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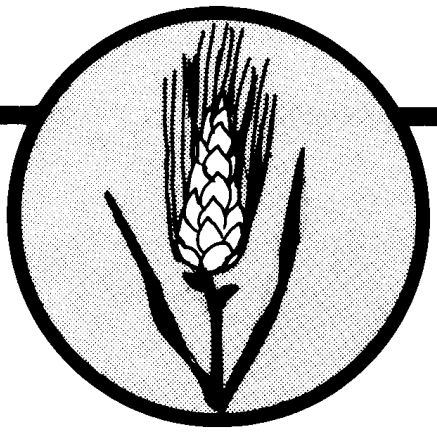
Managing Insect and Mite Pests of Texas Small Grains



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Acknowledgment

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Managing Insect and Mite Pests of Texas Small Grains

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Insect management refers to the use of the most economical and ecologically sound pest suppression techniques. These techniques include cultural practices such as crop rotation, fertilization, and variety and planting date selection; biological control, involving recognition and use of pests'natural enemies; and chemical control, the judicious use of selected products and rates to suppress pest numbers below economically damaging levels. Certain cultivars are resistant to pests such as the greenbug, Russian wheat aphid and Hessian fly. Plant damage does not always relate directly to pest numbers. Other factors such as plant vigor, stage of growth, moisture conditions, crop rotation practices, and weather influence crop damage.

The best pest control strategy is prevention.Use good agronomic practices and cultural methods. Use insecticides only when pest populations reach levels that can cause crop losses greater than the cost of treatment.The potentially damaging population, or plant damage level, is called the **economic threshold** or **action level**.

Pests are active at different times during the small grains growing season—September through June. Figure 9 shows the probable seasonal occurrence of pests as related to plant development. Fields must be inspected regularly, twice weekly during critical periods, to make informed pest management decisions. Pest descriptions, methods of monitoring insects and mites, and various pest control methods are included in this publication.

CULTURAL PRACTICES

Plant Health

Factors that affect a small grain plant will also affect the insects and mites that feed upon the plant. The healthier, more vigorously growing, and larger the plant, the more pests it can tolerate without significant loss. This has been demonstrated for the greenbug, bird cherry-oat aphid, winter grain mite and Hessian fly.

Varietal Selection

In areas where the Hessian fly has been a problem, planting resistant varieties of wheat or barley is a major component of management. However, the Hessian fly has developed new biotypes that overcome the resistance genes. This has also been a problem with greenbug, although the TAM-110 variety is resistant; in the Panhandle, its area of adaptation, TAM-110 provides effective greenbug control.

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Tillage and Other Management Factors

Tillage has long been recognized as important for insect control. It not only destroys host plants, but also may bury some insects too deeply for survival. Plowing under stubble reduces Hessian fly and some other pests that remain on or in the stubble.

Reduced tillage leaves more crop residue on the soil surface, reduces soil temperatures, and increases soil moisture. Some evidence shows that reduced tillage may encourage certain diseases and insects. The wheat curl mite, a vector of the wheat streak mosaic virus, is an example. This mite is a particular problem in the Texas Panhandle, where it survives between crops on volunteer wheat. Winter grain mites and brown wheat mites increase where there is crop residue. However, other research indicates that reduced tillage reduces aphid numbers. In a reduced tillage program, intensified pest management may be needed to prevent crop losses.

Reducing small grain stubble and controlling volunteer plants and summer weeds will help in managing Hessian fly and wheat curl mite where they are a problem.

Crop Rotation

Crop rotation is particularly useful for managing pests with a limited dispersal range, such as Hessian fly, white grubs, wireworms and winter grain mites. Rotation is often very profitable.

Planting Date

Small grains are cool season plants and will not grow well when daytime high temperatures are in the upper 90s. Small grains planted when temperatures are cooler will establish more quickly and grow more vigorously. Small grain pastures should be planted after mid-September, and grain production fields should be planted after October 1. Delayed planting will allow wheat and barley to miss at least part of the first Hessian fly generation. Greenbug, Russian wheat aphid and bird cherry-oat aphids will have less time to establish populations. Wheat curl mite infestation can be reduced when volunteer small grain plants are destroyed before the small grain crop is planted.

GRAZING MANAGEMENT

In Texas, wheat is planted on more than 6 million acres each year; about 40 percent of the acreage is grazed to some extent and 30 percent is used only for forage. Oats, barley, rye and triticale also are used for livestock forage. Small grains pastures are usually seeded after there is adequate moisture in September or

early October, and cattle are allowed to graze after the plants have established a good root system.

Grazing of small grains suppresses aphid and winter grain mite infestations. However, where aphid populations are above the economic threshold after small grains are well established, livestock might be placed on part of the pasture and the remainder treated. After the re-entry interval for grazing specified on the insecticide label, the livestock can then be turned into the treated portion of the pasture. The grazed area should then be inspected to determine if aphid control is still needed. Under heavy grazing it is unlikely that the aphid infestation will still be above the economic threshold.

Comparisons of aphid infestations in wheat that is and is not grazed have shown that grazing reduces aphid numbers three to ten fold. However, when aphid infestations are very light and many of the aphids are winged, there will be little difference in the numbers of aphids found in grazed and ungrazed wheat. In general, the heavier the grazing the more an aphid infestation is reduced. When livestock are taken off the pastures, aphids will increase. Livestock are generally removed from wheat pasture just before it begins jointing and rapidly growing. The chance that damaging numbers of aphids will develop then is greatly reduced because the plants are large and growing vigorously.

BIOLOGICAL CONTROL

Insect and mite infestations are often held below damaging levels by weather, inadequate food, and natural enemies such as parasites, predators and pathogens. It is important to recognize the impact of these natural control factors and, where possible, to encourage them. Parasitic wasps and lady beetles often increase in warm weather, further reducing the need for insecticide.

Biological control is the use of living organisms (parasites, predators and pathogens) to control pests. Important natural enemies of the insect and mite pests attacking wheat include several kinds of parasitic wasps, lady beetles and lacewings. Other predators include syrphid flies, damsel bugs, big-eyed bugs and spiders. Pathogenic fungi also control aphids somewhat.

Biological control is most effective when used with other compatible pest control practices in an integrated pest management (IPM) program. These practices include cultural control, host plant resistance, and the selective use of insecticides when other practices fail to keep pest numbers below economic levels.

Methods of biological control are conservation, importation and augmentation of natural enemies. 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. The effects of insecticides also can be minimized by using those more toxic to the target pest than to the natural enemy. Certain cultural practices also can encourage natural enemies.

Importation is the release of natural enemies into areas where they do not naturally occur. This method has been effective where an exotic pest has entered Texas without the natural enemies that help control the pest in its native country. Several species of natural enemies have been imported into Texas to control the Russian wheat aphid.

Augmentation is the purchase and periodic release of natural enemies that do not naturally occur in sufficient numbers to provide pest control. Green lacewings and convergent lady beetles are sometimes sold for release in wheat. Because definitive information on augmentation (when to apply, how many to release, etc.) is lacking, entomologists with the Texas Agricultural Extension Service cannot provide guidelines for augmentation as a management tool in wheat.

Refer to publication B-5044, “Biological Control of Insect Pests of Wheat,” available from your county Extension office, for detailed information on natural enemies of wheat insect pests and their use in biological control.The Texas A&M University System is committed to the development of pest management tactics that use biological control.

SOIL PESTS OF SMALL GRAINS

White grubs, wireworms, false wireworms and cutworms are the most common soil insect pests of Texas small grains. Weeds are important food sources for soil pests. Summer fallowing, tillage, and/or the use of herbicides to reduce crop residues and kill weeds are important measures for reducing soil pests.

Wireworms and False Wireworms

Wireworms are the immature stages of click beetles. Wireworms are shiny, slender, cylindrical, and usually hard-bodied.Larvae range from white to yellow to brown.

False wireworms are the immature stages of darkling beetles. Wireworms and false wireworms destroy planted seed and feed on seedling roots, reducing stands and plant vigor. Sample fields for wireworms before planting. False wireworms are more common when there is little rainfall.

Cultural controls for these pests include killing weeds in fields and rotating to warm season crops. Rotating to crops that can be treated with a preplant soil insecticide also will reduce wireworm damage.

Certain species of wireworms are abundant only in poorly drained soils; properly draining them will help prevent damage.

Imported Fire Ant

Imported fire ants feed on wheat seeds along field margins, where colonies are concentrated. Feeding may cause stand loss extending 10 to 15 feet into the field. Damage is most common during dry, warm weather that delays germination and gives ants more time to feed. Loose, dry soil gives ants easy access to the seed.

Control Techniques

It is important to prepare the seedbed properly and inspect the soil for soil pests before planting. There are no effective methods of treating soil pests with insecticides once the crop has been planted and seedlings have emerged. No insecticides are labeled for preplant soil application to small grains fields, but if damaging numbers of soil pests are detected, approved insecticides can be applied to the seed before planting. Preplant seed treatment or planter box treatment is generally effective in controlling wireworms and false wireworms.

Seed Treatment. Seed can be treated with a 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 insecticide label and mix thoroughly. Insecticides applied to prevent insect damage while seed is in storage will not control soil pests.

Planter Box Treatment. Lindane is specifically formulated as a planter box seed treatment for controlling wireworms, false wireworms and fire ants. This method should be used in strict accordance with label instructions. **Surplus treated seed must not be used for feed or food.**

White Grubs

White grubs are the larval stage of May or June beetles. Larvae are "C-shaped" with white bodies and tan to brown heads. The last abdominal segment is transparent, allowing dark, digested material to be seen. Larvae vary in size according to age and species. Larvae feed on plant roots, often killing small seedlings and causing stand loss. Larger plants with severely pruned roots may be stunted and more susceptible to drought.

Control Techniques

As soil temperature decreases in the fall, white grub feeding decreases and larvae migrate deeper into soil. Delayed planting may improve stand establishment.Seed and planter box insecticide treatments are not effective in controlling white grubs. There are no registered insecticides for white grub control in wheat.

Cutworms

Cutworms are the immature stages of drab, brownish moths that are active at night; several species can damage small grains. Grassy, weedy fields are attractive to moths for egg laying; however, army cutworm will lay eggs even in bare soil. Newly hatched cutworms are brown to black and feed on small grain seedlings. Older larvae have a shiny or "greasy" appearance. They clip the above ground portion of the plant from the root system at or below the soil surface. Infested fields have the appearance of being closely grazed, and damage may be "clumped" (occur in spots in the field).

Army cutworm is a true cutworm but feeds much like an armyworm.During late summer and early fall, female moths will lay 1,000 to 2,000 eggs each as they migrate through an area. Eggs hatch in a few days and larvae feed periodically through the fall and winter as temperature allows. By mid- to late winter, larvae as large as 3/8 to 1 3/4 inches can be found in small grains. Large populations can cause considerable damage by defoliating plants and reducing stands, especially in February and March as small grains begin to green up. Late, poorly tillered, or thin stands are particularly vulnerable to army cutworm. In outbreak years, it is not uncommon to find 10 to 20 cutworms per square foot. On sunny days they will be under debris or slightly below the soil surface. An insecticide application should be considered when four to five per square foot can be found. Small grains under good growing conditions can easily tolerate 10 to 12 per square foot.Larvae pupate in the soil in early spring and emerge as moths about 3 to 4 weeks later. These moths are attracted to lights and can become a real nuisance. They migrate from the area and return in late summer and early fall to begin the cycle again.

Control Techniques

Reduce weeds and crop residues in fallowed fields. Delay planting until fields have been clean plowed to reduce cutworm numbers. Aerial or ground applications of approved pesticides are effective in controlling cutworms in established stands of small grains.

SUGGESTED INSECTICIDES FOR CONTROLLING CUTWORMS*

Insecticide	Amount per acre	Waiting period (days) to: Harvest	Grazing
Methyl parathion			
(4 lb.)	12-16 oz.	15	15
(7.5 lb.)	6-8 oz.	15	15
Lambda cyhalothrin			
(Warrior® T)	1.92-3.2 oz.	30	30

Remarks

Applying insecticide in late afternoon or evening may improve control.

Lambda cyhalothrin. Labeled for wheat, wheat hay and triticale. Do not apply more than 0.48 pints per acre per season.

ABOVE GROUND PESTS OF SMALL GRAINS

Fall Armyworm

In addition to small grains, fall armyworms are found on corn, grain sorghum, sorghum grass hybrids, peanuts, alfalfa, cowpeas and cotton. The larvae are usually shades of brown, but may also be greenish to nearly black. There are four distinct spots on top of the eighth abdominal segment, and a white, inverted Y on the front of the head. Mature larvae are 1 1/2 inches long. Early planting of small grains increases the risk of fall armyworm infestation.When large infestations occur on other hosts, fall armyworm moths may deposit eggs in seedling small grains. Small larvae feed on the leaf tissue, creating tiny "window panes" in the leaves. Larger larvae consume entire leaves and are more difficult to control. **Control is suggested when there are four or more larvae, 1 inch or longer, per square foot, and their damage is threatening the stand. Delaying planting can reduce damage when there are large infestations in other host crops or when dry conditions limit the attractiveness of other hosts.**

Armyworm

Armyworms may attack small grains in large numbers, devouring all material in their path. Outbreaks are favored by cool, damp weather from late March through June. The larvae feed mostly at night and are 1 1/2 inches long when fully grown. They are green to brown with light stripes on the sides and back; there is a dark band on the outer side of each proleg. The head has a pattern of narrow lines that looks like a net, but no white, inverted Y as in the fall armyworm. Once high temperatures average 88 degrees F armyworm larvae do not develop well and their numbers dramatically decrease. Infestations often begin in areas of fields where small grains are the tallest and thickest, or near the edges of fields where weeds provide a favorable environment. Armyworms can cause extensive damage below the crop canopy before they are detected. Early detection is important because small larvae are easier to control and the larger the larvae, the more they will consume. Damage symptoms include defoliation and beard and head clipping. **Control is suggested when four or five larvae per square foot are found in combination with evidence of extensive feeding on lower leaves.**

Control Techniques

Armyworms hide at the bases of the plants during the day and move up the plants to feed during cloudy weather, late in the afternoon and at night. Insecticide applied late in the afternoon is more effective.

SUGGESTED INSECTICIDES FOR CONTROLLING FALL ARMYWORMS AND ARMYWORMS

Insecticide	Amount per acre	Waiting period (days) to: Harvest	Grazing
Carbaryl			
(Sevin® *XLR Plus)	1-1.5 qts.	21	0
(Sevin® 4-Oil)	1-1.5 qts.	21	0
(Sevin® 80S)	1.25-1.875 lbs.	21	0
Ethyl parathion		See remarks	
(4 lb.)	0.75-1 pt.	15	15
(8 lb.)	4 oz.	15	15
Methomyl			
(Lannate®)			
(90% SP)	0.25-0.5 lbs.	7	0
(2.4 lb. LV)	0.75-1 pt.	7	0
Methly parathion			
(4 lb.)	0.75-1 pt.	15	15
(7.5 lb.)	6-13 oz.	15	15
Lambda cyhalothrin		See remarks	
(Warrior® T)	2.56-3.84 oz.	30	30

Remarks

Ethyl parathion. Not cleared for use on oats or rye. No ground application.Application only by certified commercial aerial applicator with closed mixing-loading system.

Lambda cyhalothrin. Labeled for wheat, wheat hay and triticale. Do not apply more than 0.48 pints per acre per season.

Greenbug

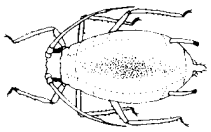

Figure 1. Greenbug

Greenbugs suck plant juices and inject toxins into plants. These aphids are pale green, approximately 1/16 inch long, with a dark green stripe on the back. Greenbugs develop in large numbers under favorable conditions and may cause economic losses. They reproduce rapidly at temperatures between 55 and 95 degrees F. Their natural enemies, however, reproduce slowly when temperatures are below 65 degrees F. Thus, in cool weather the greenbug may increase to enormous numbers while its natural enemies multiply slowly. The average temperature must be below 20 degrees F for at least a week to kill 99 percent of greenbugs. The population also must be without protection from snow cover. During the winter, infested plants may turn yellow. Spots in fields or entire fields may be affected. Small grains may be killed by heavy, uncontrolled infestations. Greenbugs cause more damage when small grains suffer from lack of moisture during a mild winter and cool spring.Greenbug damage may be confused with moisture stress, nitrogen deficiency or dryland root rot (foot rot). Greenbugs are a vector of barley yellow dwarf virus.

Sampling for Greenbugs. While walking diagonally across the field, make at least five random counts per 20 acres of field area, each count consisting of 1 linear foot of row. Greenbugs can be counted on small plants. On larger plants, slap the plants against the ground to jar

greenbugs loose for counting. If greenbugs are numerous, estimate the number present. Make counts during the warmest part of the day when greenbugs are most likely to be exposed on the above ground parts of the plants. During cool, dry weather, greenbugs may congregate in loose soil at the bases of plants, making detection and chemical control difficult.

When to Treat. The need to apply insecticide depends on the number of greenbugs present, the size and vigor of plants, the temperature, time of year, moisture conditions, stage of plant growth, and effectiveness of parasites and predators. Irrigated small grains can withstand larger greenbug populations.

Greenbug populations may be reduced by predators and parasites, including lady beetles, parasitic wasps, spiders, damsel bugs, lacewing larvae and syrphid fly larvae. The convergent lady beetle and the parasitic wasp *Lysiphlebus testaceipes* are the most important beneficials.

It is impractical to specify all conditions under which insecticides should be applied for greenbug control. Following is a general guide for determining the need for treatment.

Plant height (inches)	Number of greenbugs per linear foot
3-6	100-300
4-8	200-400
6-16	300-800

Yellow or brown plants caused by greenbug feeding in spots in the field may indicate a need for treatment. **Occasionally, populations of 25 to 50 greenbugs per foot of drill row on very young plants may warrant treatment.**

Heavy, rapidly increasing greenbug infestations can cause excessive damage;however, lady beetles and parasitic wasps, under favorable weather conditions, can reduce greenbug populations. Where there are one to two lady beetles (adults and larvae) per foot of row, or 15 to 20 percent of the greenbugs have been parasitized, control measures should be delayed until it can be determined whether the greenbug population is continuing to increase. When weather conditions remain favorable for predator and parasite activity, greenbug populations will be significantly reduced during the following week.

Insecticide Resistant Greenbugs. Greenbug resistance to registered insecticides has created problems for small grain producers in the Texas High Plains. An extensive 1992 survey in High Plains sorghum found insecticide resistant greenbugs in 14 counties, especially north of Amarillo. Resistant greenbugs are known to overwinter in small grains and to develop after an insecticide treatment for Russian wheat aphids. Every effort should be made to apply insecticide only to fields where economic thresholds have been exceeded.

Host Plant Resistance. TAM-110 is the first wheat variety to carry resistance to all current greenbug biotypes (E, I and K). TAM-110 is basically TAM-107 with improved resistance to greenbug.

Control Techniques

Low temperatures will slow the activity and effectiveness of most insecticides. It may take twice as long for an insecticide to kill at 45 degrees F as it would at 70 degrees F. For best results, apply insecticides when temperatures are above 50 degrees F. If an application must be made when the temperature is lower, use the highest rate recommended.

SUGGESTED INSECTICIDES FOR CONTROLLING GREENBUGS

Insecticide	Amount per acre	Waiting period (days) to: Harvest	Grazing
Chlorpyrifos		See remarks	
(Lorsban® 4E-SG)	0.5-1 pt.	28	14
Dimethoate		See remarks	
(2.67 lb.)	0.75-1 pt.	35	14
(4 lb.)	0.5-0.75 pt.	35	14
Disulfoton		See remarks	
(Di-Syston® 8 lb.)	0.25-0.75 pt.	30	
Ethyl parathion		See remarks	
(4 lb.)	0.5-1.5 pts.	15	15
(8 lb.)	4 oz.	15	15
Malathion		See remarks	
(5 lb.)	0.5-1.5 pts.	7	7
Methyl parathion			
(4 lb.)	0.5-1.5 pts.	15	15
(7.5 lb.)	4-12 oz.	15	15
Encapsulated (Penncap-M®)			
(2 lb.)	1-1.5 pts.	15	15

Remarks

Chlorpyrifos. Labeled for use on wheat only. Do not make more than two applications per crop.

Dimethoate. Labeled for use on wheat only.

Disulfoton. Labeled as foliar spray only on wheat. Do not graze or harvest forage in treated fields. Do not repeat application within 30 days.

Ethyl parathion. Not labeled for use on oats and rye. No ground application. Application only by certified commercial aerial applicator with closed mixing-loading system.

Malathion. Not as effective as disulfoton or methyl parathion, but may be used where a less toxic material is preferred for ground applications.

Russian Wheat Aphid

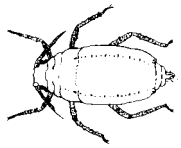

Figure 2. Russian wheat aphid

The first appearance of the Russian wheat aphid in the U.S. was in March 1986 in the Texas High Plains. It has since extended its range throughout the Great Plains, into Canada and to the west coast. The Russian wheat aphid is up to 1/16 inch long, lime green, and spindle-shaped. It has short antennae and no prominent cor-

nicles, but a projection above the cauda (tail) gives it a "double tail" appearance.

Russian wheat aphids inject a toxin while feeding, causing white and purple longitudinal streaks on leaves. Heavily infested plants appear flattened and leaf edges roll inward, giving the entire leaf a tube-like appearance. Russian wheat aphids prefer feeding on the younger, uppermost leaves of a plant.They may be vectors of viral diseases.

Russian wheat aphids cause the most damage in small grains that are stressed. Use cultural practices that reduce crop stress. Destroying volunteer wheat and planting later will delay the initial aphid infestation.

Predators and parasites are important in suppressing the Russian wheat aphid. Many of the natural enemies that attack the greenbug also attack the Russian wheat aphid. Wheat should be managed to conserve these natural enemies.

Wheat and barley are preferred Russian wheat aphid hosts, while triticale, rye and oats are less preferred. They are occasionally observed on corn and sorghum, but are not known to cause any damage. Wild hosts include cool season grasses such as jointed goat grass, various brome grasses, and several species of wheat grasses. The aphid is found in the greatest numbers and has the greatest impact in the High Plains. Although it is found in the Rolling Plains (Fig. 3), it is not now considered an important pest there because it is unable to oversummer. In the High Plains, the aphid can oversummer on warm season grasses such as green sprangletop, buffalo grass, and several species of grama grass.

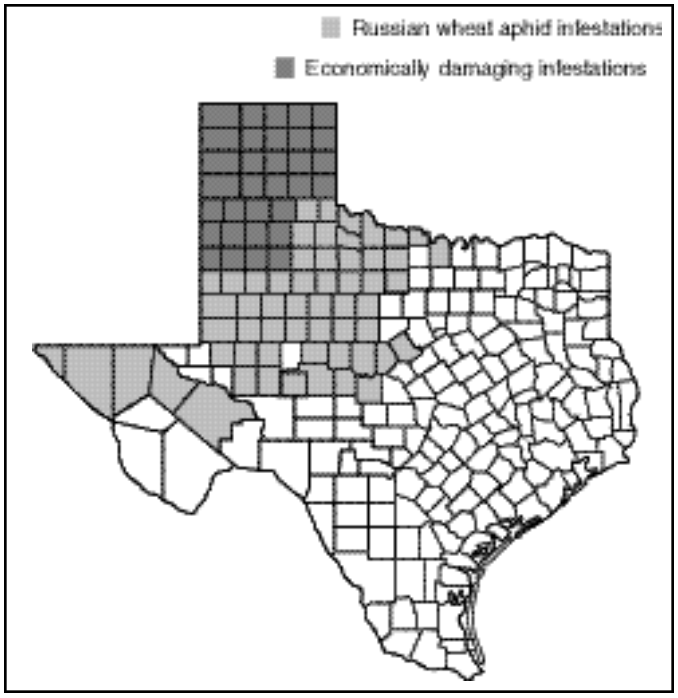

Figure 3. Texas counties where Russian wheat aphids have been found.

Texas Agricultural Experiment Station scientists have developed economic thresholds for Russian wheat aphids infesting wheat in late winter and spring. The thresholds are based upon the cost of control and the market value of wheat. **For every 1 percent of the tillers infested, there is a 0.5 percent yield loss.**

Sampling and Economic Thresholds for Russian Wheat Aphid. While walking across a field, randomly select 100 tillers, each from a different site. To prevent bias, select tillers without looking at them. Carefully examine each tiller and record the number infested. Consider any tiller with one or more Russian wheat aphids as infested. Determine the percent of infested tillers and use the following table to decide whether treatment is justified. For example, if the market value of the crop is projected to be $50 per acre and control costs are $9 per acre, the treatment threshold is 36 percent infested tillers.

Russian Wheat Aphid Economic Threshold Using Percent Infested Wheat Tillers as the Sampling Unit

	Market value of crop ($) per acre					
Control cost per acre $	**50**	**100**	**150**	**200**	**250**	**300**
	---------- Percent infested tillers ----------					
4	16	8	5	4	3	3
5	20	10	7	5	4	3
6	24	12	8	6	5	4
7	28	14	9	7	6	5
8	32	16	11	8	6	5
9	36	18	12	9	7	6
10	40	20	13	10	8	7
11	44	22	15	11	9	7
12	48	24	16	12	10	8

SUGGESTED INSECTICIDES FOR CONTROLLING RUSSIAN WHEAT APHIDS

		Waiting period (days) to:	
Insecticide	**Amount per acre**	**Harvest**	**Grazing**
Chlorpyrifos		See remarks	
(Lorsban® 4E-SG)	0.5-1 pt	28	14
Dimethoate		See remarks	
(2.67 lb.)	1 pt.	35	14
(4 lb.)	0.75 pt.	35	14
Disulfoton		See remarks	
(Di-Syston® 8 lb.)	0.25-0.5	30	
Methyl parathion			
(4 lb.)	1-1.5 pts.	15	15
(7.5 lb.)	6-14 oz.	15	15

Remarks

Chlorpyrifos. Labeled for use on wheat only. Do not make more than two applications per crop.

Dimethoate. Labeled for use on wheat only.

Disulfoton. Labeled as foliar spray only on wheat.Do not graze or harvest forage in treated fields. Do not repeat application within 30 days.

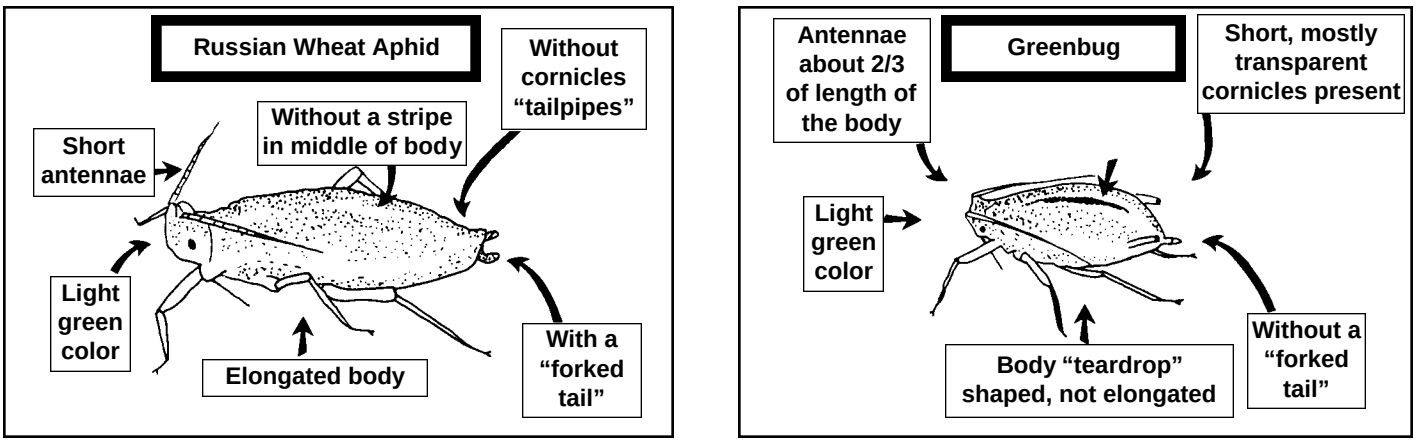

Figure 4. Comparison of greenbug and Russian wheat aphid.

Bird Cherry-Oat Aphid

This aphid spends almost its entire feeding period on various grains and grasses and is particularly abundant on small grains. Bird cherry-oat aphids are yellowish-green to dark green to black, with a reddish-orange area around the base of the cornicles. This aphid is often present with greenbugs. It is an important vector of barley yellow dwarf virus. Control is seldom required.

English Grain Aphid

English grain aphids are usually green with black legs, cornicles and antennae. These aphids are most abundant from late February through June. English grain aphids cluster on the developing heads of small grain plants, and their feeding may result in shrunken, shriveled grain.

This aphid is normally controlled by many of the same predators and parasites that help control the greenbug, and seldom cause yield losses. It is a vector of barley yellow dwarf virus.

Rice Root Aphid

The primary hosts of the rice root aphid are *Prunus* spp., (peaches, plums). Secondary host plants include rice, wheat and other small grains. The rice root aphid is a vector of barley yellow dwarf virus. It is found on plant roots in spots within wheat fields. Stunted plants may be the first indication of its presence, with only a small percentage of plants infested.These aphids are up to about $^{1}/_{10}$ inch long, dark green or olive, and usually have a reddish area at the posterior between and around the base of the cornicles. Insecticidal control measures have not been developed and are not suggested.

Winter Grain Mite

Figure 5.Winter grain mite

The winter grain mite may damage oats, wheat and barley. Mites range from $^{1}/_{32}$ to $^{1}/_{16}$ inch long. The adult has four pairs of reddish-orange legs, and the body is dark brown to black. Mite damage is generally more severe when small grains were planted in previous years. Rotation with other kinds of crops reduces infestations.

This pest feeds primarily at night and remains around the base of the plant during the day. Mites are less active in hot, dry weather; the greatest damage occurs in winter and early spring. Mites cause leaf tips to turn brown and plants to become stunted with a silvery-gray appearance. These symptoms, and the presence of mites, indicate the need for control.

SUGGESTED INSECTICIDES FOR CONTROLLING WINTER GRAIN MITES

Insecticide	Amount per acre	Waiting period (days) to: Harvest	Grazing
Disulfoton		See remarks	
(Di-Syston® 8 lb.)	0.25-0.5 pt.	30	
Methyl Parathion			
(4 lb.)	0.5 pt.	15	15
(7.5 lb.)	4-12 oz.	15	15
Malathion			
(25% WP)	1 lb.	7	7

Remarks

Disulfoton. Labeled as foliar spray only on wheat. Do not graze or harvest forage in treated fields. Do not repeat application within 30 days.

Brown Wheat Mite

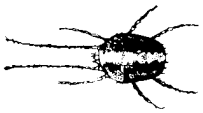

Figure 6. Brown wheat mite

The brown wheat mite is about the size of a period in newsprint, considerably smaller than the winter grain mite. Its rounded body is metallic, dark brown, with a few short hairs on the back. The front legs are about twice as long as the other three pairs of legs. It is most prevalent in dry weather and populations increase when wheat suffers from deficient moisture. The brown wheat mite occurs throughout the High Plains and Rolling Plains. Insecticides may not economically control this pest if the crop is unable to respond because of dry conditions.

Wheat Curl Mite

The wheat curl mite is approximately 1/100 inch long, white, sausage-shaped, and has four small legs on the front. It carries and spreads the virus that causes wheat streak mosaic, but causes very little damage otherwise. Mite feeding alone causes leaves to roll, taking on an onion-leaf appearance; if the virus is present, leaves become mottled and streaked with yellow.

Mites reproduce most rapidly at temperatures between 75 and 80 degrees F. They crawl very slowly and depend almost entirely on wind for dispersal. The mite is most active during warm weather. It moves mostly on warm, southwesterly winds; consequently, most wheat streak mosaic virus symptoms develop from southwest to northeast across a field. Mites survive the summer on volunteer wheat and grass; volunteer wheat is the most important host for the mite as well as for the disease. The potential for wheat curl mite and wheat streak mosaic virus is highest in the following conditions:

- Early volunteer wheat as a result of hail damage to wheat nearing maturity.
- Good stands of volunteer wheat as a result of July rains.
- Volunteer wheat that is not destroyed, or not destroyed until after planted wheat is up.
- Early planted wheat.
- Cool summers.
- Warm, dry fall for optimum mite reproduction and movement.

Control wheat curl mite and wheat streak mosaic virus by managing volunteer wheat and planting at the appropriate time. The usual pattern of wheat streak mosaic virus is from wheat, to summer grass or crop, to volunteer wheat or early planted wheat, and then to later planted wheat. To control wheat streak mosaic virus, this cycle must be broken. During the summer, the mite can survive only a few hours without living plant tissue on which to feed. Till to destroy summer grasses and volunteer wheat, and plant late so that wheat emerges after frost. Some wheat varieties are more susceptible to wheat streak mosaic virus than others, but none is totally resistant. TAM-107 and other varieties with the Amigo gene confer resistance to the mite and the virus. Chemical control of mites has not been effective.

Hessian Fly

Between 1978 and 1989, Hessian flies spread through wheat in 46 Texas counties from the Red River south through Central and East Texas. Since 1990 it has spread south and west into 15 additional counties (Fig. 7). Movement to the west and east was limited by dry conditions and the lack of host plants. Heaviest damage occurs where susceptible varieties are planted and there are no Hessian fly parasites. Hessian flies attack wheat and barley, but do not develop well in rye and triticale and have not been found in oats.

The 1/10-inch-long, mosquito-like Hessian fly adult has dark wings, a black thorax and a dark red abdomen. Adult flies live no more than 3 days. Females deposit an average of 200 eggs in clusters of five to twelve eggs, preferring younger plants and leaves. The glossy red eggs are deposited in the grooves on the upper leaf surface. Maggots move down the grooves of the leaf and under the leaf sheath and come to rest just above the plant crown or just above a node. Larvae suck plant juices and form a shallow depression in the stem as they develop. Newly hatched larvae are red but turn lighter in a few days; fully developed larvae are white with a translucent green stripe down the middle of the back. As a dormant, fully developed larva, the Hessian fly survives summer and very cold winter conditions in a tiny, dark brown puparium; this is known as the "flaxseed stage," because it resembles a seed of flax.

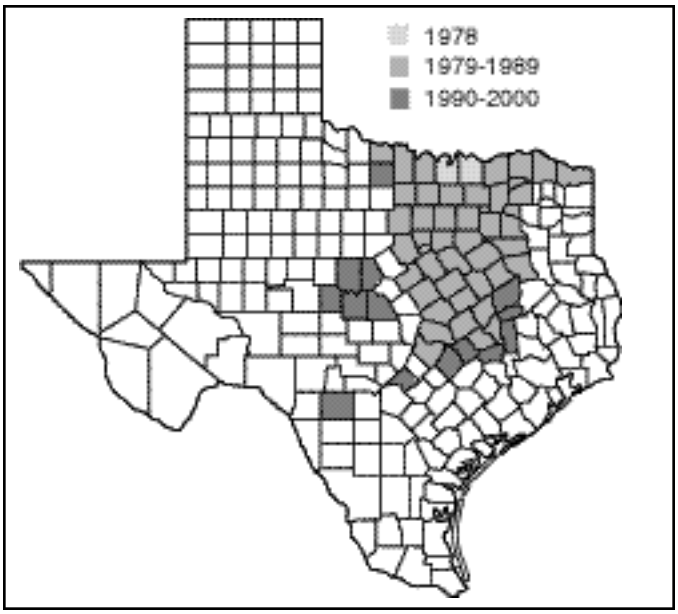

Figure 7. Texas counties infested with Hessian fly.

Management Strategies. Cultural management practices that can be used to reduce economic losses include:

- Growing genetically adapted resistant wheat varieties. Ask your county Extension agent about resistant varieties for your area.
- Planting wheat later in the fall (after October 15) to avoid the fall generation.
- Deeply burying crop residue to reduce Hessian fly numbers.
- Rotating to crops other than wheat or barley to suppress the fly population.
- Not moving infested straw from an infested area to an uninfested area.

In Texas, insecticide treatment may not be economical or practical.

OCCASIONAL PESTS OF SMALL GRAINS

Beet Armyworm

Fully developed beet armyworms are 1 1/4 inch long. They are light green with a conspicuous black spot on each side of the thorax above the second pair of thoracic legs. Damaging populations are most likely to occur in

late summer or early fall when hot, dry conditions inhibit the growth of preferred hosts and moths are forced to deposit egg masses on young, small grains.

There are few insecticides for controlling beet armyworms, and replanting may be more cost effective. Fields planted after mid-October usually escape beet armyworm infestation.

SUGGESTED INSECTICIDES FOR CONTROLLING BEET ARMYWORMS

Insecticide	Amount per acre	Waiting period (days) to: Harvest	Grazing
Methomyl			
(Lannate®)			
(90% SP)	0.25-0.5 lb.	7	10
(2.4 lb. LV)	0.75-1.5 pts.	7	10
Lambda cyhalothrin		See remarks	
(Warrior® T)	2.56-3.84 oz.	30	30

Remarks

Lambda cyhalothrin. Labeled for wheat, wheat hay and triticale. Do not apply more than 0.48 pints per acre per season.

Chinch Bug and False Chinch Bug

Adult chinch bugs are about 1/8 inch long. The body is black, but the wings are mostly white with black triangular spots at the middle of the outer margin. Young chinch bugs are shaped like the adults. They are red at first, but turn darker as they mature. There is a white band across the abdomen of immature chinch bugs.

In early spring, chinch bugs move into small grains fields from bunchgrass where they overwintered. Both young and adult chinch bugs feed on small grains. Very heavily infested plants may be stunted or killed. Infestations are usually confined to small, well defined spots. When a damaging infestation occurs on the field border, prompt treatment may prevent infestation of the entire field.

Adult false chinch bugs are 1/8 inch long, narrow, and dull yellowish-gray. The wing tips are transparent and extend beyond the end of the abdomen. These bugs often migrate in large numbers. By sucking sap from the stems and heads of small grains, false chinch bugs may cause poorly filled heads and shriveled grain, but the extent of their damage is not well documented. Small grains are not preferred hosts. Before applying insecticides, consider the percentage of the field infested and make sure that these bugs are feeding on the small grain and are not just migrating through.

SUGGESTED INSECTICIDES FOR CONTROLLING CHINCH BUGS AND FALSE CHINCH BUGS

Insecticide	Amount per acre	Waiting period (days) to: Harvest	Grazing
Methyl parathion			
(4 lb.)	1.5	15	15
(7.5 lb.)	12 oz.	15	15
Lambda cyhalothrin		See remarks	
(Warrior® T)	2.56-3.84 oz.	30	30

Remarks

Lambda cyhalothrin. Labeled for wheat, wheat hay and triticale. Do not apply more than 0.48 pints per acre per season.

Grasshoppers

Grasshoppers are an occasional problem in Texas small grains. Most damage occurs in the fall when grasshoppers migrate into fields. Check areas around wheat fields before planting to locate and treat heavy infestations before planted wheat emerges.

SUGGESTED INSECTICIDES FOR CONTROLLING GRASSHOPPERS

Insecticide	Amount per acre	Waiting period (days) to: Harvest	Grazing
Chlorpyrifos		See remarks	
(Lorsban® 4E-SG)	0.5-1 pt.	28	14
Carbaryl			
(Sevin® 4 lb.)	1 qt.	21	0
(Sevin® XLR Plus)	1-1.5 qts.	21	0
(Sevin® 4-Oil)	0.5-1.5 qts.	21	0
(Sevin® 4F)	0.5-1.5 qts.	21	0
Ethyl parathion		See remarks	
(4 lb.)	0.5-1.5 qts.	15	5
(8 lb.)	8 oz.	15	15
Malathion			
(5 lb.)	2 pts.	7	7
(91% ULV 9.33 lb.)	8 oz.	7	7
Lambda cyhalothrin		See remarks	
(Warrior® T)	2.56-3.84 oz.	30	30

Remarks

Chlorpyrifos. Labeled for use on wheat only. Do not make more than two applications per crop.

Ethyl parathion. Not cleared for use on oats and rye. No ground application. Application only by certified commercial aerial applicator with closed mixing-loading system.

Lambda cyhalothrin. Labeled for wheat, wheat hay and triticale. Do not apply more than 0.48 pints per acre per season.

Flea Beetles

Flea beetles are shiny, black, and about the size of a pin head. They readily jump when approached. During the fall flea beetles may infest the borders of a field, gradually moving across the field, feeding on and killing plants as they go. Leaves are skeletonized, giving injured plants a bleached appearance before they wilt and die. Fields and field borders that have been kept clean of weeds the previous season are less subject to flea beetle damage.

Wheat Stem Maggot

Adult flies of the second generation wheat stem maggot emerge in the spring and lay eggs on the leaves of wheat and other grass hosts. The developing larvae, or maggots, feed on the stem just above the last stem joint, cutting the moisture and nutrient flow to the head. The head loses its green color, turning tan to white, but the leaf sheath remains green.Infested tillers seldom exceed 1 percent, and chemical control of this insect is not recommended.

INSECTICIDE APPLICATION METHODS

Ground machines or aircraft can be used to apply most insecticides. For best results with aerial applications, swaths should meet or slightly overlap.

Spray applications are most effective when wind velocity does not exceed 15 miles per hour. Avoid spraying when plants are wet from dew or rain. For broadcast applications, use No. 3 cone nozzles set 20 inches apart on a rear-mounted boom of a tractor sprayer. Pump pressure should be 60 pounds per square inch.

Nozzle size and number, ground speed and pressure influence the rate of output per acre; therefore, calibrate the sprayer carefully to ensure application of recommended rates.

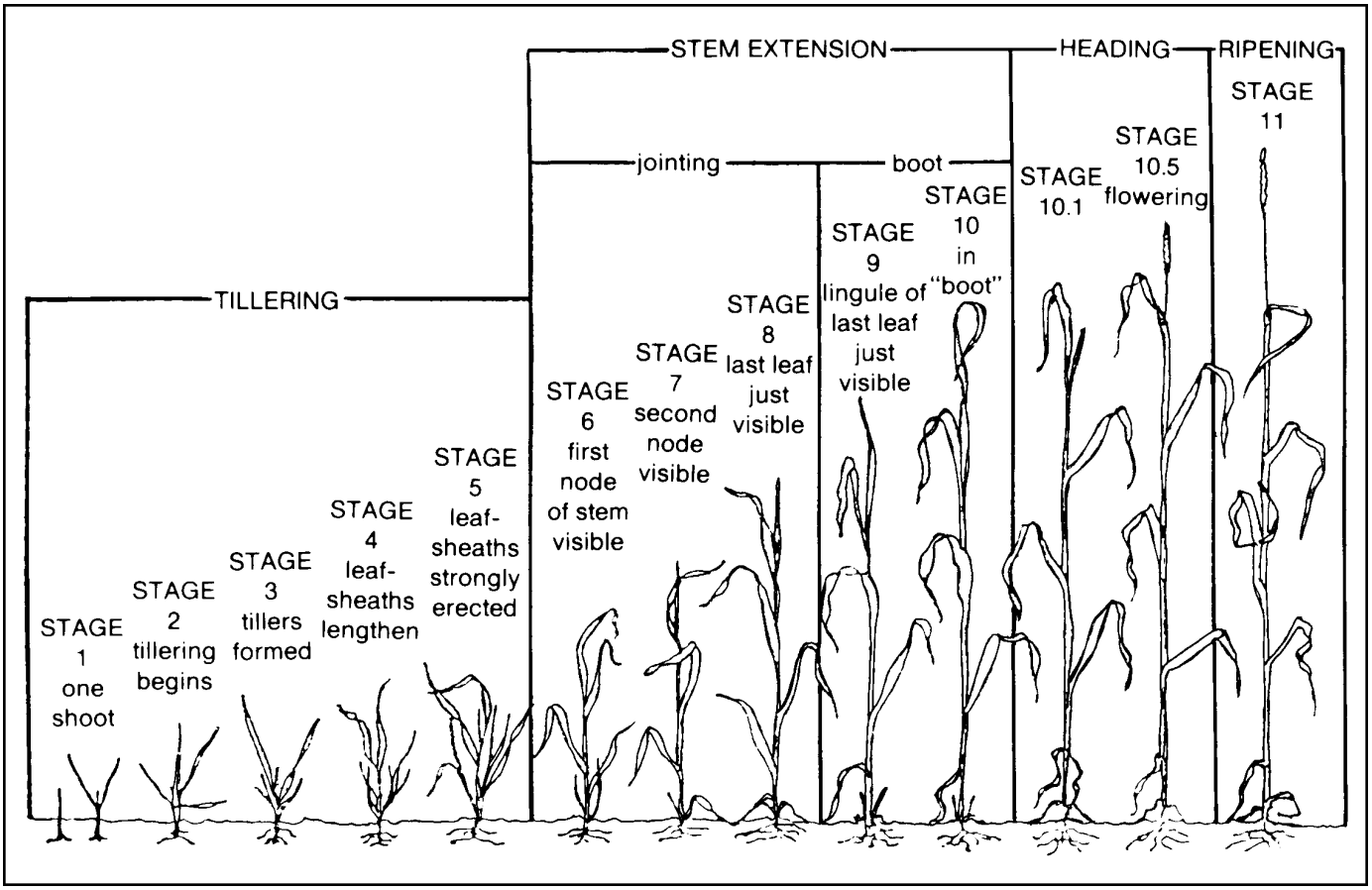

Figure 8. Feekes scale of small grain development.

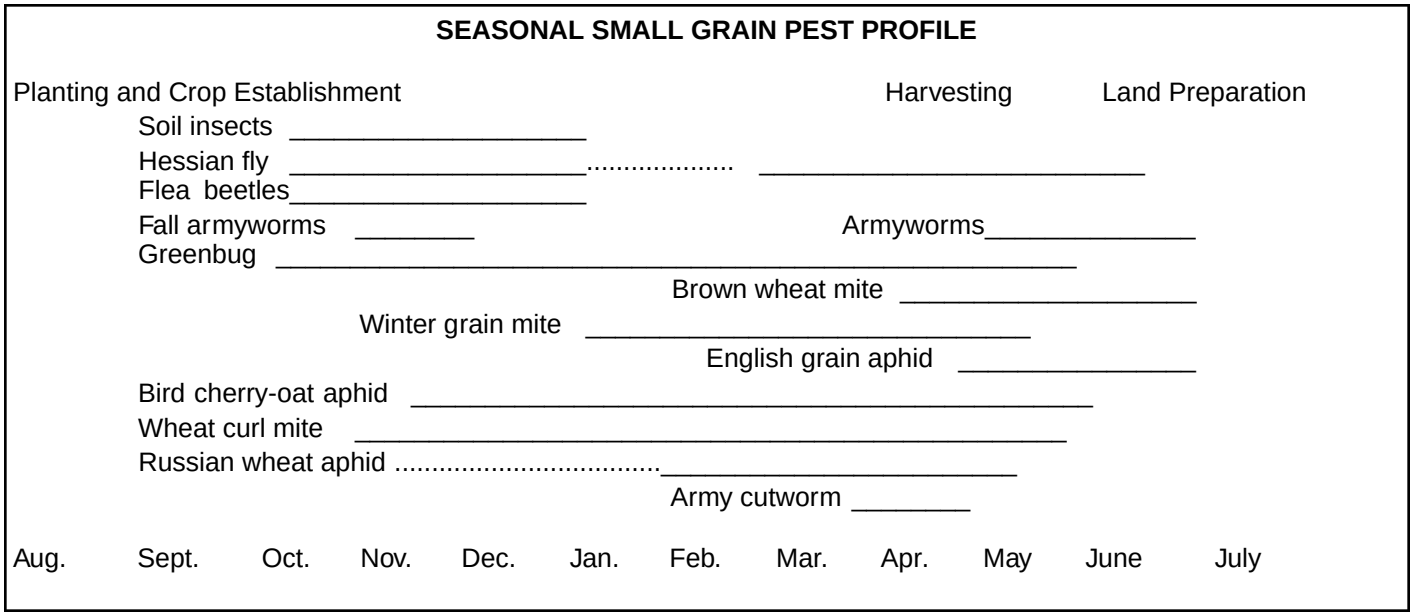

Figure 9. The occurrence and development of various small grain pests are usually related to plant development and various environmental factors. Although the severity of insect problems cannot be predicted, this pest occurrence profile indicates insect and mite pests that may attack small grains in various seasons and stages of development. Careful field inspection to determine the presence and damage potential of each pest is strongly advised.

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

Suggested pesticides must be registered and labeled for use by the Environmental Protection Agency and the Texas Department of Agriculture. The status of pesticide label clearances is subject to change and may have changed since this publication was printed. County Extension agents and appropriate specialists are advised of changes as they occur.

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

ENDANGERED SPECIES REGULATIONS

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

WORKER PROTECTION STANDARD

The Worker Protection Standard (WPS) is a set of new federal regulations that applies to all pesticides used in agricultural plant production. If you employ any person to produce a plant or plant product for sale, and apply any type of pesticide to that crop, WPS applies to you. The WPS requires you to protect your employees from pesticide exposure. It requires you to provide three types of protection. You must: 1) inform employees about exposure; 2) protect employees from exposure; and 3) mitigate pesticide exposures that employees might receive. The WPS requirements will appear in the “DIRECTION FOR USE” part of the pesticide label. For more detailed information, consult EPA publication 735-B-93-001 (GPA #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.

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