Wheat INSECT PEST MANAGEMENT *2023*

K-STATE Research and Extension
Kansas State University
Agricultural Experiment Station
and Cooperative Extension Service

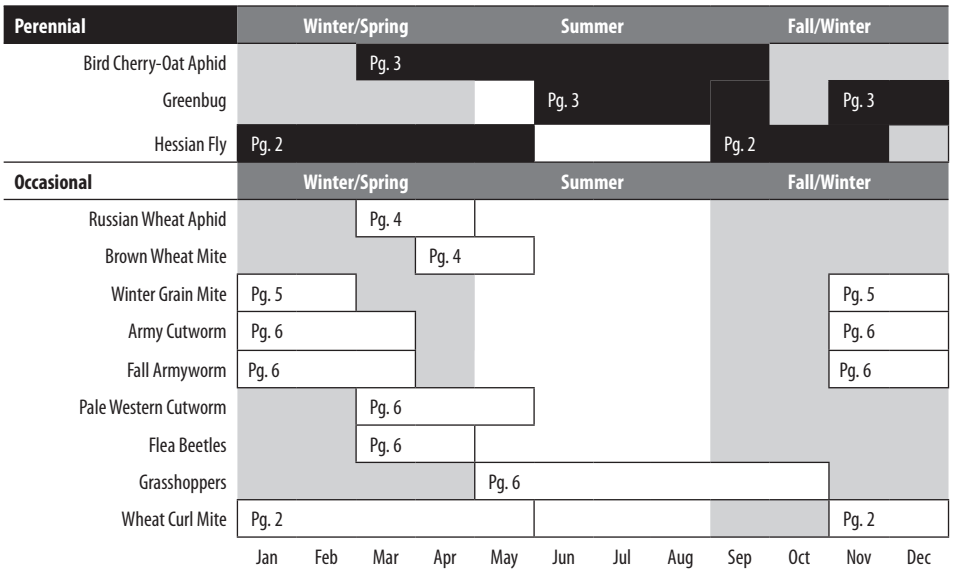
How to Use This Guide

This publication is to help producers manage insect pest populations with the best available methods proven practical under Kansas conditions. It is revised annually and intended for use this calendar year. Pesticide label directions and restrictions are subject to change, and some may even have changed since this publication was written.

The economics of control should be considered in any pest management decision. Because costs vary greatly over time and are influenced by factors beyond the scope of this publication, product cost in general is not considered a reason for including or omitting specific insecticide products in these recommendations.

Always compare product price, safety and availability when making treatment decisions. The user bears the ultimate responsibility for correct pesticide use and should always read label directions carefully before making any pesticide applications. Remember, it is illegal to use a pesticide in a manner inconsistent with the label.

Additional information on the individual pests mentioned in this guide as well as other potential wheat pests is available through your local K-State Research and Extension office and on our website at: *entomology.k-state.edu/extension/insect-information/crop-pests/wheat/*. Kansas State University entomologists assume no responsibility for product performance, personal injury, property damage, or other types of loss resulting from handling or use of pesticides listed.



Using Insecticides Safely

Injury or death can result from swallowing, inhaling, or prolonged skin contact with insecticides. Risk of injury due to ingestion is greatest among pets, livestock, and young children. The greatest risk to users is usually a result of skin absorption and sometimes inhalation. Handle all pesticides with care and use only when needed. Avoid spilling concentrates on skin or clothing.

If a spill occurs, remove contaminated clothing immediately and wash with soap and water. If in the eyes, flush with water for 15 minutes and seek prompt medical attention. If exposed and in need of medical treatment, take the pesticide label with you. For poison control information go to the Mid-America Poison Control Center website at *kansashealthsystem.com/care/centers/poison-control-center* or call the emergency phone number: 1-800-222-1222.

Wear protective equipment (respirators, clothing, etc.) as specified on the label. Bathe and change clothing frequently. Launder contaminated clothing separately from other articles in the wash. Protect fish, wildlife, and other nontarget organisms. Do not dispose of unused pesticides where the runoff may contaminate streams, lakes, ponds or drinking water supplies, or apply in a manner that could pollute such sites.

Consider the presence of honeybees before applying insecticides. Avoid drift to beehives or adjacent blooming crops. Notify the bee owner before applications are made in the general vicinity. Applying treatment late in the day when bees are not foraging may help to reduce the risk.

Read the label carefully. It tells what, where, how and when the product can be used. It is against the law to use a pesticide in a manner inconsistent with the label.

Label Terms

The waiting or preharvest interval (PHI) refers to the time that must elapse between application and harvest. The interval usually is different for forage than grain harvest, but when not specified, the interval usually is the same regardless of the treated product. The waiting interval does not signify how long an insecticide will provide control following application. The restricted entry interval (REI) specifies the time that must elapse before persons can safely return to treated fields without the use of protective clothing and/or equipment.

A number of pesticides are classified as Restricted Use products. The Kansas Department of Agriculture must certify private or commercial applicators before they can purchase or use restricted products. Some pesticide uses may be permitted by means of State of Kansas Special Local Needs (SLN) labels. The law requires that an applicator possess this label when using a SLN product.

Potential Concern for Kansas Wheat

The wheat stem sawfly, *Cephus cinctus* (Hymenoptera: Cephidae), long a serious pest of wheat in the northern Great Plains, has begun to cause significant damage to winter wheat in Wyoming, eastern Colorado, and portions of Nebraska in the past couple of years. A long-time resident of Kansas, this pest has likely been laying eggs in wheat for many years, although its larvae have enjoyed little, if any, survival. This has been attributed to the phenology of winter wheat in Kansas which has not allowed sufficient time for completion of larval development prior to crop maturity. Thus, sawfly populations in Kansas have largely been maintained through infestation of alternative hosts like wild *Agropyron* spp. This may be about to change, as an increasing proportion of larvae are surviving in wheat each year to emerge as adults in these neighboring regions. The full extent of range expansion by this fast-developing biotype is not yet known, but it is now confirmed present in northwest Kansas along the Colorado border, although it has yet to reach levels of economic significance there. Mature sawfly larvae girdle the wheat stalk at its base, leading to lodging and significant crop losses. Incomplete development can pass unnoticed because girdling does not occur. When split, infested stalks contain a powdery frass that resembles fine sawdust. Wheat kernels of infested plants may be shrivelled and seed weight and protein content reduced.

Management is multifaceted and requires significant modification of cultural practices. Although adult dispersal appears to be limited, populations can explode quickly where wheat is grown continuously. Growers or crop consultants who suspect a sawfly infestation or collect suspect specimens should contact their local K-State Research and Extension agent.

Pre-Planting Decisions

Several insect pest management decisions should be made prior to planting. These fall into three categories: cultural practices, variety selection, and seed treatments. Cultural practices refers to all general cropping system management practices associated with wheat production — from crop rotation to tillage practices to planting dates. Several of these decisions affect insect populations.

Probably the most important issue before planting is **destruction of volunteer wheat**. Ideally, this should be accomplished at least two weeks before planting. Volunteer wheat is a source of several insect problems as well as many diseases. Breaking the green bridge between last year's wheat crop and the new wheat crop is critical for getting the crop off to a good start. **Hessian fly**, aphids, and wheat curl mites all use volunteer wheat as a staging ground to attack new wheat stands. The next critical decision is planting date. This is often a balancing act between the need to establish a good stand, the need for wheat pasture, the timing of fall rains, and scheduling conflicts due to the harvest of summer crops.

For insect pest management, **delaying planting to near the best pest management (BPM) date** generally reduces the chance of serious problems with **Hessian fly, wheat curl mites** (wheat streak), aphids, and white grubs (see page 2 for BPM dates).

Although not fail-safe because weather varies from year to year, delayed planting greatly reduces the amount of time insect pests have to infest the crop in the fall. It is highly recommended if grain production is the primary reason for planting wheat.

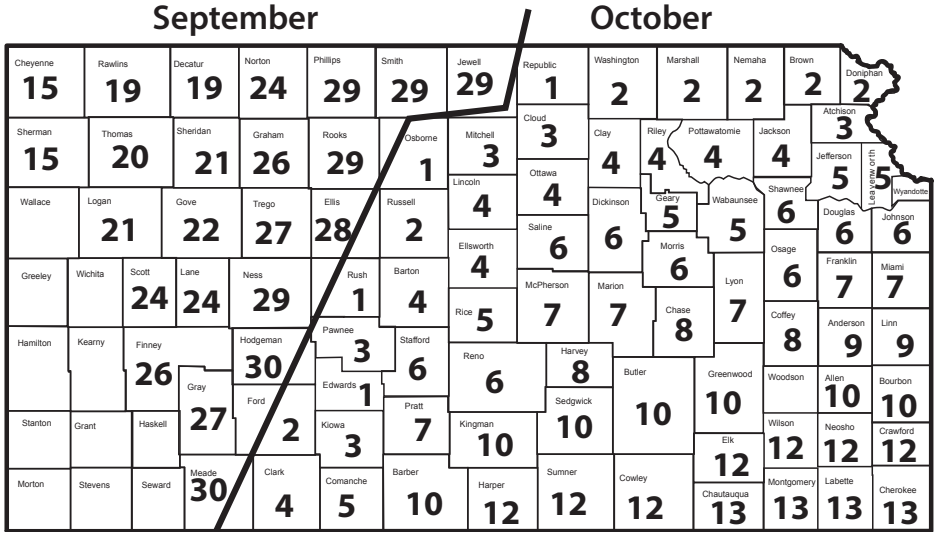
Tillage often is cited as a way to manage some pests, but current emphasis on soil and moisture conservation and the fuel savings associated with reduced traffic are encouraging reduced and no-till farming. Consequently, there may be an increase in pests that are favored by reduced soil disturbance or the presence of crop residues in the field.

Crop rotation also can influence pest populations. Problems with brown wheat mite, winter grain mite, **Hessian fly** and other pests are exacerbated by continuous wheat cultivation. If specific pests are a recurrent problem, producers should examine their rotations and cultural practices that may be contributing to problems.

Varieties should be selected that have demonstrated good performance in your region and resistance to insects common in that area. Currently, the selection of **insect-resistant varieties** is limited. There are a few varieties resistant to **Hessian fly** and greenbug, but many of these are no longer resistant to wheat diseases. In addition, there are new biotypes of Russian wheat aphid in western Kansas virulent to all commercial wheat varieties.

For more information on insect resistance see, *Wheat Variety Disease and Insect Ratings*, found at *ksre.ksu.edu/bookstore/pubs/mf991.pdf*. New varieties are being developed to improve this situation in the near future. For more on these and other insects affecting wheat visit *entomology.k-state.edu/extension/insect-information/crop-pests/wheat/*.

Seed treatments are another way to protect wheat plantings from insect pests. The neonicotinoid compounds imidacloprid (numerous products) and thiamethoxam (Cruiser) provide good control of wireworms (plus Teraxxa and Teraxxa 4 are also available for wire worm control) and, depending upon the rate, can also provide significant activity against other insect pests such as aphids and **Hessian fly** for at least two weeks post-emergence. However,



Best Pest Management Planting Date

These dates were established several years ago. Although fields may still be infested with **Hessian fly** when planted after these dates if the weather is mild, later planting dates generally reduce problems from **Hessian fly**, aphids, **wheat curl mites**, and many diseases.

they may not give adequate protection against false wireworms.

Seed treatments should be selected based on potential economic returns. Early planted wheat, wheat planted back into wheat stubble, or wheat being grown where **Hessian fly**, grasshoppers, greenbug, or Russian wheat aphid have been perennial problems for seedling establishment, will probably benefit most from seed treatments. Check with suppliers and seed dealers for the latest seed treatment options.

In-Season Decisions

Aphids

Bird Cherry-Oat Aphid

The bird cherry-oat aphid is dark, olive green with a reddish-brown patch on the back of the abdomen. Under cool conditions, the color can be so dark that the reddish patch can be difficult to see. Its antennae and cornicles are black. It is one of the largest aphids found on wheat. They thrive at cool temperatures, are the last aphid to remain active in the fall and are the first aphid to be active in the spring.

Direct feeding damage to wheat does not result in visible symptoms, but populations of 50 or more per tiller at the boot to heading stage may affect yield and grain quality. Large populations in the spring may roll up the flag leaf into a corkscrew shape that can trap the awns, resulting in "fish-hooked" heads. Estimate the population based on a sample of 25 to 50 randomly selected tillers. If treatment is elected, choose products broadly labeled for aphid control on wheat. This aphid is also the primary vector of barley yellow dwarf virus (BYDV). Infections that occur in fall while plants are still small are the most damaging to yield. Conventional sprays usually are not effective in reducing virus incidence; Imidacloprid and thiamethoxam are effective at controlling aphids but have not yet proven to reduce the incidence of BYDV.

Greenbug

Greenbugs are pale green aphids with a dark green line down the back and body-length antennae. They prefer to feed on the underside of lower leaves. Infested leaves turn yellow, then reddish brown and eventually die. In the field, damage often appears as yellow or reddish-brown irregularly shaped patches that can spread to become almost field wide.

Once a statewide pest of wheat, in recent years damaging populations have been largely confined to southern parts of the state along the Oklahoma border. The guidelines in the table above are useful in estimating the need for greenbug control. For convenience, damaging levels are expressed as the number of greenbugs per foot of row, but in assessing the need for control, the condition of the stand is important. Fifty greenbugs per foot of row in a thin stand would be more serious than in a thick stand because the number of aphids per plant would be greater. Similarly, larger plants can tolerate somewhat larger numbers before significant damage occurs. During vegetative stages, wheat plants can outgrow considerable damage with enough moisture and favorable growing conditions.

Producers in southern Kansas may benefit from the Oklahoma State University 'Glance 'n Go' sampling program, which calculates a greenbug threshold based on the cost of control, market value of wheat and the month of the year. For more information on this greenbug pest management decision support system, see the website at: *entoplp.okstate.edu/gbweb/welcome%20gb.htm*.

Treatment during early fall is advisable if the threshold is reached unless a great number of beneficial insects are active. Look for lady beetles and their alligator-like larvae on the wheat, and the brown, dried up husks of parasitized aphids (mummies) adhering to leaves. Greenbug numbers decline naturally in December and January, and treatment usually becomes unnecessary.

During mild winters, overwintering greenbugs can rapidly develop into damaging infestations during warm periods in February and March. Close field surveillance is necessary if greenbugs are present. Beneficial insects such as lady beetles, lacewings, and hoverflies become increasingly effective in reducing greenbug populations around mid-April. Once parasitism levels reach between 10 and 15 percent, greenbug populations usually decline fairly rapidly.

Greenbug control on small grains is occasionally needed during periods of relatively cool weather (below 60°F, but above freezing). Experience has shown that good results are possible under these conditions with some, and perhaps most, of the recommended insecticides. Dimethoate may not give acceptable control below 60°F.

Approximate Damaging Levels of Greenbugs

Stage and development of plants	No. of greenbugs per linear foot
Seedlings, thin stands less than 3 tillers	50
3- to 6-inch wheat, 3 tillers or more	100 to 300
6- to 10-inch wheat	300 to 500

Greenbug Management Options

Insecticide	Rate
Alpha-cypermethrin (Fastac CS)	3.2 to 3.9 fl oz. (0.020 to 0.025 lb. a.i.)/acre
Gamma-cyhalothrin (Proaxis)	0.015 lb. a.i./acre (3.84 fl. oz.)
Lambda-cyhalothrin (Warrior II with Zeon Technology)	0.03 lb. a.i./acre or 1.92 fl. oz./acre
Malathion 5	1.5 pints/acre
Sulfoxaflor (Transform WG)	0.75 to 1.5 fl. oz./acre (0.023 to 0.047 lb. a.i./acre)
Zeta-cypermethrin (Mustang MAXX, etc.)	0.02 to 0.025 lb. a.i./acre (3.2 to 4.0 fl. oz.)

Russian Wheat Aphid

This small, lime-green aphid has a football-shaped body and short cornicles and antennae. These aphids feed on the upper leaf surfaces and roll up the leaves to produce a protected microhabitat where they can feed undisturbed. Infested leaves exhibit purple or white longitudinal streaks. Heavily infested plants may appear flattened, with young tillers lying almost prostrate on the ground.

Persistent large populations of Russian wheat aphids can lead to serious crop losses. Risk of yield loss is highest when infestations develop in early spring. Fortunately in Kansas, climatic conditions and biological control by predators, especially lady beetles, are normally quite effective in keeping them below damaging levels. Significant infestations in Kansas have generally been limited to the counties near the Colorado border.

The recommended threshold for treatment varies with the time of year and the expected yield. Populations that develop soon after the crop emerges in early fall can be damaging but are unusual in Kansas. At this time, a 20 to 30 percent infestation of plants may warrant treatment. In spring if wheat has yield potential of at least 20 bushels per acre, treatment should be considered when 20 percent of tillers show symptoms and most have live aphids. In fields with a yield potential of 40 bushels or more, it may be economical to treat when as few as 10 percent of tillers are infested. When 30 to 40 percent of primary tillers are infested between flowering and the soft-dough stage, treatment may be advisable, but infestations confined to late-developing secondary tillers are less damaging to yield.

Mites

Brown Wheat Mite

The brown wheat mite is a common pest of dryland wheat in western Kansas that can be a problem as far east as Highway 77 in dry years. The dark brown body is rounded or slightly oval, with the first pair of forelegs notably longer than the others.

Affected plants have finely mottled leaves that appear yellowed or bronzed at a distance but lack the webbing produced by the Banks grass mite. Activity is highest in late fall and early spring, with populations usually peaking around mid-April. Eggs are laid in the soil and those produced in winter are brick red and lack the waxy coating of summer eggs.

Outbreak potential is high because all adults are female, and each can produce 70 to 90 winter eggs in a three-week period. Later in spring, females begin laying small, white, oversummering eggs at the base of infested plants. These eggs do not hatch until fall. Damaging populations are usually limited to continuous wheat fields or those where volunteer wheat was present during the previous spring. Mite populations can be quickly reduced by heavy rains.

Brown wheat mites feed during the day and spend the night in the soil. They are usually most visible on foliage during the early afternoon on warm days, but populations can be difficult to assess as mites quickly drop off plants. The economic threshold is not well defined, but is estimated to be at least several hundred mites per foot of row in early spring. Concern is greater if plants are stressed or poorly tillered. This is a dry weather pest

Russian Wheat Aphid Management Options

Insecticide	Rate
Alpha-cypermethrin (Fastac CS)	3.2 to 3.9 fl. oz./acre
Beta-cyfluthrin (Baythroid XL)	0.014 to 0.019 lb. a.i./acre (1.8 to 2.4 fl. oz.)
Dimethoate (Dimate and others, formerly Cygon)	0.25 to 0.375 lb. a.i./acre
Gamma-cyhalothrin (Proaxis)	0.01 to 0.015 lb. a.i./acre (2.56 to 3.84 fl. oz.)
Lambda-cyhalothrin (numerous products)	0.02 to 0.03 lb. a.i./acre
Sulfoxaflor (Transform WG)	0.75 to 1.5 fl. oz./acre (0.023 to 0.047 lb. a.i./acre)
Zeta-cypermethrin (Mustang MAXX, etc.)	0.02 to 0.025 lb. a.i./acre (3.2 to 4.0 fl. oz.)

Brown Wheat Mite Management Options

Insecticide	Rate
Dimethoate (Dimate and others, formerly Cygon)	49 WSB is 1 lb./acre

Winter Grain Mite Management Options

Insecticide	Rate

Because options for this pest are so limited, producers might want to consider other insecticides labeled on wheat for controlling this pest under Kansas 2ee regulations. Dimethoate (Dimate and others, formerly Cygon) at 0.25 to 0.375 lb. a.i./acre and Lambda-cyhalothrin (numerous products) at 0.015 to 0.025 a.i./acre appear to be effective against this pest under limited testing. Note: Because this particular mite does not appear on these product labels, the user assumes responsibility for the application and must abide by all restrictions and application requirements for other wheat pests.

and treatment response often depends on subsequent rainfall to assist plant recovery. Treatments applied after populations begin natural decline in mid or late April are of no value.

Winter Grain Mite

This mite is dark bluish to nearly black, with conspicuous reddish-orange legs. Front legs are longer than the others, although not as noticeable as on the brown wheat mite. Other unique features are a reddish-orange anal pore on the top of the abdomen and the presence of two tarsal claws on the end of each leg. Viewing under a 10x hand lens, or preferably a microscope, may be required to distinguish some of these features.

During daylight, winter grain mites can be found around the base of plants or hiding just under the soil surface. They thrive in cool, moist weather and retreat deeper into the soil under hot, dry conditions. Fields with loose, sandy, or loamy soils are more at risk than those with hard, clay soils. Significant infestations are ordinarily confined to central Kansas.

Mites feed on plants mostly at night, puncturing individual cells and causing leaves to turn silvery-gray. Leaf tips may turn brown. Young plants are most susceptible and may become stunted, producing little grain. Control may be necessary if large portions of a field show symptoms and plant growth is retarded by dry conditions. Because fall populations develop from eggs laid the previous spring, problems are worse in continuous wheat. Crop rotation is preventive to some degree, but field borders may be affected when mites migrate from wild grasses.

Caterpillars

Army Cutworm

The army cutworm is a late fall to early spring pest that occurs sporadically in the western two-thirds of Kansas. Infestations are notoriously unpredictable on a field-to-field basis. Adult moths lay eggs in soil in the fall. The brown, faintly striped larvae hatch during the fall and early winter. Larvae feed on many plant species, and each adult female can lay more than a thousand eggs. Both factors contribute to the outbreak potential of this species, as happened in 2020.

Larvae begin feeding during the winter whenever temperatures rise a few degrees above freezing. Small larvae strip cells from only one surface of the leaf, creating "windowpane" holes that often go unnoticed unless plants are carefully inspected. Larvae hide in loose soil at the base of plants, emerging to feed in the evening. Unlike other cutworms, only above ground plant parts are consumed, giving plants the appearance of being grazed by cattle.

Infestations in well-established stands will probably not require insecticide applications while wheat is dormant, but some fields never green up in the spring because of cutworm feeding. Frequent inspections during warm periods in February, March, and early April are strongly encouraged, particularly when preceded by a dry fall.

Moisture availability, crop condition, and regrowth potential are all factors influencing potential losses to this pest. Late-planted fields under dry conditions with poor tillering may suffer economic damage with as few as one or two larvae per square foot.

In most fields, treatment will not be necessary until populations average four

Army Cutworm Management Options

Insecticide	Rate
Alpha-cypermethrin (Fastac CS)	1.3 to 3.8 fl. oz./acre
Beta-cyfluthrin (Baythroid XL)	0.008 to 0.014 lb. a.i./acre (1.0 to 1.8 fl. oz.)
Gamma-cyhalothrin (Proaxis)	0.0075 to 0.0125 lb. a.i./acre (1.92 to 3.20 fl. oz.)
Lambda-cyhalothrin (Grizzly Z)	0.015 to 0.025 lb. a.i./acre or 1.92 to 3.20 fl. oz./acre Numerous other products with same ingredients
Zeta-cypermethrin (Mustang MAXX, etc.)	0.008 to 0.025 lb. a.i./acre (1.28 to 4.0 fl. oz.)

Armyworm Management Options

Insecticide	Rate
Alpha-cypermethrin (Fastac CS)	1.8 to 3.8 fl. oz./acre
Beta-cyfluthrin (Baythroid XL)	0.014 to 0.019 lb. a.i./acre (1.8 to 2.4 fl. oz.)
Chlorantraniliprole (Vantacor)	0.047 to 0.098 lb. a.i./acre or 1.2 to 2.5 fl. oz./acre
Gamma-cyhalothrin (Proaxis)	0.01 to 0.015 lb. a.i./acre (2.56 to 3.84 fl. oz.)
Lambda-cyhalothrin (Numerous products)	0.02 to 0.03 lb. a.i./acre
Spinosad (Blackhawk)	0.025 to 0.075 lb. a.i./acre (1.1 to 3.3 fl. oz./acre)
Zeta-cypermethrin (Mustang MAXX, etc.)	0.011 to 0.025 lb. a.i./acre (1.76 to 4.0 fl. oz.)

to five worms per square foot. Vigorous, well-tillered fields under optimal growing conditions can tolerate even higher populations, as many as nine or 10 larvae per square foot, without measurable yield loss. Infestations in later stages of crop development are less damaging than early ones because established plants can compensate for considerable defoliation and larvae normally finish feeding before wheat enters reproductive stages.

Armyworm

Armyworms feed on a variety of plants, preferring grasses, and females lay eggs in large clusters on lush vegetation. Larvae are green to black with stripes of various colors. The head capsule is medium brown with dark markings. Most damage to wheat in Kansas occurs in southern and eastern areas of the state during warm, moist periods from late April to early June.

Each larva, feeding mostly at night, can consume 43 linear inches of wheat leaf, or the equivalent of three whole plants, in the course of its development. However, 80 percent of this damage occurs during the last three to five days of larval feeding. When leaf feeding is observed, look for larvae curled up on the ground under litter, especially in patches of lodged plants. Treatment is usually not necessary below levels of four or five larvae per foot, but is probably justified at infestations of five to eight per foot provided most larvae are still small. Wheat is likely to suffer yield loss if the flag leaf is destroyed before the soft dough stage is completed. Plant developmental stage is a factor to consider when making treatment decisions.

As wheat plants mature and leaves dry out, armyworms may feed on beards and clip heads to complete their development. Head clipping in barley is serious and should be prevented. While it is less likely in wheat, worms should be watched closely if present after heading and forced to feed on the upper parts of plants to complete development. Migration out of maturing grain fields and into adjacent fields of corn and sorghum is also possible.

Fall Armyworm

This moth does not overwinter in the Great Plains but migrates northward annually from southern states. It usually arrives in Kansas in July where it deposits eggs on corn, sorghum and other summer crops. Several generations occur and reproduction may continue through August and into September, putting early-planted wheat at greatest risk. Early-planted fields should be inspected frequently during the first few weeks following emergence.

The first sign of damage is "windowpane" injury caused by tiny larvae chewing on seedling leaves. The larvae, which are usually too small to be easily observed at this time, hide in or around the base of seedlings. Within a few days the larvae become large enough to destroy entire leaves.

Fields with 25 to 30 percent of plants with windowpane injury should be re-examined daily and treated immediately if stand establishment appears threatened. Larvae increase in size at an exponential rate, and so do their food requirements. Later instars do the most damage, sometimes destroying entire stands, and are the least susceptible to insecticides. Without treatment, problems can continue until larvae reach maturity or until a killing freeze.

Pale Western Cutworm

Damage from this pest occurs in spring and is limited to extreme western Kansas. Outbreaks usually are associated with a series of dry winters. Loose soil is preferred for oviposition, and late-cultivated, summer-fallowed fields are especially attractive to egg-laying moths. Clusters of eggs are laid in the soil in the fall and hatch in early spring. Whitish larvae feed below ground, severing plants and leading to dead spots in the field. Control measures are justified when two or more larvae per square foot are found. This insect tends to stay underground. Consider higher rates of registered insecticides when populations are high.

Miscellaneous Pests

Flea Beetles

These tiny, jumping beetles are dark and shiny and strip off the upper surface of leaves causing whitish streaks. They are typically a problem along field margins, especially in western Kansas in early plantings. Forage sorghum or weedy borders often harbor summer populations that can migrate to wheat fields in fall. Injury is more severe when beetles are present as plants emerge. A population of three to five beetles per row foot can kill seedling plants. Since damage is often localized along a field border, spot treatment of affected area may be sufficient to control populations.

Grasshoppers

There are many species of grasshoppers in Kansas, and not all are crop pests, although most have the potential to inflict damage if present in large numbers. Damage can occur in fall or spring. Typically, grasshoppers invade from field margins as fall-planted wheat emerges. Occasionally, heads may be damaged before harvest.

Vegetation bordering wheat fields should be inspected 10 days before planting. Counts of seven to 12 grasshoppers per square yard signal potential problems. Once wheat has been planted, three or more hoppers per square yard within the field can destroy seedling wheat.

Fall Armyworm Management Options

Insecticide	Rate
Alpha-cypermethrin (Fastac CS)	3.2 to 3.8 fl. oz./acre
Beta-cyfluthrin (Baythroid XL)	0.014 to 0.019 lb. a.i./acre (1.8 to 2.4 fl. oz.)
Gamma-cyhalothrin (Proaxis)	0.01 to 0.015 lb. a.i./acre (2.56 to 3.84 fl. oz.)
Lambda-cyhalothrin (Numerous products)	0.02 to 0.03 lb. a.i./acre
Spinosad (Blackhawk)	0.038 to 0.075 lb. a.i./acre (1.7 to 3.3 fl. oz./acre)
Zeta-cypermethrin (Mustang MAXX, etc.)	0.02 to 0.025 lb. a.i./acre (3.2 to 4.0 fl. oz.)

Pale Western Cutworm Management Options

Insecticide	Rate
Alpha-cypermethrin (Fastac CS)	1.8 to 3.8 fl. oz. (0.012 to 0.025 lb. a.i.)/acre
Beta-cyfluthrin (Baythroid XL)	0.014 to 0.019 lb. a.i./acre (1.8 to 2.4 fl. oz.)
Gamma-cyhalothrin (Proaxis)	0.0075 to 0.0125 lb. a.i./acre (1.92 to 3.20 fl. oz.)
Lambda-cyhalothrin (Numerous products)	0.015 to 0.025 lb. a.i./acre
Zeta-cypermethrin (Mustang MAXX, etc.)	0.011 to 0.025 lb. a.i./acre (1.76 to 4.0 fl. oz.)

Endangered Species

EPA's Endangered Species Protection Program (ESPP) helps promote the recovery of endangered species. Pesticide use limitations to protect listed species in a certain geographic area are communicated through endangered species protection bulletins. Pesticide labels may direct applicators to contact their local extension office or to visit the EPA online at: *epa.gov/endangered-species*.

The Worker Protection Standard

The Worker Protection Standard (WPS) is a series of federal regulations pertaining to pesticides used in agricultural plant production on farms, forests, nurseries, and greenhouses. You must comply with these regulations if you are an agricultural pesticide user and/or an employer of agricultural workers or pesticide handlers. For more information, see EPA publication, *The Worker Protection Standard for Agricultural Pesticides — How to Comply, What Employers Need to Know*, available at your local K-State Research and Extension office.

Flea Beetle

Insecticide	Rate
Alpha-cypermethrin (Fastac CS)	0.012 to 0.025 lb. a.i./acre (1.8 to 3.8 fl. oz./acre)
Beta-cyfluthrin (Baythroid XL)	0.014 to 0.019 lb. a.i./acre (1.8 to 2.4 fl. oz.)
Carbaryl (Sevin)	0.625 to 1.25 lb. a.i./acre
Gamma-cyhalothrin (Proaxis)	0.01 to 0.015 lb. a.i./acre (2.56 to 3.84 fl. oz.)
Lambda-cyhalothrin (Numerous products)	0.02 to 0.03 lb. a.i./acre
Zeta-cypermethrin (Mustang MAXX, etc.)	0.011 to 0.025 lb. a.i./acre (1.76 to 4.0 fl. oz.)

Grasshopper Management Options

Field Sprays	Rate
Alpha-cypermethrin (Fastac CS)	3.2 to 3.8 fl. oz./acre
Beta-cyfluthrin (Baythroid XL)	0.014 to 0.019 lb. a.i./acre (1.8 to 2.4 fl. oz.)
Chlorantraniliprole (Vantacor)	8.0 to 20.0 fl. oz./acre (0.027 to 0.066 lb a.i.)
Dimethoate (Dimethoate 4 EC)	¾ pint/acre
Gamma-cyhalothrin (Proaxis)	0.01 to 0.015 lb. a.i./acre (2.56 to 3.84 fl. oz.)
Lambda-cyhalothrin (numerous products)	0.02 to 0.03 lb. a.i./acre
Malathion 57	1.5 pints/acre
Zeta-cypermethrin (Mustang MAXX, etc.)	0.02 to 0.025 lb. a.i./acre (3.2 to 4.0 fl. oz.)

Noncrop Area Treatments for Grasshopper Management

Insecticide	Rate	Special Instructions
Acephate (Bracket 90 Orthene 75S)	Bracket 90, 0.28 lb./acre (4oz); Orthene 75S, ⅓ lb./acre	Apply in 10 to 20 gallons by ground, or 1 to 5 gallons by air. Use as a treatment on ditch banks, roadsides, or field borders. Do not apply to wheat or graze treated forage.
Alpha-cypermethrin* (Fastac CS)	3.2 to 3.9 fl. oz./acre	Do not make applications less than 14 days apart. Do not apply more than 11.4 fl. oz. of product per acre per season. REI is 12 hours. PHI is 14 days.
Beta-cyfluthrin* (Baythroid XL)	2.6 to 2.8 fl. oz./acre	Labeled for use in pastures, rangeland, grass for hay, and grass grown for seed. PHI is 0 days.
Chlorantraniliprole (Vantacor)	0.7 to 1.7 fl. oz./acre (0.07 to 0.066 lb a.i.)	Labeled for control of nymphs and supression of adults in grass forage fodder and hay (rangeland and pasture grass). Performance is improved with the addition of a Methylated Seed Oil (MSO) adjuvant at 1 gallon per 100 gallons of spray volume (1% v/v) when eggs have hatched and the majority of the grasshopper population is 2nd-3rd instar nymphs. REI is 4 hours. PHI is 0 days.
Esfenvalerate* (Asana XL)	0.015 to 0.03 lb. a.i./acre (2.9 to 5.8 fl. oz./acre of Asana XL)	Note: Do not apply to wheat. This label is for noncrop use on land adjacent to tilled area to control migrating insects. Repeat as needed, but do not exceed 0.5 lb. a.i./acre per year. Do not feed the treated vegetation. Do not spray ditch banks or areas adjacent to water.
Gamma-cyhalothrin* (Proaxis)	0.0075 to 0.015 lb. a.i./acre, 1.92 to 3.84 fl. oz/acre	Spray non-cropland adjacent to agricultural areas to control migratory insects that may threaten crops. Use highest labeled rates for dense/tall foliage, high insect populations and/or larger insects. Do not graze livestock in treated area. REI is 24 hours.
Lambda-cyhalothrin* (Grizzly Z)	0.02 to 0.03 lb. a.i./acre or 2.56 to 3.84 fl. oz./acre	Spray non-cropland adjacent to agricultural areas to control migratory insects that may threaten crops. Use highest labeled rates for dense/tall foliage, high insect populations and/or larger insects. Do not graze livestock in treated area. REI is 24 hours.
Zeta-cypermethrin* (Mustang MAXX, etc.)	0.0175 to 0.025 lb. a.i./acre (2.8 to 4.0 fl. oz./acre)	Labeled for use on grass forage, fodder, pasture, and rangeland with a 12 hour REI and a 0-day harvest restriction on forage. Thus, this material may be used to treat these areas when grasshoppers are threatening to move from these areas into neighboring crop fields.

* Restricted Use Pesticide

Wheat Insecticide Use Instructions **

Insecticide	Special Instructions
Alpha-cypermethrin* (Fastac CS)	Do not make applications less than 14 days apart. Do not apply more than 11.4 fl. oz. of product per acre per season. REI is 12 hours. PHI is 14 days. Do not use any products containing cypermethrin or zeta-cypermethrin during a crop season when using Fastac EC.
Beta-cyfluthrin* (Baythroid XL)	Pre-grazing or foraging interval is 3 days. REI is 12 hours. PHI is 30 days.
Carbaryl (Sevin)	Do not make more than two applications nor apply more than once every 14 days. REI is 12 hours. PHI is 21 days for grain or straw, or 7 days for use as pasture or forage.
Chlorantraniliprole (Vantacor)	Do not make more than four applications per acre per calendar year. Minimum interval between treatments is 7 days. Do not apply more than 5.1 fl. oz. or 0.2 lb. a.i. of chlorantraniliprole per acre per year. REI is 4 hours. PHI is 1 day.
Dimethoate (Dimate and others, formerly Cygon)	Do not graze immature plants within 14 days of application. REI is 48 hours. PHI is 35 days.
Gamma-cyhalothrin* (Proaxis)	Apply with ground or air equipment, using sufficient water and application methods to obtain full coverage of foliage. When applying by air, apply in a minimum of 2 gallons of water per acre. REI is 24 hours. PHI is 30 days.
Lambda-cyhalothrin* (Numerous products, including Silencer, Taiga Z, Lambda T, and Warrior II with Zeon Technology)	Apply by ground or air in sufficient gallonage to obtain full coverage of target location. Use a minimum of 2 gallons of water per acre by air. Do not graze or harvest forage as feed within 7 days after treatment. Do not feed treated straw within 30 days after treatment. REI is 24 hours. PHI is 30 days. Do not apply more than 0.06 lb. a.i./acre per season.
Malathion	REI is 12 hours. PHI is 7 days for grazing or harvest.
Spinosad (Blackhawk)	Apply in 2 to 5 gallons per acre by air or in a minimum of 5 gallons by ground application. Time application to coincide with peak egg hatch. Do not apply more than 9 fl. oz. of product per acre per year. REI is 4 hours. PHI is 21 days for grain or straw or 3 days for forage or hay.
Sulfoxaflor (Transform WG)	If blooming vegetation is present 12 feet out from the field, maintain a downwind 12-foot on-field buffer. Refer to the label for prohibited tank-mix partners. REI is 24 hours.
Zeta-cypermethrin* (Mustang MAXX, etc.)	Apply in a minimum of 10 gallons of water by ground or 2 gallons by air. Do not make applications less than 14 days apart. Do not apply more than 0.25 lb. a.i./acre per season. REI is 12 hours. PHI is 14 days for grain, forage and hay.

* Restricted Use Pesticide

**Insecticides listed in this table are intended to provide a guide to products labelled for use against the pest(s) listed. These lists are intended as a guide only and are not a substitute for the actual product label. For questions or more specific information relative to any insecticide, always refer to the actual label on the product.

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