

AGRONOMIC

ALERT



Late-Season Frost Damage to Corn

An early frost, during the grain-filling period, in September can cause losses in corn yield and quality. Losses will depend on the temperature, duration, and corn growth stage at the time of the frost. Frost damaged corn management will depend on the corn growth stage and severity of damage.

Damage from Killing and Light Frosts

A killing frost can occur when the air temperature drops to 32°F for 4 to 5 hours, or when it drops to 28°F for only 5 to 10 minutes. This can kill the entire corn plant or severely damage the leaves, stalk, ear shank, and husks. A light frost can occur when the air temperature is 30 to 32°F for an hour or two, which could kill corn leaves, but not the corn stalk. The corn stalk is a temporary storage organ for material that could move into the corn kernels. Grain yield can continue to increase after a light frost that only kills the leaves. The temperature and time of exposure will influence the degree of damage to the corn plant.¹

Damaging frost to corn can also occur when temperatures are slightly above 32°F and conditions are ideal for rapid heat loss from the corn leaves (i.e. clear skies, low humidity, and no wind). Under these conditions, leaf temperature can drop below actual air temperature. This generally only results in damage to the uppermost leaves of the corn plant. When temperatures are close to freezing, variations in terrain can result in frost damage in low-lying areas. Thin stands of corn and plants at the edges of fields are more susceptible to frost damage.

Table 1. Estimated risks to corn grain yield and quality from late-season frost damage.²

Corn Growth Stage	% Yield Loss (Quality Concerns)	
	Killing Frost	Light Frost
Dough (R4)	40 (Severe)	25 (Severe)
Early Dent (R5)	25 (Moderate)	15 (Moderate)
Half Milk Line	10 (Minor)	0-5 (None)
Black Layer (R6)	0 (None)	0 (None)

NOTE: This table is meant as a guide. Differences among corn products, vigor at the time of frost, and subsequent temperatures will affect grain yield and quality.

Frost Damage Assessment

Frost damage symptoms are water soaked leaves or plant material that eventually turns brown. Symptoms will start to show up about 1 to 2 days after a frost, but it often takes 5 to 7 days before the degree of damage can be accurately assessed.³

Corn Growth Stage and Frost Damage

The early dent stage is generally considered the cut-off point where corn can withstand frost damage to the leaves and still produce a reasonable grain yield. Early dent stage is when kernels are showing small indentations, at least in the lower half of the ear. Frost damage can be more severe when it occurs on corn prior to the dent stage. Potential yield losses are generally negligible if frost occurs when grain moisture is below 35% (Table 1).

The impact of frost damage on grain quality is directly proportional to the stage of maturity and leaf tissue killed. Grain quality concerns are based mostly on low test weights. However, the feeding value of low test weight corn (46-52 lbs./bushel) can be similar to normal test weight corn.² Severe impacts on grain quality can occur with frost damage at the dough stage, with moderate impacts at the early dent stage, and only minor impacts once corn kernels have reached half milk line.³

Management Considerations

Options for handling frost damaged corn depends on the plant growth stage when frost occurred and whether it can be harvested for silage as well as grain. In some situations, harvesting the crop as silage can be the better option.

Grain Harvesting. When frost damage occurs at the dough stage of corn kernel development, grain yields will be reduced and test weights will be low. The grain will need to dry in the field for a longer period to a maximum of 35%

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kernel moisture before combining. The extended drying period can lead to increased field losses. Immature corn that has been frosted tends to have more stalk breakage than mature corn. Ear molds can also develop with an extended field drying period. During combining, the grain can be more susceptible to breakage, and the wet cob could break into small pieces. Making adjustments to the cylinder speed of the combine can help to reduce the dockage due to broken corn and foreign material. Bin drying issues need to be considered due to greater variations in kernel moisture and increased physical damage and broken cobs, which can increase mold problems in storage.⁴

Corn damaged by a killing frost during the early to mid-dent stage can also have a reduced grain yield with below normal test weight, and can require a longer field drying period before combining. Requirements for handling the corn can be similar to that described above for the dough stage. Grain yield loss can be small and test weights closer to normal if corn is in the late dent stage before the frost, and only a portion of the plant tissue has been killed. Grain yield and quality will not be affected by frost after corn has reached black layer or physiological maturity.⁴

Silage Harvesting. Generally, corn moisture is too high for silage harvest if a frost occurs when it is in the dough stage. It should be allowed to field-dry until whole-plant moisture reaches at least 70 to 75% before harvesting. Recommended whole-plant moisture at harvest can vary with the type of structure for ensiling, and needs to be considered to prevent or minimize storage seepage, spoilage, and handling problems. Waiting to harvest frost-damaged corn can improve silage quality, but can decrease dry matter yield. Corn can also appear drier than it actually is after a frost event, and the whole-plant moisture content should be checked before harvesting for proper storage. A balance between waiting to harvest corn for silage at the ideal moisture and harvesting to prevent yield loss needs to be considered.⁵

If frost occurs when corn is in the early dent stage, some field-drying time will also be necessary before it is ready for silage harvest. When corn kernels have reached the half milk line, whole corn is at or very close to ideal moistures for ensiling. Corn that has been damaged by frost at half milk line or in the mid to late-dent stage should be harvested for silage immediately to minimize reductions in dry matter yield.⁵

Sources:

¹Corn frost damage. North Dakota State University Corn Production Guide A-1130, May 1997. <http://www.ag.ndsu.edu> (verified 9/14/2011).

²Stewart, G. 2009. Corn and cold September nights. Ontario Ministry of Agriculture, Food and Rural Affairs. <http://www.omafra.gov.on.ca>, or <http://www.topcropmanager.com> (verified 9/14/2011).

³Lauer, J. 2004. Guidelines for handling corn damaged by frost prior to grain maturity. Wisconsin Crop Manager 11(23):148-149 August 26, 2004. The University of Wisconsin Cooperative Extension. <http://www.uwex.edu> (verified 9/14/2011).

⁴Carter, P.R. and Hesterman, O.B. 1990. Handling corn damaged by autumn frost. National Corn Handbook 57 April 1990. Michigan State University Cooperative Extension Service. <http://baycounty-mi.gov> (verified 9/14/2011).

⁵Lee, C. and Herbek, J. 2004. Late-season frost damage to corn grown for silage. University of Kentucky Cooperative Extension Service publication AGR-183. <http://www.ca.uky.edu> (verified 9/14/2011).

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible.

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