



# Extension FactSheet

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## Wheat Growth Stages and Associated Management

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At least five scales commonly are used worldwide to describe stages of growth of wheat and other small grains. The most widely used scale in the United States is the Feekes scale, although the Zadoks scale has more detail. Careful study of the developing crop and knowledge of factors that affect grain yield potential can enhance management decisions. These decisions can make wheat production more profitable.

### Feekes 1.0: Emergence

The number of leaves present on the first shoot can be designated with a decimal. For example, 1.3 is a single shoot with three leaves unfolded. The most significant event in achieving high yields is stand establishment. Late-planted wheat has less time to tiller and should be planted at a higher rate to compensate for fewer tillers.

### Feekes 2.0: Beginning of Tillering (usually in fall)

A tiller is a shoot that originates at the coleoptilar node. Tillers share the same root mass with the main stem. During tillering, the major management consideration is whether stands are adequate to achieve yield goals. Management inputs will not compensate for skimpy or erratic stands caused by insects, seedling diseases, poor seed quality, herbicide injury, etc. If stands are thin but uniform, an early March nitrogen (N) application may enhance the rate of tillering, potentially increasing the number of heads per square foot. Fall N application of 25 to 40 pounds per acre usually increases winter survival, tillering, and yield. Excess N applied at this time leads to a lush, vegetative growth which makes the crop more susceptible to winter-kill and foliar fungal disease. Adequate phosphorus (P) and a soil pH above 6.0 are needed for good rooting and tiller development. If tiller development is a historic problem in a given field, close attention must be given to P soil test recommendations prior to planting.

### Feekes 3.0: Tillers Formed (late fall or early spring)

Winter wheat can continue to tiller for several weeks. Depending upon the planting date and weather conditions, tillering

can either be interrupted by or completed prior to the onset of winter dormancy. Most of the tillers that contribute to grain yield potential are completed during this stage. Many winter wheats are prostrate or “creeping” at Stage 3.

### Feekes 4.0: Beginning of Erect Growth (March – April)

Most tillers have been formed by this stage, and the secondary root system is developing. Winter wheats, which may have a prostrate growth habit during the development of vegetative parts, begin to grow erect. Leaf sheaths thicken. The key management step at Feekes 4.0 is continued scouting for insect and weed infestations.

### Feekes 5.0: Leaf Sheaths Strongly Erect (early– mid-April)

Further development of the winter wheat plant requires vernalization, or a period of cool weather. After the appropriate amount of chilling, followed by the resumption of growth, the growing point (located below the soil surface) differentiates. At this stage of growth, the size of heads, or number of spikelets per spike, is determined. No effect on yield is expected from tillers developed after Feekes 5.0. Nitrogen applied at Feekes 5.0 can affect the number of seeds per head and seed size, but not the number of heads. This is an ideal stage of growth for the spring topdress N application.

At this stage, the wheat plant becomes strongly erect. All meaningful tiller development has ceased. Weed control decisions should be made before or during Feekes 5.0 with 2,4-D and similar phenoxy herbicides being applied during growth Stages 5 and 6.

### Feekes 6.0: First Node Visible (mid – late April)

Feekes 6.0 will not occur prior to vernalization, because it is required for spikelet differentiation. Prior to Feekes 6.0, the nodes are all formed but are sandwiched together so that they are not readily distinguishable. At 6.0, the first node is swollen and appears above the soil surface. Above this node is the head

or spike, which is being pushed upwards eventually from the boot. The spike at this stage is fully differentiated, containing all potential spikelets and florets or seed forming branches.

Growers should look carefully for the first node to emerge. It can usually be seen and felt. A sharp knife or razor blade is useful to split stems to determine the location of the developing head. The stem is hollow in most wheat varieties behind this node. By Feekes 6.0, essentially all weed-control applications have been made. Do not apply phenoxy herbicides such as 2,4-D, Banvel, or MCPA after Feekes 6.0, as these materials can be translocated into the developing spike, causing sterility or distortion. Sulfonyl-urea herbicides are safe at this growth stage, but for practical reasons, weed-control should have been completed by now.

Small grains can still show good response to N topdressed at this time, although yield responses will be better at Feekes 5.0. Mechanical injury to wheat can occur from fertilizer applicators at this stage of growth, but response to applied N will usually more than compensate for the damage if soil N is deficient.

### **Feekes 7.0: Second Node Becomes Visible (late April – early May)**

This stage is characterized by the rapid expansion of the spike.

### **Feekes 8.0: Flag Leaf Visible (late April – early May)**

This growth stage begins when the last leaf (flag leaf) begins to emerge from the whorl, and the second node is visible. This stage is particularly significant because the flag leaf makes up approximately 75 percent of the effective leaf area that contributes to grain fill. When the flag leaf emerges, three nodes are visible above the soil surface. To confirm that the leaf emerging is the flag leaf, split the leaf sheath above the highest node. If the head and no additional leaves are found inside, Stage 8.0 is confirmed, and the grower should decide whether to use foliar fungicides or not. This decision should be based upon the following considerations:

1. Is a fungal disease present in the field?
2. Does the variety have resistance to the fungal disease, or is the disease spreading rapidly?
3. Does the crop-yield potential warrant the cost of application of the fungicide in question to protect it?
4. Is the crop under stress?

If a positive answer applies to the first three questions, and a negative response to the last, plans should be made to protect

the crop from further damage. Check product labels and apply as soon as possible. In most situations, the greatest return to applied foliar fungicides comes from application at Feekes Stages 8–10. Nitrogen applications at Feekes 8.0 and later can enhance grain protein levels but are questionable with respect to added yield.

### **Feekes 9.0: Ligule of Flag Leaf Visible (early May)**

Stage 9.0 begins when the flag leaf is fully emerged from the whorl. From this point on, leaves are referred to in relation to the flag leaf (i.e., the first leaf below the flag leaf is F-1, the second leaf below is F-2, and so forth). After flag leaf emergence, army worms can seriously damage yield potential.

### **Feekes 10.0: Boot Stage (mid-May)**

At this stage, the head is fully developed and can be easily seen in the swollen section of the leaf sheath below the flag leaf. Feekes growth scale for Stage 10 is divided as follows:

- |        |   |
|--------|---|
| 10.0   | Boot stage  |
| 10.1   | Awns visible, heads emerging through slit of flag leaf sheath |
| 10.2   | Heading 1/4 complete  |
| 10.3   | Heading 1/2 complete  |
| 10.4   | Heading 3/4 complete (late May)                               |
| 10.5   | Heading complete  |
| 10.5.1 | Beginning flowering   |
| 10.5.2 | Flowering complete to top of spike                            |
| 10.5.3 | Flowering complete to base of spike                           |
| 10.5.4 | Kernels watery ripe   |

Wheat is self-pollinating. Most florets are pollinated before anthers are extruded. Although tillers have developed over a several week period, bloom in a given wheat plant is usually complete four to five days after heading. The grain-fill period of wheat varies somewhat, depending upon climate. It is typically as little as 13 days in high-stress environments, and may exceed 20 days in high-yield, low-stress environments. After Feekes Stage 10.5.3, remaining growth stages refer to ripeness or maturity of the kernel.

### **Feekes 11.0: Ripening**

- |      |  |
|------|--|
| 11.1 | Milky ripe (early June)                |
| 11.2 | Mealy ripe                             |
| 11.3 | Kernel hard (late June)                |
| 11.4 | Harvest ready (late June – early July) |

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