Extension Responds: Feed supplies

Guidelines for Handling Corn Damaged by Frost Prior to Grain Maturity

By Joe Lauer, Extension Professor of Agronomy, University of Wisconsin-Madison, UW-Extension Corn Agronomist, 608-263-7438, jglauer@wisc.edu

This past weekend widespread frost occurred in northern Wisconsin roughly north of a line between Hudson and Green Bay with scattered pockets south of this line in the central sands area. Corn plant damage ranged from no leaves killed to all leaves killed completely to the ground, with most fields having a few top leaves killed. Because of the late planting dates and cool growing season that has occurred this year, corn development in affected fields range from V10 to R3 (slightly taller than knee high to early dough stage) (Ritchie et al., 1993).

For fields that only had light frost damage, it is too early to harvest. Growing conditions may improve during September allowing the crop to mature and produce reasonable grain and silage yields.

Corn is killed when temperatures are near 32 F for a few hours, and when temperatures are near 28 F for a few minutes. A damaging frost can occur when temperatures are slightly above 32 F and conditions are optimum for rapid heat loss from the leaves to the atmosphere, i.e. clear skies, low humidity, no wind. At temperatures between 32 to 40 F, damage may be quite variable and strongly influenced by small variations in slope or terrain that affect air drainage and thermal radiation, creating small frost pockets. Field edges, low lying areas, and the top leaves on the plant are at greatest risk. Greener corn has more frost resistance than yellowing corn.

Symptoms of frost damage will start to show up about 1 to 2 days after a frost. Frost symptoms are water soaked leaves that eventually turn brown. Because it is difficult to distinguish living from dead tissue immediately after a frost event, the assessment should be delayed 5 to 7 days.

Yield Impact
Yield losses are negligible if frost occurs when grain moisture is below 35 percent. Yield loss is directly proportional to the stage of maturity and the amount of leaf tissue killed. Those who will be advising growers about the likelihood of frost damage and its impact on yield should get ready by consulting the National Corn Handbook NCH-1 "Assessing Hail Damage to Corn" (Vorst, 1990). This publication has charts used by the National Crop Insurance Association for assessing yield loss due to defoliation. Knowing how to recognize frost damage and assess probable loss is important for decision making. An abbreviated version of the loss chart is shown in Table 1. For example, corn that was defoliated 20% at the milk stage would have 3% yield loss.

Table 1. Estimated percent corn yield loss due to defoliation occurring at various stages of growth.

	Percent leaf area destroyed				
Stage of growth	**20**	**40**	**60**	**80**	**100**
Tassel	**7**	**21**	**42**	**68**	**100**
Silked	**7**	**20**	**39**	**65**	**97**
Blister	**5**	**16**	**30**	**50**	**73**
Milk	**3**	**12**	**24**	**41**	**59**
Dough	**2**	**8**	**17**	**29**	**41**
Dent	**0**	**4**	**10**	**17**	**23**
Black layer	**0**	**0**	**0**	**0**	**0**

derived from Vorst (1990)

The stem on a corn plant is a temporary storage organ for material that eventually moves into the kernels (Afuakwa and Crookston, 1984). Grain yield will continue to increase about 7 to 20% after a light frost that only kills the leaves as long as the stem is not killed (Table 2).

Table 2. Potential grain yield losses after frost.

	Killing frost	Light frost
Corn development	**(Leaves and stalk)**	**(Leaves only)**
stage	**percent yield loss**	
R4 (Soft dough)	**55**	**35**
R5 (Dent)	**40**	**25**
R5.5 (50% kernel milk)	**12**	**5**
R6 (Black layer)	**0**	**0**

derived from Afuakwa and Crookston (1984)

Moisture drydown

Corn silage should be harvested at the appropriate moisture content for the type of silo in which it will be stored. If corn is frosted prior to 50% kernel milk, the moisture content of corn may be too high to be properly ensiled. However, during the drydown period, dry matter yield will decrease due to leaf loss, plant lodging and ear dropping. Thus, a trade-off exists between moisture and yield.

For corn silage frosted prior to the dent stage, the moisture content will be too high for successful ensiling. The silage crop should be allowed to dry in the field for several days and moisture content should be monitored. For corn frosted during the dent stage, harvest should begin quickly to prevent yield loss as damaged leaves are shed or break off the plant.

Since mold can grow on the ears before the desired moisture level is reached, harvest may have to begin immediately. To help control problems with excess moisture, wet silage can be mixed either with ground grain, straw, or chopped hay to reduce the

overall moisture of the stored silage, The rule of thumb is about 30 pounds of dry material per ton of silage will be needed to reduce silage moisture one percentage unit.

Grain quality impact

Late season frost damage can affect grain quality and is directly proportional to the stage of maturity and leaf tissue killed. Severe impacts on grain quality can occur at mid-dough, while moderate impacts are seen at the dent stage. By the time the kernel has reached half milk line only minor impacts will occur to grain quality. Differences among hybrids, overall plant vigor at the time of frost and subsequent temperatures will all affect final grain quality.

Other considerations

Growers should monitor stalk rot of severely defoliated plants that have a good-sized ear. Photosynthate will be mobilized towards the ear rather than the stalk. This could weaken the stalk and encourage stalk rot development. These fields may need to be harvested early to avoid standability problems.

Some growers have expressed concern about nitrate poisoning. If frosted corn is ensiled at the proper moisture content and other steps are followed to provide good quality silage, nitrate testing should not be necessary. However, it is prudent to follow precautions regarding dangers of nitrate toxicity to livestock (especially with grazing and green-chopping) and silo-gasses to humans when dealing with drought-stressed corn. Nitrates absorbed from the soil by plant roots are normally incorporated into plant tissue as amino acids, proteins and other nitrogenous compounds. Thus, the concentration of nitrate in the plant is usually low. The primary site for converting nitrates to these products is in growing green leaves. The highest concentration of nitrates is in the lower part of the stalk or stem, so raising the cutter bar on a corn silage chopper will leave most nitrates in the field. Nitrate concentration usually decreases during silage fermentation by one-third to one-half, therefore sampling one or two weeks after filling will be more accurate than sampling during filling. If the plants contain nitrates, a brown cloud may develop around your silo. This cloud contains highly toxic gases and people and livestock should stay out of the area. The only way to know the actual composition of frosted corn silage is to have it tested by a good analysis lab.

Literature Cited

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For more information: Joe Lauer, 608-263-7438, **jglauer@wisc.edu** August 31, 2004