Assessing Freeze Injury to Winter Wheat - UNL CropWatch

April 17, 2013

Winter wheat development is behind normal in many areas of Nebraska. At the University of Nebraska–Lincoln West Central Research and Extension Center Dryland Farm south of North Platte, the average temperature since January 1, 2013, was 32.7°F. This compares to an average temperature of 34°F. In 2012, when winter wheat was as much as two weeks ahead of normal growth stage, the average temperature from January 1 to this point was 40.2°F.

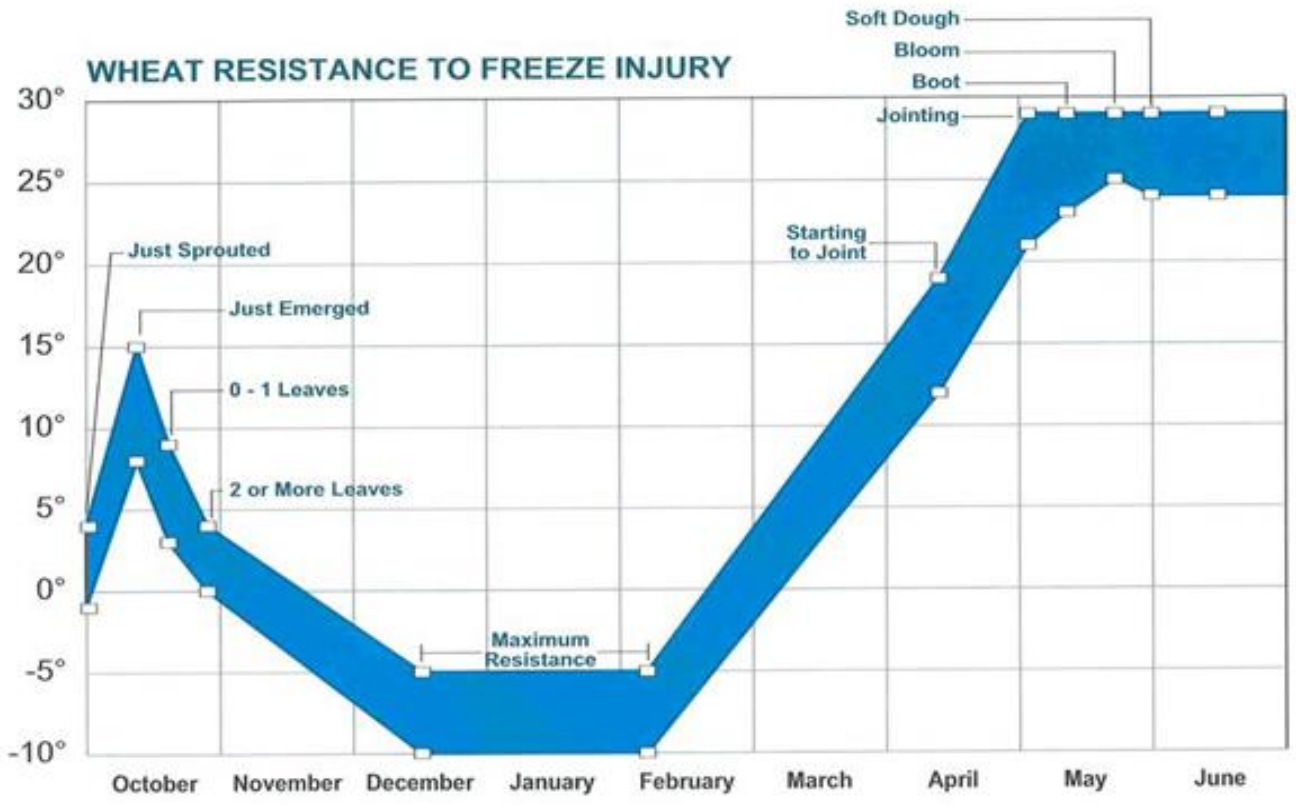

Figure 1. Temperatures that cause freeze injury to winter wheat at different growth stages. Winter wheat rapidly loses hardiness during spring growth and is easily injured by late freezes.

Before the joint growth stage, the temperature must get really low to cause freeze injury to winter wheat (see *Table 1*). The April 15 crop report showed that only 3% of Nebraska's winter wheat had jointed. Also, much of the winter wheat during the last cold snap was covered with a blanket of snow which insulated the crop.

Table 1. Temperatures that cause injury to wheat at spring growth stages and symptoms and yield effect of spring freeze injury.

Growth Stage	*Approximate Injurious Temperature (Two Hours)*	*Primary Symptoms*	*Yield Effect*
Tillering	12°F	Leaf chlorosis; burning of leaf tips; silage odor; blue cast to fields	Slight to moderate
Jointing	24°F	Death of growing point; leaf yellowing or burning; lesions, splitting or bending of lower stem; odor	Moderate to severe
Boot	28°F	Floret sterility; head trapped in boot; damage to lower stem; leaf discoloration; odor	Moderate to severe
Heading	30°F	Floret sterility; white awns or white heads; damage to lower stem; leaf discoloration	Severe
Flowering	28°F	Floret sterility; white awns or white heads; damage to lower stem; leaf discoloration	Severe
Milk	28°F	White awns or white heads; damage to lower stems; leaf discoloration; shrunken, roughened or discolored kernels	Moderate to severe
Dough		Shriveled, discolored kernels; poor germination	Slight to moderate

The following section provides information on how freeze injury occurs at various growth stages of winter wheat and what the implications are for the crop.

Figure 2. Burned and yellowing leaf tips are common spring freeze symptoms at the tillering stage.

Figure 3. More severe freeze damage causes the entire leaf to turn yellowish-white and the plants to be limp or flacid. A silage odor may be detected after several days.

Winter wheat is protected by a microclimate. Moist soil cools and warms six times slower than dry soil. With the precipitation we received in many areas of the state, this reduces the temperature lows experienced by the wheat plant. Also, good stands and dense canopies reduce the lowering of temperatures to which the plant is exposed.

In 2005, winter wheat fields that had the most damage from freeze injury were those that were low on soil water (under moisture stress) and had poor stands and/or a poor canopy.

It takes a number of warm days (a week or more depending on temperatures) after freezing to determine the condition of the winter wheat crop, so don't make any quick decisions after a freeze. The main tillers may be killed or injured, but other tillers may survive and help compensate for some of the lost yield potential. See NebGuide G1429, "Estimating Winter Wheat Grain Yields".

A number of factors determine the degree of freeze injury to a winter wheat crop. They include, as previously mentioned, air temperature, soil moisture, stand, canopy density, and the winter wheat growth stage. Others include the length of time of the low temperature, and wind speed and temperature gradient in the field. Not all parts of the field will have the same amount of damage. Cold air often settles in low spots in fields, although wheat canopies in low spots are frequently better as the result of increased soil moisture.

Take time to thoroughly evaluate the winter wheat condition before making any decision to spray out the crop and seed or plant to another crop. Always consider that winter wheat crop residue provides a good foundation for succeeding crops.

Before destroying any crop or making changes, check with your crop insurance, Farm Service Agency, and any other representatives that need to be kept informed.

Assessing Freeze Injury by Crop Growth Stage

Following is information from EC132, "Freeze Injury to Nebraska Wheat", http://extensionpublications.unl.edu/assets/pdf/ec132.pdf to help determine injury in the tillering and jointed stage to winter wheat.

Tillering Stage

Spring tillering of wheat in Nebraska usually begins in March and continues through mid-April. The growing point is just below the soil surface during this stage and is protected against injury. Most damage occurs to leaves, which become twisted and light green to yellow in color and are necrotic ("burned") at the tip within one or two days after freezing (*Figures 2 and 3*). A strong odor of dehydrating vegetation may be present after several days. Injury at this stage slows growth and may reduce tiller numbers, but growth of new leaves and tillers usually resumes with warmer temperatures.

Figure 4. A yellow necrotic leaf emerging from the whorl indicates the growing point may be damaged.

Jointing Stage

The jointing stage is when the internodes (stem segments between joints or nodes) are elongating in the wheat stem and the embryonic head is moving up through the stems. This usually occurs from early April through early May. Leaves of freeze-injured plants show the same symptoms as the Tillering stage (*Figures 2 and 3*), but the most serious injury occurs to the growing points (*Figure 4*).

The growing points can be located by splitting stems lengthwise with a sharp knife. A normal, uninjured growing point is bright yellow green and turgid; freeze injury causes it to become white or brown and water soaked in appearance (*Figure 5*). This injury can occur even in plants that appear otherwise normal because the growing point is more sensitive to cold than other plant parts. Stem growth stops immediately when the growing points are injured, but growth from later tillers may obscure damage. Partial injury at this stage may cause a mixture of normal tillers and late tillers and result in uneven maturity and some decrease in grain yield.

Figures 5a and 5b. A healthy growing point has a crisp whitish-green appearance (left). A growing point that has been damaged loses its turgidity and greenish color within several days after a freeze. A hand lens will help detect subtle freeze damage symptoms (right).

Figure 6. Discoloring and roughening of the lower stem are symptoms of spring freeze damage.

Figure 7. The stem can split with severe freeze damage.

Injury to the lower stems in the form of discoloration, roughness, lesions, splitting, collapse of internodes, and enlargement of nodes frequently occurs at the jointing stage and the following stages after freezing (*Figures 6 and 7*). Injured plants often break over at the affected areas of the lower stem so that one or two internodes are parallel to the soil surface.

Stem injury does not appear to seriously interfere with the ability of wheat plants to take up nutrients from the soil and translocate them to the developing grain. Injured areas might become infected by microorganisms, however, which can cause further stem deterioration. Lodging, or falling over, of plants is the most serious problem following stem injury. Wind or hard rain will easily lodge the plants, decreasing grain yields and slowing harvest.

Robert Klein
Western Nebraska Crops Specialist, West Central REC