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Research and Extension

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eUpdate

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These e-Updates are a regular weekly item from K-State Extension Agronomy and Steve Watson, Agronomy e-Update Editor. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time. If you have any questions or suggestions for topics you'd like to have us address in this weekly update, contact Steve Watson, 785-532-7105 swatson@ksu.edu, or Curtis Thompson, Extension Agronomy State Leader and Weed Management Specialist 785-532-3444 cthompso@ksu.edu.

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1. Effect of freezing temperatures on wheat in jointing, boot, and early heading stages

Temperatures over the weekend of April 22-23 dropped below freezing and into the lower 30's for most of the state. In a few specific locations in southwest Kansas, temperatures were in the upper 20's in the early morning of April 23, and were well below 32F for as long as 7.3 hours (Figure 1). In low areas of the fields, temperatures will typically be lower than the officially recorded temperatures.

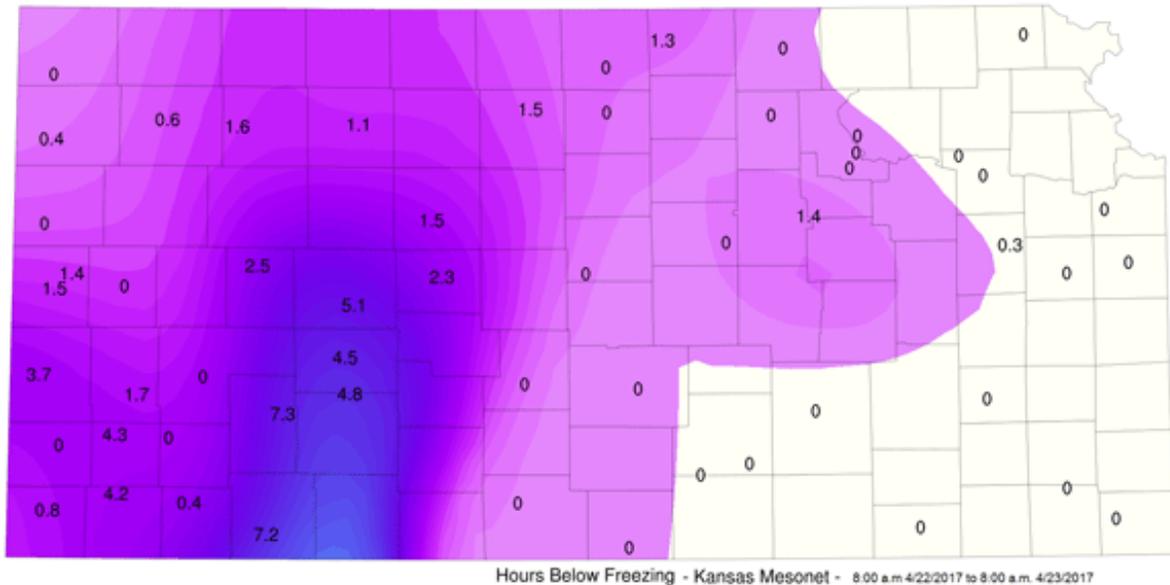
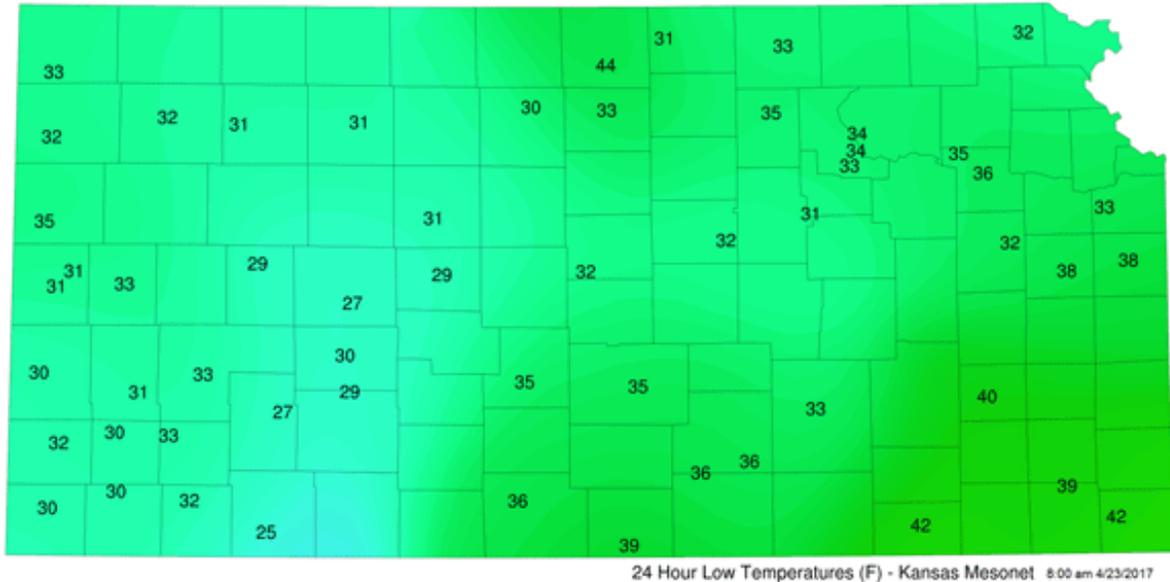


Figure 1. Minimum temperatures during the morning of April 23 (upper panel) and length of time below 32 degrees Fahrenheit during the 24-hour period encompassing the morning of April 23 (lower panel). Source: K-State Weather Data Library.

The effects of a freeze event to the wheat crop will depend on how the event matches up with critical sensitive stages of crop development. Based on our recent estimates of wheat growth stage across the state (Fig. 2), the areas where we are more likely to see cold damage include Meade, Gray, Ford, Hodgeman, Ness, Lane, and Rush counties. These counties reported the coldest temperatures, the longest period below 32F, and the wheat in those counties is mostly between boot and flowering. This is especially true for early maturing varieties which were already headed as of last week. The risk of freeze injury in the remainder of the state is lower, as either temperatures did not reach critical levels (south central and southeast Kansas), or did not match sensitive growth stages of the crop (northwest Kansas).

Estimated Wheat Growth Stage April 21, 2017

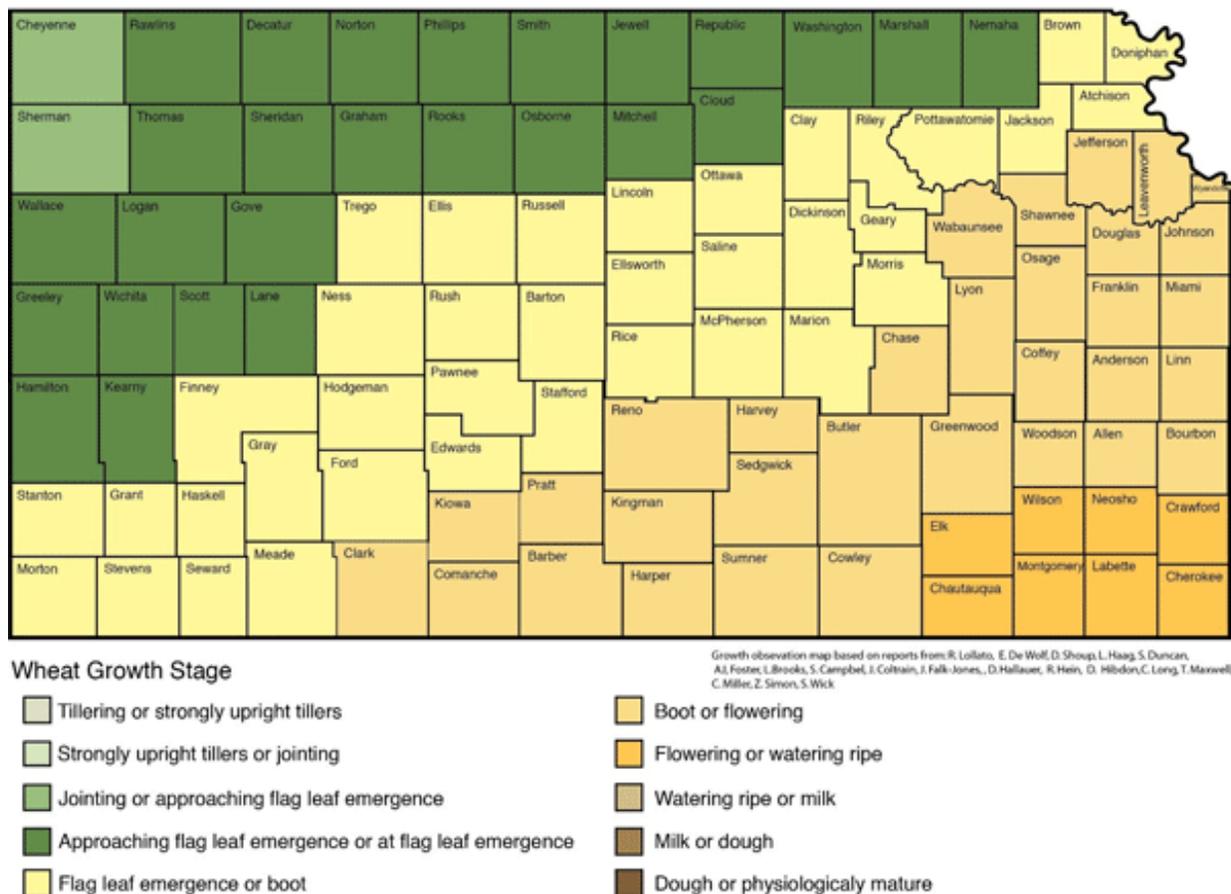


Figure 2. Estimated wheat growth stages across Kansas as of April 24, 2017.

Here are the possibilities for freeze injury by the most common stages of growth in the areas of the latest freeze:

Jointing to pre-boot: Jointing wheat can usually tolerate temperatures in the mid to upper 20's with no significant injury. The lowest official readings were all in that range or above on April 23. But, if temperatures in some low-lying areas fell into the low 20's or even lower for several hours, the lower

stems, leaves, or developing head may have sustained injury. If the tillers were in this stage or earlier at the time of the freeze and the tillers are green and growing actively now, then the heads should be fine. If the head had been killed, the tiller would not be green and actively growing. If the leaves coming out of the whorl are chlorotic, then the head on that tiller is dead. Few fields in southwest Kansas are still at this stage, most fields have flag leaf emerging or are at boot stage.

Boot. In this stage, wheat can be injured if temperatures drop down into the mid to upper 20's for several hours. Injury is more likely if this occurs repeatedly and if it is windy at night. Temperatures at these levels were measured in parts of southwest Kansas (Fig. 1). To detect injury, producers should wait several days then split open some stems and look at the developing head. If the head is green or light greenish in color and seems firm, it is most likely going to be fine. If the head is yellowish and mushy, that's a sign of freeze injury.

Freeze injury at the boot stage causes a number of symptoms when the heads are enclosed in the sheaths of the flag leaves. Freezing may trap the spikes inside the boots so that they cannot emerge normally. When this happens, the spikes will remain in the boots, split out the sides of the boots, or emerge base-first from the boots.

Sometimes heads emerge normally from the boots after freezing, but remain yellow or even white instead of their usual green color. When this happens, all or part of the heads have been killed. Frequently, only the male parts (anthers) of the flowers die because they are more sensitive to low temperatures than the female parts. Since wheat is self-pollinated, sterility caused by freeze injury results in poor kernel set and low grain yield.

It's possible for some of the spikelets to be alive and a healthy dark green while other spikelets on the same head are damaged. If a spikelet flowers normally and the kernels on that spikelet develop normally, then the head is at least partially viable and will produce grain (unless it freezes again, of course).

Awns beginning to appear. If the awns have begun to appear, there can be significant injury to the heads if temperatures reach about 30 degrees or lower for several hours. The heads may fully exert from the boot, but few, if any, of the spikelets may pollinate normally and fill grain. Damaged heads from a freeze at this stage of growth may seem green and firm at first glance, but the floral parts will be yellowish and mushy.

Flowering. It's possible a few fields may be in the flowering stage where temperatures got below freezing on April 23, particularly early-maturing varieties. Wheat is particularly vulnerable to damage from freezing weather as the head starts to emerge through the flowering stage. Temperatures of 30 degrees or lower can damage anthers.

If the wheat was in the flowering stage at the time of the freeze, you can determine if the anthers are damaged by examining them with a magnifying lens. Healthy anthers will first be lime green, then yellow (Figure 3). If they are damaged by a freeze, they will begin twisting within 2 to 3 days (Figure 4). Shortly afterward, they will begin to turn whitish or brown (Figure 5). The stigma in the florets may or may not also be damaged by a freeze. If the anthers are damaged by freeze, the flowers may fail to develop a kernel.

Fortunately, wheat doesn't flower all at the same time on the head. Flowering proceeds from florets near the center of wheat spikes to florets at the top and bottom of the spikes over a 3- to 5-day period. This small difference in flowering stage when freezing occurs can produce some odd-looking heads. The center or one or both ends of the spikes might be void of grain because those florets were at a sensitive stage when they were frozen (Figure 6). Grain might develop in other parts of the spikes, however, because flowering had not started or was already completed in those florets when the freeze occurred.



Figure 3. Healthy wheat anthers are trilobed, light green and turgid before pollen is shed. Each wheat floret contains three anthers. Healthy stigmas are white and have a feathery appearance. Photos from Spring Freeze Injury to Kansas Wheat, K-State Research and Extension publication C646.



Figure 4. Anthers become twisted and shriveled, yet they are still their normal color within 24 to 48 hours after a freeze. A hand lens is necessary to detect these symptoms.



Figure 5. If damaged, anthers become white after 3 to 5 days and eventually turn whitish-brown. The anthers will not shed pollen or extrude from the florets.



Figure 6. Damage may occur in different areas of the spike because flowering, which is the most sensitive stage to freeze, does not occur at the same time in all florets.

If you are unsure whether there has been freeze damage to the anthers, wait several days and determine whether kernels are developing normally. A week after flowering, kernels should be well-formed up and down the head under normal conditions.

In addition to this, be watching for any freeze damage to lower stems. If the damage is severe enough, the plants will eventually lodge.

More information

The comments above are general guidelines. Actual damage, if any, will not become apparent until temperatures have warmed back up for several days and growth has resumed.

For more information on freeze damage to wheat, see *Spring Freeze Injury to Kansas Wheat*, K-State Research and Extension publication C646, at:

<http://www.ksre.ksu.edu/bookstore/pubs/c646.pdf>

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