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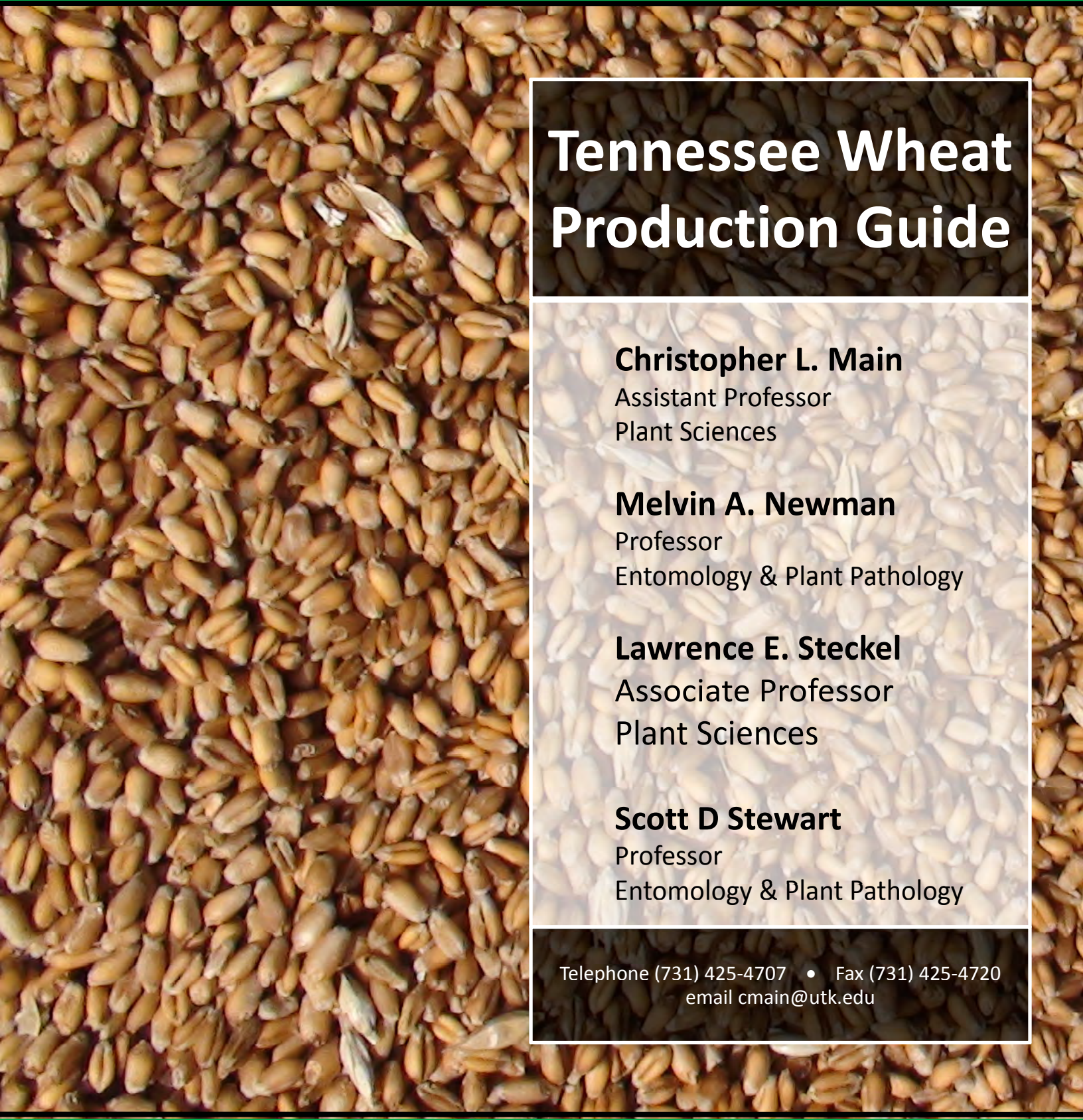

# Tennessee Wheat Production Guide

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# Wheat Production in Tennessee

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## INTRODUCTION

Tennessee's climate is well-suited for the production of high-quality, low-protein, soft red winter wheat. This wheat is in demand by the flour milling industry and well-established local markets are adequate. Tennessee-produced soft wheat is used primarily for milling general-purpose or family flours, pastry flours and cake flours. Very little of Tennessee's wheat is used for livestock feed, except as by-products of the milling industry.

Winter wheat is a cool-season crop and can be grown successfully in all counties of the state. Soft red winter wheat varieties commonly grown in Tennessee have adequate winter-hardiness to survive the lowest winter temperatures that normally occur.

When winter temperatures are extremely low, well-rooted wheat plants may die back to the ground, but then resume growth in the spring. Wheat sown in the late fall has a shallow root system and is more susceptible to frost heaving and winter killing than wheat sown earlier. Freeze damage to winter wheat is more serious from late freezes in the spring when the head has just emerged from the boot. All varieties are susceptible to freeze injury in the milk and soft dough stages in the spring.

The optimum moisture requirement for favorable wheat production is somewhat less than the normal rainfall in Tennessee. Wheat is tolerant of high moisture under the cool fall and spring growing seasons of Tennessee. High moisture, in combination with high temperatures, may cause the spread of diseases and reduce yield.

Wheat is best adapted to well-drained, medium-to-heavy-textured soils of high natural fertility. The highest yields are generally produced on silt and clay loams, but wheat is also grown successfully on clay soils and fine sandy loams. University of Tennessee research shows that wheat grown on soils with poor internal drainage can be productive, providing they have adequate surface drainage to prevent ponding of water.

## VARIETY SELECTION

It is wise to select a variety that has been tested and evaluated under Tennessee conditions. Consider the characteristics of each variety, then select the variety or varieties that best suit the conditions on your farm. Varieties tested in Tennessee and the varietal characteristics at all research locations can be found in the University of Tennessee Agricultural Experiment Station Research Report, "Performance of Wheat, and Barley Varieties," by Allen, et al. at http://varietytrials.tennessee.edu and utcrops.com.

## VARIETAL CHARACTERISTICS

**Maturity:** Maturity can be defined in different ways. Depending on the growing season, a medium-maturity variety might be ready to harvest within two to three days of an early-maturity variety planted on the same date. An important consideration is that early varieties will joint and head earlier. Therefore, they are more susceptible to stem and head freeze in March and head freeze in April if planted too early in the fall.

**Seeding:** Unless only a small acreage is involved, it is always a good idea to plant more than one variety to spread risk. Plant two to three of the top varieties for your area, depending on your acreage. Variations in pest severity and weather conditions will favor one variety over another in any given year. When trying a new variety for the first time, you should usually plant the majority of your acreage in a proven performer.

**Certified Seed:** Use of certified seed provides a level of insurance against poor germination and introduction of weed seeds.

**Seedbed Preparation:** Wheat requires a firm seedbed with enough loose soil to cover the seed to a depth of 1 to 1.5 inches. Disking to a depth of 2 to 4 inches is usually all that is necessary in preparing a seedbed for wheat where it follows corn, soybeans, grain sorghum or other row crops. When it is necessary to plow, the land should be plowed far enough in advance of seeding to allow for development of a firm seedbed with conventional practices. Where erosion is a problem with conventional seedbed preparation, wheat can be planted no-till with excellent results. A preplant burndown herbicide should **always** be applied prior to planting when weeds are present.

## SEEDING DATES AND RATES

**Dates:** For best winter survival and top grain yield, plant wheat from October 15 to November 10. **Do not plant wheat until after the fly-free date of October 15**. Wheat should be planted early enough for young plants to become well-rooted and develop 3 to 4 inches of top growth before going into the winter (December 21$^{st}$). Research indicates that planting during the latter half of the recommended planting period or planting treated seed (systemic insecticide) reduces the incidence of barley yellow dwarf by avoiding or controlling aphids that transmit the virus to wheat. In most Tennessee fields, an insecticide seed treatment will at least pay for itself by controlling early-season aphid populations.

**Rates:** Wheat seeding rates vary from 1.5 to 2.0 bushels per acre depending upon the condition of the seedbed, time of seeding, quality of seed and method of seeding. A seeding rate of 2 bushels per acre should generally be used. Increase the rate to 2.0 to 3.0 bushels per acre (1) if seed are broadcast, or (2) when seeding is delayed until November 1$^{st}$. Ideally, you want to end up with 1.3 to 1.5 million plants per acre. This seeding rate can be calculated by dividing the desired population by the percent germination printed on the bag to obtain how many seed need to be sown. Then divide by the number of seeds per pound to get the number of pounds of seed needed per acre; then divide the number of pounds per acre by 60 pounds (number of pounds of wheat seed per bushel) to get the number of bushels per acre needed.

**Example:** Desired population **1,300,000** (1.3 million) plants per acre.
Seed germination percentage = **85 percent**
Number of seed per pound = **12,000**
Number of pounds per bushel = **60**
1,300,000 ÷ 0.85 ÷ 12,000 = **127 lbs seed per acre**
127 lbs seed per acre ÷ 60 lbs per bushel = **2.12 bushel per acre**

**Table 1. Wheat Seeding Dates and Rates (*also for barley or rye*).**

| Use* | Seeding Rate | Seeding Date/Method |
|---|---|---|
| For grain or spring grazing | 1.5 – 2.5 bu. | October 15-November 10 no-till drilled |
| | 1.5 – 2.5 bu. | October 15-November 10 conventional |
| | 2-3 bu. | October 15-November 10 Over-seeded, no-tillage |
| For winter cover | 1-1.5 bu. | September 15-November 10 no-till drilled |
| | 1-1.5 bu. | September 15-November 10 Over-seeded, no-tillage |
| | 1-1.5 bu. | September 15-October 20 Conventional |
| For cover, wildlife enhancement or fall grazing | 2-3 bu. | August 15-October 1 Over-seeded |
| **Use higher seeding rate if seeding under adverse conditions. Increase seeding rate by 50 percent if using bin-run seed.* | | |

**Method and Depth:** Sowing wheat with a drill instead of broadcasting insures a more uniform depth of covering, higher germination, less winter injury and generally higher yields. Drill or cover wheat to a depth of 1 to 1.5 inches when adequate moisture is available. When soil is dry, a slightly greater depth is advisable, but should not exceed 2 inches.

**Broadcast Seeding:** The two most important aspects to consider when broadcast-seeding wheat are to insure that adequate seeding rates are used and that good seed-to-soil contact is established. To accomplish these goals, 2 to 3 bushel of seed should be broadcast uniformly and incorporated by a shallow pass with a "do-all" or similar equipment. Seed that are broadcast and left lying on the soil surface are subject to animal predation, poor germination and frost heaving. All will lead to a loss of stand.

## GROWTH AND DEVELOPMENT

Successful wheat management requires understanding of how the wheat plant grows and develops. You should make management decisions and apply inputs, such as nitrogen, fungicides, herbicides and insecticides, at the proper stages of growth, not according to calendar dates. Wheat (like any other crop) responds best to inputs at certain stages of development. You can maximize potential effectiveness of an input and optimize production and profit by knowing wheat growth stages and observing plant development. The most popular system of identifying wheat growth stages is the Feekes scale (Table 2). The Feekes scale goes from 1.0 (just after emergence) to 11.4 (ripe for harvest).

**Table 2. Description of Feeke's Scale of Wheat Development.**

| Stage | Feeke's Scale | Description |
|---|---|---|
| **Tillering** | **1** | One shoot (number of leaves can be added), first leaf through coleoptile. |
| | **2** | Beginning of tillering; main shoot and one tiller. |
| | **3** | Tillers formed; leaves often twisted spirally. Main shoot and six tillers. In some varieties of winter wheat, plant may be "creeping," or prostrate. |
| | **4** | Beginning of the erection of the pseudo-stem; leaf sheaths beginning to lengthen. |
| | **5** | Pseudo-stem (formed by sheaths of leaves) strongly erected. |
| **Stem Extension** | **6** | First node of stem visible at base of shoot. |
| | **7** | Second node of stem formed; next-to-last leaf just visible. |
| | **8** | Flag leaf (last leaf) visible gut still rolled up; ear beginning to swell. |
| | **9** | Ligule of flag leaf just visible. |
| | **10** | Sheath of flag leaf completely grown out; ear swollen but not yet visible. |
| **Heading** | **10.1** | First spikelet of head just visible. |
| | **10.2** | One-quarter of heading process completed. |
| | **10.3** | Half of heading process completed. |
| | **10.4** | Three-quarters of heading process completed. |
| | **10.5** | All heads out of sheath. |
| **Flowering** | **10.51** | Beginning of flowering. |
| | **10.52** | Flowering complete to top of head. |
| | **10.53** | Flowering completed a base of head. |
| | **10.54** | Flowering completed; kernel watery ripe. |
| **Ripening** | **11.1** | Milky ripe. |
| | **11.2** | Mealy ripe; contents of kernel soft but dry. Soft dough. |
| | **11.3** | Kernel hard (difficult to divide with thumbnail). |
| | **11.4** | Ripe for cutting. Straw dead. |

## FERTILIZATION

Apply lime and fertilizer based on soil test recommendations. If lime is needed, it should be applied before seeding. All the phosphate and potash can be applied immediately before or at planting (Table 3). **When double-cropping wheat with grain sorghum or soybeans, the fertilizer should be applied to the soil with the total amount of phosphate and potash needed for both crops prior to planting wheat.** Apply 15 to 30 pounds of nitrogen at seeding time to stimulate vigorous plant growth. Apply 30 to 60 pounds of nitrogen as a top-dressing February 15-March 30. Use the earlier date if the wheat stand is thin to encourage more tillering. **All the nitrogen should be applied before wheat begins to joint**. Research has shown no difference in source of nitrogen (ammonium nitrate, urea or liquid nitrogen) when applied according to recommendations. Total **economical** nitrogen needs for a wheat crop grown in Tennessee should be between 45 to 90 lbs. per acre.

Consider split-applying the top-dress nitrogen application when wheat is planted after November 15 or when there is an average of less than four tillers per plant in early January.

**Table 3. Wheat Fertility Recommendations.**

| Soil test level | Wheat alone | | Wheat with double-crop beans | |
|---|---|---|---|---|
| | $P(P_2O_5)$ | $K(K_2O)$ | $P(P_2O_5)$ | $K(K_2O)$ |
| Low | 80 | 40 | 90 | 120 |
| Medium | 40 | 20 | 60 | 60 |
| High | 0 | 0 | 0 | 0 |
| Very High | 0 | 0 | 0 | 0 |
| *Nitrogen should be applied from 45 to 90 lbs per acre. | | | | |

## HIGH-INPUT PRODUCTION SYSTEMS

Some wheat production systems look to maximize yield potential by utilizing crop protection chemical and fertilizer inputs at increased rates when compared to UT Extension recommendations. UT Extension recommendations attempt to maximize economic returns for wheat producers by only applying inputs that have been proven to provide economic returns over multiple years of research. UT Extension recommendations are based on using sustainable practices including proper scouting with Integrated Pest Management (IPM) programs, soil testing and reasonable yield goals. UT Extension discourages the use of any management system that requires inputs based on calendar dates without appropriate scouting or testing procedures.

While high-input systems are attractive when high yields are realized, producers need to evaluate how much monetary risk they are willing to take in their management budget. The most important decision you make with either a high-input or traditional production system is to stick to your original plan. Using a traditional system and attempting to increase nitrogen fertility will usually result in lodging. Likewise, starting with a high-input system and deciding late in the season to abandon your plan will result in losing the previously applied inputs. Choose a system that fits your production needs and manage the crop accordingly.

## WEED CONTROL

Weed control in wheat should be successfully accomplished before the onset of winter (December 21$^{st}$) to maximize yield potential and prevent less than acceptable control when temperatures are cold, or when weeds become too large.

Wild garlic (commonly called wild onion), annual ryegrass, cheat and henbit are major weed problems in Tennessee wheat fields. Wild garlic infestations may cause considerable dockage at harvest. Annual ryegrass and cheat compete with wheat for light, nutrients and water and will reduce wheat yield. Weeds that infest wheat may delay harvest in the spring. Thus, an effective weed management program should be used for producing optimum wheat yields.

Good production practices aid in the control of weeds. Using weed-free seed, proper seeding rate, proper seedbed preparation and controlling weeds in the previous rotational crop will assist in effective weed control. Where herbicides are used, timeliness of application is critical to success.

Always read and follow label directions. Adhere to wheat growth-stage recommendations when applying herbicides.

**Cheat:** can become a serious weed problem in many wheat fields. In fields with heavy cheat pressure, Sencor 75DF can be used. Use of Sencor may result in injury to some wheat varieties. The degree of injury is related to variety, growth stage at application and health of the wheat plants. UT research has found that most popular wheat varieties are tolerant to Sencor**.** A management program for cheat should include the following:

1. Start with a weed-free seedbed either by using a burndown herbicide or tillage
2. Crop tolerance is dependent upon a good root system and a healthy wheat plant prior to and at time of application.
3. Apply 0.33 lb. to 0.67 lb. of Sencor 75DF per acre, depending on soil type, after wheat plants have developed 3 to 4 tillers and at least 4 secondary roots, 2 inches long.
4. Do not apply Sencor to wheat that has begun to joint.

**Ryegrass** is a problem for many wheat producers. Ryegrass will reduce yields and cause delays at harvest. Hoelon 3EC (u)* was the standard for preemergence or postemergence control of annual ryegrass in fall-planted wheat. Most populations of ryegrass in Tennessee are not resistant to Hoelon. However, broader-spectrum grass weed control can be expected by using Axial or Osprey herbicides for control of annual ryegrass. Only one application of Hoelon should be made per season. Apply in at least 10 gallons of water per acre by ground or 5 gallons of water per acre by air. Postemergence application should be made prior to wheat jointing.

**Wild Garlic** (commonly called wild onion) is a major weed problem in Tennessee wheat fields. To obtain the best control of wild garlic and the least amount of injury to the wheat crop, the following procedure should be followed:

1. Apply 0.45 to 0.90 ounces Harmony Extra Total Sol per acre.
2. Apply at least 15 gallons spray volume per acre to ensure coverage. **Note: thorough coverage is essential for control.**
3. Add nonionic surfactant (80 percent active or greater) at a rate of 1 quart per 100 gallons of water. Liquid nitrogen fertilizer may be used as a spray carrier for Harmony Extra Total Sol. Surfactant must be included (1 to 2 pints per 100 gallons of spray solution). Wheat plants may exhibit temporary yellowing or stunting when sprayed with the liquid nitrogen.
4. Apply when wild garlic plants are less than 12 inches tall, with 2 to 4 inches of new growth. New growth is essential for control. The new growth on garlic can be observed at the base of the garlic plant.
5. Apply when daytime temperatures of at least 60 F are expected for three or more days. Adequate soil moisture before, during and immediately after application will improve control.
   Harvest wheat early, prior to excessive lodging, to remove as few aerial bulblets with the combine as possible.

**Vetch** problems in Tennessee wheat fields continue to increase each year. Harmony Extra Total Sol will give fair to good control of vetch. However, vetch is usually too big for good control with Harmony Extra Total Sol if treatment is delayed until most growers are treating for wild garlic. For

improved vetch control, 2,4-D (0.5 pint per acre of a 4 lb. per gallon formulation) may be tank mixed with Harmony Extra Total Sol. Remember that 2,4-D has a more restrictive wheat growth stage limitation. Apply 2,4-D or Harmony Extra Total Sol plus 2,4-D on well-tillered wheat, prior to jointing.

**Wild Mustard, Turnips, Mayweed and Cornflower:** Harmony Extra Total Sol or 2,4-D will give good to excellent control of wild mustard and turnips. Mayweed must be controlled with Harmony Extra Total Sol. Harmony Extra Total Sol is weak on cornflower (also called bachelor's button). To get good control of this weed, apply 2,4-D or Clarity with Harmony Extra Total Sol.

## INSECT CONTROL

Many farmers in Tennessee use wheat as a double-crop with soybeans. As with any crop, wheat has several insect pests that may reduce yields if not effectively controlled in the field. Yields can be improved if more producers take time to inspect their fields during the growing season for insect pests. This publication is designed to acquaint the producer with the major insect pests of wheat, the damage they cause and measures used to control the pests.

**Aphids:** Several aphids feed on the leaves and grain heads of wheat. These pests are significant in that they are capable of transmitting diseases to the plant such as barley yellow dwarf virus in addition to the damage inflicted by their feeding habits.

**Oat-Bird Cherry Aphid** is dark green and is responsible for transmission of the barley yellow dwarf virus. This is usually the most common aphid observed in wheat.
**Corn Leaf Aphid** is bluish-green and all of the legs, cornicles and antennae are black. The cornicles differ from the English grain aphid by being short and broad.
**Greenbug** is a pale green, sometimes having a dark green stripe down the back of the wingless forms. The tips of the legs and cornicles are black, and the antennae are mostly black.
**Rice Root Aphid** occurs on the roots of wheat and has been known to transmit barley yellow dwarf virus.

**Armyworms:** Armyworms can be serious pests of wheat when populations reach large numbers. Armyworms get their name from their migrating habit, as they sometimes start at one portion of the field and devour everything in their path.

**True Armyworm:** Damaging infestations of true armyworm normally occur in the spring. Mature larvae are smooth, almost without any hairs, greenish-brown to reddish-brown, with a dark stripe along each side. A broad dorsal stripe runs down the length of the back. This species differs from the fall armyworm by having a dark lateral band on the outer portion of each proleg. Besides feeding on foliage, larvae will sometimes cut the heads of maturing wheat plants.

**Fall Armyworm:** As the name implies, the fall armyworm is normally a pest of early planting, seedling wheat in the fall. These insects can completely defoliate a wheat field when populations are very large. This insect differs from the true armyworm by having a prominent inverted Y on the front of the head and no dark bands on the outer portion of the prolegs.

**Hessian Fly:** These small insects have been responsible for tremendous wheat losses in the past. Hessian fly larvae feed on stems at the base of plants, hidden behind the leaf sheaths. Larvae are reddish at first emergence and turn white or greenish white; they are shiny and without legs. Larvae are legless, resembling small grains of rice, and are approximately ¼ inch long when full grown. The pupae, or flax seed stage, are brown but otherwise similar to the larvae. Tennessee typically does not have significant problems with this pest. However, early-planted wheat is susceptible to infestation. Planting after October 15 (i.e., the "fly-free date") will greatly reduce the likelihood of serious Hessian fly infestations. Also, avoid planting wheat as a cover crop prior to the fly-free date. Volunteer wheat is a good fall host for this pest, and any volunteer wheat should be destroyed before September. Plowing under wheat stubble after harvest may help reduce subsequent infestations in the fall. Although some varieties are available with resistance to Hessian flies, there are no varieties with adequate resistance to the fly biotype most common in Tennessee (Biotype L).

**Cereal Leaf Beetle:** The cereal leaf beetle is a pest of wheat, oats, barley and other cereal crops. It has been found in most all counties in Tennessee. The larvae are pale yellow and soft-bodied. The larvae glue pieces of fecal material to their backs as camouflage. Adults are shiny, black beetles with red legs and thorax and are approximately 3/16 inch long. Feeding by adults and larvae skeletonizes the leaf tissue between the veins. Check 10 plants per sample site for larvae and adults, which are present from April through June.

## SUGGESTED ECONOMIC THRESHOLDS

**Corn Leaf, Oat-Bird Cherry and Rice Root Aphid:** No thresholds have been established in Tennessee. Treatment should be considered when heavy populations are causing leaves to dry up and die in several portions of the field. An insecticidal seed treatment such as Gaucho or Cruiser can be used to reduce transmission of barley yellow dwarf virus. Data suggest that early-planted wheat is most likely to benefit from use of a seed treatment. Foliar insecticide applications in the fall can also reduce transmission of barley yellow dwarf virus, but they must be applied before aphid populations are already established in the field.

**Greenbug:** This aphid injects a toxin while feeding. Treatment should be made when aphids are killing three or more leaves per plant. For wheat less than 6 inches tall, treatment should also be considered if greenbugs number 50 or more per linear foot. Treatment should also be made if greenbugs number 200 or more per foot in wheat 6-10 inches tall.

**Armyworms:** Treatment for fall armyworm should be considered when four or more larvae are present per square foot (16 per 4 square feet). For true armyworm, use a threshold of 6-8 larvae per square foot if wheat is still in the milk stage. Once past the milk stage, wheat can tolerate higher populations, and treatment is not usually recommended unless larvae are cutting wheat heads.

**Hessian Fly:** Foliar applied insecticides are difficult to time and only marginally effective. Plant after the fly-free date and use resistant varieties if they are available. Resistant varieties may help suppress Hessian fly populations, although no varieties provide adequate resistance to Biotype L.

**Cereal Leaf Beetle** – Treatment is necessary if one larva and/or adult is present per stem.

**Table 4. Recommended Chemical Controls for Wheat Insects.**

| Insect | Insecticide (Trade Names) | Rate/Acre |
|---|---|---|
| Aphids | Seed Treatments | |
| | imidacloprid (Gaucho 600) | 0.8 - 2.4 oz per 100 lb seed |
| | thiamethoxam (Cruiser 5) | 0.75 - 1.33 oz per 100 lb seed |
| | Foliar Treatments | |
| | dimethoate 4* | 8 - 12 oz |
| | methomyl (Lannate LV 2.4)* | ¾ - 1½ pt |
| | methyl parathion 4* | ½ - 1½ pt |
| | β-cyfluthrin (Baythroid XL 1) | 1.8 - 2.4 oz |
| | γ-cyhalothrin (Prolex 1.25) | 1.54 oz |
| | λ-cyhalothrin (Karate 2.08) | 1.28 - 1.92 oz |
| | Z-cypermethrin (Mustang Max 0.8) | 3.2 - 4.0 oz |
| Armyworms (True & Fall) | carbaryl (Sevin XLR Plus 4) | 1 - 1½ qt |
| | methyl parathion 4* | 1½ pt |
| | methomyl (Lannate LV 2.4)* | ¾ - 1½ pt |
| | spinosad (Tracer 4) | 1.5 - 3 oz |
| | β-cyfluthrin (Baythroid XL 1) | 1.8 - 2.4 oz |
| | γ-cyhalothrin (Prolex 1.25) | 1.02 - 1.54 oz |
| | λ-cyhalothrin (Karate 2.08) | 1.28 - 1.92 oz |
| | Z-cypermethrin (Mustang Max 0.8) | 3.2 - 4.0 oz |
| Cereal Leaf Beetle | carbaryl (Sevin XLR Plus 4) | 1 qt |
| | methomyl (Lannate LV, 2.4)* | ¾ - 1½ pt |
| | spinosad (Tracer 4) | 1 - 3 oz |
| | β-cyfluthrin (Baythroid XL 1) | 1.0 - 1.8 oz |
| | γ-cyhalothrin (Prolex 1.25) | 1.02 - 1.54 oz |
| | λ-cyhalothrin (Karate 2.08) | 1.28 - 1.92 oz |
| | Z-cypermethrin (Mustang Max 0.8) | 1.76 - 4.0 oz |

* Use extra caution when handling these insecticides.

## WHEAT DISEASES

Disease pressure can develop any time environmental conditions are favorable for disease development. Diseases that occur frequently in Tennessee are barley yellow dwarf, leaf rust, powdery mildew, Septoria glume and leaf blotch.

Glume blotch is most consistent in its ability to reduce yields year after year. Leaf rust and powdery mildew only cause damage in certain years when environmental conditions are favorable for these diseases.

**Barley Yellow Dwarf:** In the past, this virus disease has received little attention in wheat, but it is becoming a limiting factor to production in some areas. The light green to yellowish and sometimes reddish foliage and stunting induced by the virus are similar to the symptoms attributed to non-

parasitic factors such as nutrient deficiencies and poorly-drained soil. The virus is transmitted from plant to plant by several species of aphids which feed on wheat. Some degree of control of barley yellow dwarf can be obtained by planting late in the fall, but early enough to provide an adequate root system that will withstand low winter temperatures. Aphid vector control with seed-applied insecticides has been found to be effective in controlling this virus disease.

**Leaf Rust:** *Puccinia recondita f. sp. tritici* − Rust appears as small, round or oblong raised orange-red pustules, mainly on the upper surface of the leaves. Leaf rust, when severe, reduces both grain yield and test weight. It is transmitted by wind-borne fungus spores. Foliar fungicides are effective in controlling leaf rust.

**Powdery Mildew:** *Erysiphe graminis f. sp. tritici*
Diseased plants are usually found in the spring in moist areas of fields where the growth is rank. Powdery mildew is very noticeable on the leaves as a white-powdery mass that often covers the entire blade. Later, the affected leaves turn yellow and die prematurely. Heavy attacks of powdery mildew cause plants to lodge and kernels to shrivel. Foliar fungicides are effective in controlling powdery mildew.

**Glume Blotch:** *Stagonospora* (*Septoria) nodorum* − Glume blotch may first be noticeable on the lower leaves as small oblong lesions that are light brown with dark borders. After heading, the fungus moves to the head. First indication of infestation is the brown discoloration of the glume (chaff). As the grain matures, the glume takes on a black peppery appearance which is due to spores (pycnidia) of the fungus.

Infection of the leaves can be serious and severe attacks on the head can significantly reduce yield and grain quality. Glume blotch is primarily a warm-weather disease. Both glume and leaf blotch fungus spores live through the summer in crop residue. General control measures include plowing under crop residue immediately after harvest (unless using no-till practices), allowing at least one year between wheat crop and use of foliar fungicides.

**Leaf Blotch:** *Septoria tritici* − Leaf blotch is more noticeable early in the spring, when it appears as irregular reddish-brown spots scattered over the leaf blade. The spots, often with ashen white centers, contain many black specks. Lesions tend to be restricted laterally and assume parallel sides. The damage caused to portions of the leaf can reduce yields. Leaf blotch also damages the seedling and tillers.

**Tan Spot***: Pyrenophora tritici-repentis* **–** Tan spots develop on both upper and lower leaf surfaces. The spots start out as brown or tan (*delete* colored) flecks, expanding into lens-shaped blotches from 1/8-3/4 inch long, often with yellow borders. Later these lesions may coalesce and become dark brown at their center containing conidia (spores) of the fungus. Dark pseudothecia of the fungus appear as dark, raised specks on mature wheat straw. Foliar fungicides are effective in controlling tan spot.

**Loose Smut:** *Ustilago tritici* − Loose smut is easily recognized as soon as the affected heads emerge from the boot. Smut-infected heads appear earlier than normal ones and a loose, dark-colored spore mass replaces the seed in the head. Spores are washed and blown away by rain and wind, and by

harvest, nothing remains of the head except a bare spike. Loose smut may reduce the yield but does not affect grain quality.

The disease is seed-borne within the wheat kernel and may be controlled by treating the seed before planting with various fungicides.

**Head Blight or Scab:** *Fusarium* spp. − Head blight, also called pink mold, white heads or tombstone scab, is manifested by the premature death or blighting of spikelets of the head. The disease appears on all small grain crops and is especially important in humid regions. Prolonged rainy spells during the blooming stage of the wheat will enhance conditions for infection. Significant yield losses result from floret sterility and poor seed filling.

Grain from head-blighted fields is less palatable to livestock and sometimes contains sufficient mycotoxins to induce muscle spasms and vomiting in humans and certain non-ruminant animals. The toxins apparently remain stable for years in stored grain. Bread made from scabby wheat has been described as intoxicating. Control with crop rotation and fungicides are only slightly effective.

**Take-All:** *Gaeumannomyces graminis var tritici.* − The term "Take-All" originated in Australia more than 100 years ago and referred to a severe seedling blight disease. Today, Take-All is best recognized as a root and shoot disease of winter wheat that interrupts plant development and seriously suppresses yield.

Take-All is most obvious near heading on plants grown in moist soil. Diseased crops appear uneven in height and irregular in maturity. Severely diseased plants easily break free at the crown when pulled from the soil.

Infested plants are stunted, mildly chlorotic, have few tillers and ripen prematurely. The heads are bleached (white heads) and sterile. Roots are blackened and brittle from fungal invasion. A black-brown dry rot extends to the crown and basal stem. Control by crop rotation and other cultural practices is not very effective. Foliar fungicides are not effective in controlling this disease.

*A complete description of all wheat disease can be found in *"Compendium of Wheat Diseases (2nd edition), sold by The American Phytopathological Society.*

**WHEAT FOLIAR FUNGICIDE POINT SYSTEM**

This point system should be used only as a guide to determine the need for application of foliar fungicides. It does not guarantee an economical return. If a "zero" is indicated in category # 1 or 3, then the field **should not** be sprayed.

| | | | Points |
|---|---|---|---|
| I. | **Yield Potential** (5-7 days before first spray) | | |
| | 1. 40 b./A or above | = 150 | |
| | 2. 30-39 b/A. | = 50 | |
| | 3. Below 30 b/A. | = 0 | I._____ |
| II. | **Cropping History** | | |
| | 1. Wheat in field last year | = 100 | |
| | 2. Wheat in field two years ago | = 50 | |
| | 3. First time in wheat three years or longer | = 25 | II._____ |
| III. | **Fertility** (total Nitrogen) | | |
| | 1. Applied 90-120 lbs. of Nitrogen/A. | = 100 | |
| | 2. Applied only 60-90 lbs. of Nitrogen/A. | = 50 | |
| | 3. Applied no nitrogen | = 0 | III._____ |
| IV. | **Seeding rate** (assuming 80% plus germination) | | |
| | 1. Planted 2 or more b./A. | = 75 | |
| | 2. Planted 1.5-2.0 b./A. | = 50 | |
| | 3. Planted less than 1.5 b./A. | = 25 | IV._____ |
| V. | **Disease** at application time (stage F10.3). | | |
| | 1. Severe (disease starting on flag leaf) | = 100 | |
| | 2. Moderate (bottom & middle leaves diseased) | = 75 | |
| | 3. Light (disease found on lower leaves) | = 50 | |
| | 4. No foliar disease present | = 25 | V._____ |
| VI. | **Seasonal rainfall** prior to first application | | |
| | 1. Above normal | = 100 | |
| | 2. Normal | = 75 | |
| | 3. Below normal | = 25 | VI._____ |
| VII. | **Traditional Disease Pressure** | | |
| | 1. Heavy | = 125 | |
| | 2. Moderate | = 75 | |
| | 3. Light | = 25 | VII._____ |
| | | | Total Points _____ |

After inspection of each field (boot stage), producers should total the number of points to determine the probability of a yield increase

| **Total Field Points** | **Chances of Yield Increase** |
|---|---|
| 750-1000 | Excellent |
| 500-749 | Fair |
| Below 500 | Poor |

**Stage of Growth to Apply Foliar Fungicides:** Close attention must be paid to the stage of growth to obtain maximum benefit from foliar fungicides. If the application is made too late, then infection could have already occurred. If application is made too early, the flag leaf and head will not be protected. Unless powdery mildew or a rust disease is threatening the flag leaf, the best time to apply a foliar fungicide is a **Feeke's scale 10.3** (when one-half of the head has emerged).

Each application must be made in at least 5 gallons of water per acre by airplane or at least 20 gallons of water per acre with ground rigs. Always use a spreader-binder that is labeled for fungicides with either application method.

**Table 5. Foliar Fungicides for Use in Wheat.**

| Chemical Name | Trade Name | Formulation | Rate/A per Application | Diseases Best Controlled |
|---|---|---|---|---|
| Pyraclostrobin | Headline (BASF) | 23.6 % EC | 6 to 9 fl oz | Glume blotch and Septoria leaf spot, rust diseases, Tan spot *(change , to .)* |
| Propiconazole | PropiMax (Dow) | 41.8 % EC | 4 fl oz | Rust diseases, powdery mildew, leaf blight and glume blotch and tan spot *(add .)* |
| Azoxystrobin | Quadris (Syngenta) | 22.9 % F | 4- 12 fl oz (general use: 6-9 fl oz) | Glume blotch and leaf blight, rust diseases, tan spot *(add .)* |
| Propiconazole | Tilt 3.6 (Syngenta) | 41.8% EC | 4 ozs. | Rust, Glume Blotch, rust diseases, powdery mildew, glume blotch and leaf blight. |
| Azoxystrobin + Propiconazole | Quilt (Syngenta) | 7 % + 11.7 % F | 10.5 to 14 fl oz | Rust diseases, powdery mildew, glume blotch and leaf blight, tan spot. |
| Propiconazole + Trifloxystrobin | Stratego (Bayer) | 11.4 % + 11.4 % | 10.0 fl oz | Glume blotch and leaf blight, powdery mildew, rust diseases, tan spot. |

## HARVESTING AND STORING

Wheat is ripe and dry enough for satisfactory combine harvest when the moisture content of the grain reaches 14 percent or less. Wheat must be 13.5 percent moisture or less to be marketed without a price discount. The discount on wheat at 14 percent is approximately 1 percent of the market value. The moisture discount is progressively greater for each .5 percent increase above 13.5 percent.

For safe storage, the moisture content of wheat for grain should not be more than 13 percent. The wheat should also be free of green foreign material. The moisture content of seed wheat in storage should be 12 percent or less to maintain high viability and vigor. Ripe grain should be combined as soon as possible, because alternate wetting and drying of the grain results in reduced test weights.

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