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Golden Plains Area Extension

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Freeze Injury on Wheat
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Freezing temperatures can affect wheat fields within the Colorado High Plains Region some seasons. In fields where only some of the tillers have been damaged, there is still plenty of time for undamaged tillers to compensate and minimize any potential yield loss. However, frost damaged wheat heads will be permanently damaged. Wheat heads emerging white in color indicate frost damage and will not produce seeds.

Important factors determining freeze damage

There are a number of key factors in determining freeze damage: the stage of development of the wheat, the density of the stand and condition of the plants, the amount of residue on the soil surface, the extent and duration of low temperatures, temperature gradients within the field, soil moisture, and the wind speed.

* Stage of development.

-- Greenup. Wheat that has greened up but hasn't started to joint yet will probably suffer damage to the existing foliage, but the growing points will be protected by the soil and should escape injury. This wheat will have cosmetic damage to the leaves that will show up almost immediately. If new leaves emerging over the next few weeks are green, that will indicate that the growing points survived and the plants will still produce tillers. If the new leaves are yellow, the growing point of that particular tiller was killed by the freeze.

-- Jointing wheat can usually tolerate temperatures in the mid to upper 20's with no significant injury. But, if temperatures fall into the low 20's or even lower for several hours, the lower stems, leaves, or developing head can sustain injury. If the leaves of tillers are yellowish when they emerge from the whorl, this indicates those tillers have been damaged. Existing leaves may also be damaged so severely that they turn bluish-black and have a water-soaked appearance, then bleach out. This usually results in the field's having a "silage smell."

-- Heading wheat is most vulnerable. Temperatures of near 31 F. and lower can sterilize wheat flowers rendering the head sterile.

* Density of the stand and condition of the plants. If the stand is thick, that will tend to reduce the extent of freeze damage. Thin stands, which are not common this year, are at higher risk of injury because the air can penetrate the stand more easily. If the plants were wet before the freeze, this can result in a coat of ice on the plants that may help protect the growing points and heads to some extent. If temperatures get too low, however, the cold will go through the ice.

* Residue. Many times we see more freeze damage in no-till fields because the residue acts as a blanket and doesn't allow the heat from the soil to radiate up into the plant canopy.

* Extent and duration of low temperatures. Significant injury becomes much more likely if the temperatures in the damaging range last for two hours or longer.

* Soil moisture. There is often less freeze injury at a given temperature when soils are wet than when dry. Wetter soils tend to radiate a little more warmth than dry soils.

* Wind speed. Slightly breezy conditions during the nighttime hours when temperatures reach their lows will decrease the chance of injury. Warm air is drawn up from the soil surface and insulates heads better with a small amount of breeze.

* Temperature gradients within the field. Low spots in the field are almost always the first to have freeze injury. The coldest air tends to settle in the low areas, especially under calm wind conditions.

Injury symptoms

The best thing producers can do for the first few days is simply walk the fields to observe lodging, crimped stems, and damaged leaves. Be patient. Do not take any immediate actions as a result of the freeze, such as destroying the field for recropping. It will take several days of warm weather to accurately evaluate the extent of freeze damage. After several days, producers should split open some stems and check the developing head. If the head is green or light greenish in color and seems firm, it is probably fine. If the head is yellowish and mushy, it may have freeze injury.

There are also a couple of early signs producers might have noticed right away.

* Silage smell. If a field of wheat is giving off the aroma of silage that indicates that leaves have been damaged. Damaged leaves will likely turn black within a few days, then become bleached.

* Ice in the stems. If there was ice in the stems below the first node the morning of the freeze, those tillers will probably be damaged (although not always) and may not produce grain. If plants continue to grow and exhibit a green color, then damage is minimal.

* Lodging. If the wheat lodged immediately after the freeze, that indicates stem damage. Later tillers may eventually cover the damaged tillers.

If the main tillers are injured, secondary tillers may begin growing normally and fill out the stand. The wheat may look ragged because the main tillers are absent, but enough tillers may survive to produce acceptable yields (if spring growing conditions are good). If both the main and secondary tillers are injured, the field may eventually have large areas that have a yellowish cast and reduced yield potential.

Tillers damaged during early jointing may stop growing, so the head will never emerge. In the boot stage, the heads will go ahead and emerge even if they are severely freeze damaged. However, that head may be partially damaged or completely dead. If the freeze damage is light to severe, heads may “back out of the boot.” Exhibiting a twisting appearance.

If the lower stems are damaged by freeze injury, the wheat plants will likely lodge at some point. Lodging could also be caused by other factors, however, so it will be important for producers to examine the lower stems on lodged plants to determine the cause. Plants may have simply leaned over due to environmental factors, such as a hard rain or high winds, after a freeze and will eventually come back up if the lower stem isn't damaged.



Leaf burn from freeze damage. By itself, this is cosmetic damage only. Photos by Jim Shroyer, K-State Research and Extension.



The yellowing at the base of the new leaf emerging is not a good sign. This means that the tiller is probably dead from freeze injury.



Freeze injury to the lower stem caused significant lodging.



Close up of stem damage from freeze injury, resulting in lodging.

Source: Jim Shroyer, Kansas State University

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