



Frost Effects on Winter Wheat Near Heading Stage

Considerations for Potential Frost Injury

Consider the forecast. Radiative frosts occur during cool, calm nights often just before daybreak.¹ A two-hour exposure to temperatures of 28 and 30°F can be tolerated by boot-stage and heading-stage winter wheat, respectively.^{2,3} Less injury is expected when exposure to subfreezing temperatures is brief. Alternatively, longer exposure times can cause plant injury at temperatures greater than these mentioned.

Consider the landscape. Fields prone to frost damage may be near river bottoms, valleys, depressions, and low-lying areas. Soil conditions also change the amount of heat available to plants overnight:

- 1) Loose and dry soil surfaces are expected to have lower surface temperatures than compacted soil.
- 2) Excessively wet soils gain less sun energy during the day, and less heat is released to the crop at night.
- 3) Soils that are poor heat conductors with very low heat storage (peat) may experience lower temperatures compared to mineral soils.¹

Identifying Injury to Winter Wheat

Winter wheat loses hardiness during spring growth and becomes more sensitive to freezing injury during late boot and heading stages.³ It is important to scout fields after frost events; although continued cold temperatures could delay the development of injury symptoms. Fields with severe damage can have the damaged crop routed for alternative use or be replanted.

Jointing Stage Wheat³

- Temperatures dropped to 24°F for two hours or more
- Growing point damage/death
- Leaf yellowing/burning
- Lesions, splits, or bends of lower stems

Booting Stage Wheat^{1,3}

- Temperatures dropped to 28°F for two hours or more
- Abnormal emergence or heads trapped inside the boot
- Twisted awns
- Leaf discoloration, damage to lower stem. (Temperatures cold enough to injure leaves are usually fatal to male flower parts)
- Floret sterility, specifically male flower parts (anthers) are sensitive to freezing temperatures and may be damaged without damage to foliage. Anthers become twisted and shriveled within 48 hours of a freeze
- Poor kernel set

Heading and Flowering Stage Wheat³

- Temperatures dropped to 30°F for two hours or more
- Emerged spikes may remain yellow or white (portions or entire head effected)
- Bleaching of awns
- Leaf discoloration, damage to stems

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- A 'frost ring' or white/yellow tissue one to two inches below heads days after frost event
- Floret sterility (male anthers)
- Poor kernel set depending on timing of freezing temperatures. Over a two- to four-day window, flowering moves from florets in the center of wheat heads and to the top and bottom florets. Grain set may lack at the top and bottom if flowering had not started there. Alternatively, flowering and pollination may be complete in other parts of spikes and those should fill with grain.

Assessing Injury⁴

Assessing injury should occur after three to four days of more seasonal temperatures. Using a razor blade or sharp knife, cut stems lengthwise to inspect the head. Uninjured heads should be bright pale green and firm. Heads turn white to brown colored and are soft or easily squeezed under finger pressure when injured by frost. Inspect stems; lower stems discolor and may even split where injury is severe. Stem growth ceases upon injury to the head, this may be hidden by subsequent growth of tillers.

Management and Harvest

Damage can be widespread or spotty within a field. Ironically, lush green and growing plants are higher in moisture and may experience more damage compared to drier plants hardened by drought stress. Reductions to grain yield potential could be moderate to severe at booting stage. Severe reductions of yield potential can occur when winter wheat is at heading and flowering stages. Small

differences in temperature, duration of exposure, and other factors lead to major differences in the amount of injury during the flowering stage. Surviving fields should still be scouted until harvest. Full heads could break over at the 'frost ring' later in the growing season, especially during windy conditions.³

Patience may be the best management practice if injury is only partially affecting fields. Unless severe, frost-damaged wheat usually produces yields that exceed additional harvesting and hauling costs. Total losses could warrant quickly moving toward haying or forage harvest if weather cooperates. Nitrates should be tested if the crop is ensiled or used for livestock feed. Where the growing season is long enough, replanting is an option after herbicides are used to completely kill what is left of the crop.

Sources

¹ Bootsma, A., Brown, D.M. 2009. Freeze protection methods for crops. FACTSHEET ISSN 1198-712X Order# 85-116.

² de Rocquigny, P. 2019. The potential impact of spring frost on winter wheat. Crop Chatter Manitoba. <http://cropchatter.com/the-potential-impact-of-spring-frost-on-winter-wheat/>

³ Freeze injury on wheat. Texas A&M AgriLife Research and Extension Center at San Angelo. <https://sanangelo.tamu.edu/extension/agronomy/agronomy-publications/freeze-injury-on-wheat>

⁴ Klein, R. 2006. Freeze injury to Nebraska wheat. University of Nebraska Extension. <http://extensionpublications.unl.edu/assets/pdf/ec132.pdf>

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