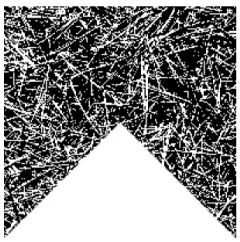
IPM Small Grains



Insect, Disease, and Weed Control Recommendations for 2012

INSECT PEST MANAGEMENT

Small grain fields provide an ideal habitat for many beneficial as well as harmful insect species. Some closely resemble each other, so accurate identification is important. Insects can be identified by visual appearance, location in the field, and seasonal occurrence. After identification, it is important to determine if the insect population level has increased to the point of economic damage. This level is called the *economic threshold* and refers to the projected loss of crop that is equivalent to the cost of treatment. Many factors influence the amount of damage that occurs. Determining when an insect infestation causes economic damage is the basis of pest management. Most insect pests including aphids can be controlled by applying foliar insecticides when population numbers exceed economic thresholds. Economic thresholds presented here apply to wheat unless otherwise indicated. Pest impact on other small grains has not been well studied in the Southeast.

The primary insect pests of wheat and triticale in the Southeast are aphids and the Hessian fly. Aphids are important because they transmit barley yellow dwarf virus. Cereal leaf beetle occurs in the northern two-thirds of the state. A number of other insects also attack small grains, but these pests occur sporadically. Insect pests of oats are similar to those of wheat, except that oats are not attacked by Hessian fly. Rye is frequently interplanted and/or planted early as a forage crop. As such, it is often prone to damage from fall armyworms, winter grain mites, and green June beetle grubs. Cereal leaf beetle, Hessian fly, and chinch bug are also pests of rye. The major insect pests of barley are aphids and occasionally Hessian fly.

See the Alabama Small Grain Production Guide at www.alabamacrops.com for more information on best management practices for wheat in Alabama.

General Insect Pest Management Recommendations for Wheat

- Avoid continuous planting of wheat in the same field.
- Select a Hessian fly resistant variety.
- Control volunteer wheat.
- If possible, chisel plow and disk harrow fields to bury wheat debris.
- Do not plant wheat for grain before the recommended planting date for your area.
- Consider planting rye, oats, or ryegrass instead of wheat for grazing.
- Scout fields (sample 5 to 10 sites per field) for insect pests and control with foliar-applied insecticides when numbers exceed treatment thresholds.

General Scouting Procedure

It is a good management practice to scout fields for damaging infestations of insects. At a minimum, check grain fields in the fall, in late winter before applying nitrogen, and during the boot and heading stages. Scouting during the first 20 to 50 days after planting is especially critical, because this is when insect control with a foliar spray can provide greatest economic returns. Check fields as often as possible after this time, particularly before applying fertilizer, herbicides, or fungicides. If insect populations exceed thresholds, it may be possible to apply an insecticide as a tank mix with another chemical.

Check five to 10 spots in the field, examining at least 1 row-foot at each location. Be sure to include at least two samples near the field edges. Check closely because insects, particularly aphids and pupae of the Hessian fly, can sometimes be found at the base of the plant below ground level. It may be necessary to pull some plants out of the ground in order to sample for insect infestations. For larger plants, slap the plants to jar insects to the ground for counting.

Aphids

Wheat in the Southeast is attacked by a number of species of aphids. These include the greenbug, *Schizaphis graminum*; English grain aphid, *Sitobion avenae*; yellow sugarcane aphid, *Sipha flava*; bird cherry-oat aphid, *Rhopalosiphum padi*; rice-root aphid, *Rhopalosiphum rufiabdominale*; and corn leaf aphid, *Rhopalosiphum maidis*. All of these species attack a wide range of grass hosts including all of the small grain crops. Aphids have become the number one insect pest of wheat in the Southeast.

Aphids cause two types of damage. They directly damage plants by sucking sap and, in the case of the greenbug, by injecting a toxin while feeding. In general, the greenbug and English grain aphid cause more severe direct damage than the

other species. Yellow sugar cane aphid can also cause direct damage. It is less common than the other aphids, and is more likely to be found in southwest Alabama than in other parts of the state. The greenbug is particularly prevalent in the fall, and it can cause economic losses due to direct feeding on the young plants. Feeding by the greenbug causes the wheat plant to turn yellow, and heavy feeding will cause it to die. Heavy feeding also causes typical "greenbug spots" in a field. The centers of the spots are made of dead plants with visible skins of greenbugs, surrounded by living plants that are heavily infested and beginning to turn yellow. English grain aphid, more common in the spring, can cause reduction in yield during heading. Mild, dry winters and cool, dry springs often favor aphid outbreaks.

Indirect damage from aphids is more important than the direct damage, because aphids transmit plant disease viruses of which barley yellow dwarf is the most devastating. The bird cherry-oat and other *Rhopalosiphum* spp. aphids are the most important vectors in our area. Infection of seedling and vegetative stage plants in the fall and winter is much more damaging than infection during the spring. Fall infection stunts plants, increases susceptibility to cold injury, and reduces grain yield of infected plants by about 50 percent. Early planting enhances fall aphid infestations and infection of barley yellow dwarf virus. For more detailed information and photographs, please see Circular ANR-1082, "Barley Yellow Dwarf in Small Grains in the Southeast." (www.aces.edu/pubs/docs/A/ANR-1082).

Description and Life Cycle. Aphids are small, soft-bodied insects. They are about $^1/_8$ inch long when fully grown. Most species have a pair of cornicles, which extend like exhaust tailpipes from the hind end of the aphid. Some aphids have wings; some do not.

Aphids do not have distinct generations, but population numbers are greatest in the fall and spring. Winged adults move from summer grass crops, weeds, and volunteer small grain plants to newly sown fields in the fall.

The winged adult produces wingless forms that feed in clusters on all vegetative parts of the plants and on the grain heads. In the Southeast, aphids overwinter in wheat fields as nymphs and wingless adults. Several aphid species often occur together in the same field. Aphid populations are predominantly greenbug, bird cherry-oat, and rice root aphids in the fall and winter, whereas English grain aphid becomes predominant in the spring.

Aphids are born pregnant; consequently, populations can increase and reach economic levels rapidly. Dry, warm (but not hot) weather promotes rapid population increase. Heavy and violent rainstorms can reduce populations considerably during the spring when aphids are exposed on grain heads. Aphids also are attacked and killed by parasitic wasps, which cause aphids to become light brown "mummies." Several species of ladybird beetle adults and larvae are important predators of aphids. Ladybird beetle adults move into wheat fields from overwintering sites usually in March or early April where they feed voraciously on aphids and often control aphid infestations. This is too late to prevent transmission of barley yellow dwarf virus but may prevent direct aphid injury to developing grain. Hover fly larvae also can be found eating aphids in wheat fields.

Scouting Procedure. Follow the General Scouting Procedure (above) to scout for aphids.

Threshold Level and Management. The incidence of barley yellow dwarf may be reduced by controlling aphids in the fall and late winter using foliar insecticides or by using an insecticide seed treatment at planting. The cost of these treatments should be weighed against the historic or expected loss from aphid infestation and barley yellow dwarf infection. Insecticide seed treatments for control of aphid vectors are more likely to pay off in north Alabama than in south Alabama. Insecticides to control aphids are most likely to reduce barley yellow dwarf when applied in the fall in North Alabama and when applied in early spring (at the time of nitrogen-topdress application) in the Coastal Plain. Setting threshold levels for aphids is difficult because of the influence of factors other than the number of aphids per foot of row. The planting date, temperature, time of year, moisture conditions, stage of growth, presence of parasites and predators, and the number of virus sources all need to be taken into consideration in deciding whether to apply insecticides. Yield-limiting infections of barley yellow dwarf occur before heading. Do not treat to control barley yellow dwarf at or after heading.

Threshold levels in Table 1 are based on research conducted in South Carolina and Georgia.

Table 1. Aphid Thresholds in Wheat

Growth Stage	Treat if there are more than:
Seedling (0-30 days after planting)	1-2 bird cherry-oat aphids per foot of row (North Ala.) or 10+ greenbugs or sugarcane aphids per foot of row
6- to 10-Inch Tall Plants	6 aphids per foot of row
Stem Elongation	2 aphids per stem
Boot/Flag Leaf Stage	5 aphids per stem
Head Emergence	10 aphids per head
Soft/Hard Dough	Do Not Treat

Hessian Fly

Hessian fly, *Mayetiola destructor*, populations were high in Alabama in 2008 and 2009. Changes in the biotype of the Hessian fly, combined with increased wheat acreage and increased areas planted to continuous wheat, contributed to the problem. This is not the first outbreak of Hessian fly that has occurred in Alabama. This insect was a major factor limiting wheat production throughout the southern United States during the 1980s. In 1989, the Hessian fly destroyed many fields and caused losses of $28 million in Georgia alone. Wheat is the primary host of the Hessian fly, but the insect also will infest barley, triticale, and rye. Hessian fly does not attack oats or ryegrass.

Description and Life Cycle. The adult fly is dark with long legs and is the size of a small mosquito. Adult females live for 2 to 3 days during which they mate. Females lay about 200 eggs in the grooves of the upperside of the wheat leaves. Eggs are orange-red, $^{1}/_{32}$ inch long and hatch in 3 to 5 days. Young reddish larvae move along a leaf groove to the leaf sheath and then move between the leaf sheath and stem where they begin to feed on the stem above the crown or joints along the stem. Maggots become white after molting and appear greenish white when full grown. These white maggots discharge a toxic salivary secretion which stunts plant growth. Feeding by a single larva for several days will completely stunt the growth of a vegetative tiller. Maggots molt into a resting stage (puparia) which is often referred to as the "flaxseed" stage because the puparia resemble seeds of flax. The entire life cycle requires about 35 days at 70°F. Newly hatched larvae are prone to drying while they are exposed on the leaf surface, but once larvae move to the stem base, they are protected from weather extremes. Plants infested in the fall may die, and spring-infested wheat often lodges or has smaller heads.

The Hessian fly is a cool season insect and is active during the fall, winter, and spring. The insect oversummers as puparia in wheat stubble. The number of generations during the year is governed largely by temperature. Generally, three to four generations occur in the Piedmont region of the Southeast, and four to five generations occur in the Coastal Plain. Adults emerge from oversummered pupae in wheat stubble about September 1. Because wheat has not yet been planted, the first generation develops entirely in volunteer wheat and weed hosts. Little barley is the only important non-crop host in our area. A second and sometimes a third generation occur in late fall and winter. One generation usually occurs in the spring. The fall and first spring generations stunt and kill seedling plants and vegetative tillers. The spring generation infests jointed stems during stem elongation with larvae feeding between the stem and leaf sheath above a joint (node).

Management Strategies for Hessian Fly. Host plant resistance is the most economical means of Hessian fly control. However, use of resistant plant varieties has resulted in the development of numerous Hessian fly biotypes. Biotypes are identical to each other and to the parental type, except each biotype contains the ability to overcome a specific set of wheat genes for resistance to the pest.

Laboratory studies and field surveys of the Hessian fly in Alabama have shown that wheat varieties with the H13 gene (so-called Biotype L resistant varieties) provide the most protection from Hessian fly in Alabama. However, varieties with very good H7H8 resistance are still more helpful than varieties that are known to be susceptible to Hessian fly. See the latest version of the Alabama wheat production guide for more information on specific varieties. This guide can be found at www.alabamacrops.com.

Generally, insect damage is more severe in early wheat plantings. Early plantings allow insects to become established and increase before freezing temperatures limit activity. Damage by many insects can be minimized or avoided by not planting before the recommended planting date in your area. Growers who plant fly-susceptible varieties should plant near the end of the recommended planting dates for their area (see Table 2). Planting after the recommended planting date usually results in a loss of yield potential.

Table 2. Recommended Planting Dates for Wheat in Alabama

	Grain	Forage Plus Grain	Forage Only
North	Oct. 15-Nov. 1	Sept. 15 - Nov. 1	Aug. 25-Sept. 10
Central	Oct. 15-Nov. 15	Sept. 15-Nov. 1	Sept. 1-Sept. 15
South	Nov. 1-Dec. 1	Oct. 1-Nov. 15	Sept. 15-Sept. 30

The average Hessian fly-free date in North Alabama is around November 1. South Alabama is similar to Georgia's coastal plain region and does not have a fly-free date.

The effect of planting date on Hessian fly populations in wheat is shown in Table 3. Fall infestations decline in later planting dates. Therefore, damage by the Hessian fly may be minimized by timely planting, but fall damage probably will not be eliminated, particularly in the coastal plain region where activity can occur throughout the winter. Several other cultural practices can aid in the management of Hessian fly in wheat. Most insect pests, including the Hessian fly, aphids, fall armyworms, and others can become established in a field on volunteer wheat growing in the summer annual crop before wheat planting. Therefore, control of volunteer wheat by reducing combine losses of grain at wheat harvest and effective subsequent weed control will help in reducing early pest buildup on volunteer wheat. Tillage can have a large impact on fall populations of insects in wheat. Insect populations and damage generally are greater under no tillage than under conventional tillage systems. Table 4 shows the effect of moldboard plowing on fall Hessian fly infestations in wheat. Fall infestations were almost three times greater in the no-till than the plow tillage systems. Plowing buries wheat stubble where Hessian flies oversummer and suppresses volunteer wheat.

Table 3. Effect of Planting Date on Hessian Fly Infestation in Susceptible Winter Wheat at Plains, Georgia

Planting Date	% Infested Tillers		
	Dec. 5	Feb. 9	May 12
Oct. 23	42	24	65
Nov. 5	16	23	70
Nov. 20	0	20	77
Dec. 5	---	2	70

SOURCE: David Buntin, University of Georgia, Field trials from Plains and Griffin, Georgia.

Table 4. Effect of Moldboard Plowing on Hessian Fly Infestation in the Fall and Spring

Tillage Treatment	% Infested Tillers	
	Fall	Spring
Plowing (fall and spring)	8	40
Plowing (fall only)	7	44
No-tillage	23	43

SOURCE: David Buntin, University of Georgia,

Using a seed treatment will provide some control of Hessian fly. Growers who plant fly-susceptible wheat in high-risk situations may benefit from high rates of seed treatments such as clothianidin, thiomethoxam, and imidacloprid. Seed treatments will not prevent reinfestation by subsequent generations during the winter and spring. Foliar application of insecticide at or before the second to third leaf stage may protect the young wheat plants from attack by Hessian fly. See the North Carolina small grain production guide for more information (www.smallgrains.ncsu.edu/NCSmallGrains/ProductionGuide.html). Foliar applications of insecticides in the spring for Hessian fly control are highly variable in effectiveness. Apply when adults are actively laying eggs. More information on the proper timing of foliar applications can be found at www.ces.ncsu.edu/plymouth/pubs/ent/HFLYupdate03.html.

Several non-stinging, parasitic wasps attack and kill Hessian fly larvae. *Platygaster hiemalis* attacks Hessian fly larvae in the fall and winter, and several other parasitic wasps attack the spring generation. Because of the number of generations, parasites cannot control the Hessian fly during an outbreak year, but natural enemies probably provide long-term regulation of Hessian fly populations.

For more information, see ANR-1069, "Biology and Management of Hessian Fly in Wheat" (www.aces.edu/pubs/docs/A/ANR-1069/). Information on varietal selection and Hessian fly resistance is provided by the annual Small Grain Performance Tests (Univ. of Georgia), and the Performance of Small Grain Varieties for Grain in Alabama (www.alabamavarietytesting.com) (Auburn University).

Scouting Procedure. Stunted vegetative tillers usually have a bottom leaf which is greener and wider than the leaf of a non-infested plant. The infested tillers do not elongate or produce new leaves, and die after the maggots pupate. Separating the leaf sheath from the stem reveals the white maggots or brown flaxseed stage. Infested jointed stems are short, and the stem is weakened at the joint where feeding occurs. Grain filling of infested stems is reduced, and damaged stems often lodge before harvest. For more information, see "Hessian Fly Scouting Guide," www.aces.edu/dept/grain/documents/HessianFlyScoutingGuide.pdf.

Threshold Level. Yield loss usually becomes significant when fall infestations exceed 5 to 8 percent infested tillers or spring infestations exceed 20 percent infested stems. Growers who plant fly-susceptible varieties should inspect the wheat prior to making their customary nitrogen application between Feb. 15 and March 15. If 20 percent of the tillers are infested with Hessian fly maggots or pupae at this time, significant yield losses can be expected and the money spent for nitrogen may not produce the desired yield response.

Fall Armyworm and Its Relatives

The fall armyworm, *Spodoptera frugiperda;* beet armyworm, *S. exigua;* and yellowstriped armyworm, *S. ornithogalli*, can move into wheat in the autumn as summer crops mature. Damage usually is limited to early plantings for forage production. There is the potential for armyworm damage until the first heavy frost. Small larvae often produce clear windowpane-like areas on leaves which normally does not reduce grain yield. Older, larger larvae can destroy seedling plants, but most years they do not occur in sufficient numbers to cause damage. Fall armyworm damage is likely after a dry summer.

Description and Life Cycle. The full-grown caterpillar is from 1 to 1.5 inches long. Within a species, larvae (caterpillars) of these moths are highly variable in size and color. The circular ANR-1121, "Identifying Caterpillars in Field, Forage, and Horticultural Crops" (www.aces.edu/pubs/docs/A/ANR-1121) has a key that can be used to separate the three species of caterpillars. Beet armyworm larvae generally have a spot on the side of the second segment behind the head. Fall armyworms and yellow-striped armyworms have an inverted, light colored, Y-shaped line on the front of the head. Fall armyworms have four black spots on the back of each segment behind the legs, and three white lines on the back on the first segment just behind the head. Yellow-striped armyworms do not have these markings. Eggs are laid in clusters at night on grasses or other plants. Eggs hatch in a few days, and the larvae mature in about 3 weeks. A complete cycle requires as little as 30 days. There are several generations each year.

Scouting Procedure. Record the number of caterpillars per linear foot of drill row, or square foot of broadcast wheat. Include the small larvae. Be sure to take samples from the edge as well as the interior of the field because this pest is often heaviest near the field margins. Sometimes, only the field margins require treatment.

Threshold Level. These armyworms attack grain in the fall in the seedling stage; therefore, a relatively small number of larvae per foot of row can do heavy damage. The threshold level is from two to three larvae per linear row foot (three per square foot) for seedling wheat. For older plants, three to four larvae and obvious foliage loss justify control measures.

"True" Armyworm

The armyworm, *Mythimna unipuncta*, typically attacks wheat during the stem-elongation and heading stages during the spring. It is often called "true armyworm" to separate it from the fall armyworm and various cutworms. True armyworms can be hard to detect because they hide on or in the soil during the daytime. At night, larvae climb stalks to chew holes in leaves, eat spike glumes and kernels, and sometimes cut seed heads. The most severe damage to wheat is caused by cutting through the stem below the head and separating it from the plant. Heavy populations may destroy the leaves and beards in only a few nights of feeding.

Description and Life Cycle. Mature larvae are about 1.5 inches long, smooth-bodied, and dark gray to greenish-black. The chief distinguishing feature is five stripes extending lengthwise on the body, three on the back and one on each side. The true armyworm adult is a moth. For egg deposition, the moth is especially attracted to rank-growing grains in low areas. The destructive period of the armyworm's life cycle lasts about 10 days. At the end of this time, the worms may disappear as suddenly as they came. In most years, armyworms are attacked by numerous parasites and several diseases, which prevent them from causing economic damage. *Damage usually occurs during cool, wet springs.*

Scouting Procedure. The heaviest infestations of true armyworms are generally found near field margins and in low-lying areas of rank-growing grain, especially where it has lodged. Check for this pest in and under debris at the base of the plants, as well as in the heads. The presence of frass (feces) and dropped plant material can be an indication that worms were or are present. Shake or beat the heads and straw to dislodge the larvae. Check several locations in the field and average the counts for each. A sweep net can be a useful tool to find armyworms before they cause damage.

Threshold Level. Three to four armyworms per linear row foot is a commonly accepted economic threshold. However, if the crop is nearly mature and there is no evidence of head clipping, control may not be necessary. If the larvae are all mature, insecticidal control is not advised because these larvae will soon drop to the soil and pupate.

Cereal Leaf Beetle

The cereal leaf beetle, *Oulema melanopus*, was introduced from Europe into Michigan in the 1950s and is slowly spreading southward. It is now found as far south as central Alabama and Georgia. The immature stage (larva) of cereal leaf beetle feeds on the leaves of wheat, oats, and certain other grasses; it prefers oats but also readily accepts winter wheat.

Feeding activity by cereal leaf beetle larvae results in long, window-like slits in the leaves. Feeding occurs in the spring usually from the boot stage through early heading.

Description and Life Cycle. Cereal leaf beetle adults are about $^{3}/_{16}$ inch long and $^{1}/_{16}$ inch wide. The adults have dark, metallic blue wing covers, orange legs, and an orange collar. The head and the rest of the body are black. Eggs are cylindrical with rounded edges. They are light orange when laid and darken gradually over time to brown. Eggs are usually deposited singly or in rows of two to four on the top side of the leaves. Each female lays from 12 to 50 eggs. Larvae are pale yellow with a brown head and legs. In the field, they look mostly black because they smear excrement over their bodies. People walking through a field infested with cereal leaf beetle larvae may emerge with black-stained pants legs because this black coating easily rubs off the larvae. The larvae are about $^{1}/_{16}$ inch long just after hatching and $^{1}/_{3}$ inch long when fully grown.

Cereal leaf beetle has one generation per year. Adult beetles spend the winter in the woods and field borders. During the first warm days of spring, the beetles fly into small grain fields, mate, and begin to lay eggs in mid to late March. Eggs hatch in about seven days, and larvae begin to feed on the cereal leaves. The larvae feed for about 3 to 4 weeks, then leave the plant, and move into the soil. The adults of the new generation come out in late May and early June, feed briefly, then move out of the fields, and remain inactive until the following spring. New generation adults may feed on corn leaves but seldom cause serious damage.

Scouting Procedure. Start checking for cereal leaf beetle eggs, larvae, and adults in early March in the vicinity of Talladega County and in mid-March in the Tennessee Valley region. Check fields weekly for about a month. Look for feeding damage, adult beetles, eggs, and larvae. Stop in five to ten areas in each field, and count the eggs and larvae on the top two leaves of five stems at each location. Sample the middle of the fields as well as the edges.

Threshold Level and Management. If cereal leaf beetle larvae have begun to hatch and there is more than one cereal leaf beetle egg or larva per two stems, treat with one of the suggested insecticides. All suggested insecticides provide good control of cereal leaf beetle larvae, but best yield response occurred when a long-residual insecticide, such as lambda-cyhalothrin, was applied at or before 30 percent egg hatch. Because dying larvae are hard to distinguish from living ones, wait 2 to 3 days after treatment before checking to make sure the treatment was successful. Heavy rains can kill larvae, so if heavy rains occur between the time a field is checked and insecticides are to be applied, wait for the foliage to dry and recheck the fields. Cereal leaf beetle has few natural enemies in the southern United States, but exotic parasites of the egg and larval stages are being released throughout the region.

See “Management of Cereal Leaf Beetles, Pests of Small Grains,” ANR-984 (www.aces.edu/pubs/docs/A/ANR-0984), for more information.

Chinch Bugs

Adult chinch bugs, *Blissus leucopterus*, are $^{1}/_{6}$ to $^{1}/_{5}$ inch long and are black with white wings that are marked with a triangular black patch on the outer margins. The white wings give the insect a spotted appearance. Nymphs are brown to reddish with a transverse pale colored band. Both nymph and adult chinch bugs feed on grasses, including all the small grain crops, by sucking sap. Feeding can discolor and stunt plants, but populations usually are not large enough to cause economic damage on small grains. The insect overwinters as an adult and the entire life cycle takes about 40 days. Chinch bugs avoid damp, shaded areas; therefore, they are usually found along field edges and in thinner stands where sunlight reaches the soil. Chinch bugs are mainly a problem in dry years. They also may increase in small grain crops in the spring and move, as the wheat matures, to summer annual grass crops such as corn, sorghum, and millet in adjacent fields or to double-cropped plants in the same field. Chinch bugs can be very damaging to double cropped corn, sorghum and millet seedlings, especially under dry conditions. Economic thresholds have been estimated as one to two adults per five seedling plants. In spring, the economic threshold is one adult per stem.

Pathogenic fungi are especially important in suppressing populations of chinch bugs. These fungi require wet, humid conditions to develop; consequently, *populations of these pests typically are worse in dry than wet years.*

Grasshoppers

Grasshoppers destroy leaves of seedlings during fall. The damage is usually along field margins. The economic threshold is three to five per square yard within the field.

Lesser Cornstalk Borer

The lesser cornstalk borer, *Elasmopalpus lignosellus,* is a moth whose larvae bore into the stem base at or below the soil surface and kill seedling plants in the fall. This insect feeds on many host plants and often moves from weeds and stubble of the previous crop to newly planted small grain plants in the same field. Damage by lesser cornstalk borers usually is restricted to small grains that are planted early for grazing.

Stink Bugs

Large numbers of brown, *Euschistus* spp., or Southern green, *Nezara viridula*, stink bugs sometimes infest wheat in the coastal plain region during grain filling to harvest. Stink bugs feed by sucking fluid from developing grain, causing grain to be shriveled. The impact of stink bug feeding injury on wheat has not been determined, but most likely infestations rarely cause economically important damage. Instead, stink bugs disperse from wheat fields at harvest to infest adjacent summer crops where they may cause significant damage.

Thrips

Thrips are very small (3 inch or less in length) slender-bodied insects either wingless or winged with two pairs of very slender wings fringed with long hairs. Studies in Georgia and Florida found that the predominant species attacking small grains in the Southeast are the tobacco thrips, *Frankliniella fusca*, and cereal thrips, *Limothrips cerealium*. Nymphs are variously colored but adults are typically black. Thrips feed between the leaf sheath and stem where they suck plant fluids. Although thrips may become very abundant, they do not cause significant damage in small grains and do not require control in wheat. Wheat is not a host for tomato spotted wilt virus, which can be transmitted by tobacco thrips. However, as wheat matures, thrips may disperse to new plantings of adjacent summer crops where they can cause direct feeding damage.

Winter Grain Mites

Winter grain mites *(Penthaleus major)* are large, dark brown or black mites with red legs. They attack wheat, barley, and oats, particularly when these grains are over-seeded into perennial grass sod. Damage often appears between Thanksgiving and Christmas. See "Winter Grain Mite": http://pubs.ext.vt.edu/444/444-037/444-037.html.

Organic Insecticides That Can be Applied to Small Grains

Organic producers may want to consider the following insecticides, most if not all of which are OMRI approved. Be sure to read the insecticide label to make sure it meets your needs. The following products contain azadirachtin: Neemix 4.5, Molt-X, Ecozin Plus, Azatrol, and Azatin XL. The following products contain *Bacillus thuringiensis:* Biobit HP (subsp. *kurstaki* strain ABTS-351), Dipel ES (subsp. *kurstaki* strain ABTS-351), Dipel DF (subsp. *kurstaki* strain ABTS-351), Javelin WG (subsp. *kurstaki* strain SA-11), Lepinox WDG (subsp. *kurstaki* strain EG7826), CryMax WDG (subsp. *kurstaki* strain EG7841), and Xentari (subsp. *aizawai* strain ABTS-1857). PyGanic Crop Protection EC 1.4_{II} and PyGanic Crop Protection EC 5.0_{II} insecticides are OMRI approved and contain natural pyrethrins. There are other insecticides that contain pyrethrins. Be sure to choose one that does not contain piperonyl butoxide, as that chemical is not considered organic. Pest Out contains cottonseed, clove, and garlic oils. M-Pede contains potassium salts of fatty acids. Entrust and Justice Fire Ant Bait contain spinosad. Other formulations of spinosad can be found. Be sure to check the labels to see if they meet the requirements for your cropping system. Other organic insecticides may be available.

Table 5. Small Grains (Barley, Oats, Rye, Triticale, and Wheat) Insect Control [1]

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest (h) or Grazing (g)	Comments
Aphids–***Seed Treatment***					
	clothianidin NIPSIT INSECTICIDE	0.75-1.79 fl.oz./ 100 lb. seed	0.03-0.07 lb./100 lb. seed	Not specified	Check with your Valent representative to verify the current product name and registration status.
	imidacloprid GAUCHO 600 Other trade names [2]	0.8-2.4 fl.oz./ 100 lb. seed	0.03-0.09 lb./100 lb. seed	45	Use as a seed treatment. Apply as a slurry either on-farm or as a commercial seed treatment. Ensure thorough coverage. See label for plantback restrictions.
	imidacloprid + captan + carboxin ENHANCE AW	4 oz/ 100 lb. seed	0.066 lb. of each	45	For oats, barley, and wheat. See label for plantback restrictions. Apply as a planter box treatment.
	imidacloprid + metalaxyl + tebuconazole GAUCHO XT	3.4 fl.oz/ 100 lb. seed	0.03 lb. imidaclo-prid/100 lb. seed	45	For barley, oats, rye, and wheat. See label for plantback restrictions.
	thiamethoxam CRUISER 5FS	0.75-1.33 fl.oz./100 lb. seed	0.03-0.07 lb. /100 lb. seed	Do not graze	Apply as a water-based slurry for wheat and barley seed treatment **ONLY**. See label for plantback restrictions.
	thiamethoxam + mefenoxam + difenoconazole CRUISER MAXX cereals	5 fl.oz./ 100 lb. seed	0.01 lb./ 100 lb. seed	Not specified	**Add an additional amount of Cruiser 5FS (0.48 to 1 fluid ounces of Cruiser 5FS).**
Aphids–***Foliar Treatment***					
	beta-cyfluthrin BAYTHROID XL [3]	1.8-2.4 fl.oz.	0.014-0.019	30 (h), 3 (g)	Baythroid XL is a **RESTRICTED USE** pesticide.
	cyfluthrin TOMBSTONE [3] Other trade names [2]	1.8-2.4 fl.oz.	0.028-0.038	30 (h), 3 (g)	For wheat only. Tombstone is a **RESTRICTED USE** pesticide.
	dimethoate DIMETHOATE 4EC Other trade names [2]	0.5-0.75 pt.	0.25-0.375	35 (h), 14 (g)	For wheat only. Other formulations are registered on triticale.
	gamma-cyhalothrin DECLARE [3] Other trade names [2]	1.02-1.54 fl.oz.	0.01-0.015	30 (h), 7 (g)	For wheat, wheat hay, and triticale **ONLY.** Declare is a **RESTRICTED USE** pesticide. Use maximum rate for greenbug. Best control is achieved before the boot stage.

[1] See Table 6 for a list of insecticides, formulations, restricted entry intervals, days to grazing or harvest, and maximum amount to apply.
[2] See Table 6 for other trade names.
[3] Use higher rate and increased water after insects are present or after boot stage. After boot stage control may be limited to suppression only.

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest (h) or Grazing (g)	Comments
Aphids–*Foliar Treatment* (cont.)					
	lambda-cyhalothrin KARATE with Zeon Technology [3] Other trade names [2]	1.28-1.92 fl.oz.	0.02-0.03	30 (h), 7 (g)	Use higher rate for greenbugs. Best control is achieved before boot stage. Karate is a **RESTRICTED USE** pesticide.
	zeta-cypermethrin MUSTANG MAX EC INSECTICIDE Other trade names [2]	3.2-4 fl.oz.	0.02-0.025 lb. a.i./A	14	Mustang Max is a **RESTRICTED USE** pesticide. Aphid control may be variable depending on species present. Use on wheat and triticale only.
Armyworms (Fall and True)					
	beta-cyfluthrin BAYTHROID XL	1.8-2.4 fl.oz.	0.014-0.019	30 (h), 3 (g)	For first and second instar armyworm. Baythroid XL is a **RESTRICTED USE** pesticide.
	cyfluthrin TOMBSTONE Other trade names [2]	1.8-2.4 fl.oz.	0.028-0.038	30 (h), 3 (g)	For wheat only. For true armyworm or first and second instar fall armyworm. Tombstone is a **RESTRICTED USE** pesticide.
	gamma-cyhalothrin DECLARE Other trade names [2]	1.02-1.54 fl.oz.	0.01-0.015	30 (h), 7 (g)	For wheat, wheat hay, and triticale **ONLY.** Declare is a **RESTRICTED USE** pesticide.
	lambda-cyhalothrin KARATE with Zeon Technology Other trade names [2]	1.28-1.92 fl.oz.	0.02-0.03	30 (h), 7 (g)	Apply when worms are small. Karate is a **RESTRICTED USE** pesticide.
	malathion MALATHION 5 Other trade names [2]	2 pt.	1.25 lb.	7	For true armyworm only. For wheat, oats, rye, and barley.
	methomyl LANNATE 2.4LV Other trade names [2]	0.75-1.5 pt.	0.225-0.45	7 (h)	For wheat, oats, rye, and barley. Apply when worms are small. **DO NOT** apply more than 1.8 pounds active ingredient per acre per crop. Lannate is a **RESTRICTED USE** pesticide.
	methyl parathion CHEMINOVA METHYL 4EC Other trade names [2]	1.5 pt.	0.75	15	For true armyworms; not recommended for control of fall armyworms. All formulations of methyl parathion are **RESTRICTED USE** pesticides. Cheminova Methyl 4EC can be used on wheat, oats, barley, and rye.
	spinosad TRACER Other trade names [2]	1.5-3 fl.oz.	0.047-0.094	21 (grain, straw) 3 (forage, fodder, hay)	Most effective when timed to coincide with peak egg hatch.
	spinetoram RADIANT SC	3-6 fl.oz.	0.023-0.046	21 (grain, straw) 3 (forage, fodder, hay)	Apply during peak egg hatch and/or small larval stage of each generation.

[2] See Table 6 for other trade names.
[3] For suppression after boot stage.

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest (h) or Grazing (g)	Comments
Armyworms (Fall and True) (cont.)					
	zeta-cypermethrin MUSTANG MAX EC INSECTICIDE Other trade names [2]	1.76-4 fl.oz.	0.011-0.025	14	Use 3.2 to 4 fluid ounces per acre for fall armyworm. Mustang Max is a **RESTRICTED USE** pesticide. Use on wheat and triticale **ONLY**.
Cereal Leaf Beetles					
	General Comments: *See the scouting section for information on action thresholds and timing of application.*				
	beta-cyfluthrin BAYTHROID XL	1.0-1.8 fl.oz.	0.008-0.014	30 (h), 3 (g)	Baythroid XL is a **RESTRICTED USE** pesticide.
	cyfluthrin TOMBSTONE Other trade names [2]	1.0-1.8 fl.oz.	0.016-0.028	30 (h), 3 (g)	For wheat only. Tombstone is a **RESTRICTED USE** pesticide.
	diflubenzuron DIMILIN 2L	4 fl.oz.	0.06	50 (grain, straw) 15 (hay) 3 (grazing)	Dimilin is a **RESTRICTED USE** pesticide. For best results apply at first sign of egg laying. Do not apply if late instar larvae are present. For wheat, oats, barley, and triticale.
	gamma-cyhalothrin DECLARE Other trade names [2]	1.02-1.54 fl.oz.	0.01-0.015	30 (h), 7 (g)	For wheat, wheat hay, and triticale **ONLY.** Declare is a **RESTRICTED USE** pesticide.
	lambda-cyhalothrin KARATE with Zeon Technology Other trade names [2]	1.28-1.92 fl.oz.	0.02-0.03	30 (h), 7 (g)	Karate is a **RESTRICTED USE** pesticide.
	methomyl LANNATE 2.4LV Other trade names [2]	0.75-1.5 pt.	0.225-0.45	7 (h)	Lannate is a **RESTRICTED USE** pesticide. For wheat, barley, oats, and rye.
	spinosad TRACER Other trade names [2]	1-3 fl.oz.	0.03-0.09	21 (grain, straw) 3 (forage, fodder, hay)	
	spinetoram RADIANT SC	2-6 fl.oz.	0.016-0.046	21 (grain, straw) 3 (forage, fodder, hay)	
	zeta-cypermethrin MUSTANG MAX EC INSECTICIDE Other trade names [2]	1.76-4 fl.oz.	0.011-0.025	14	Mustang Max is a **RESTRICTED USE** pesticide. For wheat and triticale **ONLY**.

[2] See Table 6 for other trade names.

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest (h) or Grazing (g)	Comments
Chinch Bugs					
	beta-cyfluthrin BAYTHROID XL	2.4 fl.oz.	0.019	30 (h), 3 (g)	Baythroid XL is a **RESTRICTED USE** pesticide.
	cyfluthrin TOMBSTONE Other trade names [2]	2.4 fl.oz.	0.038	30 (h), 3 (g)	For wheat only. Tombstone is a **RESTRICTED USE** pesticide.
	gamma-cyhalothrin DECLARE Other trade names [2]	1.54 fl.oz.	0.015	30 (h), 7 (g)	For wheat, wheat hay, and triticale **ONLY.** Declare is a **RESTRICTED USE** pesticide.
	lambda-cyhalothrin KARATE with Zeon Technology Other trade names [2]	1.92 fl.oz.	0.03	30 (h), 7 (g)	Karate is a **RESTRICTED USE** pesticide.
	zeta-cypermethrin MUSTANG MAX EC INSECTICIDE Other trade names [2]	3.2-4 fl.oz.	0.02-0.025	14	Mustang Max is a **RESTRICTED USE** pesticide. For wheat and triticale only.
Grasshoppers ***General Comments:*** *Apply pesticide when 50 percent or more foliage has been lost. It may be possible to spot treat the edge of fields. Large, black and yellow lubber grasshoppers will probably not be controlled with any insecticide.*					
	beta-cyfluthrin BAYTHROID XL	1.8-2.4 fl.oz.	0.014-0.019	30 (h), 3 (g)	Baythroid XL is a **RESTRICTED USE** pesticide.
	cyfluthrin TOMBSTONE Other trade names [2]	1.8-2.4 fl.oz.	0.028-0.038	30 (h), 3 (g)	For wheat only. Tombstone is a **RESTRICTED USE** pesticide.
	diflubenzuron DIMILIN 2L	2 fl.oz.	0.03	50 (grain, straw) 15 (hay) 3 (grazing)	Dimilin is a **RESTRICTED USE** pesticide. Do not apply to adult grasshoppers. Most effective when applied when the majority of grasshoppers are in second or third nymphal stage. For wheat, oats, barley, and triticale.

[2] See Table 6 for other trade names.

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest (h) or Grazing (g)	Comments
Grasshoppers (cont.)					
dimethoate	DIMETHOATE 4EC Other trade names [2]	0.75 pt.	0.375	35 (h) 14 (g)	For wheat. Some formulations are also registered on triticale.
gamma-cyhalothrin	DECLARE Other trade names [2]	1.02-1.54 fl.oz.	0.01-0.015	30 (h), 7 (g)	For wheat, wheat hay, and triticale **ONLY.** Declare is a **RESTRICTED USE** pesticide.
lambda-cyhalothrin	KARATE with Zeon Technology Other trade names [2]	1.28-1.92 fl.oz.	0.02-0.03	30 (h), 7 (g)	See General Comments, above. Karate is a **RESTRICTED USE** pesticide.
malathion	MALATHION 5 Other trade names [2]	1.5-2 pt.	0.9-1.25	7	For wheat, oats, rye, and barley. Apply when nymphs are young.
methyl parathion	CHEMINOVA METHYL 4EC Other trade names [2]	0.75-1 pt.	0.375-0.5	15	All formulations of methyl parathion are **RESTRICTED USE** pesticides. Cheminova Methyl 4EC can be used on wheat, oats, barley, and rye.
spinetoram	RADIANT SC [4]	3-6 fl.oz.	0.023-0.046	21 (grain, straw) 3 (forage, fodder, hay)	For suppression only.
spinosad	TRACER [4] Other trade names [2]	1.5-3 fl.oz.	0.047-0.094	21 (grain, straw) 3 (forage, fodder, hay)	For suppression only.
zeta-cypermethrin	MUSTANG MAX EC INSECTICIDE Other trade names [2]	3.2-4 fl.oz.	0.02-0.025	14	Mustang Max is a **RESTRICTED USE** pesticide. For wheat and triticale only.

[2] See Table 6 for other trade names.
[4] Suppression.

Insect	Insecticide and Formulation	Amount of Formulation per Acre	Lb. Active Ingredient per Acre	Minimum Days from Last Application to Harvest (h) or Grazing (g)	Comments
Hessian Flies–*Seed Treatment*					
General Comments: *Plant resistant or tolerant varieties.*					
clothianidin	NIPSIT INSECTICIDE	1.79 fl.oz./ 100 lb. seed	0.07 lb./ 100 lb. seed	Not specified	Check with your Valent representative to verify the current product name and registration status.
imidacloprid	GAUCHO 600 Other trade names [2]	1.6-2.4 fl.oz./ 100 lb. seed	0.06-0.09 lb./100 lb. seed	45	Use as a seed treatment. Apply as a slurry either on-farm or as a commercial seed treatment. Ensure thorough coverage. See label for plantback restrictions.
thiomethoxam	CRUISER 5FS	1.33fl.oz./ 100 lb. seed	0.06lb./ 100 lb. seed	---	For barley, and wheat. Use as a seed treatment. Apply as a slurry either on-farm or as a commercial seed treatment. Ensure thorough coverage. See label for plantback restrictions.
thiamethoxam + mefenoxam + difenoconazole	CRUISER MAXX cereals	5 fl.oz./ 100 lb. seed	0.01 lb./ 100 lb. seed	Not specified	**Add an additional amount of Cruiser 5FS (0.48 to 1 fluid ounces of Cruiser 5FS).**
Hessian Flies–*Foliar Treatment*					
Foliar application of insecticide at the 2 to 3 leaf stage may protect young when plants from attack by Hessian fly. Foliar application at the time Hessian fly adults are laying eggs in winter to early spring may reduce further damage in fields where moderate to heavy Hessian fly infestations have been found. See "Hessian Fly Scouting Guide," www.aces.edu/dept/grain/documents/HessianFlyScoutingGuide.pdf and North Carolina small grains production guide www.smallgrains.ncsu.edu/NCSmallGrains/ProductionGuide.html.					
gamma-cyhalothrin	DECLARE	1.02-1.54 fl.oz.	0.01-0.015	30 (h), 7 (g)	For triticale, wheat, and wheat hay**.** Declare is a **RESTRICTED USE** pesticide. Apply when adults emerge.
lambda-cyhalothrin	KARATE with Zeon Technology	1.28-1.92 fl.oz.	0.02-0.03	30 (h), 7 (g)	Timing is critical in the effectiveness of this treatment. Apply when adult Hessian flies emerge. Karate is a **RESTRICTED USE** pesticide.
Winter Grain Mites					
The following insecticides may provide helpful control.					
gamma-cyhalothrin	DECLARE Other trade names [2]	1.54 fl.oz.	0.015	30 (h), 7 (g)	For wheat, wheat hay, and triticale **ONLY.**
lambda-cyhalothrin	KARATE WITH ZEON TECHNOLOGY Other trade names [2]	1.92 fl.oz.	0.03	30 (h), 7 (g)	Karate is a **RESTRICTED USE** pesticide.
methyl parathion	CHEMINOVA METHYL 4EC	0.5-1.5 pt.	0.25-0.75	15	Methyl parathion is a **RESTRICTED USE** pesticide. For barley, oats, rye, and wheat.
zeta-cypermethrin	MUSTANG MAX Other trade names [2]	3.2-4 fl.oz.	0.02-0.025	14	Mustang Max is a **RESTRICTED USE** pesticide.

[2] See Table 6 for other trade names.

Table 6. Insecticides Labeled for Use on Small Grains

Insecticide and Trade Name	A.I./ Formulated Product	Formulation	Restricted Entry Interval (hr)	Minimum Days from Last Application to Harvest (h) or Grazing (g)
beta-cyfluthrin (barley, buckwheat, millet, oat, rye, triticale, wheat) *MoA Group 3A				
BAYTHROID XL (Restricted Use)	1 lb./gal.	emulsifiable concentrate	12	30 (h), 3 (g)
clothianidin (wheat, oats, tritical, barley, rye) MoA Group 4A				
NIPSIT INSIDE [1] (Restricted Use)	5 lb./gal.	seed treatment	Not specified	Not specified
cyfluthrin (wheat) MoA Group 3A				
TOMBSTONE (Restricted Use)	2 lb./gal.	emulsifiable concentrate	12	30 (h), 3 (g)
TOMBSTONE HELIOS (Restricted Use)	2 lb./gal.	emulsifiable concentrate	12	30 (h), 3 (g)
diflubenzuron (wheat, oats, barley, triticale) MoA Group 15				
DIMILIN 2L	2 lb./gal.	aqueous flowable	12	50 (grain, staw) 15 (hay), 3 (forage)
dimethoate (wheat) MoA Group 1B				
DIMETHOATE 4E (also triticale)	4 lb./gal.	emulsifiable concentrate	48	35 (h), 14 (g)
DIMATE 4EC (also triticale)	4 lb./gal.	emulsifiable concentrate	48	35 (h), 14 (g)
DIMETHOATE 400	4 lb./gal.	emulsifiable concentrate	48	35 (h), 14 (g)
DIMETHOATE 4EC (also triticale)	4 lb./gal.	emulsifiable concentrate	48	35 (h), 14 (g)
			48	35 (h), 14 (g)
DIMATE 4E	4 lb./gal.	emulsifiable concentrate	48	35 (h), 14 (g)
DIMETHOATE 267	2.67 lb./gal.	emulsifiable concentrate	48	35 (h), 14 (g)
gamma-cyhalothrin (wheat, triticale) MoA Group 3A				
DECLARE (Restricted Use)	1.25 lb./gal.	microencapsulated suspension	24	30 (straw), 7 (g)
PROAXIS (Restricted Use)	0.5 lb./gal.	microencapsulated suspension	24	30 (h)
PROLEX (Restricted Use)	1.25 lb./gal.	microencapsulated suspension	24	30 (h)
imidacloprid (wheat, oats, rye, barley, triticale) MoA Group 4A				
DYNA-SHIELD IMIDACLOPRID 5	5 lb./gal.	seed treatment	12	45
GAUCHO 600	5 lb./gal.	seed treatment	12	45
IMIDA E-AG 5FST	5 lb./gal.	seed treatment	12	45
SENATOR 600FS	5 lb./gal.	seed treatment	12	45
ATTENDANT 600	5 lb./gal.	seed treatment	12	4 5
imidacloprid + captan + carboxin (oats, wheat, barley) MoA Group 4A				
ENHANCE AW	Per lb: 3.2 oz. + 3.1 oz. + 3.2 oz.	seed treatment	12	45 (g)
imidacloprid + metalaxyl + tebuconazole (rye, oats, wheat, barley) MoA Group 4A				
GAUCHO XT	Per gal: 1.16 lb. + 0.056 lb. + 0.075 lb	seed treatment	24	45

*MoA = Mode of Action classification from the Insecticide Resistance Action Committee (www.irac-online.org). Insecticides with different MoAs should be used for insecticide resistance management.

[1] Check with your Valent representative to verify the current product name and registration status.

Insecticide and Brand Name	A.I./ Formulated Product	Formulation	Restricted Entry Interval (hr)	Minimum Days from Last Application to Harvest (h) or Grazing (g)
lambda-cyhalothrin (barley, oats, rye, buckwheat, wheat, triticale) MoA Group 3A				
LAMCAP (Restricted Use)	1 lb./gal.	capsule suspension	24	30 (grain, straw), 7 (g)
GRIZZLY Z (Restricted Use)	1 lb./gal.	capsule suspension	24	30 (grain, straw), 7 (g)
KAISO 24WG (Restricted Use)	3.8 oz./lb.	wettable granule	24	30 (grain, straw), 7 (g)
KARATE with ZEON TECHNOLOGY (Restricted Use)	2.08 lb./gal.	capsule suspension	24	30 (grain, straw), 7 (g)
LAMBDA (Restricted Use) (not for oats, barley, buck-wheat, rye)	2.08 lb./gal.	capsule suspension	24	30 (grain, straw), 7 (g)
LAMBDA-CY (Restricted Use)	1 lb./gal.	emulsifiable concentrate	24	30 (grain, straw), 7 (g)
LAMBDASTAR (Restricted Use)	1 lb./gal.	emulsifiable concentrate	24	30 (grain, straw), 7 (g)
LAMBDA-T (Restricted Use)	1 lb./gal.	capsule suspension	24	30 (grain, straw), 7 (g)
MYSTIC Z (Restricted Use) (not for oats, barley, buckwheat, rye)	2.08 lb./gal.	capsule suspension	24	30 (grain, straw), 7 (g)
SILENCER (Restricted Use)	1 lb./gal.	emulsifiable concentrate	24	30 (grain, straw), 7 (g)
TAIGA Z (Restricted Use) (not for oats, barley, buckwheat, rye)	1 lb./gal.	capsule suspension	24	30 (grain, straw), 7 (g)
LAMBDASTAR 1CS (Restricted Use)	1 lb./gal.	emulsifiable concentrate	24	30 (grain, straw), 7 (g)
malathion (barley, oats, rye, wheat) MoA Group 1B				
FYFANON ULV AG	9.9 lb./gal.	emulsifiable concentrate	12	7
FYFANON	5 lb./gal.	emulsifiable concentrate	12	Not specified
MALATHION 57EC (rye, oats, barley)	5 lb./gal.	emulsifiable concentrate	12	7
MALATHION 5, others	5 lb./gal.	emulsifiable concentrate	12	7
MALATHION 8, others	8 lb./gal.	emulsifiable concentrate	12	7
methomyl (barley, oats, rye, wheat) MoA Group 1A				
LANNATE LV (Restricted Use)	2.4 lb./gal.	water soluble liquid	48	7 (h)
LANNATE SP (Restricted Use)	14.4 oz./lb.	water soluble bags	48	7 (h)
methyl parathion (barley, oats, wheat) MoA Group 1B				
4 LB. METHYL PARATHION (Restricted Use)	4 lb./gal.	emulsifiable concentrate	96	15
(also rye) PENNCAP M (Restricted Use)	2 lb./gal.	microencapsulated insecticide	31	14
CHEMINOVA METHYL 4EC	4 lb./gal.	emulsifiable concentrate	96	15
spinetoram MoA Group 5				
RADIANT SC	1 lb./gal.	suspension concentrate	4	21 (grain, straw) 3 (forage, fodder, hay)

Insecticide and Brand Name	A.I./ Formulated Product	Formulation	Restricted Entry Interval (hr)	Minimum Days from Last Application to Harvest (h) or Grazing (g)
spinosad (barley, buckwheat, oats, rye, triticale, wheat) MoA Group 5				
BLACKHAWK	5.8 oz./lb.	wettable powder	4	21 (grain, straw) 3 (forage, fodder, hay)
ENTRUST	12.8 oz./lb.	wettable powder	4	21 (grain, straw) 14 (forage, fodder, hay)
SUCCESS	2 lb./gal.	liquid	4	21 (grain, straw) 14 (forage, fodder, hay)
SPINTOR 2SC	2 lb./gal.	soluable concentrate	4	21 (grain, straw) 3 (forage, fodder, hay)
TRACER	4 lb./gal.	liquid	4	21 (grain, straw) 3 (forage, fodder, hay)
thiamethoxam (barley, wheat) MoA Group 4A				
CRUISER 5FS	5 lb./gal.	seed treatment	12	Not specified
thiamethoxam + mefenoxam + difenoconzaole (barley, wheat, triticale) MoA Group 4A				
CRUISER MAXX cereals	0.26 lb. + 0.05 lb. + 0.31 lb./gal.	seed treatment	48	Not specified
zeta-cypermethrin (triticale, wheat) MoA Group 3A				
MUSTANG MAX EC INSECTICIDE (Restricted Use)	0.8 lb./gal.	emulsifiable concentrate	12	14
RESPECT (Restricted Use)	0.8 lb./gal.	emulsifiable concentrate	12	14

Other products may be available. Always read the label to make sure the specific crop is listed and to determine what rate to use.

Insect Pest Management section prepared by Kathy L. Flanders, *Extension Entomologist,* Professor, Entomology and Plant Pathology, Auburn University. Portions of the introduction were adapted from Hudson, R., G. D. Buntin, and K. Flanders. Wheat Insects. In Southern Small Grains Resource Management Handbook. University of Georgia Cooperative Extension Service Bulletin 1190.

DISEASE CONTROL

Small grain production in Alabama can be critically limited by diseases. They are important factors in lowering both the yield and the quality of grain. Diseases must be managed effectively to achieve optimum yields of quality grains.

Many diseases can be managed without applying fungicides. Maintaining soil fertility, planting resistant varieties, rotating with nonhost crops, and following other good management practices are essential. These other practices include tilling, seedbed preparation, delayed planting, weed control, and using treated seed. However, foliar-applied fungicides may still sometimes be required to control stem and foliage disease outbreaks.

Most disease management decisions are made prior to planting! Variety selection, the type of tillage, crop rotation, planting dates, and the fertility of the soil will greatly influence diseases in small grains. The only decisions that may be required for disease control after planting will concern foliar pesticide applications needed to control leaf and head diseases and aphid outbreaks which can result in barley yellow dwarf.

Variety Selection

Selecting varieties is a very important disease control consideration. There are commercial varieties available that are tolerant and some that are resistant to many of the common diseases in Alabama. Selecting the varieties that are resistant to the prevailing diseases in a particular area can make the difference between the crop's success or failure. Also, it is important to plant more than one variety with resistance to the commonly occurring diseases to prevent the disease from overcoming the resistance of a single variety. Other factors such as the varieties' maturity dates, their ability to withstand any inclement environmental conditions, and other pests that may reduce grain production must be considered in selecting varieties.

Tillage

Destroying small grain stubble by disking grain fields speeds up the decomposition of stalks that can host diseases such as take-all, Septoria glume blotch, and scab.

Crop Rotation

Rotating crops prevents the buildup of certain small grain diseases and insect pests and improves weed control and soil fertility. Rotation is especially important in preventing take-all outbreaks in wheat. Also, rotation with nonhost crops causes a decline of foliage and stem fungal diseases such as rust, scab, septoria leaf and glume blotch, and smut by removing the hosts needed to maintain the disease-causing organisms.

Soil Fertility

High nitrogen rates can produce excessive vegetative growth in the fall, increasing the incidence of foliage diseases and barley yellow dwarf. Excessive growth and dense stands increase humidity in the canopy, which favors the development of powdery mildew, septoria leaf blotch, and leaf rust. Also, excessive vegetation prolongs the feeding activity of aphids, which transmit the barley yellow dwarf virus.

Planting Date

The development of barley yellow dwarf is greatly influenced by planting dates. Delaying the planting date to miss aphid migrations can reduce barley yellow dwarf incidence. Be careful, however, not to delay the planting date too long because planting too late can reduce small grain yields in Alabama.

Quality Seed

Selecting good seed is essential for good stands in the fall. Fungicide seed treatment provides added protection against seed- and soilborne seedling disease fungi. Though expensive, the newer sterol inhibitor class of seed treatment fungicides provides good systemic protection against loose smut, common bunt, and fall infection of powdery mildew.

Seed treatment is more effective when the fungicide covers the entire seed surface. Poor coverage of the seed will result in poor performance. Seed treatments applied at the factory are superior to on-farm treatments. However, on-farm or on-site treatments provide better coverage than hopperbox treatments.

Table 7. Small Grains Seed Treatments

Fungicide and Formulation	Rate/Cwt	Crops [1]	Comments
carboxin + captan + imidacloprin ENHANCE AW	4.0 oz.	B,O,W	Hopper box treatment for control of loose smut bunts, seed rots, and seedling diseases of small grains.
carboxin + metalaxyl + PCNB PREVAIL	2.5- 5 oz.	W	Hopper box treatment for control of loose smut bunts, seed rots, and seedling diseases.
	1.6-3.3 oz.	O	Hopper box treatment for control of loose smut, seed rots, and seedling disease in oats.
difenoconazole DIVIDEND	0.5-1.0 fl.oz.	W	Good to excellent fall-season control of powdery mildew, rust, and Septoria leaf blotch. Controls loose smut and bunt disease of wheat.

Fungicide and Formulation	Rate/Cwt	Crops [1]	Comments
difenoconazole + metalaxyl DIVIDEND EXTREME DIVIDEND XL RTA (for on-farm use)	 1-4 fl.oz. 2.5-10 fl.oz.	 B,W B,W	Good to excellent fall-season control of powdery mildew, leaf rust, and Septoria leaf blotch when applied at highest rate. Excellent loose smut and bunt control. Low rate controls only loose smut and common bunt. Gives good Pythium damping off control; partial control of Fusarium root rot, crown rot, and take-all.
imidacloprid + metalaxyl + tebuconazole GAUCHO XT	 3-4 fl.oz.	 B, W	Suppresses barley yellow dwarf by controlling aphids. Also controls Pythium seed rot and seedling damping off, loose smut, covered bunt, and suppresses early season Septoria disease complex, powdery mildew, leaf rust, and root rot. See comments for imidacloprid in Table 5.
ipconazole RANCONA APEX MD	 5-8.33 fl.oz.	 B,O,R,W	For protection against seed decay, damping-off, and seedling blight as well as bunts and smuts.
metalaxyl APRON-FL ALLEGIANCE-FL	 0.75-1.5 fl.oz. 0.75 fl.oz.	 B, O, R, W	Add if Pythium seedling disease is a problem.
tebuconazole + metalaxyl RAXIL MD	 5-6 fl.oz.	 B, O, R, W	For suppression or control of seed, seedling, and soilborne diseases. Includes early season control of powdery mildew and rust.
tebuconazole + thiram RAXIL-THIRAM	 3.5-4.6 fl.oz.	 B, O, W	Excellent loose smut and common bunt control. Good seedborne scab control and early season powdery mildew and rust control.

[1] B = Barley, O = Oats, R = Rye, W = Wheat.

Table 8. Foliar Fungicides Recommended for Control of Leaf, Stem, and Head Diseases

Fungicide	Formulation Rate/Acre[1]	Comments
azoxystrobin QUADRIS FLOWABLE	 4-12 fl.oz.	 For control of leaf rust, tan spot, Septoria glume, and leaf blotch on barley, wheat, and triticale. Apply just before or during early stage of disease development and at any growth stage between jointing (Feeke's Growth Stage 6) and flowering (Feeke's Growth Stage 10.5). Add a crop oil concentrate at 1% v/v. **DO NOT** make more than two applications of Quadris per year.
	7.5-11 fl.oz.	For control of powdery mildew on wheat. Apply just before or when disease first appears and at any growth stage between jointing (Feeke's Growth Stage 6) and flowering (Feeke's Growth Stage 10.5). Add crop oil concentrate at 1% v/v. **DO NOT** make more than two applications of Quadris per year.
fluoxastrobin EVITO 480SC	 2-4 fl.oz.	 For control of leaf stripe, stem rust, tan spot, and Septoria leaf and glume blotch. For optimum control, apply preventively and repeat as needed 14 to 21 days later. Do not apply after full head emergence (Feek's Growth State 10.51) or make more than two sequential applications.

[1] Apply fungicides in a minimum of 5 gallons per acre for aerial applications and 5 to 15 gallons per acre for ground applications. Thorough coverage of the lower and upper leaf surface is essential for optimum disease control.

Fungicide	Formulation Rate/Acre[1]	Comments
metaconazole CARAMBA	13-17 fl.oz.	For optimum suppression of Fusarium scab on wheat and barley. Apply at early flowering (Feek's Growth Stage 10.51). Do not make more than two applications of Caramba or other triazole (group 3) fungicides per year to wheat.
	10-14 fl.oz.	For control of powdery mildew, rust diseases, leaf and glume blotch, spot and rust blotch, tan spot, and scald on wheat, barley, oats, and triticale. Apply at full flag leaf extension and again 10 to 14 days later if conditions favor disease. Make no more than two applications of Caramba per crop.
propiconazole TILT 3.6E PROPIMAX EC BUMPER 41.8EC	2-4 fl.oz.	For early season disease suppression on wheat (Tilt only). Apply when powdery mildew or leaf blotch is seen. Make a second application no later than flowering.
	4 fl.oz.	Fusarium head mold (scab) suppression in wheat. Apply at 50 percent flowering (Feeke's Growth Stage 10.52) Do not apply more than 8 fluid ounces for wheat harvested as grain.
	4 fl.oz.	For control of leaf rust, Septoria glume blotch, leaf blotch, powdery mildew, and Fusarium head blight on wheat and for control of crown rust and leaf blotch on oats. Apply up to flowering (Feeke's Growth Stage 10.5). Make up to two applications per year. Add a spreader to get good leaf coverage.
propiconazole + azoxystrobin QUILT	7-14 fl.oz.	For early season suppression of leaf and glume blotch, Helminthosporium leaf spot, barley scald, barley stripe, and net blotch in barley, triticale, and wheat. Follow up with second application of Quilt for full season disease control.
	10.5-14 fl.oz.	For control of above diseases. Apply when flag leaf is 50 percent to fully emerged. A second application can be made at 14 days or later. May be applied through full head extension. Make no more than two applications at 14-day intervals.
QUILT XCEL	7-14 fl.oz.	For early season suppression of leaf and glume blotch, Helminthosporium leaf spot, barley scald, barley stripe, and net blotch in barley, triticale, and wheat. Follow up with second application of Quilt for full season disease control.
	10.5-14 fl.oz.	For control of above diseases. Apply when flag leaf is 50 percent to fully emerged. A second application can be made at 14 days or later. May be applied through full head extension. Apply no more than 28 fluid ounces per acre per year.
propiconazole + trifloxystrobin STRATEGO 250EC	10 fl.oz.	For control of rusts, powdery mildew, leaf blight, tan spot, and glume blotch on wheat. Apply when conditions favor disease. Stratego may be applied once up to flowering (Feeke's Growth Stage 10.5). See label for grazing restrictions and other instructions.
	4-8 fl.oz.	For early disease suppression of the above disease on wheat.
	7 fl.oz.	For control of crown rust and leaf blotch on barley and oats. Up to two applications can be made per year no later than flag leaf emergence. See label for additional application instructions.
STRATEGO YLD	4 fl.oz.	For control of leaf and glume blotch, powdery mildew, tan spot, and rust diseases on wheat.
	2.3 fl.oz.	For control of glume and leaf blotch, net and spot blotch, powdery mildew, rust, and scald on barley. Make first preventive spray when conditions favor disease and repeat after 14 days as needed. Do not apply after full head emergence (Feeke's Growth Stage 10.51). Do not make more than two applications of Stratego YLD.

[1] Apply fungicides in a minimum of 5 gallons per acre for aerial applications and 5 to 15 gallons per acre for ground applications. Thorough coverage of the lower and upper leaf surface is essential for optimum disease control.

Fungicide	Formulation Rate/Acre[1]	Comments
pyraclostrobin + metaconazole TWINLINE	7-9 fl.oz.	For control of all rust diseases, powdery mildew, glume and leaf blotch, and tan spot on wheat; rust diseases, net and spot blotch, and scald on barley and triticale; and crown rust and spot blotch on oats. For optimum control of above diseases, apply when flag leaf is 50 percent to fully emerged. A second application can be made at 14 days or later, preferably at full head extension. Use higher rate at shorter interval when disease is severe. Make no more than two applications or apply more than 18 fluid ounces per acre per season.
tebuconazole ORIUS 3.6F TEBUSTAR 3.6F TEBUZOL 3.6F	4.0 fl.oz.	For control of leaf, stem, and stripe rust on wheat and leaf rust on barley. For rust control, apply at earliest sign of pustules on leaves.
MONSOON MUSCLE 3.6F	4.0 fl.oz.	For Fusarium scab suppression on wheat and barley. Apply at early flowering (Feek's Growth Stage 10.51). Make only one application for a total of 4 fluid ounces per acre per year.
tebuconazole + prothioconazole PROSARO 421SC	6.5-8.2 fl.oz.	For control of all rust diseases, powdery mildew, glume and leaf blotch, and tan spot on wheat as well as rust diseases, net and spot blotch, and scald on barley.
	6.5-8.2 fl.oz.	Apply at early flowering (Feek's Growth Stage 10.51) for Fusarium scab control on wheat and barley. Spray equipment must be set to obtain good coverage of the heads. Make only one application for a total of 8.2 fluid ounce per acre per year. Apply a minimum of 5 gallons of spray volume per acre.
trifloxystrobin HEADLINE 2.09E	6-9 fl.oz.	For control of leaf and glume blotch, rust diseases, tan spot, and powdery mildew in barley, oats, rye, triticale, and wheat. Apply immediately after flag leaf emergence and repeat if conditions favor disease spread 10 to 14 days later. Apply no later than flowering (Feeke's Growth Stage 10.5) on triticale and wheat. Apply no more than twice or 18 fluid ounces per acre pre year. See label for resistance management instructions.

[1] Apply fungicides in a minimum of 5 gallons per acre for aerial applications and 5 to 15 gallons per acre for ground applications. Thorough coverage of the lower and upper leaf surface is essential for optimum disease control.

Table 9. Comparative Performance of Foliar-Applied Fungicides

Trade Name	Fungicide	Powdery Mildew	Leaf Rust	Leaf and Glume Blotch
HEADLINE	trifloxystrobin	Excellent	Excellent	Excellent
QUADRIS	azoxystrobin	Excellent	Excellent	Excellent
QUILT	propiconazole + azoxystrobin	Excellent	Excellent	Excellent
STRATEGO	propiconazole + trifloxystrobin	Excellent	Excellent	Excellent
TILT	propiconazole	Good	Excellent	Excellent

SOURCE: Table was compiled by Dr. Donald Hershman, University of Kentucky.

Disease Control section prepared by Austin K. Hagan, *Extension Plant Pathologist,* Professor, Entomology and Plant Pathology, Auburn University.

WEED CONTROL

Several weed species are of concern in the production of small grains in Alabama. Weeds such as wild garlic, mustards, and annual ryegrass are widespread and persistent problems. The use of recommended mechanical and cultural weed control practices can minimize the effect of weeds in small grain production. A shallow tillage during seedbed preparation will kill many germinating weed seeds and existing plants. If weed problems develop later, the use of herbicides should be considered.

Winter annual weeds germinate in the fall or early winter. It is important to control these weeds while they are small to prevent them from competing with the grain crop. Although most grasses that germinate after planting and emerge with the crop plants cannot be controlled effectively, many of the broadleaf weeds can be controlled with the timely use of herbicides.

It is important to select the right herbicide for the specific weed problem and to apply it at the proper time in the development of the crop plants and weeds. Through the timely use of herbicides, it is possible to obtain good weed control without injuring the grain crop.

Herbicides that can be used to control troublesome weeds in small grains are listed in the following table. The most widely used herbicide in small grains is 2,4-D. Small grains vary in their tolerance to 2,4-D, depending upon the growth stage when the herbicide is applied and the particular crop planted. Generally, wheat varieties are the most tolerant to 2,4-D, barley is intermediate, and oats are least tolerant. Rye is intermediate between wheat and barley. The least injury to the grain crop from the use of herbicides can be expected when the herbicides are applied from full tiller to just before jointing (glyphosate and paraquat are the exceptions).

The following growth stages of small grains are ranked in order from the most tolerant stages to the most susceptible stages.

1. Soft dough to maturity.
2. Fully tillered to jointing (five or more leaves per plant; each plant 5 to 8 inches tall).
3. Jointing through flowering.
4. Germination to the four-leaf stage.

Final Remarks about Herbicide Use

If herbicides are used properly, they will effectively control most weeds in small grains. If they are used incorrectly, they will injure small grains. Herbicides should be used along with good tillage practices for best weed control. The following precautions should be observed when using any herbicide:

1. Choose the right herbicide for the specific weed problem that exists in the small grain crop.
2. Read the label and follow the directions. The label specifies the correct use rate of the herbicide for maximum benefit and minimum injury.
3. If winter grazing is planned, be sure to note the grazing restrictions given for the herbicide selected.
4. Be sure that the growth stage of the small grain is right for the use of the herbicide.
5. Pick a warm day, if possible, to apply the herbicide. Weeds are easier to kill when the temperature is 60°F or above.
6. Use enough carrier with the herbicide to get good coverage and spray when the wind is low for proper herbicide placement.
7. Calibrate the equipment carefully to apply the herbicides accurately.

Table 10. Small Grains Weed Control

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
	Preplant Foliar	
BARRAGE HF (0.5 pt.)	2,4-D (0.28 lb.)	Apply a minimum of 29 days before planting wheat, oats, or rye. Will help with glyphosate-resistant horseweed control. *MOA–Synthetic auxin
ET HERBICIDE (1-2 fl.oz.)	pyraflufen (0.0016-0.0032 lb.)	Apply prior to planting for control of small broadleaf weeds. May be mixed with glyphosate. Add 1 pint crop oil concentrate per acre when used alone. MOA–PPO inhibitor
GRAMOXONE INTEON (1-4 pt.) or FIRESTORM (0.6-2.5 pt.) + Non-ionic Surfactant (2 pt./100 gal.) spray solution	paraquat (0.25-1 lb.) + non-ionic surfactant	For control of emerged weeds. Apply prior to, during, or after planting but before emergence of the crop. Apply in 20 to 30 gallons of water per acre. **DO NOT** graze treated areas. Gramoxone Max is a **RESTRICTED USE** pesticide. MOA–Photosystem I inhibitor
ROUNDUP or TOUCHDOWN or GLYPHOSATE (generic formulations)	glyphosate (See label.)	For control of emerged weeds. Apply any time prior to crop emergence. Application after crop emergence **WILL KILL CROP. DO NOT** plant subsequent crops, other than those on the label, for 30 days after application. Follow label directions carefully and note all precautionary statements. Some formulations may require additional surfactants. MOA–EPSP synthase inhibitor
	Postemergence	
AXIAL (0.5 pt.)	pinoxaden (0.052)	Provides postemergence control of grass weeds in **wheat** and **barley** from two-leaf to boot stage. Tank mix with MCPA to increase broadleaf weed control after tiller. The label specifies the use of Adigor adjuvant at 9.6 fluid ounces per acres with Axial. MOA–ACCase inhibitor
AXIOM DF (4-10 oz.)	flufenacet + metribuzin (0.17-0.43 lb.)	Apply early postemergence to **wheat**. **DO NOT** apply before wheat emerges. Axiom provides control of wild radish, henbit, and bluegrass and suppresses annual ryegrass if activated prior to weed emergence. Check label for use on cultivars NOT tolerant to Axiom. MOA–Mitosis inhibitor + photosystem II inhibitor
CLARITY or VISION (0.25 pt.)	dicamba (0.125 lb.)	Controls most broadleaf weeds in **wheat, oats, barley,** and **rye**. Apply immediately after winter dormancy and before grain begins to joint. **DO NOT** graze treated areas or harvest for dairy feed prior to crop maturity. Proper timing and calibration are necessary to prevent delayed crop maturity and crop stunting. **YIELD REDUCTION** will occur when treatment is applied to jointing wheat. MOA–Synthetic auxin
ET HERBICIDE (0.5-1 fl.oz.)	pyraflufen (0.008-0.0016 lb.)	Apply when **wheat** is 6 to 8 inches tall to jointing, but prior to boot stage for control of several annual broadleaf weeds including wild radish. Add 1 pint crop oil concentrate per acre. MOA–PPO inhibitor

*MOA=Mechanism of action. Herbicides with different MOAs should be used in weed resistance management programs. See Table 12 for classifications of mechanisms of action.

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
	Postemergence (cont.)	
EXPRESS 75DF (0.167-0.33 oz.) + Non-ionic Surfactant (2 pt./100 gal.) spray solution	tribenuron (0.125-0.25 oz.) + non-ionic surfactant	For control of broadleaf weeds in **wheat** and **barley.** Apply after the crop is in the two-leaf stage but before the flag leaf is visible. Apply in fall for wild mustard and wild radish. Application made later should include MCPA (see label). **DO NOT** harvest sooner than 45 days after treatment. MOA–ALS inhibitor
HARMONY SG (0.45-0.9 oz.) + Non-ionic Surfactant	thifensulfuron (0.22-0.45 oz.) + non-ionic surfactant	For control of wild garlic and other broadleaf weeds in **wheat, oats,** and **barley**. Apply from two-leaf to pre-flag leaf. Add a non-ionic surfactant at 2 pints per 100 gallons of spray mix. MOA–ALS inhibitor
HARMONY EXTRA (0.3-0.6 oz.) + Non-ionic Surfactant (2 pt./100 gal.) spray solution	thifensulfuron + tribenuron (0.22-0.45 oz.) + non-ionic surfactant	For wild garlic and wild radish control in **wheat, barley,** and **oats.** Apply after wheat is in the two-leaf stage but before flag leaf is visible. Use **LOW RATE** on **OATS.** Add non-ionic surfactant at 2 pints per 100 gallons of water. Wild garlic should be less than 12 inches tall. See label for wild radish control. Herbicidal action requires 2 to 5 weeks. Any crop may be planted 60 days after treatment. Temporary crop injury may occur if applied with liquid nitrogen fertilizer. MOA–ALS inhibitor
HOELON 3EC (1.33-2.67 pt.)	diclofop (0.5-1 lb.)	For control of annual ryegrass in **wheat** and **barley.** Apply postemergence in wheat when annual ryegrass is in the one- to four-leaf stage. Use low rate when weed is in the one- or two-leaf stage and high rate when weed is in the four-leaf stage. Ryegrass larger than the four-leaf stage is not effectively controlled. Make application with at least 10 gallons of water per acre at a spray pressure of at least 40 psi with ground equipment. Use a minimum of 5 gallons of water per acre by aerial application. Hoelon does not control broadleaf weeds or perennial grasses. **DO NOT** graze treated fields. **DO NOT** mix Hoelon with 2,4-D, Banvel, or Harmony Extra. Hoelon is a **RESTRICTED USE** pesticide. MOA–ACCase inhibitor
MCPA AMINE (0.5-1 pt.)	MCPA (0.25-0.5 lb.)	Controls broadleaf weeds in **wheat, oats, barley,** and **rye.** Apply after grain is tillered but before jointing. Small grains, especially oats, are more tolerant of MCPA than of 2,4-D. MOA–Synthetic auxin
OSPREY (4.75 oz.) + Non-ionic Surfactant (2 pt./100 gal.) spray solution	mesosulfuron-methyl (0.013 lb.) + non-ionic surfactant	Apply postemergence to **wheat** from emergence to the joint stage. Controls annual ryegrass in the one-leaf to two-tiller stage. Suppresses the growth of several Brome species at the same growth stage. Osprey will only control 1 to 2 inch tall wild mustard. Apply in a minimum of 10 gallons of spray solution per acre with ground equipment. Make only one application per season. See label for recropping restrictions. MOA–ALS inhibitor

Herbicide Trade Name (Rate/Acre Broadcast)	Herbicide Common Name (Active Herbicide/Acre)	Comments
	Postemergence (cont.)	
PEAK 57 WDG (0.38-0.5 oz.) + Non-ionic Surfactant (2 pt./100 gal.) spray solution	prosulfuron (0.2-0.3 oz.) + non-ionic surfactant	Apply postemergence to **wheat, barley, rye,** or **oats** from the three-leaf stage until the second node is detectable in stem elongation. Controls several winter annual weeds including wild garlic and wild mustard. A crop oil concentrate may be used under dry conditions. See label for rotational restrictions (10 months for cotton, peanuts, and soybean). MOA–ALS inhibitor
POWER FLEX (3.5 oz.) + Non-ionic Surfactant (2 pt./100 gal.) spray solution	pyroxsulam (0.016 lb.) + non-ionic surfactant	Apply postemergence to **wheat** from three-leaf to joint stage. Controls several annual grasses, including ryegrass, and broadleaf weeds. DO NOT mix with dicamba or amine formuations of 2,4-D or MCPA. See label for rotational restirctions. MOA–ALS inhibitor
PROWL H_2O (1.5-3 pt.)	pendimethalin (0.7-1.4 lb.)	Apply postemergence to **wheat** that is in the first leaf to flag leaf stage for preemergence control of annual grasses and small-seeded broadleaf weeds. Prowl will not control emerged weeds but may be mixed with any postemergence herbicide registered for use in wheat. Plant wheat at least 0.5 to 1 inch deep to avoid crop injury. MOA–Mitosis inhibitor
2,4-D AMINE or ESTER (1-1.5 pt.)	2,4-D (0.5-0.75 lb.)	Controls many winter annual broadleaf weeds such as mustards, buttercups, dock, and plantains in **wheat, barley,** and **rye.** Apply during warm (60°F), sunny weather in early spring when grain is fully tillered (5 to 8 inches tall) and has five or more leaves, but before jointing. Usually this occurs in February. **DO NOT** use this rate on oats (see 2,4-D Amine, below). **DO NOT** forage or graze treated fields for 2 weeks after treatment. See label for use rate of product selected. MOA–Auxin inhibitor
2,4-D AMINE (0.5-1 pt.)	2,4-D (0.25-0.5 lb.)	Use this rate on **oats.** Oats are more sensitive to 2,4-D than other grains. Make application in spring when oats are well established and fully tillered but before jointing. Some yield reduction may occur. Note weather conditions and grazing restrictions for 2,4-D Amine, above.
2,4-D ESTER (1.5-2 pt.) or 2,4-D AMINE (2-3 pt.)	2,4-D (0.75-1 lb.) 2,4-D (1-1.5 lb.)	For wild garlic and wild onion control. Will not control wild garlic completely but will reduce the production of aerial bulblets. Apply in early spring during warm (60°F), sunny weather when grain is fully tillered and has five or more leaves, but before jointing. Usually this occurs in February. These rates of 2,4-D **WILL INJURE OATS.** Amine formulation is not as effective as ester.
	Harvest Aid	
2,4-D AMINE (1-2 pt.)	2,4-D (0.5-1 lb.)	Apply when grains are in hard-dough stage to suppress large weeds that may interfere with harvest. Best results will be obtained when soil moisture is adequate for plant growth and weeds are growing well. **DO NOT** feed treated straw. Read label carefully.
	Labeled Tank Mixes	
BUCTRIL + HOELON BUCTRIL + 2,4-D HARMONY EXTRA + 2,4-D		

Table 11. Estimated Effectiveness of Recommended Herbicide Treatments on Important Weeds Infesting Small Grains in Alabama and Properties That May Affect Water Quality[1]

WEEDS	HERBICIDES					
	Barrage (PPF)	Gramoxone MAX (PPF)	Glyphosate Roundup Touchdown (PPF)	2,4-D Ester (POST)	2,4-D, MCPA Amine (POST)	Axiom (POST)
Annual Ryegrass	0	7	9	0	0	4
Buttercup	7	7	9	8	7	--
Chickweed	7	8	9	8	7	8
Common Ragweed	8	6	9	8	8	--
Eveningprimrose	9	3	7	7	7	5
Pepperweed	7	6	8	7	7	--
Shepherdspurse	7	7	9	8	7	--
Wild Garlic	5	6	8	8	6	0
Wild Mustard	7	5	9	8	7	6
Wild Radish	7	5	9	8	6	8
Surface-Loss Potential[2]	S	S	S	M	M	M
Leaching Potential[3]	S	S	M	M	M	S

continued

[1]Ratings are based on observations of research plots and field use under average weather conditions for several years by weed control workers in Alabama and the South. Leaching and surface-loss potentials are based in part on herbicide chemical characteristics and pesticide behavior models developed by USDA scientists as well as on field experience.
[2]The surface-loss potential indicates the tendency of the pesticide to move with sediment in runoff.
[3]The leaching potential indicates the tendency of the pesticide to move in solution with water and to leach below the root zone.
KEY TO CONTROL RATINGS AND ABBREVIATIONS
Ratings range from 0 to 10: 0 = No control; 10 = 100% control.
PRE = Preplant or Preemergence: Applied to emerged weeds before planting or crop emergence.
POST = Postemergence: Applied to weeds and crop after crop emergence.
S = Small; M = Medium; L = Large.

Table 11. Estimated Effectiveness of Recommended Herbicide Treatments on Important Weeds Infesting Small Grains in Alabama and Properties That May Affect Water Quality[1] (cont.)

WEEDS	HERBICIDES					
	Axial (POST)	Bucril (POST)	Clarity, Vision (POST)	ET (POST)	Express (POST)	Harmony SG (POST)
Annual Ryegrass	9	0	0	0	0	0
Buttercup	0	--	6	--	6	1
Chickweed	0	--	7	9	8	5
Common Ragweed	0	6	8	8	--	1
Eveningprimrose	0	--	7	8	3	5
Pepperweed	0	8	7	--	--	1
Shepherdspurse	0	8	5	8	--	8
Wild Garlic	0	2	4	0	6	6
Wild Mustard	0	8	5	5	8	8
Wild Radish	0	8	5	7	8	8
Surface-Loss Potential[2]	--	M	S	L	S	S
Leaching Potential[3]	--	S	L	L	S	S

continued

[1]Ratings are based on observations of research plots and field use under average weather conditions for several years by weed control workers in Alabama and the South. Leaching and surface-loss potentials are based in part on herbicide chemical characteristics and pesticide behavior models developed by USDA scientists as well as on field experience.

[2]The surface-loss potential indicates the tendency of the pesticide to move with sediment in runoff.

[3]The leaching potential indicates the tendency of the pesticide to move in solution with water and to leach below the root zone.

KEY TO CONTROL RATINGS AND ABBREVIATIONS

Ratings range from 0 to 10: 0 = No control; 10 = 100% control.

POST = Postemergence: Applied to weeds and crop after crop emergence.

S = Small; M = Medium; L = Large. -- = Information not available.

Table 11. Estimated Effectiveness of Recommended Herbicide Treatments on Important Weeds Infesting Small Grains in Alabama and Properties That May Affect Water Quality[1] (cont.)

WEEDS	Harmony Extra (POST)	Hoelon (POST)	Osprey (POST)	Peak (POST)	Power Flex (POST)	Prowl (POST)
Annual Ryegrass	0	9	9	0	8	8
Buttercup	7	0	0	--	--	--
Chickweed	8	0	5	8	9	8
Common Ragweed	1	0	0	8	2	4
Eveningprimrose	6	0	0	8	2	2
Pepperweed	2	0	0	--	8	1
Shepherdspurse	8	0	0	--	9	4
Wild Garlic	8	0	0	8	0	1
Wild Mustard	8	0	8	8	8	5
Wild Radish	8	0	7	8	8	5
Surface-Loss Potential[2]	S	L	--	S	S	M
Leaching Potential[3]	S	S	--	S	S	L

[1]Ratings are based on observations of research plots and field use under average weather conditions for several years by weed control workers in Alabama and the South. Leaching and surface-loss potentials are based in part on herbicide chemical characteristics and pesticide behavior models developed by USDA scientists as well as on field experience.
[2]The surface-loss potential indicates the tendency of the pesticide to move with sediment in runoff.
[3]The leaching potential indicates the tendency of the pesticide to move in solution with water and to leach below the root zone.
KEY TO CONTROL RATINGS AND ABBREVIATIONS
Ratings range from 0 to 10: 0 = No control; 10 = 100% control.
POST = Postemergence: Applied to weeds and crop after crop emergence.
S = Small; M = Medium; L = Large. -- = Information not available.

Table 12. Herbicide Classified by Mechanism of Action

Mechanism of Action	Herbicide
Acetyl CoA Carboxylase (ACCase) inhibitor	Axial, Hoelon
Acetolactase Synthase ALS inhibitors	Express, Harmony, Peak, Osprey
Enolpyruval shikimate-3-phosphase (EPSP) inhibitor	Roundup, Touchdown
Mitosis inhibitor	Prowl, Axiom
Photosystem I inhibitor	Gramoxone, Firestorm
Photosystem II inhibitor	Axiom
Protoporphyrinogen osidase (PPO) inhibitor	ET
Synthetic auxin	2,4-D, Clarity MCPA

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For more information, contact your county Extension office. Visit http://www.aces.edu/counties or look in your telephone directory under your county's name to find contact information.

Use pesticides **only** according to the directions on the label. Follow all directions, precautions, and restrictions that are listed. Do not use pesticides on plants that are not listed on the label.

The pesticide rates in this publication are recommended **only** if they are registered with the Environmental Protection Agency or the Alabama Department of Agriculture and Industries. If a registration is changed or canceled, the rate listed here is no longer recommended. Before you apply **any** pesticide, check with your county Extension agent for the latest information.

Trade names are used **only** to give specific information. The Alabama Cooperative Extension System does not endorse or guarantee any product and does not recommend one product instead of another that might be similar.

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