Texas Agricultural Extension Service
The Texas A&M University System

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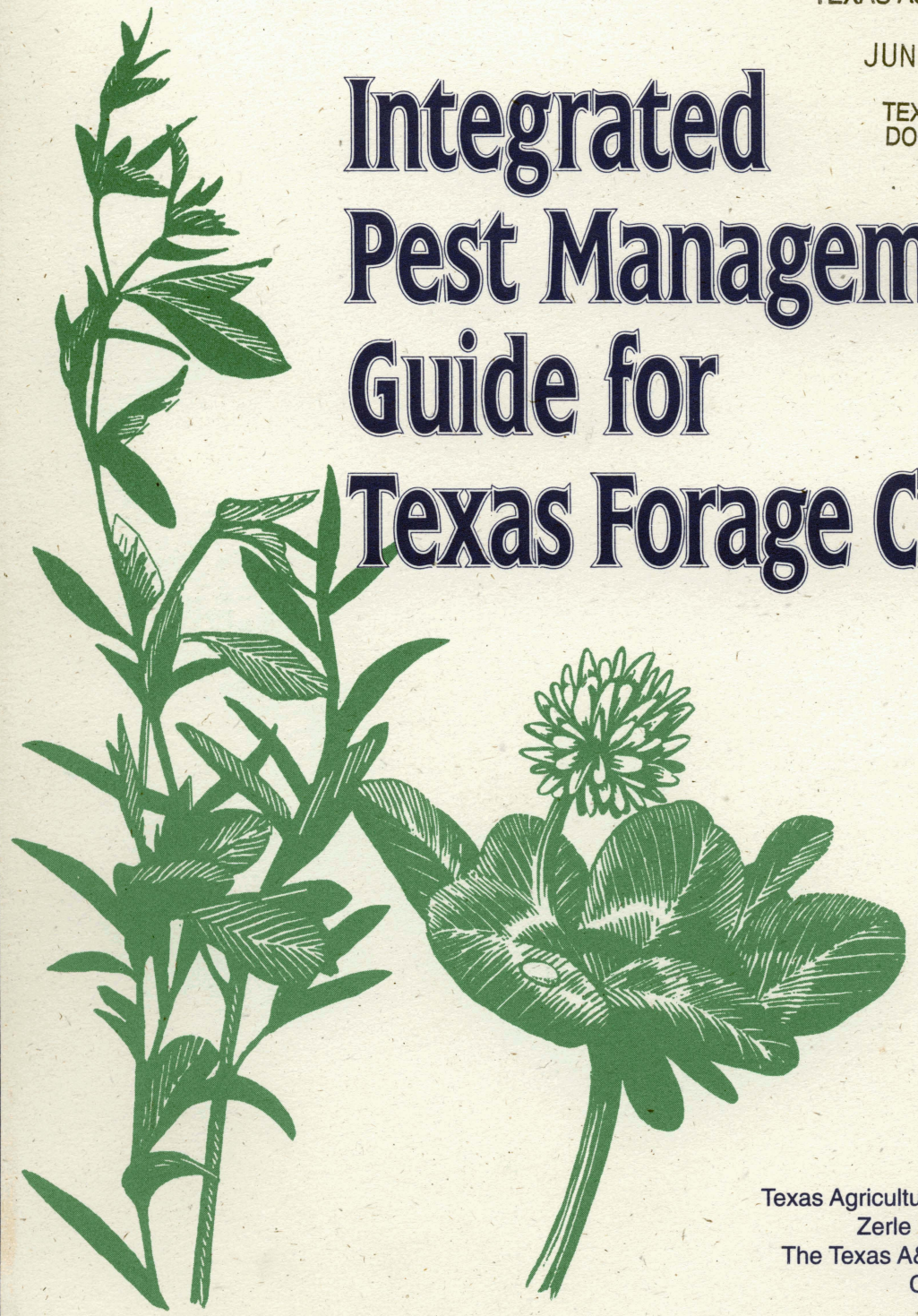
Integrated Pest Management Guide for Texas Forage Crops



Texas Agricultural Extension Service
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Integrated Pest Management Guide for Texas Forage Crops

Charles T. Allen[1]

In planning an integrated pest management (IPM) program, the producer should consider the effective use of cultural control practices, natural enemies, resistant crop seed and accurate field scouting and, when warranted, chemical control. IPM programs utilize all available means 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: 1) protection of natural enemies of crop pests; 2) resurgence of secondary pests following application; 3) insect resistance to insecticides; 4) effects on livestock, man and other non-target organisms, 5) the effectiveness of the product against the target pest; and 6) 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.

[1]Extension Entomologist, The Texas A&M University System

Suggestions in this publication are based on the results 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.

Insecticide Application

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

Nozzle size number and condition, ground speed and application pressure influence the rate of insecticide applied per acre. The sprayer should be carefully calibrated to insure 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, possible injury to the plants or livestock and an increase in the cost of production. Low rates may result in poor control.

Insecticide Resistance Management

Experience has shown that repeated use of a single group of insecticides that act in the same way may cause pests to develop resistance to the entire group of insecticides. A good strategy to help avoid pest resistance is to use non-pesticidal control techniques. And, when chemicals must be used, rotate insecticide groups, taking advantage of different modes of action. These management strategies should delay the development of resistance and also provide better overall insect control.

Insecticides with similar chemical structures affect insects in similar ways. For example, pyrethroids (including esfenvalerate and permethrin) act on an insect's nervous system in the same way. Other types of insecticides such as organophosphates (methyl parathion, chlorpyrifos, dimethoate, malathion and acephate) or carbamates (methomyl and carbaryl) also affect the insect's nervous

POLICY STATEMENT FOR MAKING PEST MANAGEMENT SUGGESTIONS

The information and suggestions included in this publication reflect the opinions of Extension entomologists based on field tests and use experience. Our management suggestions are a product of research and are believed to be reliable. However, it is impossible to eliminate all risk. Conditions or circumstances which are unforeseen or unexpected may result in less than satisfactory results even when these suggestions are used. The Texas Agricultural Extension Service will not assume responsibility for risks. Such risks shall be assumed by the user of this publication.

Suggested pesticides must be registered and labeled for use by the Environmental Protection Agency and the Texas Department of Agriculture. The status of pesticide labels is subject to change and may have changed since this publication was printed. County Extension agents and appropriate specialists are a good source of information on the label status of pesticides.

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

system but in a different way than do the pyrethroids. Repeated use of insecticides from any one group often quickly leads to insect pests which are resistant to that group.

Biological Control

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

Biological control is the use of predators, parasites and disease organisms to control pests. Important natural enemies 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.

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

Existing populations of natural enemies are conserved by avoiding the use of insecticides until they are needed to prevent the development of economically damaging pest infestations. When insecticides are needed, their impact can be minimized by choosing products that are more toxic to the target pest than to the natural enemy. Classical biological control is the importation of natural enemies from other countries. This method has been effective on exotic pests which have entered Texas without their natural enemies, and to compliment existing natural enemies of native pests.

Augmentation involves the purchase and release of natural enemies on a periodic basis. The most notable commercially available natural enemies include the egg parasite, Trichogramma, and the lady beetle and lacewing predator groups. Although the control of caterpillar larvae by the release of commercially reared Trichogramma wasps is theoretically possible, researchers have not been able to consistently achieve the level of parasitism necessary to reduce infestations below economically damaging levels. Multiple Trichogramma releases of parasitized eggs at high rates ranging from 50,000 to 150,000 per acre were used in these studies. There are currently no economic thresholds established for augmentative releases of Trichogramma for caterpillar control. Parasite mortality from insecticides used to control other pests in or around parasite release areas is a major factor adversely affecting the success of augmentative releases.

Research studies have shown that releasing large numbers of lacewing larvae (30,000 and more per acre) can reduce bollworm infestations in cotton to below damaging levels. However, these release rates are currently cost-prohibitive because of high production costs for rearing lacewings. Introducing lacewing eggs has been less successful. There is little information on the efficacy of introducing lacewings or lady beetles in any of their life stages in forage crops.

Because definitive information on augmentation (when to apply, what density to apply, etc.) is lacking, entomologists with the Texas Agricultural Extension Service cannot provide guidelines for the application of augmentation as a management tool in 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 local county Extension agent or Fish and Wildlife Service personnel to determine what restrictions apply to your area. Regardless of the law, it is important that pesticide users 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 new federal regulations that applies to all pesticides used in agricultural plant production. If you employ any person to produce a plant or plant product for sale and apply any type of pesticide to that crop, WPS applies to you. As of January 1, 1995, you must comply with all WPS regulations. The WPS requires you to provide three basic types of pesticide protection to your employees. You must:

- inform employees about exposure,
- protect employees from exposure, and
- mitigate pesticide exposures that employees might receive.

In 1995 all agricultural pesticides will bear a Worker Protection Standard statement on the label. It will appear in the "DIRECTIONS FOR USE" part of the label. For more detailed information, consult EPA publication 735-B-93-001 (GPO #055-000-0442-1) The Worker Protection Standard for Agricultural Pesticides – How to Comply: What Employers Need to Know, or call Texas Department of Agriculture, Pesticide Worker Protection Program, (512) 463-7717.

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 flower fertilization, the producer, insecticide applicator and beekeeper should cooperate closely to minimize losses of bees. The following guidelines will prevent or reduce bee losses:

1. Apply insecticides **before** bees are moved into the fields for pollination.
2. Use insecticides only when pest infestations exceed action levels. Then, use materials least toxic to bees.
3. Make all applications late in the evening (6 to 7 p.m.) when bees are not visiting the field. EVENING APPLICATIONS AFTER BEES HAVE LEFT THE FIELD ARE LESS HAZARDOUS THAN EARLY MORNING APPLICATIONS.
4. Use spray or granular formulations rather than dust.
5. Where it is necessary to use one of the insecticides in Groups 1 or 2 in the following list, notify the beekeeper so that he can make necessary arrangements to protect the bees.
6. Avoid drifting 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 or direct spray at this time generally results in heavy 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 insecticide label and contact the manufacturer and the seed company regarding possible phytotoxic effects.

ALFALFA AND CLOVER PESTS

A large variety of insects are found in alfalfa and clover. Some are only visitors or may be feeding on other plants scattered 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 which are resistant to insect damage. Many cultivars are available which have both insect and disease resistance. The relative levels of resistance in many of the commercially available alfalfa cultivars are provided in the following table. 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 about which fall dormancy group to select from, contact your county Extension agent or talk to a reputable seed salesman in your area.

Insecticides Grouped According to Relative Hazards to Honeybees

Insecticides	Remarks
Group 1. Highly Toxic carbaryl (Sevin® 80S, Sevin® XLR Plus) carbofuran (Furadan®) chlorpyrifos (Lorsban®) dimethoate (Cygon®, Dimethoate®) malathion (wettable powder or ULV) methidathion methomyl (Lannate®) methyl Parathion permethrin (Ambush®, Pounce®) phosmet (Imidan®)	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 all bees have completed foraging. Ultra low-volume malathion applications should be avoided 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 in late evening.
Group 3. Relatively Non-Toxic *Bacillus thuringiensis* (Agree®, Dipel®, Condor®, Design®, Javelin®, Xentari®) hydramethylnon (Amdro®)	These materials are least toxic to bees. Applications should be made in late evening when bees are not foraging.

Characteristics of Available Alfalfa Varieties*

Variety	Company	FD	BW	VW	FW	An	PRR	SAA	PA	BAA	SN	RKN	APH
5151	Pioneer	1	R	–	R	–	–	R	LR	–	MR	–	–
5262	Pioneer	2	HR	LR	MR	–	R	R	R	–	MR	–	–
A-54	Embro Seed	2	MR	–	–	–	MR	MR	–	–	–	–	–
Agate	Public	2	HR	–	HR	MR	R	–	–	–	–	–	–
Alfagraze	America's Alfalfa	2	MR	–	R	MR	LR	–	–	–	–	–	–
Alpine	Oasis/Spangler	2	R	R	R	R	R	R	–	–	MR	–	–
Baker	Public	2	HR	–	R	LR	–	HR	HR	–	–	–	–
Clipper	Interstate/Payco Seeds	2	HR	R	HR	R	R	–	R	–	MR	–	–
DK 122	DeKalb Plant Genetics	2	HR	R	R	HR	HR	MR	R	–	–	–	–
Evolution	Jacques	2	HR	R	HR	HR	HR	–	R	–	–	–	R
Flagship 75	Peterson Seed	2	HR	R	HR	R	HR	–	MR	–	–	–	–
Garst 636	ICI Seed	2	HR	R	R	MR	R	–	R	–	–	–	–
Milk Maker II	PGI/MBS	2	R	–	MR	–	R	LR	R	–	R	–	–
Nordic	ICI Seeds	2	HR	R	R	R	HR	MR	HR	–	–	–	MR
Pacesetter	Research Seeds/ Brown/Servos	2	HR	R	R	HR	HR	–	–	–	–	–	–
Profit	Ciba Seeds/Wensman Seed	2	HR	R	HR	MR	R	–	MR	–	MR	–	–
Quantum	Renk Seed	2	HR	HR	HR	HR	HR	–	HR	–	–	–	R
Vernal	Public	2	R	–	MR	–	–	–	–	–	–	MR	–
Viking 1	Northrup King	2	R	HR	HR	R	R	–	MR	MR	–	–	–
WL 225	W-L Research	2	HR	R	HR	MR	HR	R	R	–	LR	MR	–
Wrangler	Public	2	R	LR	R	LR	HR	HR	HR	–	–	–	–
98	Olds Seed Co.	3	HR	R	R	HR	R	R	R	–	–	–	–
120	DeKalb Plant Genetics	3	HR	–	R	LR	R	–	R	–	R	–	–
2833	Ciba Seeds	3	HR	R	HR	HR	HR	MR	R	–	–	–	–
2841	Ciba Seeds	3	HR	R	R	R	R	HR	R	–	–	–	–
2980	Olds Seed Co.	3	HR	R	R	R	HR	R	R	–	–	–	R
5246	Pioneer	3	HR	R	HR	HR	HR	R	R	–	MR	–	MR
5252	Pioneer	3	HR	HR	HR	R	HR	MR	R	–	LR	–	HR
5311	Pioneer	3	HR	MR	HR	–	R	R	HR	–	MR	–	–
9323	Research Seeds/Shissler	3	HR	R	HR	R	HR	–	–	–	MR	–	R
Accolade	Chemgrow	3	R	HR	R	R	R	–	R	–	–	–	–
Achieva	Agway/Allied	3	R	R	HR	HR	HR	R	R	–	MR	R	–
Allegiance	Keltgen/Lynks	3	R	R	R	HR	R	LR	R	–	R	–	–
AgriBoss	Cropmate	3	HR	MR	HR	HR	HR	–	HR	–	MR	–	–
Arrow	American's Alfalfa	3	HR	R	HR	MR	HR	–	R	–	MR	–	–
Attainer	Hoffman	3	HR	HR	HR	HR	HR	R	R	–	MR	–	LR
Benchmark	Research Seeds/ Ag Venture	3	HR	R	HR	HR	HR	–	–	–	–	–	R
Big 10	Great Lakes	3	HR	–	HR	R	R	LR	R	–	–	–	–
Blazer XL	Cenex/Land O'Lakes	3	R	R	HR	HR	HR	HR	R	–	R	–	R
Bolt ML	Research Seeds/Jung	3	R	R	HR	HR	HR	–	–	–	MR	–	R
Break-thru	Custom Farm Seed	3	HR	R	HR	MR	HR	R	HR	–	MR	–	–
Bronco	Jung/AgAmerica	3	HR	R	HR	HR	HR	R	R	–	–	–	–
Centurion	Agway/Allied	3	HR	R	R	R	R	MR	R	–	–	–	–
Champ	Research Seeds/Brown	3	R	MR	HR	–	MR	–	HR	–	HR	–	–
Class	Union Seeds	3	HR	R	R	HR	HR	R	R	–	MR	–	R
Columbo	PGI/MBS	3	R	HR	HR	R	R	R	HR	–	MR	MR	–
Comet	Moews	3	HR	R	R	MR	R	–	MR	–	–	–	–
Crown	Cargill	3	R	R	R	HR	R	MR	R	–	R	–	–
Crown II	Cargill	3	HR	R	HR	HR	HR	MR	R	–	–	–	–
Dart	AgriPro	3	HR	R	HR	R	HR	–	R	–	–	–	–
DK 125	DeKalb Plant Genetics	3	HR	R	R	HR	R	MR	R	–	–	–	–
Elevation	Jacques	3	R	MR	R	–	MR	–	R	–	HR	–	–

FD - Fall dormancy
1 - most dormant
9 - least dormant
† - new varieties

Bw - Bacterial wilt
Vw - Verticillium wilt
Fw - Fusarium wilt
An - anthracnose

PRR - Phytophthora root rot
SAA - spotted alfalfa aphid
PA - pea aphid
BAA - blue alfalfa aphid

SN - stem nematode
RKN - root knot nematode
APH - aphanomycetes root rot

LR - 6-14% of plants resistant
MR - 15-30% of plants resistant
R - 31-50% of plants resistant
HR - 51% or more of plants resistant

Characteristics of Available Alfalfa Varieties*

Variety	Company	FD	BW	VW	FW	An	PRR	SAA	PA	BAA	SN	RKN	APH
Encore	Research Seeds/ Spangler	3	HR	R	HR	HR	HR	–	–	–	–	–	R
Envy	Peterson Seed	3	HR	R	HR	HR	R	–	R	–	MR	–	MR
Future	Ray Bros. Seed	3	HR	MR	MR	LR	R	–	R	–	MR	–	–
GH777	Golden Harvest	3	HR	R	HR	R	HR	–	–	–	MR	–	R
GH787	Golden Harvest	3	HR	R	R	HR	HR	R	R	–	–	–	R
Genesis	Pfister	3	HR	R	HR	HR	HR	–	HR	–	–	–	MR
Green Field	Peterson Seed	3	HR	R	HR	HR	HR	–	HR	–	–	–	R
Husky	PGI/MBS	3	R	–	R	MR	MR	–	R	–	–	–	–
Hyland	Oasis	3	HR	R	HR	R	HR	R	HR	MR	MR	–	MR
ICI 645	ICI Seeds	3	HR	R	R	HR	HR	–	R	–	–	–	–
Impact	Peterson Seed	3	HR	R	HR	MR	R	–	R	–	MR	–	–
K93	Kussmaul	3	R	R	R	–	R	–	R	–	MR	–	LR
Magnum III-Wet	Dairyland Seed	3	–	MR	R	MR	R	MR	HR	MR	–	–	MR
Majestic	Agway/Allied	3	HR	HR	HR	HR	R	S	–	–	R	–	–
Mercury	Moews	3	R	–	HR	MR	HR	LR	–	–	–	–	–
Milkmaker	PGI/MBS	3	R	–	HR	MR	MR	–	R	–	–	–	–
MultiKing 1	Northrup King	3	HR	R	HR	R	R	MR	MR	–	MR	–	–
Multi-plier	*Jacques*	*3*	*HR*	*R*	*HR*	*HR*	*HR*	*MR*	*R*	–	–	–	–
Multistar	FFR	3	HR	R	HR	HR	HR	R	–	–	R	–	–
Oneida VR	N.Y.S.I.C.	3	R	HR	HR	MR	MR	–	–	–	–	–	–
Perry	Public	3	R	–	R	LR	MR	–	–	–	–	–	–
Renegade	Geerston	3	R	LR	MR	–	R	R	R	–	–	–	–
RFV-2000[1]	Custom Farm Seed	3	HR	R	HR	HR	HR	R	R	–	R	–	LR
Royalty	Cargill	3	HR	R	HR	HR	HR	R	R	–	MR	MR	LR
Spark	Brunner	3	HR	R	R	R	R	–	R	–	–	–	–
Starmaster	Doeblers	3	R	R	R	MR	R	–	R	–	–	–	–
Sure	Cenex/Land O'Lakes	3	HR	R	HR	HR	R	LR	HR	–	–	–	–
Surpass	ABI	3	HR	R	HR	MR	R	–	R	–	–	–	–
Thrive	Great Lakes	3	HR	R	HR	HR	HR	HR	R	–	R	–	–
Trident II	Cargill	3	HR	R	R	R	HR	LR	MR	–	LR	–	MR
Ultra	Seedtec	3	HR	R	HR	HR	R	LR	R	–	R	–	–
Ultra Leaf 87[1]	La Crosse Seed	3	HR	HR	HR	HR	HR	–	R	–	–	–	R
VIP	Research Seeds/Schuman	3	HR	R	R	R	R	MR	HR	LR	MR	–	–
Webfoot	Great Lakes	3	R	–	MR	–	R	–	–	–	–	–	–
WL 317	W-L Research	3	HR	R	HR	R	HR	R	HR	–	R	MR	–
Zenith	ICI Seeds	3	HR	R	R	HR	HR	HR	R	–	MR	–	–
555	Pioneer	4	HR	–	MR	–	–	HR	HR	–	–	–	–
630	ICI Seeds	4	HR	MR	R	MR	R	MR	R	MR	MR	–	–
631	ICI Seeds	4	HR	R	HR	R	HR	R	HR	MR	R	–	MR
2852	Ciba Seeds/Hoffman	4	HR	R	R	HR	R	MR	R	–	–	–	–
5333	Pioneer	4	HR	MR	HR	HR	R	R	HR	–	LR	–	–
5364	Pioneer	4	R	MR	R	MR	MR	HR	HR	–	R	–	–
5373	Pioneer	4	HR	R	HR	HR	MR	R	HR	–	–	–	LR
5454	Pioneer	4	R	MR	HR	HR	HR	R	R	–	MR	–	LR
5472	Pioneer	4	HR	MR	HR	MR	MR	R	HR	–	R	–	–
Action	Research Seeds/Spangler	4	R	MR	R	HR	R	MR	R	–	–	–	–
AF 21	Asgrow	4	HR	R	R	HR	R	R	R	–	MR	MR	–
AF 31	Asgrow	4	HR	R	HR	HR	HR	R	HR	–	MR	–	–
Agressor	America's Alfalfa	4	HR	R	HR	HR	HR	MR	HR	–	MR	–	MR
Agri-Mate	Cropmate	4	R	R	HR	R	R	MR	R	–	MR	–	–
AlfaLeaf	Plains Alfalfa	4	HR	R	R	R	HR	R	R	–	–	MR	–
Allegro	Keltgen/Lynks	4	HR	R	R	HR	HR	–	HR	–	MR	–	R
Allstar	Beachley-Hardy	4	HR	R	HR	HR	HR	LR	R	–	R	MR	–
Apollo	America's Alfalfa	4	R	–	R	LR	R	MR	MR	–	MR	–	–

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Apollo II	America's Alfalfa	4	R	MR	R	MR	HR	MR	–	–	MR	–	–
Apollo Supreme	America's Alfalfa	4	HR	R	HR	HR	R	–	HR	–	–	–	–
Arc	Public	4	LR	–	MR	HR	–	–	HR	–	LR	LR	–
Asset	Allied Seed	4	HR	R	R	R	HR	R	R	–	–	–	MR
Chief	Jacques	4	HR	R	R	R	HR	R	R	–	MR	MR	–
Cimarron VR	Great Plains Research	4	HR	R	HR	HR	R	HR	HR	MR	R	MR	MR
Commandor	Northrup King	4	R	MR	R	HR	R	MR	–	–	MR	–	–
Crystal	PGI/MBS	4	HR	R	HR	R	HR	LR	R	MR	MR	–	LR
Cutter	Interstate/Payco Seeds	4	R	R	HR	R	HR	R	R	–	MR	–	MR
DK 133	DeKalb Plant Genetics	4	HR	R	HR	HR	HR	R	R	–	MR	–	R
Dynasty	Dairyland Seed	4	HR	R	R	MR	R	R	–	–	–	–	–
Eagle	Asgrow	4	HR	MR	R	R	MR	R	R	LR	R	–	–
Echo	Callahan	4	R	R	R	MR	R	R	HR	–	MR	–	–
Edge	Research Seeds/Servos	4	R	R	R	HR	R	R	R	–	–	–	–
Empress	Blaney/Gutwein	4	HR	R	HR	R	HR	R	HR	–	R	MR	–
Enterprise	Mershman Seeds	4	HR	R	HR	R	HR	HR	HR	–	–	–	–
Epic	Mike Peterson	4	R	–	MR	–	R	–	HR	–	HR	–	–
Fortress	Northrup King	4	R	R	R	R	HR	HR	R	–	HR	–	–
GH 737	Golden Harvest	4	R	R	R	MR	HR	R	R	–	MR	MR	–
GH 747	Golden Harvest	4	HR	MR	R	HR	HR	–	HR	–	MR	–	–
GH 755	Golden Harvest	4	HR	R	HR	HR	HR	R	R	R	R	–	–
Good as Gold	Johnson/Top Farm/ Hoegemeyer	4	HR	R	HR	R	HR	R	HR	MR	–	–	LR
Gourmet Hay	Blaney/Gutwein	4	HR	R	HR	HR	R	MR	HR	R	R	MR	–
Jade	NC+ Hybrids	4	HR	R	R	R	HR	MR	–	–	–	–	–
Jewell	Wilbur-Ellis	4	HR	R	R	R	HR	R	R	–	–	–	MR
Legacy	Genesis	4	HR	R	HR	R	HR	HR	R	–	–	–	–
Legend	Cenex/Land O'Lakes	4	HR	R	HR	HR	HR	LR	R	–	MR	–	–
Magnum III	Dairyland Seed	4	R	MR	R	MR	R	MR	R	MR	MR	–	LR
New Era 90	Stine	4	HR	R	HR	HR	HR	MR	R	–	R	R	–
Ogallala 633	Germain's	4	HR	R	R	HR	HR	HR	R	–	MR	–	MR
Ovatron[1]	Callahan	4	HR	HR	HR	HR	HR	MR	R	–	MR	–	R
Peak	Research Seeds/Royal	4	R	LR	R	–	MR	–	HR	–	HR	–	–
Persist	Kaltenberg/Doeblers	4	HR	R	HR	R	HR	R	–	MR	MR	–	MR
Precedent	Doeblers/Wyffels	4	HR	R	R	R	HR	R	R	–	–	–	R
Premier	Wyffels/Wetsel	4	HR	R	HR	HR	HR	MR	HR	–	MR	MR	–
Prism	Beachley-Hardy/Wilson	4	HR	R	R	HR	HR	–	–	–	–	–	MR
Pro-Cut	L. Herried Seed	4	HR	R	HR	R	HR	R	R	–	MR	MR	–
Pro-Cut 2	L. Herried Seed	4	HR	R	R	R	HR	R	R	–	–	–	MR
ProGro 424	Casterline Seeds	4	HR	R	HR	R	HR	R	R	MR	–	–	MR
Promise	ICI Seeds/Hoffman	4	HR	R	HR	HR	HR	MR	R	–	MR	MR	–
Quest	Renk Seed	4	HR	R	HR	R	HR	MR	R	–	R	MR	–
RamRod	Bio-Plant Research	4	R	R	R	MR	R	R	–	–	–	–	–
Resistar	FFR	4	R	HR	HR	R	HR	MR	–	–	R	–	–
Reward	Drussel/Patriot	4	HR	R	HR	R	HR	R	R	MR	MR	–	LR
Riley	Public	4	HR	LR	–	MR	–	HR	HR	–	–	–	–
Sabre	Kinder/Allied	4	HR	HR	HR	HR	R	S	HR	–	MR	–	–
Stine 9227	Stine	4	HR	R	HR	HR	HR	R	–	–	–	–	MR
Target II	Bio-Plant Research	4	HR	R	R	R	R	R	–	–	–	–	–
Terminator	La Crosse	4	HR	R	HR	R	R	–	–	–	MR	–	–
Vemema	Public	4	MR	MR	–	LR	LR	MR	–	–	HR	–	–
Verta+	NC+ Hybrids	4	HR	R	R	HR	R	LR	R	–	–	–	–
Voyager	Bio-Plant Research	4	HR	MR	R	MR	R	MR	–	–	–	–	–
Voyager II[1]	Ziller/Lemke/Bio-Plant	4	HR	R	HR	R	HR	R	HR	MR	MR	MR	MR

FD - Fall dormancy
1 - most dormant
9 - least dormant
† - new varieties

Bw - Bacterial wilt
Vw - Verticillium wilt
Fw - Fusarium wilt
An - anthracnose

PRR - Phytophthora root rot
SAA - spotted alfalfa aphid
PA - pea aphid
BAA - blue alfalfa aphid

SN - stem nematode
RKN - root knot nematode
APH - aphanomycetes root rot

LR - 6-14% of plants resistant
MR - 15-30% of plants resistant
R - 31-50% of plants resistant
HR - 51% or more of plants resistant

Characteristics of Available Alfalfa Varieties*

Variety	Company	FD	BW	VW	FW	An	PRR	SAA	PA	BAA	SN	RKN	APH
WAMPR	FFR	4	R	R	R	R	R	MR	–	–	MR	–	–
WL 320	W-L Research	4	R	MR	HR	MR	R	R	MR	MR	MR	MR	–
WL 322 HQ	W-L Research	4	HR	R	HR	MR	R	HR	HR	R	LR	–	–
WL 323	W-L Research	4	HR	R	HR	HR	HR	MR	R	–	HR	–	R
Archer	America's Alfalfa	5	MR	HR	MR	R	R	HR	HR	R	R	R	–
Belmont	Great Plains Research	5	HR	R	HR	HR	R	HR	HR	MR	R	–	–
Crockett	Northup King	5	HR	–	MR	HR	R	HR	S	S	–	–	–
Deseret	Public	5	MR	–	–	–	–	–	–	–	R	–	–
Mede	Union Seed	5	MR	MR	HR	R	R	HR	R	R	–	R	–
Washoe	Public	5	R	–	–	LR	R	R	R	–	R	–	–
581	Pioneer	6	LR	–	HR	–	MR	HR	MR	–	R	–	–
ABI 700	America's Alfalfa	6	MR	MR	HR	HR	R	HR	HR	HR	R	R	–
DK 169	DeKalb Plant Genetics	6	R	MR	R	–	MR	HR	R	LR	R	–	–
Express	Union Seed	6	MR	MR	HR	R	HR	HR	HR	R	R	R	–
Lahontan	Public	6	MR	–	LR	–	LR	MR	LR	–	R	–	–
LM 455	Lohse Mill	6	R	MR	HR	LR	R	HR	HR	MR	R	–	–
Lobo	Seedtec	6	MR	R	HR	R	HR	R	R	R	HR	R	–
Meteor	Northrup King	6	R	LR	HR	S	R	HR	HR	HR	HR	–	–
Pike	Northrup King	6	MR	–	R	–	MR	MR	R	–	R	–	–
Wilson	Public	6	R	–	R	–	–	MR	R	–	MR	–	–
5683	Pioneer	7	MR	–	R	–	R	HR	R	MR	R	–	–
Dona Ana	Public	7	MR	–	MR	LR	R	R	R	–	–	–	–
Malone	Public	7	R	–	HR	R	R	R	HR	–	MR	–	–
Rio	Great Plains Research	7	R	–	HR	HR	HR	HR	HR	HR	MR	R	MR
Sutter	PGI/MBS	7	R	MR	HR	–	HR	HR	RR	MR	R	HR	–
Valley+	NC+ Hybrids	7	MR	–	HR	R	R	HR	HR	R	–	–	–
WL 457	W-L Research	7	MR	LR	HR	LR	HR	HR	HR	HR	HR	–	–
13R Supreme	America's Alfalfa	8	MR	MR	R	MR	R	R	R	MR	MR	R	–
5715	Pioneer	8	LR	LR	HR	HR	R	HR	R	HR	–	–	–
5888	Pioneer	8	–	–	HR	–	R	HR	R	R	R	–	–
Arroyo	PGI/MBS	8	MR	–	HR	LR	HR	HR	HR	MR	HR	–	–
Condor	Northup King	8	–	–	HR	–	HR	HR	HR	HR	–	–	–
DK 189	DeKalb Plant Genetics	8	MR	MR	HR	HR	R	HR	R	R	MR	R	–
Falcon	Lohse Mill	8	LR	–	HR	–	MR	MR	MR	MR	–	–	–
GT 13R Plus	America's Alfalfa	8	R	–	MR	LR	R	R	MR	LR	R	MR	–
Madera	PGI/MBS	8	MR	MR	HR	LR	MR	HR	HR	LR	MR	HR	–
Maricopa	PBI/MBS	8	MR	MR	HR	LR	R	HR	HR	R	R	HR	–
Moapa 69	Public	8	–	–	HR	–	–	R	–	–	–	MR	–
Nitro	Public	8	–	–	HR	–	R	R	HR	–	–	–	–
Pierce	Northrup King	8	LR	–	HR	–	R	R	HR	R	R	–	–
WL 515	W-L Research	8	LR	–	R	–	R	R	R	MR	R	–	–
WL 516	W-L Research	8	MR	–	HR	LR	HR	HR	HR	HR	MR	–	–
WL 525 HQ[1]	W-L Research	8	MR	–	HR	–	HR	HR	HR	HR	R	–	–
Yolo	PGI/MBS	9	LR	LR	HR	LR	MR	HR	HR	R	MR	HR	–
SW 14	S & W Seed	9	–	LR	HR	–	LR	HR	HR	R	–	HR	–
5929	Pioneer	9	–	–	HR	–	R	R	HR	HR	–	–	–
CUF 101	Public	9	–	–	HR	–	MR	HR	HR	HR	LR	MR	–
Florida 77	Pioneer	9	–	–	HR	MR	–	MR	–	–	–	R	–
Mecca	PGI/MBS	9	LR	–	HR	LR	MR	HR	HR	MR	MR	HR	–
Sundor	Northrup King	9	–	–	HR	–	MR	HR	HR	HR	HR	–	–
UC Cibola	Public	9	–	–	HR	–	MR	HR	RL	R	–	R	–
WL 605	W-L Research	9	–	–	HR	LR	HR	HR	HR	HR	MR	–	–

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Field Scouting

Fields of alfalfa or clover grown for hay or grazing should be checked weekly during the growing season for insect activity.

It is important to sample as much of the field as possible (at least 4 or 5 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. Most sampling should be done away from field edges. Fields should be sampled when the hay is dry so that the insects can easily be found.

Stem Sampling. In areas where alfalfa weevil is the key pest in alfalfa during spring, stem sampling is the preferred sampling method. Stem sampling is made easier using a beat bucket. A 30-stem sample should be taken, selecting stems at evenly spaced intervals through the field. For fields larger than 30 acres, 2 or more stem samples should be taken. During sampling, the stems can be conveniently held in the bucket. After the 30-stem sample has been collected, beat the stems vigorously against the inside of the bucket for 10 to 20 seconds. This dislodges the medium sized and large larvae and they can easily be counted.

Sweep Net Sampling. A standard 15-inch diameter sweep net is the basic sampling tool used in many Texas alfalfa and clover fields. A sampling unit consists of 10 consecutive (180-degree) sweeps taken while walking through the 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. If foliage and stems are not obtained in the sample, 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 each edge of the field.

A sweep net can be used to sample a field for aphids and other pests. Often aphids are too abundant to count individually, but can be estimated in 10s or 100s.

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 aphids can produce huge population increases. Pea aphids generally cause the greatest amount of damage in the spring.

Resistant cultivars are very helpful in reducing pea aphid damage (see table pages 7-10). Use of an insecticide is justified when aphid populations reach the action level (See table below).

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 of honeydew which interfere with cutting and baling and degrade 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 due to spotted alfalfa aphid (see table, pages 4-7). In some cases insecticides may be needed (see table, page 9).

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 is bluish-green rather than light green. The blue aphid tends

Action Levels for Aphid Control

	Hay height (inches)	No. aphids per stem	No. aphids per sweep
Pea Aphid	<10	40	200[1/]
	>10	70	300-400
Spotted Alfalfa Aphid	<10	20	100-200[1/]
	>10	40	200-400
Blue Alfalfa Aphid*	<10	10-12	50
	>10	40-50	200[1/]

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

Suggested Aphid Control on Alfalfa and Clover*

(Pea, Spotted Alfalfa, Yellow Clover and Blue Alfalfa Aphids)

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
chlorpyrifos		(see remarks)	
(Lorsban® 4 lb)	1/2 pt	7	7
dimethoate		(see remarks)	
(Dimethoate 400)	1/2 - 1 pt	10	10
(Dimethoate 2.67 lb)	3/4 - 1 1/2 pt	10	10
disulfoton		(see remarks)	
(Di-Syston® 15% G)	6.7 lb	28	28
malathion		(see remarks)	
(Cythion® 5 lb)	1 1/2 - 2 pt	0	0
(Cythion® 8 lb)	1 1/4 - 1 1/2 pt	0	0
methyl Parathion			
(Methyl Parathion 4 lb)	1 pt	15	15
(Methyl Parathion 7.5 lb)	1/4 - 1/2 pt	15	15
(Penncap-M®)	2 - 3 pt	15	15

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

Remarks

Chlorpyrifos. Do not make more than four applications per year or apply more than once per crop cutting. Not labeled for use on clover.

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.

Disulfoton. Make only one application per crop season.

Malathion. When alfalfa is in bloom, spray only in the early morning or late evening to avoid bee kill.

to congregate 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.

Resistance to this pest is available in several alfalfa cultivars (see table, pages 4-7).

Three Cornered Alfalfa Hopper. 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, three cornered alfalfa hoppers are rarely an important factor in forage alfalfa production. In East Texas, however, the girdling damage to the vascular tissue of the stems results in a condition which mimics boron deficiency. Leaves on affected stems take on a red color underneath, and a light yellow-green color on top. Individual damaged stems which develop these symptoms usually die.

Check crowns closely near the soil surface for three cornered alfalfa hop-

Suggested Three Cornered Alfalfa Hopper Control in Alfalfa and Clover

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		(see remarks)	
(Sevin® 4 F)	1 qt	7	7
(Sevin® 50 W)	2 lb	7	7
(Sevin® 80 S)	1/4 lb	7	7
(Sevin® XLR Plus)	1 qt	7	7
malathion		(see remarks)	
(Cythion® 5 lb)	1 1/2 - 2 pt	0	0
(Cythion® 8 lb)	1 1/4 - 1 1/2 pt	0	0

Remarks

Carbaryl. Apply only once per cutting.

Malathion. Do not apply to clover or alfalfa in bloom. Do not apply to seed clover or alfalfa.

per nymphs. Check several locations in each field. The action level in alfalfa and clover crops grown for hay is reached when nymphs average 25 to 30 per crown. In seed alfalfa and clover crops sample for three cornered alfalfa hopper adults with a sweep net. The action level is reached when sweep net counts average 150 or more per 100 sweeps.

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

Chewing Pests

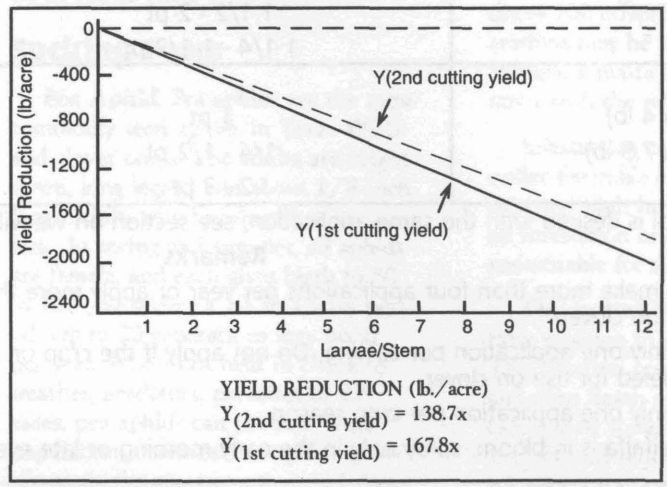
Alfalfa Weevil. The alfalfa weevil is primarily a pest of alfalfa, but may also attack several species of clover. The first and second alfalfa cuttings are most heavily damaged. Upon hatching, larvae feed on leaf buds, at the tip of the plant. Older larvae feed mostly on open leaflets, but they also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

Adult weevils lay eggs inside alfalfa stems in late fall, winter and early spring. Eggs are laid in groups of from 1 to 40 per stem. Each female lays 600 to 800 eggs. Activity ceases on cold days during winter. Fall-laid eggs begin to 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. Young larvae are white and feed inside stems 3 to 4 days. Larvae which emerge from stems are small and yellowish green. 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. The most severe damage is done by large larvae. The damage stunts the plant. High populations may remove virtually all 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:

1. the size of the alfalfa plant;
2. the size of the larvae; and
3. the number of larvae per alfalfa stem.

The following figure depicts losses which have been documented from various levels of alfalfa weevil infestation in Oklahoma.



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 and go to nearby protected areas for a summer resting period, returning to the fields again in the fall.

Crop production 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. Care should be taken to scout for alfalfa weevil damage to the regrowth, especially in the strips which were under the windrows.

Grazing 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 action level has been reached. The action level (see table, page 11) should be based on plant size, plant damage and numbers of weevil larvae. When conditions approaching the action level are found, cutting or insecticide treatment should be considered. If weevil populations are above treatment action levels and larvae are small, sprays can be delayed until the oldest larvae are half grown to allow as much egg hatch as possible. Using this strategy, care should be taken to allow passage of the label-specified time between spraying and cutting or grazing (see table, page 11). This strategy minimizes the chances of having to spray a cutting twice and allows for treatment of the maximum number of larvae without exposing the crop to excessive damage.

Sampling can be accomplished using several methods. Under situations in which the alfalfa weevil is a serious annual pest of alfalfa, the stem sampling (beat bucket) method is best. Using this method, 30 stems are collected at random throughout a field. (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. Larvae 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 which have only sporadic and occasionally severe alfalfa weevil damage, a sweep net can be used to quickly and effectively monitor weevil populations.

The following table provides action levels for each of these methods.

Action 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/ With presence of 1 medium or large larva per stem.

2/ In alfalfa within 1 to 2 weeks of cutting, it may be advisable to cut early rather than apply an insecticide.

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

Suggested Alfalfa Weevil Control on Alfalfa

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		(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
(Sevin® 50W)	3 lb	7	7
carbofuran		(see remarks)	
(Furadan® 4 lb.)	1 - 2 pt	14 - 28	14 - 28
chlorpyrifos		(see remarks)	
(Lorsban® 4E)	1 - 2 pt	14 - 21	14 - 21
malathion		(see remarks)	
(Cythion® 5 lb.)	1 1/2 - 2 pt	0	0
(Malathion ULV 9.79 lb.)	16 oz	5	5
(Cythion® 8 lb.)	1 1/4 - 1 1/2 pt	0	0
methyl Parathion			
Methyl Parathion (4 lb.)	1/2 - 1 pt	15	15
Methyl Parathion (7.5 lb)	1/4 - 1/2 pt	15	15
Penncap-M®	2 - 3 pt	15	15
permethrin		(see remarks)	
Ambush®	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)	
(Imidan® 70 WP)	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. Not 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 within 28 days after using 2 pts 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 days after application of 1 pt per acre, or within 21 days after application rates above 1 pt per acre.

Malathion. Do not apply when plants are in bloom. Do not use on seed alfalfa. For alfalfa weevil larvae only.

Permethrin. When rates are .1 lb ai/acre or less (Ambush® 6.4 oz/acre, Pounce® 4 oz/acre), application can be made on the day of harvest. When rates above .1 lb ai/acre are used, do not apply within 14 days of harvest. Apply no more than .2 lb ai/acre per cutting.

Phosmet. Do not apply more than once per cutting. Not effective against aphids.

Clover Head Weevil. The most important pest of Texas crimson clover is clover head weevil. It was first observed in Texas in light, scattered infestations during the spring of 1965. 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 clover 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 egg laying 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 in color 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. Damage is also caused by adults feeding on stems. This often results in lodging of the flowers.

The action level is based 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.

Grasshopper. Grasshoppers are 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. Grasshoppers are most damaging in dry years.

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

Suggested Clover Head Weevil Control on Clover

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
Methyl Parathion			
(Methyl Parathion 4 lb)	1 pt	15	15
(Methyl Parathion 7.5 lb)	1/2 pt	15	15

Suggested Grasshopper Control on Alfalfa and Clover

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl			
(Sevin® 80S)	2/3 - 1 7/8 lb	7	7
(Sevin® XLR Plus)	1/2 - 1 1/2 qt	7	7
(Sevin® 4F)	1/2 - 1 1/2 qt	7	7
(Sevin® 50W)	1 -3 lb	7	7
carbofuran		(see remarks)	
(Furadan® 4F 4 lb)	1/4 - 1/2 pt	7	7
dimethoate		(see remarks)	
(Dimethoate 400 4 lb.)	1/2 - 1 pt	10	10
(Dimethoate 2.67 lb.)	3/4 - 1 1/2 pt	10	10
malathion		(see remarks)	
(Cythion® 5 lb.)	1 1/2 - 2 pt	0	0
(Malathion ULV 9.33 lb.)	8 oz	0	0
(Cythion® 8 lb.)	1 1/4 - 1 1/2 pt	0	0

Remarks

Carbofuran. 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.

Dimethoate. Make only one application per cutting. Do not apply if crop or weeds in treatment area are in bloom. Not labeled for use on clover.

Malathion. Do not apply to alfalfa or clover in bloom.

Suggested Grasshopper Control on Pasture, Range and Non-cropland Before Grasshoppers Move to Fields

Insecticide (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Labeled application sites
acephate		(see remarks)
(Orthene® 75 S)	1/8 - 1/6 lb	pasture, range and wasteland
(Orthene® 75 S)	1/3 lb	non-cropland
(Orthene® 75 WSP)	1/8 - 1/6 lb	pasture, range and wasteland
(Orthene® 75 WSP)	1/3 lb	non-cropland
carbaryl		(see remarks)
(Sevin® 4F)	1/2 - 1 1/2 qt	pasture, range, non-cropland
(Sevin® 4-oil ULV)	1/2 - 1 1/2 lb	pasture, range, non-cropland
(Sevin® 50 W)	1 - 3 lb	rangeland, wastelands, non-cropland
(Sevin® 80 S)	2/3 - 1 7/8 lb	pasture, rangeland, non-cropland
(Sevin® XLR Plus)	1/2 - 1 1/2 lb	pasture, rangeland
(Sevin® XLR Plus)	1/2 - 1 lb	non-cropland
esfenvalerate		
(Asana® XL)	2.9 - 5.8 oz	non-cropland
malathion		(see remarks)
(Cythion® 5 lb)	1 1/2 - 2 pt	pasture, range
(Cythion® 5 lb)	1 1/2 - 3 pt	non-cropland
(Cythion® 8 lb)	1 1/4 pt	pasture, range
(Cythion® 8 lb)	1 - 2 pt	non-cropland
(Malathion ULV 9.79 lb)	8 12 oz	pasture, range, non-cropland
methyl parathion		(see remarks)
(Penncap-M®)	2 - 3 pt	pasture and rangeland
naled		(see remarks)
(Dibrom® 8 lb)	1/2 - 3/4 pt	rangeland
phosmet		(see remarks)
(Imidan® 70 WP)	2 1/8 - 2 3/4 lb	alfalfa field margins

Remarks

Acephate. For pasture range and wasteland: Do not apply when lactating dairy animals are present and do not feed or graze lactating dairy animals on treated foliage. Within 21 days of treatment, remove meat animals at least 1 day before slaughter. One application per season. For non-crop areas (field borders, fence rows, roadsides, ditch banks and barrow pits): Do not graze or feed vegetation from treated area.

Carbaryl. Zero days preharvest interval for aerial application. Fourteen days preharvest interval for ground applications on pastures and non-cropland. Non-cropland is wasteland, right-of-ways, hedge rows, ditchbanks and roadsides.

Malathion. Dilute in water or diesel fuel oil. Zero days preharvest or grazing interval.

Methyl parathion. Do not apply within 15 days of harvest or grazing.

Naled. Grazing animals may be present during treatment. Do not graze lactating dairy animals on treated area.

Phosmet. Do not harvest or graze treated area.

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 action level for field infestations is an average of 10 or more grasshoppers per square yard. Spot and/or border treatments can be effective.

Blister Beetle. Several species of blister beetles may be found in alfalfa fields during the growing season. The beetles range from 1/2 inch to more than 1 inch long and are black, gray, reddish or brown in color. Some species are striped. Adult blister beetles are narrow, cylindrical, rather soft-bodied beetles. The heads of blister beetles are wider than the neck areas. This feature separates them from the 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. 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. Horses and poultry are very sensitive to cantharidin, but all livestock are at risk.

Hay and feed producers should inspect alfalfa fields for the presence of blister beetles before hay is cut, especially during the months of June through September when the beetles most commonly move into 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.

Pay attention to the harvest interval on the insecticide you use.

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 action level for the primary foliage feeding caterpillars in alfalfa is used. It is important, however, to be able to identify these worms since insecticides which work against one worm may be ineffective against another.

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

Alfalfa Caterpillar. The alfalfa caterpillar is the larval stage of a yellow or white butterfly that 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 attach themselves to stems and pupate. The pupa is uncovered by a cocoon, is attached head up to the stem and lasts 5 to 7 days before the adult emerges. Mature larvae are

Suggested Blister Beetle Control on Alfalfa

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl			
(Sevin® 80S)	2/3 - 1 1/4 lbs	7	7
(Sevin® XLR Plus)	1/2 - 1 qt	7	7
(Sevin® 50W)	1 - 2 lbs	7	7
(Sevin® 4F)	1/2 - 1 qts	7	7

Suggested Alfalfa Caterpillar Control on Alfalfa

Insecticides (listed alphabetically) - toxicant per gallon or per pound	Concentrate per acre	Days from last application to: Harvest	Grazing
Bacillus thuringiensis			
(Agree®, Dipel®, Javelin®, Xentari®)	(see remarks)	0	0
carbaryl		(see remarks)	
(Sevin® 80S)	1/4 lb	7	7
(Sevin® XLR Plus)	1 qt	7	7
(Sevin® 50 W)	2 lb	7	7
(Sevin® 4F)	1 qt	7	7
methomyl			
(Lannate® 90% SP)	1/4 - 1/2 lb	0	7
(Lannate® LV)	1 - 1 1/2 pt	0	7
methyl Parathion			
(Methyl Parathion 4 lb)	1 pt	15	15
(Methyl Parathion 7.5 lb)	1/2 pt	15	15

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.

Methomyl. Do not apply when bees are in the field. Not registered on clover.

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 numbers usually increase when not held in check by diseases, beneficial insects and spiders or weather.

The alfalfa caterpillar usually becomes a pest after the third alfalfa hay cutting and is usually most abundant in mid to late summer (see action level, page 14). Crop damage can sometimes be avoided by early cutting.

Alfalfa caterpillar is normally the most damaging caterpillar on alfalfa in Texas. It is easily controlled with insecticides, however.

Armyworm. Armyworms are the immature stages of dull-colored, nocturnal 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 (see action level, page 15). The yellow-striped armyworm is an occasional pest in alfalfa. The armyworms are marked with an inverted "y" marking on the head. Infestations of armyworms are usually most severe in mid to late summer. Armyworms lay their eggs in 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 falling to the soil, burrowing (not deeper than 1 inch), constructing a loose pupal cell and pupating. Armyworms are normally the most difficult worms to control in alfalfa. Increased insecticide rates and/or tank mixes of insecticides may be required.

Corn Earworm. Corn earworm moths are tan in color, about 3/4 inch long, with 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 in color from pale green or pinkish to brown.

After emerging, feeding on nectar and mating, 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 feed on numerous plants. 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. (See action level, page 15).

Suggested Armyworm Control on Alfalfa

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
Bacillus thuringiensis (Agree®, Dipel®, Javelin®, Xentari®)	(see remarks)	0	0
chlorpyrifos (Lorsban® 4E)	1 - 2 pt	(see remarks) 14-21	14-21
methomyl (Lannate® 90% SP)	1/4 - 1 lb	(see remarks) 0	7
(Lannate® LV lb)	3/4 - 3 pt	0	7

Remarks

Bacillus thuringiensis. Application rates must be taken from the individual product labels due to the variation in formulations.

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.

Methomyl. Do not apply during bloom or when bees are present in field. Not registered for use on clover.

Suggested Corn Earworm Control on Alfalfa and Clover

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl (Sevin® 80S)	1 1/4 - 1 7/8 lb	7	7
(Sevin® XLR Plus)	1 - 1 1/2 qt	7	7
(Sevin® 50W)	2-3 lb	7	7
(Sevin® 4F)	1 - 1 1/2 qt	7	7

Remarks

Carbaryl. Apply only once per cutting.

Occasional Caterpillar Pests

Army Cutworm. There is only one generation per year of the army cutworm. Female moths lay eggs in the fall on the soil surface. 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 resume their feeding and growth. Mature 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 often 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 to three larvae more than 1/2 inch in length per square foot.

Webworm. Webworms are larval stages of small, buff-yellow to brown moths with 1-inch wing spans. The alfalfa webworm, the garden webworm and the beet webworm feed on alfalfa, clover, cowpeas, peas and similar crops as well as several weed species, especially pigweed. The larvae of all three 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 the cutting stage. The action level for insecticide use is reached when the crop is more than 2 weeks from cutting and 25 to 30 percent of plant terminals are infested.

Suggested Army Cutworm Control on Alfalfa

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl			
(Sevin® 80S)	1/4 - 1 7/8 lb	7	7
(Sevin® XLR Plus)	1 - 1 1/2 qt	7	7
(Sevin® 50W)	2-3 lb	7	7
chlorpyrifos		(see remarks)	
(Lorsban® 4 lb)	1 - 2 pt	14-21	14-21
permethrin		(see remarks)	
(Ambush®)	3.2 - 12.8 oz	0 - 14	
(Ambush® 25 W)	3.2 - 12.8 oz	0 - 14	
(Pounce® 3.2 EC)	2 - 8 oz	0 - 14	

Remarks

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

Permethrin. For rates less than .1 lb/ac (Ambush® 6.4 oz, Pounce® 4 oz), zero days cutting restriction. For rates above .1 lb/ac, 14 days cutting restriction.

Suggested Webworm Control on Alfalfa and Clover

(Alfalfa Webworm, Beet Webworm, Garden Webworm)

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		(see remarks)	
(Sevin® 80S)	1 1/4- 1 7/8 lb	7	7
(Sevin® XLR Plus)	1 - 1 1/2 qt	7	7
(Sevin® 4 F)	1 - 1 1/2 qt	7	7
(Sevin® 50 W)	2 - 3 lb	7	7
methyl parathion			
(Methyl Parathion 4 lb)	1 pt	15	15
(Methyl Parathion 7.5 lb)	1/2 pt	15	15

Remarks

Carbaryl. Apply only once per cutting. Pre-harvest interval is zero days on clover.

VETCH PESTS

Sucking Pests

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

A discussion of pea aphid biology is given on page 8 under alfalfa.

Thrips are tiny insects (1/15 inch long) with bodies which are much longer than they are wide. They are generally yellow to light brown in color, 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.

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. They readily move to new host plants. When flower buds are fed on, they often abort and fall from the plant.

The action level for these insects is shown in the following table.

Chewing Pests

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 are 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 of 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 vetch 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.

Pest Action Level – Pea Aphid, Thrips and Lygus Bug

Pea Aphid	When visible signs of plant wilting are observed, accompanied by foliage yellowing, honeydew and increasing aphid numbers.
Thrips	When seed production is a goal and excessive blasting and shedding of blooms is observed.
Lygus Bug	When seed production is a goal and lygus average two per sweep in bud and early bloom stages.

Suggested Aphid, Thrips and Lygus Bug Control on Vetch

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
malathion (Cythion® 5 lb)	1 1/2 - 2 pt	7	7
methyl parathion Methyl parathion (4 lb)	1 pt	15	15

Suggested Bruchid Control on Vetch

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
malathion (Cythion® 5 lb)	1 1/2 - 2 pt	7	7
methyl parathion (Methyl parathion 4 lb)	1 pt	15	15

Armyworm and Cutworm. Armyworms and cutworms may occur in damaging levels in fields of 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.

concrete mixer, custom designed seed treatment equipment or similar devices. Seed should be evenly coated with insecticide. Sprinkle 1 pint of water on each 100 pounds of seed and mix to coat the seed evenly with moisture. Add the correct amount of insecticide to the seed as specified by the pesticide label and mix thoroughly. Lindane 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 beds are thrown up or when bed shaping is done.

Suggested Armyworm and Cutworm Control on Vetch

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
methyl parathion (Methyl parathion 4 lb)	1 pt	(see remarks)	

Remarks

Methyl Parathion. For rates below 2 pt/acre, do not apply within 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 and Gaucho® are labeled insecticides which can be applied to forage sorghum seed by commercial seed treaters to control soil pests. In addition to its activity against soil insects, Gaucho® has activity on sucking pests.

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 pests.

Pre-plant Seed Treatment – On Farm. On-farm, pre-plant seed treatment can be accomplished by using a

available for on-farm seed treatment. Follow recommendations on the insecticide label to achieve effective control. Lindane is phytotoxic on sorghum seed and will adversely affect germination. **Do not treat seed with lindane more than 3 to 4 weeks prior to planting.**

Planter Box Seed Treatment. Some insecticides are formulated to be applied to seed in the planter box. This direct seed treatment method is effective only against certain pests and certain population levels. Use this soil insect control technique in strict accordance with recommendations on the insecticide label.

Uniform distribution of insecticide in the planter box is important. Do not get insecticide on the skin or in the eyes and do not breath insecticide dust.

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

With lister or conventional planters, mount spray or granular application equipment on the planter with the nozzle or spout just behind the opening plow and in front of the covering devices. Adjust nozzles or spouts so that the treatment band is about 7 to 10 inches wide and the seed furrow, as well as the covering soil, is treated. Usually, insecticide is adequately incorporated during seed covering. Applying some insecticide products directly in the seed furrow and in direct contact with the seed may affect germination. For these products, row-banding the insecticide behind the covering attachments is suggested.

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

Postemergence. Insecticides can be used against some of the soil dwelling pests of forage sorghums as a postemergence or rescue treatment. These applications are applied in a band directed at the base of the plant.

Suggested On-Farm (Pre-Plant or Planter Box) Seed Treatments

Insecticides - percent active ingredient	Remarks
Lindane	
Protox Seed Protectant - Drill Box Treatment (lindane 12.5%, Captan 6.25% dust)	Use according to label directions.
Triple Seed Protectant - (lindane 16.6%, diazinon 11%, captan 35% dust)	Use according to label directions.

Soil Pests

True and false wireworm, white grub, corn rootworm, cutworm, seed corn maggot and fire ants are common soil pests of forage sorghum in Texas. 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 preplant soil inspection for the presence of soil pest populations are important in the management of 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 wireworm, seed corn maggot and seed corn beetle and may suppress white grubs. Moderate to large populations of white grub and corn rootworm 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 in color from yellow to brown.

Wireworms damage forage sorghum by destroying planted seed and, to a lesser degree, by feeding on seedling plant roots. Stand establishment and plant vigor are reduced.

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

Fields should be sampled for the presence of wireworms prior to planting. Eight to ten soil samples 1 foot square by 4 inches deep should be taken from the rows and examined thoroughly. If two or more wireworm larvae per linear foot of row are detected, control measures are warranted.

No postemergence rescue treatments for wireworm control are registered. Therefore, pre-plant sampling for these pests is important.

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. Small seedlings often are killed, resulting in stand loss. The roots of larger plants can be severely pruned, resulting in stunting, plant lodging and increased susceptibility to drought and stalk rot.

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 which are labeled on sorghum may suppress white grubs, but none specifically list white grubs.

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 burrow into the roots and crowns of sorghum plants. Poor stands, reduced plant vigor and the occurrence of dead heart in young plants are characteristic of rootworm damage. Plant lodging may occur later in the season.

Seed treatments with lindane are effective in controlling light infestations of corn rootworm. See Seed Treatment Section for procedures. More severe infestations require an at-planting soil insecticide. The decision to apply an at-planting insecticide is based primarily on damage in previous years.

Cutworm. A complex of cutworms can damage forage sorghum. Cutworms are the immature stages 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 only during the seedling stage.

Cultivation, crop rotations which include fallow fields, and the use of herbicides to kill weeds are important methods for controlling cutworms in forage sorghum.

Suggested Corn Rootworm Control on Forage Sorghum

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Amount per acre on a 40 inch row spacing (lbs/acre)
chlorpyrifos Lorsban® 15G	8 oz/1000 linear ft	(see remarks) 6.5
fonofos Dyfonate II® 20G	6 oz/1000 linear ft	(see remarks) 5

Remarks

Lorsban. Apply in a 6 - 8 inch band or T-band and incorporate into the top 1 inch of soil at planting.

Dyfonate. Apply in a 7 inch wide band using a row-bander directly behind the seed furrow opener and in front of the press wheels, or in a 7 inch wide band directly behind the press wheels using drag chains or spring tines to insure incorporation. **Do not make in-furrow applications.**

Suggested Cutworm Control on Forage Sorghum			
Insecticides (listed alphabetically) - toxicant per gallon or pound	**Concentrate per acre**	**Days from last application to: Harvest**	**Grazing**
carbaryl			
(Sevin® 80S)	2 1/2 lb	0	0
(Sevin® XLR Plus)	2 qt	0	0
(Sevin® 50W)	4 lb	0	0
(Sevin® 4F)	2 qt	0	0

Aerial or ground application of insecticides effectively controls cutworms in established forage sorghum stands.

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

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 the 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 at which 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.

Fire Ants. Fire ants can become a problem on minimum till or no-till forage sorghum in the eastern half of Texas. Damage to seed and seedlings by fire ants is generally most severe during dry years. Fire ant suppression can reduce damage. Baits such as Amdro® can be used on non-crop land (land which will be farmed, in the months prior to planting) to suppress ants. Other options to prevent fire ant damage are seed treatments (see preplant seed treatment sections) and T-band granular insecticide applications at planting.

Suggested Lesser Cornstalk Borer Control on Forage Sorghum		
Insecticides (listed alphabetically) - toxicant per gallon or pound	**Concentrate**	**Amount per acre on a 40 inch row spacing (lb/ac)**
chlorpyrifos		(see remarks)
(Lorsban® 4 E)	1 - 2 pt/ac	1 - 2 pt
(Lorsban® 15 G)	4 - 12 oz/1000 linear ft	3.3 - 9.8
fonofos		(see remarks)
(Dyfonate® II 20-G)	6 oz/1000 linear ft	5

Remarks

Chlorpyrifos. Lorsban® 4 E, apply in 8-12 inch band directed at bases of plants, postemergence. Lorsban 15G, apply in 6-8 inch T-band and incorporate into the top 1 inch of soil at planting.

Fonofos. Apply in a 7 inch band using a row-bander behind furrow opener but in front of press wheel or behind press wheel using drag chains or spring tines for incorporation. It is acceptable to allow some granules to fall into the seed furrow, but **do not apply as an in-furrow treatment**.

Suggested Fire Ant Suppression on Forage Sorghum		
Insecticides (listed alphabetically) - toxicant per gallon or pound	**Concentrate per acre**	**Application**
chlorpyrifos		(see remarks)
(Lorsban® 15G)	8 oz/1000 ft^2	T-band at-plant

Remarks

Lorsban. Apply in a T-band at planting.

Above-ground Pests

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

Greenbugs can cause stand loss, stunting and plant death in forage sorghums. They are not as damaging in forage sorghum as in grain sorghum, however. 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 scouting 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 requiring treatment.

Armyworm. Armyworms are the immature stages of dull-colored, nocturnal moths. Armyworm larvae range in color from pale green to brown or black and are often striped with white to yellowish lines from head to tail. They are characterized by having an inverted "Y" marking on the head.

Fall armyworm is the most common of this group in forage sorghums. Armyworm populations often increase in late summer and early fall, but insecticides are not recommended because economically important damage is very rare.

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 if the pest population is large. An average of six to seven grasshoppers per square yard can consume as much forage as one cow per acre.

Grasshopper control in forage sorghum production should be initiated before the pests move out of hatching areas such as fence rows, ditch banks, weedy fields, etc. Grasshoppers are most damaging during dry years.

Suggested Greenbug Control on Forage Sorghum

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
Attention: Review all **remarks** below thoroughly.			
dimethoate		(see remarks)	
(Dimethoate® 4 lb)	1/2 - 1 pt	28	28
(Dimethoate® 5 lb)	6.4 - 12.8 oz	28	28
(Dimethoate® 2.67 lb.)	3/4 - 1 1/2 pt	28	28
disulfoton		(see remarks)	
(Di-Syston® 15% G)			
in-furrow	5 - 6.7 lb	45	45
band	6.7 lb	45	45
whorl	6.7 lb	45	45
(Di-Syston® 8 lb)			
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
phorate		(see remarks)	
(Thimet® 15% G)	6.5 - 8.7 lb	30	30
(Thimet® 20% G)	4.9 - 6.5 lb	30	30

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, the initial insecticide application should be made at the 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.

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. 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.

Phorate. Labeled for use at planting in a 7 inch band over the row, or placed 1 inch below and 2 inches to the side of the seed. **Do not place in contact with the seed**. May be applied postemergence as a side-dress. Application rates depend on row widths (consult label).

Suggested Grasshopper Control on Forage Sorghum

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		(see remarks)	
(Sevin® 80S)	2/3 - 1 7/8 lb	0	0
(Sevin® XLR Plus)	1/2 - 1 1/2 qt	0	0
(Sevin® 50W)	1 - 3 lb	0	0
(Sevin® 4F)	1/2 - 1 1/2 qt	0	0
dimethoate		(see remarks)	
(Dimethoate 4 lb)	1 pt	28	28
malathion		(see remarks)	
(Cythion® 5 lb)	1 1/2 - 2 pt	0	0
(Cythion® 8 lb)	1 1/4 pt	0	0
(Malathion ULV 9.79 lb)	8 - 12 oz	0	0
methyl parathion		(see remarks)	
(Methyl Parathion 4 lb)	1 1/2 pt	15	15

Remarks

Carbaryl. Use lower rates against nymphs on small plants and higher rates when grasshoppers are mature or crop has more foliage.

Dimethoate. Make no more than 3 applications. Do not apply after heading. For ground application, use 25 - 40 gallons water per acre. For aerial, use at least 1 gallon of water per acre.

Malathion. Cythion 5 lb. may be mixed 1 1/2 pt per gallon in diesel fuel. When mixed with diesel, apply only the 1 1/2 pt/ac rate.

Methyl parathion. Labeled use: Grass (Forage).

Suggested Grasshopper Control on Pasture, Range and Non-Cropland

Insecticide (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Labeled application sites
acephate		(see remarks)
(Orthene® 75 S)	1/8 - 1/6 lb	pasture, range and wasteland
(Orthene® 75 S)	1/3 lb	non cropland
(Orthene® 75 WSP)	1/8 - 1/6 lb	pasture, range and wasteland
(Orthene® 75 WSP)	1/3 lbs	non cropland
carbaryl		(see remarks)
(Sevin® 4-Oil ULV)	1/2 - 1 1/2 lb	pasture, range, non-cropland
(Sevin® 50 W)	1 - 3 lb	rangeland, wastelands, non-cropland
(Sevin® 80 S)	2/3 - 1 7/8 lb	pasture, rangeland, non-cropland
(Sevin® XLR Plus)	1/2 - 1 1/2 lb	pasture, rangeland, non-cropland
esfenvalerate		
(Asana® XL)	2.9 - 5.8 oz	non-cropland
malathion		(see remarks)
(Cythion® 5 lb)	1 1/2 - 2 pt	pasture, range
(Cythion® 5 lb)	1 1/2 - 3 pt	non-cropland
(Cythion® 8 lb)	1 1/4 pt	pasture, range
(Cythion® 8 lb)	1 - 2 pt	non-cropland
(Malathion ULV 9.79 lb)	8 - 12 oz	pasture, range
methyl parathion		(see remarks)
(Penncap-M®)	2 - 3 pt	pasture and rangeland
naled		(see remarks)
(Dibrom® 8 lb)	1/2 - 3/4 pt	rangeland

Remarks

Acephate. For pasture range and wasteland: Do not apply when lactating dairy animals are present and do not feed or graze lactating dairy animals on treated foliage. Within 21 days of treatment, remove meat animals at least 1 day before slaughter. One application per season. For non-crop areas (field borders, fence rows, roadsides, ditch banks and borrow pits): Do not graze or feed vegetation from treated area.

Carbaryl. Zero days preharvest interval for aerial application. Fourteen days preharvest interval for ground applications on pastures and non-cropland. Non-cropland is defined as wasteland, right-of-ways, hedge rows, ditch banks and roadsides.

Malathion. Dilute in water or diesel fuel oil. Zero days preharvest or grazing interval.

Methyl parathion. Do not apply within 15 days of grazing.

Naled. Grazing animals may be present during treatment. Do not graze lactating dairy animals on treated area.

The action level is seven to ten grasshoppers per square yard accompanied by excessive leaf loss.

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 in color 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 of seedling emergence until plants are 18 inches high. Chinch bugs are favored by hot, dry weather and large numbers of immatures 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, initiate control when immature and adult bugs infest 75 percent of the plants. With ground application equipment, direct nozzles at the infested portion of the plants. To be most effective, apply insecticide in 20 to 30 gallons of water per acre.

PESTS OF PERMANENT AND IMPROVED PASTURES

Grasshoppers, fall armyworms and true armyworms are the most common insect pests of pastures. In some areas of the state, desert termites have become a problem.

Grasshopper. Grasshoppers are the most important insect pest 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. Hatching begins when daytime temperatures are 70 degrees F. or higher for several days and soil is moist.

Eight or more grasshoppers per square yard is considered the action level on rangeland and pastures.

See the table titled Suggested Grasshopper Control on Pasture, Range and Non-cropland, page 22, for insecticide suggestions in pastures and rangeland.

Armyworm. The fall armyworm and true armyworm can be the most damaging insect pests of improved pastures, temporary winter pastures, permanent pastures and small grains. These insects commonly occur in spring, late summer or fall and are often associated with wet weather. These pests are easily controlled, but extensive damage may occur before growers notice an infestation. Improved, temporary and permanent pastures, as well as small grains should be watched closely; especially during rainy periods in late summer and fall.

The action level is three or more small worms per square foot.

Suggested Chinch Bug Control on Forage Sorghum

Insecticides (listed alphabetically) - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl			
(Sevin® 80S)	1 1/4 - 2 1/2 lb	0	0
(Sevin® XLR Plus)	1 - 2 qt	0	0
(Sevin® 50W)	2 - 4 lb	0	0
(Sevin® 4F)	1 - 2 qt	0	0

Suggested Fall Armyworm Control in Pastures

Insecticides (listed alphabetically - toxicant per gallon or pound	Concentrate per acre	Days from last application to: Harvest	Grazing
carbaryl		(see remarks)	
(Sevin® 80S)	1 1/4 - 2 1/2 lb	0 - 14	0 - 14
(Sevin® XLR Plus)	1 - 1 1/2 qt	0 - 14	0 - 14
(Sevin® 50W)	2 - 3 lb	0 - 14	0 - 14
(Sevin® 4F)	1 - 1 1/2 qt	0 - 14	0 - 14
malathion			
(Cythion 5 lb)	2 pt	0	0
methyl parathion			
(Methyl parathion 4 lb)	1 1/2 pt	15	15

Remarks

Carbaryl. Zero days waiting required for harvest and grazing with aerial application, 14 days for ground application.

Desert Termite. Desert termites infest South and West Texas coastal bermuda pasture 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 and are mostly associated with areas which have high clay content soils. Clay chimneys covering grass stems are built during the night or cooler parts of the day by the worker and soldier termites. Infested areas have a dark and unusual appearance as the population increases. Rainfall will decrease termite numbers but termites become very active following rains. If dry weather continues and stand loss of the grass is occurring, 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 help to reduce their populations. Malathion (5 pounds 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 to 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 a mound is hit. In order to reduce machinery damage, farmers may be forced to alter harvesting practices. Dragging a heavy bar to break up mounds between cuttings may be required. Disc-type or Kountz cutters can be used to cut forages in fire ant infested areas. They can withstand the impact with large mounds without damage.

See the publication, B-1536, Fire Ants and Their Control, available at your local county Extension office. This publication gives a complete description of the biology, development, identification and control of this pest.

Suggested Fire Ant Control in Pastures

Insecticides (listed alphabetically) - toxicant per gallon or pound	Mix rate/ 100 gal. water	Use rate	Method
acephate			
(Orthene® Turf, Tree & Ornamental Spray 75%)	20 oz	1 gal/mound	Indiv. mound treatment
carbaryl			
(Sevin® XLR)	1 1/2 qt	2 gal/mound	Indiv. mound treatment
(Sevin® 80S)	2 lb	2 gal/mound	Indiv. mound treatment
(Sevin® 50W)	3 lb	2 gal/mound	Indiv. mound treatment
fenoxycarb			
(Logic® 1%)		1 - 1 1/2 lb/ac	Broadcast, labeled only on horse pastures
hydramethylnon			
(Amdro® 0.88%)		1 1/2 lb/ac or 5 Tbsp/mound	Broadcast or indiv. mound treatment

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