

Managing Spring Wheat Freeze Injury

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Spring freezing of wheat can be a problem in Colorado. Freeze injury can cause crop losses through reduced leaf area, weakened stems and lodging, sterility, uneven maturity, and shriveled kernels. However, the severity of freeze injury and resulting crop losses are quite variable. Crop growth stages (see Table 10) become progressively more cold tolerant through winter dormancy and increasingly freeze susceptible from spring regrowth through flowering. Heading and flowering are the most vulnerable stages (Table 10). Crop condition is also important, with lush rapidly growing plants more susceptible than drought stressed plants. Plants located in low parts of the field and other areas where cold air tends to accumulate also are more at risk. Wind, precipitation and adequate soil moisture also can moderate the amount of freeze damage.

Table 10. Growth stage yield responses to freezing* temperatures.

Reductions in Yield	Growth Stages
Slight to Moderate	Tillering
Moderate to Severe	Jointing, Boot, Milk
Severe	Heading, Flowering

*Losses generally occur following two or more hours of temperatures below 24° - 30°F, depending on growth stage. Wheat plants in the tillering stage can tolerate temperatures as low as 12°F for two hours without damage.

The temperature reached and the amount of time the crop is exposed to that temperature are key determinants of freeze injury. Predicting crop loss from observed temperatures is difficult because crop response is so variable. Generally, two hours of exposure to temperatures in the 24 - 30°F range will damage plants that are beyond the tillering growth stage. Table 11 shows some probabilities of such temperatures in eastern Colorado. Keep in mind that temperatures reported at official weather stations are taken several feet above the soil surface and may be quite different from those the crop was exposed to during the same time period. This is due to the transfer of stored heat within soil to the air immediately above the ground surface. However, soil surfaces that are dry or insulated with large amounts of crop residues have reduced heat exchange to the air near the surface. Consequently, freeze injury can be more severe with these field conditions.

Freeze damage symptoms vary with the plant part and with the severity of the injury. Freeze damaged leaves show tip burn and yellowing a few days after the freeze event. More severe symptoms include completely yellow-to-grey, limp leaves and a detectable silage odor. Injured stems may be discolored, show lesions, or have swollen nodes. Severely injured stems may be split and lodge easily.

Internal structures, such as the growing point (a small white button found inside the stem) or developing spike, are white to light green in color and turgid in appearance. Freeze damaged internal structures will be white to whitish brown in color and have a shriveled appearance. Stems with damaged growing points will not produce seed.

Freeze injury during flowering kills anthers, resulting in sterility. Kernels injured during milk stage will have low test weight and be shriveled. Kernels affected during the dough stage may be somewhat wrinkled and also may have reduce germination. Freeze damaged heads will turn partly to completely white within one week of the freeze. White portions of the head will not produce seed.

Table 11. Probability* of 30°F or lower temperatures for selected eastern Colorado locations.

Location	Date				
	April 10	April 20	May 1	May 10	May 20
Akron	50	28	20	12	0
Briggsdale	55	15	20	25	0
Burlington	32	21	10	9	0
Byers	52	40	28	25	0
Cheyenne Wells	44	28	8	4	0
Julesburg	43	10	14	5	0
Lamar	28	8	8	4	0
Limon	52	41	32	9	5
Stratton	50	30	15	10	0
Walsh	26	9	5	5	0

*Probability is the percentage of days with temperature recordings below 30°F temperatures for the dates indicated in columns 2-6 for the period from 1973 through 1997.

Management

Little can be done to avoid freeze injury other than select varieties with appropriate maturities for your area. Also, avoid varieties that tend to initiate spring regrowth early as they will enter vulnerable growth stages sooner and therefore have a greater chance of significant freeze damage.

Options for freeze damaged wheat include:

- Harvesting the crop for grain if it is only partially damaged. Lodging and shattering may be problems and test weight may be reduced. However, freeze damaged grain does make good cattle feed.
- Freeze damaged wheat can be cut before soft dough stage to make good quality hay or ensilage. Nitrate content should be checked. If the crop is cut after heading, then animals should be monitored for big jaw or lumpy jaw, a condition caused when awns injure mouth tissues.
- The damaged crop could be abandoned, the field fallowed and this year's summer fallow ground planted to a spring crop. This option may be limited by herbicide plant back restrictions and by available soil moisture. Compare expected returns from the summer crop to those from harvesting a damaged wheat crop for grain to decide which makes more economic sense.