4 lb)	1 pt	15	15
parathion			
(Parathion 8EC)	1/4 - 1/2 pt.	15	15

Remarks

carbofuran	Harvest and grazing intervals are rate dependent. Rates at 1/4 and 1/2 pt. require 7 and 14 day harvest and grazing intervals respectively. Do not apply more than twice per season, once per cutting, with no more than 1 pt. per acre on second application. Treat alfalfa prior to bloom. Do not move bees into field within 7 days of application. Apply only to pure stands of alfalfa. Not labeled for use on clover.
chlorpyrifos	Do not make more than four applications per year or apply more than once per crop cutting. Do not cut or graze within 7 days after application of 1/2 pt. per acre or within 14 days after application of 1 pt. per acre.
cyfluthrin	Baythroid is not labeled for alfalfa grown for seed.
dimethoate	Make only one application per cutting. This product is highly toxic to bees. Do not apply if crop or weeds in treatment area are in bloom. Not labeled for use on clover.
malathion	To protect bees, do not apply to alfalfa or clover in bloom.

Blister Beetle

Several species of blister beetles may be found in alfalfa fields during the growing season. The beetles range from inch to more than 1 inch long and are black, gray, reddish or brown. Some species are striped. Adult blister beetles are narrow, cylindrical, rather soft-bodied beetles. The heads of blister beetles are wider than the neck. This feature separates them from other beetles commonly found in alfalfa. Adults feed primarily on blooms of alfalfa and many other plants. Adults can become very abundant from June through September.

Blister beetles produce cantharidin, a blistering agent (Table 10). This blistering agent, when eaten, causes livestock to colic and sometimes die as the lining of the digestive system is damaged by the toxin. Animal reaction depends on the number of beetles consumed (Table 11). Horses and poultry are very sensitive to cantharidin, but all livestock are at risk.

Table 9. Insecticides labeled for blister beetle control on alfalfa

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl			
(Sevin® 80S)	2/3 - 1 1/4 lb.	7	7
(Sevin® XLR Plus)	1/2 - 1 qt.	7	7
(Sevin® 4F)	1 - 2 lb.	7	7
lambda-cyhalothrin			
(Warrior®)	2.56 - 3.84 oz.	1	7
parathion			
(Parathion 8EC)	1/4 - 1/2 pt.	15	15

Table 10. Cantharidin levels present in common species of blister beetles found in Minnesota alfalfa

Blister beetle	Sex	Average	Range
		mg/beetle	
Black	Male	0.40	0.03 - 0.70
	Female	0.08	0.07 - 0.30
Ashgray	Male	1.250	06 - 3.38
	Female	0.49	0.14 - 0.75
Striped	Male	5.211	43 - 11.13
	Female	4.52	2.18 - 8.50

From "Blister Beetles in Alfalfa: Management Options to Minimize Poisoning in Horses." Minnesota Extension Service, AG-FO-5510-D, 1990

Table 11. Estimated number of beetles necessary to provide a lethal dose (assuming 1 mg/kg) to horses

Cantharidin content/beetle	Horse weight (lbs.)			
(mg)	275	555	835	1200
1.0	125	250	375	545
2.0	63	125	188	273
3.0	41	83	124	182
4.0	31	63	94	136
5.0	25	50	75	109

From "Blister Beetles in Alfalfa: Management Options to Minimize Poisoning in Horses." Minnesota Extension Service, AG-FO-5510-D, 1990

Hay and feed producers should inspect alfalfa fields for the presence of blister beetles before hay is cut, especially during June through September, when the beetles most commonly move into the fields. Blooming alfalfa fields can attract large numbers of blister beetles. Fields should be scouted for blister beetles starting 2 weeks before cutting and throughout the baling process. Special attention should be paid to blooming fields. Adult beetles are mobile, and some species are prone to congregate in one spot or a few small spots within a field. Infested areas should be left unharvested or sprayed with an insecticide spot treatment.

Do not sell hay for livestock feed if blister beetles are present. The cantharidin is highly toxic to all types of livestock. Swathers with crimper devices may crush beetles into the hay and increase the risk of livestock poisoning. Cutting without a crimper allows living beetles to leave the windrow before hay is baled. Cutting hay at or before 5 percent bloom greatly reduces the risk of blister beetle contamination. Finding only a few blister beetles may justify a treatment since the beetles are very toxic to livestock. Note that Sevin and Parathion have a 7- to 15-day waiting period before harvest, allowing time for beetles to again move into the field. Inspect fields prior to harvest to determine if blister beetles have re-infested.

See Table 9 for insecticide recommendations.

Common Caterpillar Pests

Several species of caterpillar larvae feed on the tender stems and leaves of alfalfa. These pests are quite similar in appearance and in the amount of damage they cause. Because of this similarity, one Treatment Threshold level for the primary foliage-feeding caterpillars in alfalfa is used. It is important, however, to be able to identify these larvae since insecticides that work against one larva may be ineffective against another.

The action level for caterpillars in alfalfa is seven larvae per sweep or two larvae per square foot.

See Tables 12-13 for insecticide recommendations.

Alfalfa Caterpillar

The alfalfa caterpillar is the larval stage of a yellow or white butterfly. It has a 2-inch wing span and black margins on the wings. The butterflies are seen flying through the fields in late spring and summer. Female butterflies lay 200 to 500 eggs singly on the undersides of alfalfa leaves. The eggs hatch in a few days, and the larvae feed on the leaves for 12 to 15 days before pupating. Mature larvae are about 1 $^{1}/_{2}$ inches long and are dark, velvety green with white stripes along each side. They have large, rounded heads. Larvae feed on foliage, and populations usually increase when not held in check by diseases, beneficial insects and spiders or weather. Mature larvae attach themselves to stems and pupate. The pupal stage lasts 5 to 7 days before the adult emerges.

The alfalfa caterpillar usually becomes a pest after the third alfalfa hay cutting and is usually most abundant in mid to late summer. Crop damage can sometimes be avoided by early cutting.

Armyworm

Armyworms are the immature stages of dull-colored moths. Armyworm larvae range in color from pale green to brown or black and are striped with white to yellowish lines from head to tail.

The fall and beet armyworms are commonly found on alfalfa and clover crops and may develop into damaging numbers that require chemical control. The yellow-striped armyworm is an occasional pest in alfalfa. Infestations of armyworms are usually most severe in mid to late summer. Armyworms lay masses of several hundred eggs, which hatch in 2 to 3 days. The larvae feed in groups when they are young and disperse as they mature. Full-grown larvae are 1 $^{1}/_{2}$ inches long. The larvae feed for about 3 weeks before crawling to the soil, burrowing (not deeper than 1 inch), constructing a loose pupal cell and pupating. Beet armyworms are generally the most difficult larvae to control in alfalfa.

Corn Earworm

Corn earworm moths are tan in color, about 3/4 inch long, and have a wing span of 1 to 1 1/2 inches. Young larvae are greenish with black heads. Fully developed worms are about 1 1/2 inches long and range from pale green or pinkish to brown. Unlike the fall armyworm, these caterpillars do not have an inverted "Y" pattern on their heads.

After emerging, the moths feed on nectar and mate. The adult female moths lay an average of 1,000 spherical eggs singly on the new growth. The eggs hatch in about 3 days, and the larvae feed and grow for 2 to 3 weeks. Full grown larvae drop to the ground, burrow 3 to 5 inches into the soil and pupate. The pupal stage normally lasts 10 to 12 days.

Earworm larvae have a large host range. In alfalfa and clover, larvae prefer the leaves, but they will feed on other plant parts. Earworms may be present in alfalfa hay crops through the growing season but usually are most abundant from July through September.

Table 12. Insecticides labeled for caterpillar (alfalfa caterpillar, corn earworm, armyworm, webworm) control on alfalfa

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
Bacillus thuringiensis (Agree®, Dipel®, Javelin®)	see remarks	0	0
carbaryl		see remarks	see remarks
(Sevin® 80S)	1/2 lb.	7	7
(Sevin® XLR Plus)	1 qt.	7	7
(Sevin® 4F)	1 qt.	7	7
chlorpyrifos		see remarks	see remarks
(Lorsban® 4E)	1 - 2 pt.	14-21	14-21
cyfluthrin		see remarks	see remarks
(Baythroid® 2E)	0.8 - 2.8 oz.	7	–
cypermethrin			
(Fury®)	2.4 - 4.3 oz.	3	3
(Mustang®)	2.4 - 4.3 oz.	3	3
lambda-cyhalothrin			
(Warrior®)	2.56-3.84 oz.	1	7
malathion		see remarks	
(Malathion 5EC)	2 pt.	0	–
(Malathion 8EC)1´ - 2 pt0-7			
methomyl			
(Lannate® SP)	1/4 - 1/2 lb.	07	–
(Lannate® LV)1 - 1´ pt07			
methoxychlor			
(Methoxychlor 2EC)	1 1/2 - 4 qt.	7	–
methyl parathion			
(Methyl parathion 4E)	1 pt.	15	15
(Penncap-M®)	1 pt.	15	15
(Declare® 4lb)	1 pt.	15	15
parathion			
(Parathion 8EC)	1/4 - 1/2 pt.	15	15
permethrin		see remarks	
(Ambush®)	3.2 - 12.8 oz	0-14	–
(Pounce® 3.2EC)		2 - 8 oz.	0-14 .....–

Remarks

bacillus thuringiensis	Application rates must be taken from the individual product labels due to the variation in formulations. carbaryl Apply only once per cutting.
chlorpyrifos	Do not make more than four applications per year or apply more than once per crop cutting. Do not cut or graze within 14 days after application of 1 pt. per acre or within 21 days after application at rates above 1 pt. per acre.
cyfluthrin	Baythroid is not labeled for alfalfa grown for seed.
methomyl	Do not apply when bees are in the field. Not registered on clover.
permethrin	Do not apply more than 12.8 oz. Ambush or 8 oz. Pounce per acre per cutting. When alfalfa is in bloom, spray only in early morning or late evening to avoid bee kill. A 0 day harvest interval exists for Ambush and Pounce when applied at rates up to 6.4 and 4oz./acre, respectively. Higher rates require a 14-day harvest interval.

Occasional Caterpillar Pests

Army cutworm

There is only one generation per year of the army cutworm. Female moths lay eggs on the soil surface in the fall. Moisture is required for the eggs to hatch. Young larvae pass the winter hibernating in the soil. As the weather warms during the day in late winter and spring, the young larvae are about 1 1/2 inches long and pale greenish-grey to brown. The back has pale stripes and is finely mottled with white and brown.

Larvae feed on a variety of plants, although alfalfa and winter wheat are the principal crops damaged. The army cutworm feeds entirely above the soil surface. Larvae prefer to feed on plant

leaves and only eat stems and other plant parts when food is scarce. Feeding occurs from late afternoon until daylight the following morning. The larvae hide under clods and in the soil during hours of bright sunshine. On dark, cloudy days, the larvae may feed both day and night. They can often be found by looking under alfalfa crowns and under field debris. Army cutworms can cause heavy damage to newly planted stands of alfalfa. Most army cutworm damage occurs in early spring, before the first cutting. Failure of a field to make spring growth is an indication armyworm damage may be occurring.

The action level is three to four larvae 1/2 inch or less in length per square foot, or two or three larvae more than 1/2 inch in length per square foot.

Table 13. Insecticides labeled for army cutworm control on alfalfa

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
cyfluthrin (Baythroid® 2E)	1.6 - 2.8 oz.	see remarks 7	see remarks –
carbaryl (Sevin® 80S) (Sevin® XLR Plus)	1/4 - 1 7/8 lb. 1 - 1 1/2 qt.	7 7	7 7
chlorpyrifos (Lorsban® 4E)	1 - 2 pt.	see remarks 14-21	see remarks 14-21
lambda-cyhalothrin (Warrior®)	2.56 - 3.84 oz.	1	7

Remarks

chlorpyrifos Do not make more than 4 applications per ear or apply more than once per crop cutting. Do not graze within 14 days after application or 1 pt. per acre or within 21 days at rates above 1 pt. per acre.

cyfluthrin Baythroid is not labeled for alfalfa grown for seed.

Webworm

Webworms are larval stages of small, buff-yellow to brown moths with -inch wing spans. The alfalfa webworm and garden webworm feed on alfalfa, clover, cowpeas, peas and similar crops as well as several weed species, especially pigweed. The larvae of these species create webs in the tops of plants and feed within the webs, completely skeletonizing the leaves. Flimsy webs near the plant terminals are noticeable in alfalfa and clover crops infested with these insects. Webworms occasionally cause serious damage to alfalfa, particularly to the second and third cuttings, primarily in East Texas.

On alfalfa hay crops, early harvest is suggested if the infested crop is near cutting stage. The action level for applying insecticide is reached when the crop is more than 2 weeks from cutting, and 25 to 30 percent of plant terminals are infested.

Vetch Pests

Sucking Pests

Pea aphids, thrips and lygus bugs are sucking insect pests of vetch.

A discussion of pea aphid biology is given in the alfalfa section. The treatment threshold is reached when visible signs of plant wilting are observed, accompanied by foliage yellowing, honeydew and increasing aphid numbers.

Thrips are tiny insects (1/15 inch long) with bodies that are much longer than they are wide. They are generally yellow to light brown, mostly tan. Thrips have tiny sucking mouthparts. Adults have feather-like wings and readily fly. The commonly-occurring species complete a life cycle in about 16 days (egg to adult), with adult females producing 50 or more eggs during their 35-day life. The treatment threshold is reached when seed production is a goal and excessive blasting and shedding of blooms is observed.

Lygus bugs are oval shaped, 1/4 inch-long bugs, which are relatively flat in profile. They vary from dark brown to light tan, light yellow and light green. All lygus bugs have a distinctive light colored triangle in the middle of the back. The life cycle lasts from 20 to 30 days. Lygus bugs feed on the flower buds of many plants, and they readily move to new host plants. When flower buds are fed on, they often abort and fall from the plant. When seed production is a goal and lygus average two per sweep in bud and early bloom stages, the treatment threshold is reached.

See Table 14 for suggested insecticides.

Table 14. Insecticides labeled for aphid, thrips and lygus bug control on vetch			
Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to:	
		Harvest	Grazing
malathion (Malathion 5EC)	1 1/2 - 2 pt.	7	7
methyl parathion (Methyl parathion 4E)	1 pt.	1	515

Chewing Pests

See Tables 15-16 for insecticide recommendations.

Vetch Bruchid

The vetch bruchid or "vetch weevil" is one of the most damaging pests for the vetch seed producer. Adults are about 1/8 inch long and black with irregular white patches on the wing covers. Larvae are grub-like in appearance, 1/8 inch long and white to cream-colored. Adults feed upon developing flower buds and pollen, but the primary damage is caused by larvae. Larvae consume the contents of the seed and may cause seed yield loses from 10 to 74 percent. Bruchids do not reproduce in stored vetch seed, although they may be found occasionally inside the seed hulls.

The action level for betch bruchid control is 10 to 25 percent fallen blooms with bruchids present. A sweep net is preferred over individual plant inspection for detection of bruchids. Check fields 6 to 8 days after treatment; if bruchids are still present, repeat application.

Armyworm and Cutworm

Armyworms and cutworms may occur in damaging levels in fields or vetch or vetch interplanted with a small grain crop. Their biologies are discussed under the alfalfa and clover section. Armyworms and cutworms should be controlled when visible foliage loss occurs.

Table 15. Insecticides labeled for bruchid control on vetch			
Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to:	
		Harvest	Grazing
malathion (Malathion 5EC)	1 1/2 - 2 pt.	7	7
methyl parathion (Methyl parathion 4E)	1 pt.	15	15

Table 16. Insecticides labeled for armyworm and cutworm control on vetch			
Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to:	
		Harvest	Grazing
methyl parathion (Methyl parathion 4E)	1 pt.	see remarks	see remarks
Remarks			
methyl parathion	For rates below 2 pt./acre, do not apply withing 15 days of harvest. For rates above 2 pt./acre, do not apply within 20 days of harvest.		

Forage Sorghum Pests

Soil Pest Treatment Methods

Pre-plant Seed Treatment Commercial Seed Treaters

Growers can purchase commercially treated forage sorghum seed or take their farm-grown seed to a commercial seed treatment facility for treatment. Lindane, Gaucho® and Cruiser® are insecticides labeled for this purpose.

Lindane has been shown to have adverse affects on sorghum seed germination. This should be considered when making treatment selection.) Gaucho and Cruiser do not affect seed germination, and they protect the seed from chewing insects such as seed corn maggot, wireworms and fire ants. Guacho and Cruiser, unlike Lindane, also protect seedling plants from sucking insects including greenbugs, yellow sugarcane aphids and chinch bugs.

See Table 17 for insecticide recommendations.

Pre-plant Seed Treatment On Farm

If commercially treated seeds are not available or farm-grown seed are preferred, lindane can be used as an on-farm treatment to control wireworms. (Read and follow the precautions listed in the following paragraph.) Seeds can be treated in a planter-box, a cement mixer or similar device. Make sure thorough coverage of the seed is achieved.

Precautions when conducting on-farm seed treatment:

- Follow all label directions when treating seeds on the farm and always wear protective clothing.
- Avoid inhaling dust when placing and mixing insecticide in a planter box or mixer to treat planting seed.
- Plant lindane treated seed within 20 days of treatment because longer exposure to the insecticide may lower seed germination of some sorghum hybrids.
- Do not use treated sorghum seed for human consumption or livestock feed.
- Lindane used on planting seed can delay and reduce seed germination when soil is cold and wet or very hot. If the 7-day forecast is for a cold, wet period or the soil temperature is marginal for seed germination, it may be best not to use lindane. Despite these precautions, lindane has been an effective, low-cost method of protecting sorghum planting seed from insect attack.

Note: Insecticides such as malathion and methoxychlor are often applied to seed to control stored grain pests. These insecticides are not effective for the control of soil insect pests.

At-Planting Soil Insecticides

Insecticides can be applied to the soil at planting time using row-band or T-band techniques. These methods are less applicable where a bed-planter is used because insecticide incorporation within the root zone may defeat major objectives of bed planting- retaining soil moisture in the bed. Where bed planting is to be used, soil insecticides can be incorporated in a band when bed shaping is done.

At-planting soil insecticides are most effective when applied just behind the opening plow and in front of the covering devices. Adjust noz.zles or spouts so the treatment band is about 7 to 10 inches wide. Best results are achieved when the seed furrow and the covering soil are treated. Incorporation during seed covering is usually adequate.

Some at-planting insecticides may adversely affect seed germination if they are in direct contact with the seed. To avoid direct seed contact, apply the insecticide in a band behind the covering attachment.

For specific soil treatment suggestions, limitations and rates of each insecticide labeled for use on forage sorghums, refer to the table for the specific pest and the product label.

Soil Pests

The common soil pests of forage sorghum in Texas include the true and false wireworm, white grub, corn rootworm, cutworm, seed corn maggot and fire ants. Non-crop plant residues are important food sources for soil pests. Crop rotation, cultivation and/or the use of herbicides to reduce crop residues and eliminate weeds are important practices for reducing soil pest problems. Proper seedbed preparation that provides for rapid seedling emergence and establishment and pre-plant soil inspection for the presence of soil pest populations are important in managing these pests. If damaging pest numbers are present, approved seed treatments may be used, or insecticides may be applied to the soil using row-band application methods. Preplant seed treatment or planter-box seed treatment has proven effective in controlling wireworms, seed corn maggots and seed corn beetles and may suppress white grubs. Moderate to large populations of white grubs and corn rootworms require at-planting application of insecticides.

Wireworm

True and false wireworms are the immature stages of click beetles and darkling beetles. Wireworms are generally shiny, slender, cylindrical and hard-bodied. They range from yellow to brown.

Wireworms damage forage sorghum by destroying planted seed and, to a lesser degree, by feeding on seedling plant roots, which reduce stand establishment and plant vigor.

Important non-chemical control methods include cultural practices that reduce non-crop plant materials in fields and rotation to tap-rooted crops that are unfavorable for wireworm development.

Sample fields for the presence of wireworms before planting. Take eight to 10 soil samples 1 foot square by 4 inches deep from the rows and examine them thoroughly. If two or more wireworm larvae per linear foot of row are detected, control measures are warranted.

Table 17. Insecticides labeled for corn rootworm and wireworm control on forage sorghum

Insecticides (listed alphabetically)	Concentrate per acre	Application
chlorpyrifos (Lorsban®15G)	8 oz./1000 linear ft.	see remarks
imidacloprid (Gaucho® 480)	8 oz./100 lb. seed	see remarks
lindane Seedmate - Lindane 25 (lindane 25%) Sorghum Guard - (lindane 16.6%, capt.an 32.75%)	 4 oz./100 lb. seed 3 oz./50 lb. seed	see remarks
thiamethoxam (Cruiser®)	 5.1 oz./100 lb. seed	see remarks

Remarks

chlorpyrifos	Lorsban is not labeled for wireworm control. Apply in a 6 - 8 inch band or T-band and incorporate into the top 1 inch of soil at planting.
imidacloprid	Gaucho is not labeled for corn rootworm control. Do not feed or grass livestock on treated areas for 45 days after planting.
lindane	Lindane is labeled only for wireworm control. Do not use lindane-treated sorghum seed for human consumpt.ion or livestock feed.
thiamethoxam	Cruiser is not labeled for corn rootworm control. Do not feed or grass livestock on treated areas for 45 days after planting.

No postemergence rescue treatments for wireworm control are registered. Therefore, pre-plant sampling for these pests is important. However, seed treatments or planter box treatments are effective in controlling wireworms. (See Seed Treatment Sections for procedures and suggested insecticide products.)

White Grub

White grubs are the larval stages of May and June beetles. Larvae are characteristically "C-shaped," with white bodies and tan to brown heads. Larvae vary in size according to age and species. The last abdominal segment is transparent, and digested material can be seen inside the larvae.

Larvae damage plants by feeding on the roots, resulting in seedling death and stand loss. The roots of larger plants can be severely pruned, which may cause stunting, plant lodging and increased susceptibility to drought and stalk root diseases.

The action level for white grub is based on the number of grubs per square foot of soil. Examine one square-foot soil sample for each 5 and 10 acres before planting. An average of one white grub per square foot is sufficient to cause significant stand loss. Where grub numbers are high (approximately two per square foot), row-band treatments are not sufficiently effective.

No products are labeled for use on forage sorghum for control of white grubs. Several products that are labeled on sorghum may suppress white grubs, but none specifically list white grubs.

Southern Corn Rootworm

Corn rootworms are the larval stages of a complex of leaf-feeding beetles. The southern corn rootworm is the most important forage sorghum pest in the rootworm complex. Rootworms are small, creamy-white larvae with brown heads. They feed in the root and crown of a plant. Poor stands, reduced plant vigor and dead heart in young plants are characteristic of rootworm damage. Plant lodging may occur later in the season.

Severe infestations require an at-planting soil insecticide. The decision to apply an at-planting insecticide is based primarily on damage in previous years.

See Table 17 for insecticide recommendations.

Cutworm

A complex of cutworms can damage forage sorghum. Cutworms are the immature states of moths that are active at night. Grassy and weedy fields attract the egg-laying cutworm moths. Newly hatched cutworms feed on sorghum seedlings and often clip plants just above the ground. Some subterranean cutworms feed on the seedling root system.

Larval feeding commonly occurs at night. Damaged fields normally have areas in which cut plants look like they have been closely grazed. Cutworms usually damage forage sorghum during the seedling stage.

Cultivation three weeks prior to planting, crop rotations that include fallow fields, and using herbicides to kill weeds are important methods for controlling cutworms in forage sorghum. Aerial or ground application of insecticides can effectively control cutworms in established forage sorghum stands.

Well-defined treatment thresholds do not exist for cutworms on forage sorghums. Control decisions are a matter of individual judgement about stand loss. Insecticides should be applied as a directed spray to the plants and adjacent soil. Increasing total spray volume normally improves control.

See Table 18 for insecticide recommendations.

Table 18. Insecticides labeled for cutworm control on forage sorghum

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		see remarks	see remarks
(Sevin® 4F)	2 qt.		
(Sevin® 80S)	2 1/2 lb.		
(Sevin® 80WSP)	2 1/2 lb.		
(Sevin® XLR Plus)	2 qt.		
chlorpyrifos		see remarks	see remarks
(Lorsban® 15G)	8 oz./1000 linear ft.		
(Lorsban® 4E)	1 - 2 pt.		
cyfluthrin		see remarks	see remarks
(Baythroid® 2E)	1.0 - 1.3 oz.		
cypermethrin		see remarks	see remarks
(Fury®)	1.4 - 4.3 oz.	45	–
(Mustang®)	1.4 - 4.3 oz.	45	–

Remarks

carbaryl	Do not apply within 21 days of harvest for grain or fodder or within 14 days of harvest or grazing of forage or silage.
chlopyrifos	Lorsban 15G, use at planting. Do not make more than one application per season. Lorsban 4E, the treated crop is not to be used for grain, forage, fodder, hay or silage within 30 days after the application of one pint per acre or within 60 days after application of rates above one pint per acre.
cyfluthrin	Restrictions on grazing and fodder vary depending on the rates used. See the label for specific applications.
cypermethrin	Pre-harvest interval is 45 days for forage sorghum.

Lesser Cornstalk Borer

The lesser cornstalk borer is an occasional pest of forage sorghum, legume and small grain crops grown on sandy soils in Texas. The insects normally over-winter as larvae, pupating in late winter. In early spring, moths emerge and lay greenish-white eggs on seedling sorghum. The eggs hatch in about 1 week, and the small bluish-green worms begin feeding on leaves or roots. Within a few days, the larvae bore into the stalks near the soil level. Each larva produces a soil-covered, silken tube at the site where it bored into the stalk. Affected plants appear moisture stressed; the leaves roll inward and plants become stunted or die. Control may be warranted where stands are threatened or where damage has occurred from this pest in previous years.

See Table 19 for insecticide recommendations.

Table 19. Insecticides labeled for lesser cornstalk borer control on forage sorghum

Insecticides (listed alphabetically)	Concentrate per acre	Application
chlorpyrifos		see remarks
(Lorsban® 4E)	1 - 2 pt.	
(Lorsban® 15G)	4-12 oz./1000 linear ft.	
cypermethrin		see remarks
(Fury®)	3.4 - 4.3 oz.	
(Mustang®)	3.4 - 4.3 oz.	

Remarks

chlopyrifos	Lorsban® 4E, the treated crop is not to be used for grain, forage, fodder, hay or silage within 30 days after the application of one pint per acre or within 60 days after application of rates above one pint per acre. Lorsban®15G, use at planting. Do not make more than one application per season.
cypermethrin	Use only to control larvae before entry into the plant stalk. Pre-harvest interval is 45 days for forage sorghum.

Fire Ants

Fire ants can become a problem on minimum till or no-till forage sorghum in the eastern half of Texas. Fire ant damage to seed and seedlings is generally most severe during dry years. Fire ant suppression can reduce damage. Other options to prevent fire ant damage are seed treatments (see preplant seed treatment sections) and T-band granular insecticide applications at planting.

See Table 20 for insecticide recommendations.

Above-ground Pests

Greenbugs

Greenbugs are aphids that suck plant juices and inject toxin into forage sorghum plants. They are pale green, approximately 1/16 inch long and have a dark green stripe on the back. Females give birth to live young at 7 to 18 days of age, reproduce for about 20 to 30 days and produce 50 to 60 young each (all female).

Although greenbugs can cause stand loss, stunting and plant death in forage sorghums, they are not as damaging in forage sorghum as in grain sorghum. Plant death in the seedling stage may occur, and growers should inspect plants frequently from emergence until the plants are 6 to 10 inches tall and continue the inspections through harvest.

The action level from emergence to about 6 to 10 inches is any visible damage (plants beginning to yellow) with greenbug colonies present and probable excessive stand loss. Maturing sorghum may infrequently have excessive leaf loss that requires treatment.

For a discussion of the management and control strategies for greenbugs, see TAEX publication B-1220, "Managing Insect and Mite Pests of Texas Sorghum."

See Table 21 for insecticide recommendations.

Table 20. Insecticides labeled for fire ant suppression on forage sorghum

Insecticides (listed alphabetically)	Concentrate per acre	Application
chlorpyrifos (Lorsban®15G)	8 oz./1000 ft.2	T-band at-planting
imidacloprid (Gaucho® 480)	8 oz./100 lb. seed	see remarks
thiamethoxam (Cruiser®)	5.1 oz./100 lb. seed	see remarks

Remarks

imidacloprid	Do not feed or graze livestock on treated areas for 45 days after planting.
thiamethoxam	Do not feed or graze livestock on treated areas for 45 days after planting.

Table 21. Insecticides labeled for aphid (English grain, corn leaf, yellow sugarcane, greenbug and Russian wheat aphids) control on forage sorghum

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
Attention: Review all remarks below thoroughly			
chlorpyrifos (Lorsban® 4E)	1/2 - 2pt.	see remarks 30-60	see remarks 30-60
dimethoate (Dimethoate® 4 lb)	1/2 - 1 pt.	see remarks 28	see remarks 28
(Dimethoate®	5 lb)6.4 - 12.8 oz.	28	28
disulfoton (Di-Syston® 15% G)		see remarks	see remarks
in-furrow	5 - 6.7 lb.	45	45
band	6.7	45	45
whorl	6.7	45	45
(Di-Syston® 8lb)			
furrow	3/4 - 1 pt.	45	45
band	1 pt.	45	45
side dress	1 pt.	45	45
foliar spray	1/4 - 1/2 pt.	45	45
imidacloprid (Gaucho® 480)	8 oz./100 lb. seed	see remarks	

continued on next page

Table 21. Insecticides labeled for aphid (English grain, corn leaf, yellow sugarcane, greenbug and Russian wheat aphids) control on forage sorghum (continued)

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
Attention: Review all remarks below thoroughly			
parathion (ethyl) (Parathion 4lb) (Parathion 5lb)	 1/4 - 1pt. 1/8 - 1/2 pt.	see remarks 12 12	see remarks 12 12
thiamethoxam (Cruiser®)	5.1 oz./100 lb. seed	see remarks	

Remarks

Difficulty in controlling greenbugs has been encountered in several counties of the Texas High Plains. Resistance to most registered materials exists in some localized areas, and extensive use of insecticides may expand the resistance problem. In areas where resistance exists, apply the initial insecticide at a higher labeled dosage rate.

In areas where insecticide resistance has not been observed, effective use of reduced rates is dependent on proper application timing. Reduced rates are designed to suppress greenbug densities below injurious levels, while causing less damage to beneficial species. Using insecticides to eliminate greenbugs completely is not desirable. To conserve beneficial species, a few aphids must be maintained as a food source.

chlorpyrifos	The treated crop is not to be used for grain, forage, fodder, hay or silage within 30 days after the application of one pint per acre or with in 60 days after application of rates above one pint per acre.
dimethoate	Do not apply more than three times per season. Do not apply after heading. For ground application, use 25-40 gallons of water per acre.For aerial application, use 2 or more gallons of water per acre.
disulfoton	Labeled only for greenbug control. Do not apply directly to the seed. Do not apply foliar spray or granules more than three times per crop season. See label for waiting period for different types of applications. Consult label for rates for various row spacings.
imidacloprid	Labeled for English grain, corn leaf and yellow sugarcane aphids. Do not feed or graze livestock on treated areas for 45 days after planting.
parathion	Labeled only for greenbug control. Aerial application only. Do not substitute with methyl parathion.
thiamethoxam	Labeled for corn leaf, yellow sugarcane, greenbug and Russian wheat aphids. Do not feed or graze livestock on treated areas for 45 days after planting.

Fall Armyworm

Fall armyworms are the immature stages of dull-colored nocturnal moths. Fall armyworm larvae range from pale green to brown or black and are often striped with white to yellowish lines from head to tail. They are characterized by an inverted "Y" on the head.

Fall armyworm is the most common of this group in forage sorghums, and larvae can severely damage forage sorghums. Populations of this armyworm often increase in late summer and early fall. Producers should inspect the fields during the summer and fall for this pest.

See Table 22 for insecticide recommendations.

Table 22. Insecticides labeled for fall armyworm control on forage sorghum

Insecticides (listed alphabetically)	Concentrate per acre	Application
carbaryl (Sevin® 4F) (Sevin® 80S) (Sevin® 80 WSP) (Sevin® XLR Plus)	 1 - 2 qt. 1 1/4 - 2 1/2 lb. 1 1/4 - 2 1/2 lb. 1 - 2 qt.	see remarks
cyfluthrin (Baythroid® 2E)	 1.3 - 2.8 fl oz.	see remarks
cypermethrin (Fury®) (Mustang®)	 1.9 - 4.3 oz. 1.9 - 4.3 oz.	see remarks

Remarks

carbaryl	For all carbaryl products: Do not apply within 21 days of harvest for grain or fodder or within 14 days of harvest or grazing of forage or silage.
cyfluthrin	Restrictions on grazing and fodder vary depending on the rates used. See the label for specific applications.
cypermethrin	Pre-harvest interval is 45 days for forage sorghum.

Grasshopper

A number of grasshopper species are common pests of forage sorghum. These pests generally migrate into the field from adjoining fence rows, ditch banks, field margins or native pastures. All grasshoppers, nymphs and adults, are foliage feeders and can cause extensive forage loss. An average of six to seven grasshoppers per square yard can consume as much forage as one cow. Grasshoppers are usually most damaging during dry years.

Grasshopper control in forage sorghum production should be started before the pests move out of hatching areas such as fence rows ditch banks, weedy fields, etc. The action level is seven to 10 grasshoppers per square yard accompanied by excessive leaf loss.

See Table 23 for insecticide recommendations.

Chinch Bug

Chinch bugs occasionally damage forage sorghum in the eastern half of Texas. The black-bodied adult chinch bug has reddish-yellow legs and fully developed wings. The whitish wings are marked with a triangular black spot at the middle of the outer margin. Immature chinch bugs resemble adults in shape but are reddish with a white band across the back.

Adult and immature chinch bugs suck plant juices and cause leaf reddening. Wilting and severe stunting of plants attacked by chinch bugs are seen from the time seedlings emerge until plants are 18 inches high. Chinch bugs are favored by hot, dry weather, and large numbers of immature chinch bugs often migrate from wild bunch grasses or small grains to congregate and feed behind the lower leaf sheaths of sorghum plants.

The action level is reached when two or more adult chinch bugs are found on 20 percent of the seedlings less than 6 inches high. Make at least five random checks per field. On taller plants, start control when immature and adult bugs infest 75 percent of the plants. With ground application equipment, direct noz.zles at the infested portion of the plants. To be most effective, apply insecticide in 20 to 30 gallons of water per acre.

See Table 24 for pesticide recommendations.

Table 23. Insecticides labeled for grasshopper control on forage sorghum

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Days from last application to: Grazing
carbaryl		see remarks	see remarks
(Sevin® 4F)	1/2 - 1 1/2 qt.		
(Sevin® 80S)	5/8 - 1 7/8 lb.		
(Sevin® 80WSP)	2/3 - 1 7/8 lb.		
(Sevin® XLR Plus)		1/2 - 1 1/2 qt.	
chlorpyrifos		see remarks	see remarks
(Lorsban® 4E)	1/2 - 1 pt.		
cyfluthrin		see remarks	see remarks
(Baythroid® 2E)	2.0 - 2.8 fl oz.		
cypermethrin		see remarks	see remarks
(Fury®)	3.4 - 4.3 oz.	45	45
(Mustang®)	3.4 - 4.3 oz.	–	–
dimethoate		see remarks	see remarks
(Dimethoate 4lb)	1 pt.	28	28

Remarks

carbaryl	For all carbaryl products: do not apply within 21 days of harvest for grain or fodder OR within 14 days of harvest or grazing of forage or silage.
chlorpyrifos	The treated crop is not to be used for grain, forage, fodder, hay or silage within 30 days after the application of one pint per acre or within 60 days after application of rates above one pint per acre.
cyfluthrin	Restrictions on grazing and fodder vary depending on the rates used. See the label for specific applications.
cypermethrin	Pre-harvest interval is 45 days for forage sorghum.
dimethoate	Do not feed or graze within 28 days of last application.

Table 24. Insecticides labeled for chinch bug control on forage sorghum

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
carbary (Sevin® 4F) (Sevin® 80S) (Sevin® 80WSP) (Sevin® XLR Plus)	1/2 - 1 1/2 qt. 5/8 - 1 7/8 lb.	lsee remarks 2/3 - 1 7/8 lb. 1/2 - 1 1/2 qt.	see remarks
chlorpyrifos (Lorsban® 4E)	1/2 - 1 pt.	see remarks	see remarks
cyfluthrin (Baythroid® 2E)	1.3 - 2.8 fl oz.	see remarks	see remarks
cypermethrin (Fury®) (Mustang®)	 3.4 - 4.3 oz. 3.4 - 4.3 oz.	see remarks 45 45	see remarks – –
imidacloprid (Gaucho® 480)	8 oz./100 lb. seed	see remarks	
thiamethoxam (Cruiser®)	5.1 oz./100 lb. seed	see remarks	

Remarks

carbaryl For all carbaryl products: do not apply within 21 days of harvest for grain or fodder or within 14 days of harvest or grazing of forage or silage.
cyfluthrin Restrictions on grazing and fodder vary depending on the rates used. See the label for specific applications.
cypermethrin Pre-harvest interval is 45 days for forage sorghum.

Pests of Permanent and Imported Pastures

Armyworms and grasshoppers are the most common insect pests of pastures. In certain arid sections of the state, the desert termite has occasionally damaged grasses. In East Texas, the fire ant often gives hay producers trouble at harvest, shipping and loading hay crops.

See Tables 25-29 for control recommendations.

Armyworms

There are two species of armyworms that can damage improved pastures, temporary winter pastures, permanent pastures and small grains the armyworm (Pseudaletia unipuncta) and the fall armyworm (Spodoptera frugiperda). These two species take approximately 4-5 weeks to go through the larval stage. When the worms are small, little forage is consumed. However, when the larvae reach 3/4 to 1 inch in length, they eat much more forage. It is estimated that mature worms will consume 75 to 80 percent of their entire diet in the last few days of their existence as larvae.

- Armyworm–Armyworms are usually associated with cool wet springs that produce a lush heavy growth of small grains and winter pastures. This species occurs in Texas during the spring. There is usually one generation in Texas, and then the insect migrates as moths further north into Oklahoma, Kansas and into the Mississippi Valley. The armyworm feeds primarily on small grains such as wheat, rye and ryegrass. It will also feed on other small grains grown for forage and grain production. It is not an economically limiting insect pest every year although it occurs in pastures and grain fields on an annual basis in April and May.

  Armyworms do not readily feed on grasses such as bermudagrass. They are often found in pastures that have a mix of bermudagrass, wheat and ryegrass. When found in these areas, the worms will feed on ryegrass and wheat first and then may feed on the grasses if there is no other small grain available. Controls are not usually necessary because the infestation coincides with the maturity of the winter forages and the spring growth of bermudagrass.

  Most cattlemen find that the winter forages have already produced their yield, and it is of little significance that the winter forages are being eaten.

  Armyworms may severely limit the production of rye and ryegrass grown for silage. Where these crops are grown for this purpose, fields need to be monitored for armyworms in April and May.

  Armyworm larvae are dark green to nearly black and do not have the stripes characteristically found on a similar species, the fall armyworm. The larvae feed mostly on leaves of the host but will feed on beards and in the seed head, causing potential grain losses.

- Fall armyworm–The fall armyworm is a major pest of permanent and improved pastures in most parts of Texas. Although it does not occur in damaging population levels statewide every year, locally damaging populations usually occur somewhere in the state each year. The insect may have from four to five generations in a season across the state. The fall armyworm usually begins its annual cycle in South Texas in early spring, and successive generations move northward as the year progresses. Pastures should be watched closely for infestations during rainy periods in late summer and early fall. Fall

Table 25. Insecticides labeled for army worm and fall armyworm control in improved pasture and grasses grown for seed

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		see remarks	see remarks
(Sevin® 4F)	1/2 to 1 1/2 qt.	14	14
(Sevin® 80S)	5/8 to 1 1/4 lb.	14	14
(Sevin® 80 WSP)	2/3 to 1 7/8 lb.	14	14
(Sevin® XLR Plus)	1/2 to 1 1/2 qt.	14	14
malathion			
(Malathion 5EC)	2 to 2 1/4 pt.	0	0
methomyl		see remarks	see remarks
(Lannate® LV)	3/4 to 3 pt.		–
methyl parathion			
(Methyl parathion 4E)	1 1/2 pt.	15	15

Remarks

carbaryl Do not apply within 14 days of harvest or grazing. Do not exceed a total of 3 quarts or 3 3/4 lbs. for liquid or solid formulation respectively per acre per year. Up to two application per year may be made but not more often than once every 14 days.

methomyl Last application to harvest: for forage, 7 days; for hay, 3 days. Do not apply more than 0.9 lbs. ai/acre/crop. Do not make more than 4 applications/crop.

armyworms may infest pastures until the first frost in the fall.

Larvae of the fall armyworm range from pale green to brown or black and are often striped with white to yellowish lines from head to tail. These stripes extend to the head, where they form an inverted "Y," a distinguishing characteristic of this species.

Moths are mostly black with white markings on the wings. Being nocturnal, the moths are attracted to outside lights and can be found in large numbers flying or resting near these lights. Eggs are laid on grass leaves and are massed together and covered with gray colored scales from the wings of the female.

The action level is three or more small worms per square foot. Controls should be based on the infestation rate, cost of control and the need for the forage.

Grasshopper

Grasshoppers are important pests of native pasture grasses. Ranchers should closely watch the development of grasshopper populations in the hatching areas during spring and early summer. Insecticides can be most effectively used in these sites before the grasshoppers have dispersed over large areas and when the hoppers are small and still juvenile. Hatching begins when daytime temperatures are 70 degrees F for several days and the soil is moist. Eight or more grasshoppers per square yard are considered the action level on rangeland and pastures.

Table 26. Insecticides labeled for grasshopper control in improved pasture and grasses grown for seed

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		see remarks	see remarks
(Sevin® 4F)	1/2 to 1 1/2 qt.	14	14
(Sevin® 80S)	5/8 to 1 7/8 lb.	14	14
(Sevin® 80 WSP)	2/3 to 1 7/8 lb.	14	14
(Sevin® XLR Plus)		1/2 to 1 1/2 qt.	14 14
malathion		see remarks	see remarks
(Malathion 5EC)	1 1/2 to 2 pt.	0	0
(Malathion 8EC)	1 to 1 1/4 pt.	0	0
(Malathion ULV 9.79lb)	8 to 12 fl oz.	0	0
methyl parathion			
(Methyl parathion 4E)	1 1/2 pt.	15	15

Remarks

carbaryl Use lower rates for nymphs. Do not exceed a total of 3 quarts or 3 3/4 lb. for liquid and solid formulations respectively per acre per year.

malathion Malathion 8 EC, apply in sufficient water for good coverage or use 1 1/4 pt. plus 1 gal. of fuel diesel oil per acre by means of an airplane or turbine blower type sprayer. Malathion ULV, a low volume sprayer is recommended for the application of this insecticide. See the label for appropriate equipment.

Table 27. Insecticides labeled for grasshopper control in rangeland

The Texas Department of Agriculture defines rangeland as land on which the vegetation is predominantly native grass.

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		see remarks	see remarks
(Sevin® 4F)	1/2 to 1 pt.	0	0
(Sevin® 80S)	5/8 to 1 1/4 lb.	0	0
(Sevin® 80 WSP)	2/3 to 1 7/8 lb.	0	0
(Sevin® XLR Plus)		1/2 to 1 1/2 qt.	0.....0
diflubenzuron		see remarks	see remarks
(Dimilin® 2L)	0.5 to 1.0 fl oz.	0	0
malathion			
(Malathion 5EC)	1 1/2 to 2 pt.	0	0
(Malathion 8EC)	1 to 1 1/4 pt.	0	0
(Malathion ULV 9.79lb)	8 to 12 fl oz.	0	0
methyl parathion		see remarks	see remarks
(Methyl parathion 4E)	1 1/2 pt.	15	15

Remarks

carbaryl	Use lower rates for nymphs. May be harvested or grazed the same day as treatment. Do not make more than one application per year. Do not exceed a total of 1 quarts or 1 1/4 lbs. for liquid and solid formulations respectively per acre per year.
diflubenzuron.	Do not exceed a total of 1.0 fl. oz. per acre per year. Do not make more than two applications per year. Effective only when applied to immature grasshoppers. This product is not labeled for pasture and hay, which is defined as improved, domesticated grasses and forages, such as bermuda grass.
malathion	No harvest or grazing restrictions. Malathion 8EC: apply in sufficient water for good coverage or use 1 1/4 pt. plus 1 gal. of fuel diesel oil per acre by means of an airplane or turbine blower type sprayer. Malathion ULV: a low volume sprayer is recommended for the application of this insecticide. See the label for appropriate equipment.

Table 28. Insecticides labeled for grasshopper control in wasteland non-crop areas and non-agricultural land including ditch banks, roadsides and fence rows

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		see remarks	see remarks
(Sevin® 4F)	1/2 to 1 1/2 qt.	14	14
(Sevin® 80S)	5/8 to 1 1/4 lb.	14	14
(Sevin® 80 WSP)	2/3 to 1 7/8 lb.	14	14
(Sevin® XLR Plus)	1/2 to 1 1/2 qt.	14	14
(Sevin® 5% Bait)	20 to 40 lb.	14	14
diazinon		see remarks	see remarks
(Diazinon® 4EC)	3/4 to 1 pt.	–	–
diflubenzuron		see remarks	see remarks
(Dimilin® 2L)	0.5 to 1 fl oz.	0	0
malathion			
(Malathion 5EC)	1 1/2 to 3 pt.	0	0

Remarks

carbaryl	Use lower rates for nymphs. Do not exceed a total of 3 quarts or 3 3/4 lbs. for liquid and solid formulations respectively per acre per year, 5 percent bait in fence rows and non-crop areas.
diazinon	Do not graze or use treated grass for forage or feed.
diflubenzuron	Do not exceed a total of 1.0 fl. oz. per acre per year. Do not make more than two applications per year. This product is not labeled for pasture and hay, which is defined as improved, domesticated grasses and forages, such as bermuda grass.

Desert Termite

Desert termites infest South and West Texas coastal bermudagrass pasture, rangeland and bunch grass areas. Populations increase during years when the summer months are dry. Highest above-ground populations occur from March through September. Few or no termites are present above ground from December through February. Infestations occur in irregular patterns, usually in areas with high clay content soils. During the night or cooler parts of the day, worker and soldier termites build clay chimneys covering grass stems. Infested areas have a dark and unusual appearance as the population increases. Rainfall will decrease termite numbers, but termites become very active after rain. If dry weather continues and stand loss of the grass occurs, a chemical spot treatment may be warranted. A spring-toothed harrow or light disc harrow may be used to break up chimneys and expose developing termites to predators, heat and drying conditions.

There are no specific insecticides labeled for desert termite control in pastures, but several insecticides labeled for other insects in pastures may reduce their populations. Malathion (5 EC) has been used at the rate of 1 quart applied in 35 to 40 gallons of water. Two treatments, 1 week apart, should be applied to the infested areas. A length of chain should be dragged ahead of the spray boom to break up the chimneys and expose termites to the insecticide. This treatment may not be economically feasible, however.

Red Imported Fire Ant

In East and Central Texas, red imported fire ants can be a serious problem in forage production. The ants build mounds as large as 18 inches or more in diameter. Farm and pasture lands may become heavily infested with hundreds of mounds per acre. In the hot summer sun these mounds become hard, and farm machinery is often broken when it hits a mound. To reduce machinery damage, farmers may alter their harvesting practices, such as by dragging a heavy bar to break up mounds between cuttings or using disk-type or Kountz cutters to cut forages in fire ant-infested areas. This equipment can withstand the impact with large mounds without damage. (See Table 31 for labeled insecticides.)

See publication, B-6076, "Managing Red Imported Fire Ants in Agriculture," available at your county Extension office, for a complete description of the biology, development, identification and control of this pest.

Table 29. Insecticides labeled for fire ant control in pasture and rangeland

Insecticides (listed alphabetically)	Concentrate per acre	Days from last application to: Harvest	Days from last application to: Grazing
Broadcast recommendations			
hydramethylnon (Amdro®)	see remarks 1.0 to 1.5 lb.	–	–
s-methoprene (Extinguish®)	1.0 to 1.5 lb.	0	0
Individual mound treatment recommendations			
carbaryl (Sevin® 4F)	see remarks 3/4 fl oz./gal. or 1 1/2 qt./100 gal. of water 1 2/5 Tbs./gal. or 1 7/8 lb./100 gal. of water	see remarks –	see remarks –
(Sevin® 80S)	One pak per 67.6 gal. of water	–	–
(Sevin® 80 WSP)	3/4 fl oz./gal. or 1 1/2 qt./100 gal. of water	–	–
(Sevin® XLR Plus)		–	–
hydramethylnon (Amdro®)	see remarks 2 to 5 level Tbs. per mound		
s-methoprene (Extinguish®)	3 to 5 Tbs. per mound	0	0
spinosad (Justice®)	4 Tbs. per mound less than 5" in diameter 4-6 Tbs. per mound greater than 15" in diameter		

Remarks

Carbaryl	Apply all Sevin products to individual mounds according to the specific product label instructions.
hydramethylnon	Broadcast treatment: broadcast bait uniformly with ground (granular spreaders) or aerial equipment. Do not apply more than 2.0 lb. per acre. Mound treatment: distribute uniformly around the mound. Do not apply more than 2.0 lb. per acre.
s-methoprene	No restrictions for grazing or harvest. Repeat applications may be made as often as fire ants are observed.
spinosad	Only mound treatments should be used in rangeland and permanent pastures.

Appendix I

Insect Pests

Blue alfalfa aphid (left); Pea aphid (right)

Cowpea aphids

Alfalfa caterpillar

Adult alfalfa butterfly (male left) (female right)

Corn earworm

Beet armyworm

Alfalfa weevil adult

Alfalfa weevil larva

Three-cornered alfalfa hopper adult

Blister beetle (note: head wider than neck)

Blister beetles

Appendix II

Beneficial Arthropods

Minue pirate bug adult

Minute pirate bug nymph

Big eyed bug nymph

Damsel bug adult

Lady beetle adult

lady beetle larva

Lacewing larva

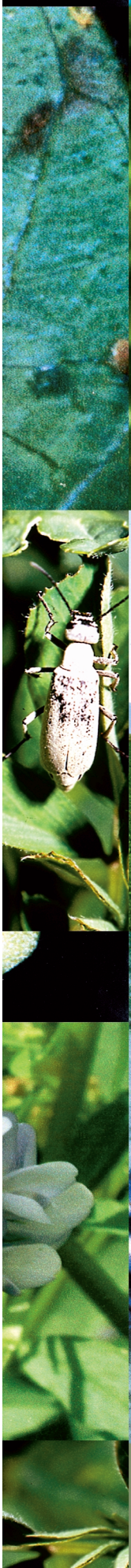
Jumping spider with corn earworm larva

Parasitoid wasp parasitizing alfalfa weevil larva

Armyworm killed by disease

Acknowledgment

We are indebted to Charles T. Allen, former Extension entomologist, for developing the original version of this publication.



Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture.
Chester P. Fehlis, Director, Texas Cooperative Extension, The Texas A&M University System.

2M, Revision