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Evaluating Early Season Frost Damage in Corn

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Frost damage on corn plants appears as water-soaked areas of plant tissue. Freezing temperatures cause the water inside the living plant cells to crystallize (become ice), which expands and ruptures cells. As temperatures warm, the ice melts, the water leaves the cell, and the plant tissue appears water-soaked. (See Figure 1.)

The severity of damage to a corn plant from frost primarily depends on temperature, duration of temperature, and corn growth stage. Corn that is emerging to about V6 growth stage (see "Growth Stages in Corn" below) will suffer some injury from temperatures between 28 and 32 degrees Fahrenheit but generally will survive with no yield loss. The growing point on corn between emergence and V6 is still below the soil surface. The ground and the plant insulate the growing point, allowing it to survive. If temperatures drop below 28 degrees Fahrenheit for more than two hours, the growing point may freeze and die. The growing point is moving above the soil surface somewhere around V5 or V6 growth stage. At these stages, freezing temperatures for at least two hours may be enough to freeze and kill the growing point.

Frost usually occurs on clear nights when there is no wind. On such nights temperatures above the soil surface can vary by several degrees in the same field, resulting in areas of the field with severely damaged corn.

Figure 1. Frost damaged corn. All aboveground plant tissue is brown and flaccid. Good growing conditions must occur for this young plant to survive.

Estimating Severity of Frost Damage

After five days of suitable growing conditions, new growth should be evident in the whorl of the corn plant. If new growth is not evident, the plant is likely dead. On small plants, cut the corn stalk to expose the growing point (at or below the soil surface on V6 and younger corn). Healthy growing points will be white or cream-colored; dead points will be dark and/or flaccid. Warm days after a frost will benefit recovery, and cooler temperatures will delay it. Wet conditions after frost can induce pathogenic infections of the dead, moist plant tissue and inhibit recovery.

At times, the frost damaged leaves will fuse together near the whorl. This fusing can impede new leaf growth. Some farmers have tried mowing corn plants to resolve the fusing problem. Mowing is not recommended because it produces inconsistent results.

If 55 to 70 percent of the leaf area is killed by frost on V4 corn but new growth is observed, nothing should be done. In most cases, the damaged corn will yield as well as undamaged corn. If all of the leaves are dead, wait up to five days after the frost for new growth. If there is no new growth, replanting is recommended.

Management Practices to Avoid Frost

Early planting of corn increases the likelihood that corn in some fields or field areas will be exposed to freezing temperatures. Planting recommendations in Kentucky factor in the risk of frost, and as a result April 1 is the earliest date recommended for corn planting in western Kentucky.

Growth Stages in Corn *(Collar Method)*

The collar is at the junction of the leaf blade and the leaf sheath, which wraps around the stalk of the plant. A corn plant with one visible collar is at growth stage V1. The first leaf of the corn plant is usually oval-shaped; all subsequent leaves will be longer and come to a sharper point. The V1 corn plant may have three or four visible leaves, but only one collar is visible. Similarly, a corn plant at V6 will have six visible collars, but eight or nine leaves may be visible.

Once the corn plant reaches V6, the stalk grows rapidly and often tears some lower leaves and collars off the plant, making staging more difficult. These later vegetative stages can be determined by digging up a plant and splitting the lower stalk lengthwise through the roots. The first elongated internode is usually 0.4 inches long. The first node above this internode is often connected to the fifth leaf (fifth collar). Once this reference node has been determined, the remaining visible collars can be counted.

The growing point on most corn hybrids will remain below ground until the V6 growth stage. Both tassel and ear shoot development have started by V6. Once corn reaches V6, the stalk will begin to grow rapidly. Frost is most likely to occur before plants reach the V8 stage.

Estimating Surviving Corn Stand

Multiple stand counts should be made in both injured and non-injured areas of the field. Use Table 1 to determine the length of row to count to estimate plant stand. Count the plants within a row and multiply that number by 1,000. The product is the estimated number of plants per acre. This process should be repeated throughout the field in injured and non-injured areas. If stands are erratic, counting 50 feet of a row may be a better way to estimate corn stands. Compare the estimated stand to the population numbers in Table 2 to help determine the remaining yield potential in the field.

Table 2 contains older data from the Midwest but is still the best general guide available. Current research indicates that corn populations closer to 30,000 plants/A will provide maximum yield on better soils. When assessing corn stands on better soils, keep this factor in mind.

Example (refer to Table 2):

A full stand of corn (25,000 plants/A) was planted on May 6 in a field that normally yields 150 bu/A.

- If the yield potential for a plant population of 25,000 planted on May 6 is 100%, the anticipated yield at harvest is 150 bu/A:

  150 bu/A x 100% = 150 bu/A

- Frost damage on May 21 reduced stands to 16,000 plants/A.
- Since the yield potential for a plant population of 16,000 planted on May 6 is 88%, the anticipated yield at harvest is reduced from 150 bu/A to 132 bu/A:

  150 bu/A x 88% = 132 bu/A

Re-planting a full stand of corn on May 31 would result in 87% yield potential or 130.5 bu/A.

Table 1. Estimating corn stand.

Row		Plants		Estimated
Width	Length	in Row	Multiply:	Plants/A
Uninjured areas of the field:				
15	34′ 10″		1,000	
20	26′ 2″		1,000	
30	17′ 5″		1,000	
36	14′ 6″		1,000	
38	13′ 9″		1,000	
Injured areas of the field:				
15	50′		696.96	
20	50′		522.72	
30	50′		348.48	
36	50′		290.40	
38	50′		275.12	

Table 2. Relative grain yields for various planting dates and plant populations.*

Planting Date	Thousand Plants/A						
	25+	22.5	20	18	16	14	12
	Yield Potential (%)						
May 6	100	98	95	92	88	83	78
May 11	99	98	95	92	88	83	77
May 16	98	96	93	90	86	81	75
May 21	95	94	91	87	83	78	73
May 26	92	90	87	84	80	75	69
May 31	87	85	82	79	75	70	64
June 5	81	80	77	73	69	64	59
June 10	75	73	70	67	63	58	52

* Expressed as a percent of the yield considered optimal for a given planting date and plant population. Plants are assumed to be uniformly spaced within the row.

Source: Adapted from the National Corn Handbook (NCH-30), "Guidelines for Making Corn Replanting Decisions." Also appears as Table 5 in *A Comprehensive Guide to Corn Management in Kentucky* (ID-139).

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