Field Diagnosis of Freeze Injury in Wheat

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Low Temperature Injury in Wheat

- Degree of injury is influenced by the duration of low temperatures
- Prolonged exposure to freezing temperatures causes more damage than brief exposure to the same temperature

Factors Influencing Freeze Injury

- Variety and plant growth stage
  - » Earlier stages of wheat growth not as sensitive as anthesis (Feekes 10.5)
- Plant moisture content
  - » Drought stress hardens plants and decreases water content
- Fertility Management
  - » High rates of nitrogen increase injury to lush growth, thinner cell walls, high moisture content

Factors Influencing Freeze Injury

- Duration of exposure
  - » Time of exposure in one or multiple events
  - » Less injury can be expected from shorter periods of exposure times while greater injury might be expected at slightly higher temperatures from longer exposure
- Low point of temperature
  - » Wheat at Feekes 5 can withstand colder temperatures than at later stages
- Field variability
  - » Low areas vs high areas
  - » Clay soils vs sandy soils

Temperatures that cause injury when exposed for 2+ Hours

Growth Stage	T^{0}F	Symptoms	Yield Effect
Tillering	12	Leaf chlorosis and burn	Slight/Moderate
Jointing	24	Leaf burn/death of growing pt	Moderate/Severe
Boot	28	Floret sterility/head discolored	Mostly severe
Heading	30	Floret sterility/head discolored/ Bleached/leaves discolored	Severe
Flowering	30	Floret sterility/head discolored/ Bleached/leaves discolored	Severe
Milk	28	Heads bleached/kernels shrunken, discolored, rough	Mostly severe
Dough	28	Seeds shriveled and discolored	Slight/Moderate

Injury Symptoms

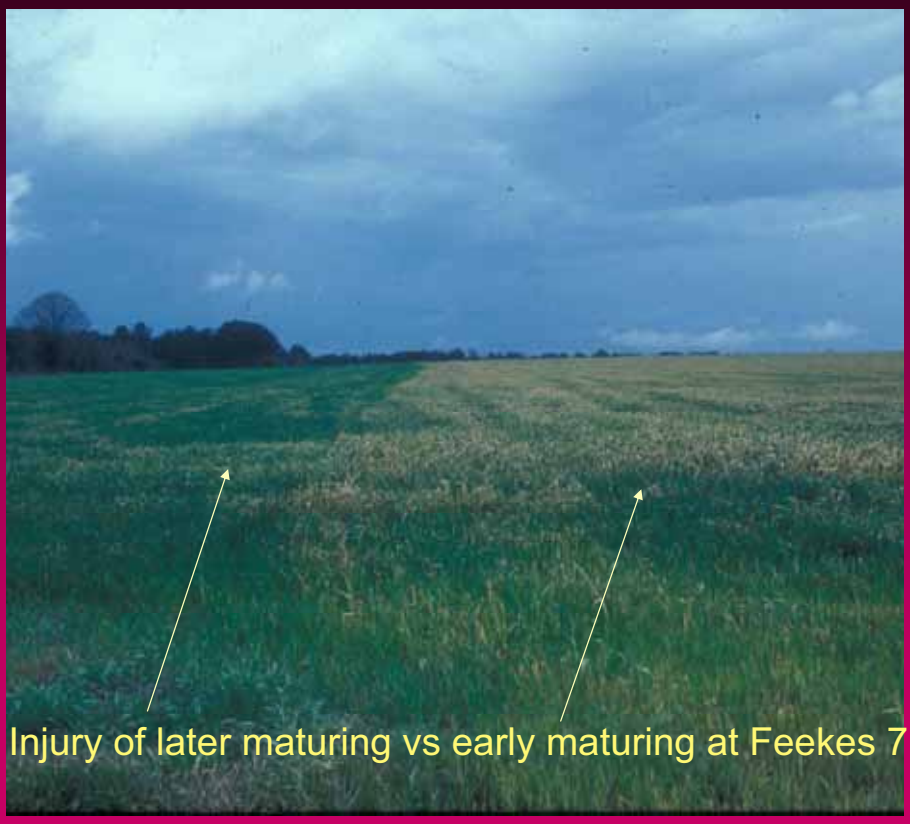
Symptoms appear in three to four days at temperatures above 40^0 F.

For best accuracy, allow a few days to pass before attempting to assess damage.

Remember wheat has the ability to compensate for injury if time allows.

Injury Symptoms in Wheat

- Emerging leaf in whorl turns yellow or is brown
- Stems are flaccid, rough and collapse
- Areas below or above nodes begin to show a brown discoloration
- Head located in boot becomes milky in color, water-soaked or begins to turn tan-brown
- Exposed head turns light tan to bleach
- Developing kernels begin shriveling, turn brown.



Injury of later maturing vs early maturing at Feekes 7

Injury to developing heads

Close up of uninjured head

Comparison of injured head
At similar age when damaged

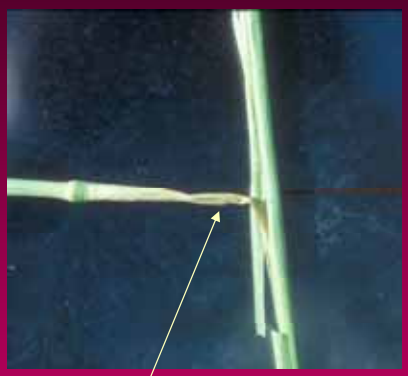
Comparisons of undamaged and Damaged heads about the same age. Note the slight discoloration and collapse of cell integrity. Undamaged heads remain a bright yellow green and turgid. Freezing injury turns heads, off white or brown and somewhat water-soaked.

Comparison of developing heads

Developing head still yellow-green, Not injuryed.

Developing head injured, turning white at 2 to 3 days after injury.

Appearance of Injury at Nodes or Stems



Notice brown discoloration and collapse of stem at injury site

Partial injury of exposed heads

Uninjured vs injured head

Heads beginning to bleach
In the field

Injury at pollination

Healthy floret

Damaged flower: note water-soaked anther and discolored ovule

Damage at early kernel development

Healthy caryopsis

Assessing the Damage

- Wait at least four days before making determination.
- Carefully cut into the stems or flowers. Look at the developing heads or caryopsis for symptoms.
- Check nodes below the head.
- Check multiple areas of the field.
- Usually wheat can compensate when damage occurs at earlier growth stages.

Website of good publications

- Spring Freeze Injury to Kansas Wheat, http://www.oznet.ksu.edu/library/crpsl2/c646.pdf
- Freeze Injury to Nebraska Wheat, http://ianrpubs.unl.edu/fieldcrops/ec132.pdf