

Managing Wheat by Growth Stage

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Management decisions in wheat production are growth-stage dependent. Applying fertilizers, herbicides, and fungicides are most effective and profitable when applied at specific times during wheat development. If certain chemicals are applied at the wrong growth stage, they may be ineffective or even damage the crop. Understanding how to correctly identify wheat growth stages can help producers make timely and profitable management decisions.

This publication describes provides descriptions and images of key wheat growth stages to help readers identify them. This publication also includes brief descriptions of management considerations at individual wheat growth stages.

Growth Stage Scales

There are several scales that describe the growth and development of cereal crops, including wheat. Commonly used scales include the Feekes scale, the Haun scale, the BBCH scale, and the Zadoks scale. Each scale differs in the level of detail it uses to describe the stages of crop growth. The Zadoks and BBCH scales are commonly used in Europe, while the Feekes scale is more widely used in the United States. In this publication we will use the Feekes scale.

Growth Staging Wheat

The Feekes scale is a numerical scale. It begins at Feekes 1.0 (which describes emergence) and ends in 11.4 (which describes a mature plant that is ready for harvest).

Traditionally, the Feekes scale only uses decimal subdivisions to describe development stages during head emergence to maturity (Feekes 10.0 through 11.4). However, some publications and sales documents may use decimal numbers with the Feekes scale to describe the number of tillers in the early stages of wheat development.

Feekes 1: Emergence

Feekes growth stage 1 is an important time to check wheat plants for uniform emergence and to determine if it is necessary to apply herbicides to control winter annual grasses or other weeds such as chickweed, deadnettle, henbit, and garlic.

Feekes 2-3: Tillering

Feekes growth stage 2 describes plants that are beginning to tiller, meaning the plant is producing axillary or side shoots. Traditionally, there is no intermediate distinction between beginning tillering (Feekes 2) and Feekes growth stage 3, which describes a plant that has completed forming tillers (Figure 1).

Photos by Kiersten Wise,
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Figure 1. Wheat between Feekes growth stages 2 and 3 — this plant has not completed tiller formation.

Adaptations of the Feekes scale can use a decimal after the growth stage number to describe the number of tillers observed. For example, a designation of Feekes 2.3 indicates the plant has three tillers in addition to the main stem at Feekes 2.0. If an individual wants to designate an intermediate growth stage between Feekes 2.0 and Feekes 3.0, he or she must dig up plants and examine them carefully to determine number of tillers.

Wheat development depends on weather conditions and planting date. Because of this, the amount of time it takes for wheat to develop from Feekes 2 to Feekes 3 will vary. Tillering may begin in the fall and not be complete until the following spring. If favorable weather conditions exist, early-planted wheat may complete tiller formation before wheat enters winter dormancy.

Feekes growth stage 2-3 is when early nitrogen applications should be applied to enhance tillering in thin stands. Fall nitrogen application of 20-30 lb/acre is sufficient for developing fall tillers. Spring tillering in thin stands can be encouraged by applying 30-50 lb/acre at dormancy break with the balance of spring topdress nitrogen applied at Feekes 5.



Figure 2. Individual wheat plant (above) and wheat in the field (below) at Feekes growth stage 5. Note the plant's dark green color. The "greening up" phase is a time for making critical management decisions



Feekes 4-5: Green Up

After tillers have formed, wheat plants enter the "greening up" phase and begin erect growth. This stage is known as Feekes 4, and it is closely followed by Feekes 5 (Figure 2).

Although these stages are difficult to distinguish from each other in the field, they are important and distinct stages in the plants' development. Feekes 5 will not occur prior to vernalization (chilling), which occurs

during the winter. After vernalization, wheat plants begin to differentiate. At this point, wheat head size (the number of spikelets per spike) is determined. Any additional tillers that form after Feekes 5 will not contribute to yield.

Feekes growth stage 4-5 is an optimal time to make spring topdress nitrogen applications and to apply post-emergence herbicides for weed control. Check your state's weed control guide for current recommendations on herbicide products, timings, and rates — in Indiana, see the *Weed Control Guide for Ohio and Indiana* (Purdue Extension publication WS-16-W), available from the Purdue Extension Education Store, www.the-education-store.com.

Feekes growth stage 4-5 also is an important time to scout for soilborne virus diseases and early-season foliar diseases such as powdery mildew and leaf blotch.

Feekes 6: Jointing

Feekes growth stage 6 is commonly referred to as jointing. At Feekes 6, the first node will be visible at the base of the shoot (Figure 3).

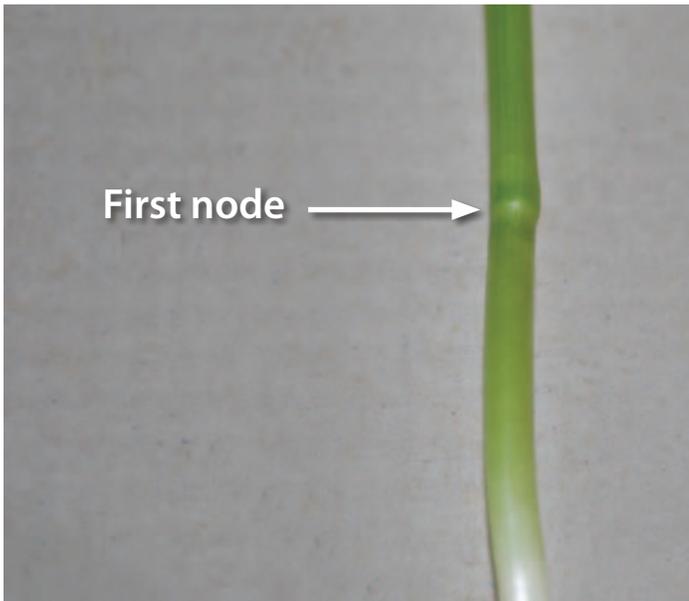


Figure 3. Feekes growth stage 6 (jointing) can be identified when the first visible node appears at the base of the shoot.

To determine if a plant is at jointing, dig up the plant, remove the tillers and examine the main stem. The first node often feels like a swollen bump on the base of the shoot. Using a knife, split the stem in half, and observe the position of the developing head and nodes. If a node is visible, the plant is at Feekes 6. The head will be visible at this point, and the spike will contain all potential spikelets and florets at Feekes 6 (Figure 4).

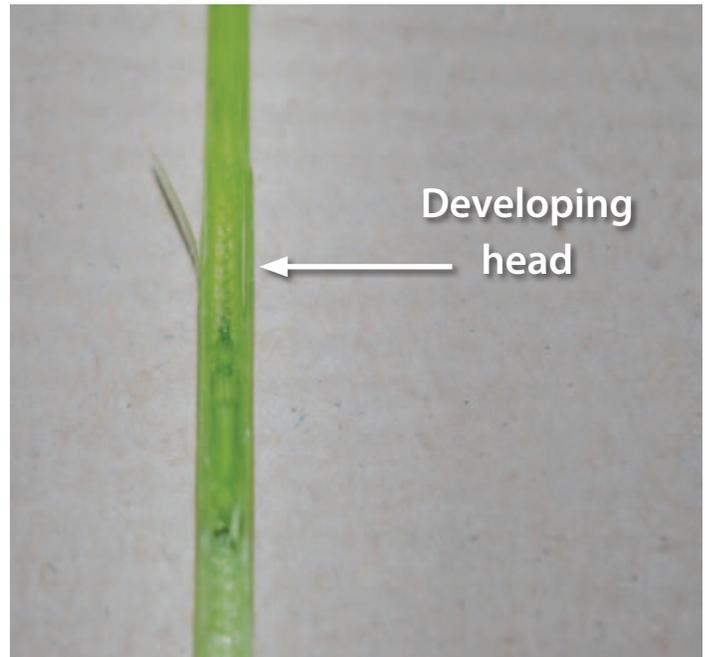


Figure 4. At Feekes 6, the developing head is visible inside the stem.

Feekes growth stage 6 is the cutoff for applying certain herbicides such as 2, 4-D and dicamba. Feekes 6 also is a good time to cut-off nitrogen applications to prevent injury.

Feekes 7-8: Two Nodes and Flag Leaf

Feekes 7 is reached when two nodes are visible above the soil line. Purdue Extension Specialist Greg Shaner examined weather data to determine the approximate time needed for wheat to develop in Indiana. His data indicate that it takes approximately one week for wheat to develop from Feekes 6 to Feekes 7.

Approximately five to 10 days after plants reach Feekes 7, the flag leaf, which is the last leaf of the wheat plant, emerges. Once the flag leaf has emerged, the wheat plant is at Feekes 8.

Two nodes are distinctly visible on the stem at Feekes 8 — the first node will be 2 to 3 inches from the soil surface and the second about 6 inches from the soil surface. A third node may be visible approximately ½-inch above the second node.

To determine if an emerging leaf is the flag leaf, split the leaf sheath and observe the head's placement. If the head is visible, and no additional leaves are inside the stem, the plant is at Feekes 8.

Feekes 8 is a critical growth stage for management decisions, especially herbicide and fungicide applications. Those who carefully observed growth stages before this point will have an advantage in making decisions to apply fungicides to protect the flag leaf.

Feekes 9-11: Boot Stage, Flowering, and Maturity

Within five days after the flag leaf emerges, wheat plants enter Feekes 9.

At Feekes 9 the flag leaf’s ligule is visible and the leaf has fully emerged from the whorl (Figure 5). The flag leaf sheath will extend and the head will begin to swell.

Once the head develops and is visible in the leaf sheath directly below the flag leaf, the plant has entered Feekes 10, commonly referred to as the boot stage (Figure 6).

At growth stage 10, the Feekes scale uses a decimal system to describe wheat development. Because wheat plants in a field will not all emerge from boot stage at the same time, these subdivisions should be assigned when 50 percent of the plants have reached the decimal designation.

Some of the important decimal designations are:

- 10.1 — awns visible, heads emerging
- 10.3 — heading half complete
- 10.5 — heading complete
- 10.5.1 — beginning flowering

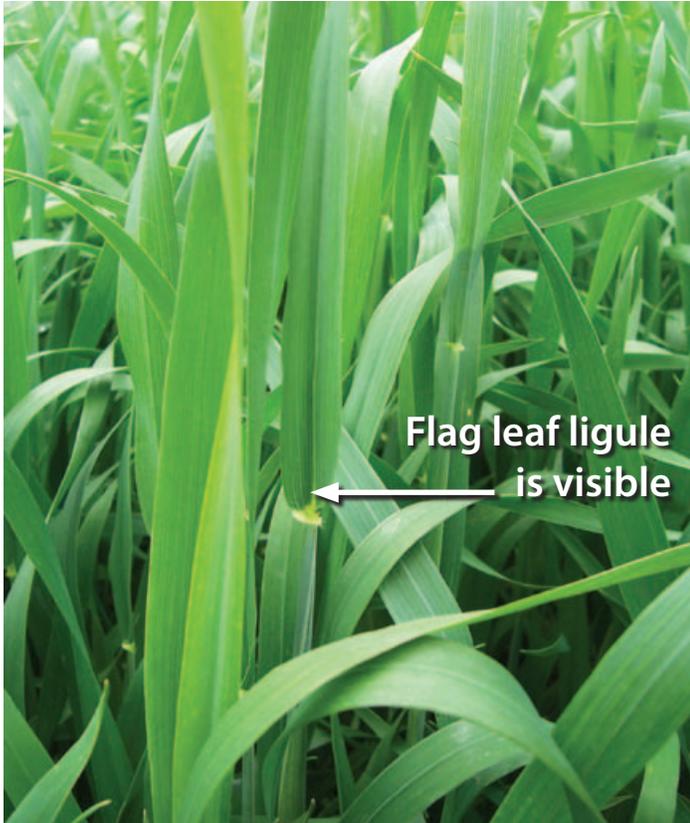


Figure 5. Wheat at Feekes 9. Note that the flag leaf is fully emerged.



Figure 6. At Feekes 10 (commonly called boot stage), the head is visible in the leaf sheath below the flag leaf.



Figure 7. Wheat at Feekes growth stage 10.5.1 is beginning flowering. At this stage, anthers will be visible on the wheat head.

In Indiana, wheat will pass from Feekes 9 to beginning flowering (Feekes growth stage 10.5.1) in nine to 16 days (Figure 7).

Feekes 10.5.1 (when wheat plants begin to flower) is the optimum time to apply fungicides to suppress *Fusarium* head blight (scab).

Once flowering begins, pollination will be complete in about four or five days — when pollination is complete, wheat is at Feekes growth stage 10.5.3. Ripening begins at Feekes 10.5.4 (kernels watery ripe) and continues through Feekes 11.4. Kernels will pass from a watery consistency at 10.5.4, to milky ripe at 11.1. Kernels will have a doughy or mealy consistency at 11.2, and by 11.3, kernels will be hardened. Harvest can occur once kernels are ripe at Feekes 11.4. Ripening can take several weeks to complete.

Find Out More

If you have questions about wheat or other crops, you can contact Purdue Extension Specialists in the Purdue Departments of Agronomy, Botany and Plant Pathology, and Entomology.

To contact a Specialist, call Purdue Extension toll free at (888) EXT-INFO (496-4636).

Purdue Extension publications also provide information on disease, weed, and insect pests. *The Diseases of Wheat* series and the *Weed Control Guide for Ohio and Indiana* (WS-16-W) are available from the Purdue Extension Education Store, www.the-education-store.com.

Other information is available on the Purdue Field Crops IPM site, extension.entm.purdue.edu/fieldcropsipm.

Reference to products in this publication is not intended to be an endorsement to the exclusion of others that may be similar. Persons using such products assume responsibility for their use in accordance with current directions of the manufacturer.

Table 1. Wheat management considerations by Feekes growth stages. This table provides a general overview of wheat management decisions by Feekes growth stage.

Feekes Growth Stage	Management Considerations
1.0	Check stands for emergence and uniformity. Check for weeds and apply herbicides if necessary ¹ . Begin monitoring for various aphid species (continue through season) ² . Check seedlings for Hessian fly feeding damage ³ .
2.0	Make early nitrogen applications to enhance tillering in thin stands. Avoid excess nitrogen.
3.0	
4.0	Scout for insect and disease problems. Check stands for heaving caused by freezing/thawing cycles. Decide whether post-emergence weed control is warranted.
5.0	Make spring topdress nitrogen applications. Apply herbicides as needed for weed control ¹ .
6.0	Cutoff for nitrogen applications to avoid leaf injury. Cutoff for some growth regulator herbicides, like 2, 4-D and dicamba ⁴ .
7.0	Scout for insect and disease problems.
8.0	Apply fungicides to protect flag leaf from foliar diseases if necessary.
9.0	Cutoff for any further herbicide applications unless harvest aid treatments are needed.
10.0	Determine if fungicide applications for glume blotch management are needed. Check risk for Fusarium head blight (scab) at www.wheatscab.psu.edu . Check for armyworm feeding. Consider control measures if armyworm feeding is clipping heads.
10.5.1	Apply fungicides to suppress Fusarium head blight if necessary

¹ See the *Weed Control Guide for Ohio and Indiana* (Purdue Extension publication WS-16-W), available from the Purdue Extension Education Store, www.the-education-store.com.

² While scouting for aphids in wheat, use the following guidelines as thresholds: Control may be advisable if an average of:

- 20 or more aphids per stem are noted while plants are in the tillering stages (Feekes growth stages 1-5)
- 30 or more aphids per stem are noted when plants are in the pre-boot stages (Feekes stages 6-9)
- 50 or more aphids per stem are noted when plants are in the boot, heading, and/or ripening stages (Feekes stages 9-11)

³ See the Purdue Field Crops IPM page on Hessian fly, extension.entm.purdue.edu/fieldcropsipm/insects/hessianfly.php.

⁴ See page 145 of the *Weed Control Guide for Ohio and Indiana* (Purdue Extension publication WS-16-W).