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G86-803 Assessing Hail Damage to Corn

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Assessing Hail Damage to Corn*

This publication examines how hail damages the corn plant, how the degree of damage can be determined and how the extent of yield loss is estimated.

J.J. Vorst, Purdue University

- When Corn Is Most Susceptible to Hail Damage
- Determining Yield Loss Due to Stand Reduction
- Determining Yield Loss Due to Defoliation
- Estimating Total Yield Loss

In the U.S., approximately half of all hailstorms occur between March and May. These early storms are responsible for only minor corn yield losses, however, because the corn either has not yet been planted or is too small to be damaged significantly. Even when fields are severely damaged early in the growing season, they can often be replanted.

On the other hand, about a third of all hailstorms occur between June and September. These have resulted in yield losses to corn estimated at $52 million annually.

Hail affects yields primarily by reducing stands and defoliating the plant. Defoliation causes most of the losses. Thus, knowing how to recognize hail damage and assess probable loss is a very valuable decision-making aid.

For instance, proper assessment of yield loss after an early-season storm can help you determine whether or not to replant or understand how an insurance adjuster determines yield loss. An accurate estimate of loss from a late storm is important for making correct harvesting and marketing decisions.

In this publication, we will examine how hail damages the corn plant, how the degree of damage can be determined and how the extent of yield loss is estimated.

**When Corn Is Most Susceptible to Hail Damage**

Prior to and for some time after emergence, the corn plant is affected very little by hail damage. At emergence, the plant's growing point is below the soil surface and remains there for about 3 weeks (until five to seven leaves have fully emerged). Because the growing point is below the soil surface and in the leaf whorl, plant damage due to hail at these early stages rarely results in any significant stand or yield
loss.

Approximately 3 weeks after emergence, all nodes and internodes have developed, and the growing point is elevated above the soil surface due to internode elongation. For the next 4-5 weeks, the plant grows rapidly and becomes increasingly vulnerable to hail damage up through the tasseling stage, which is the most critical period. Once past tasseling, hail would cause progressively less yield loss as the plant approaches maturity.

**Determining Yield Loss Due to Stand Reduction**

When a hailstorm occurs early in the growing season, an accurate stand reduction assessment is important if replanting is still a management option. Because it is difficult to distinguish living from dead tissue immediately after a storm, the assessment should be delayed for a week to 10 days. By that time, regrowth of living plants will have begun and discolored dead tissue will be apparent. (Another reason for delaying assessment is that some plants initially surviving a storm may soon die because of disease infection entering at the sites of plant damage.)

To get an accurate estimate of the extent of damage, observe and sample plants from at least three parts of affected fields, totaling about 1/100 acre. Use Table I to determine how many feet of row are required to make 1/100 acre at various row spacings. Then divide that figure by the number of sampling locations to determine how many feet to sample at each location.

| Table I. Total Feet of Row Required to Make 1/100 Acre at Various Row Spacings.* |
|---|---|---|---|
| **Row Spacing** | **Row Length** | **Row Spacing** | **Row Length** |
| 20" Rows | 261 Ft. | 32" Rows | 163 Ft. |
| 22" Rows | 238 Ft. | 34" Rows | 154 Ft. |
| 24" Rows | 218 Ft. | 36" Rows | 145 Ft. |
| 26" Rows | 201 Ft. | 38" Rows | 138 Ft. |
| 28" Rows | 187 Ft. | 40" Rows | 131 Ft. |
| 30" Rows | 174 Ft. | |

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To sample pre-tasseled corn, split the stems of several obviously damaged plants with a knife to observe the growing point. If it is whitish-yellow in color, the plant is alive and should survive; if discolored and soft, the plant is dead or dying.

Some plants may be "tied" or "crippled"--i.e., the leaves fail to expand in a normal manner from the whorl. Since it cannot be determined until much later whether or not these crippled plants will develop normally, they should be classified as non-living if replanting is being considered.

Percent yield loss due to stand reduction is estimated by comparing yield potential of the field at its original plant population with yield potential at its now-reduced population. Table II has made these estimates for 25 different original and remaining population levels in 1/100 acre. When determining the advisability of replanting, be sure to consider availability and cost of adapted hybrid seed, replanting costs,
calendar date and the possible need for additional weed control. (For more information on replant decisions, see *EC119, Hail Damage and Replant Decisions*.)

Determining Yield Loss Due to Defoliation

Most yield reduction in corn due to hail damage is a result of the loss of photosynthetically active leaf area. How severe that reduction is likely to be depends on not only the amount of leaf area removed, but also the corn's growth stage when hail occurs (*Table III*). When leaf area is removed, the plant loses some of its capability to produce dry matter, resulting in reduced grain yields. However, grain yield reductions are not directly proportional to leaf area reductions, because of increased dry matter production in the remaining leaf area and movement of dry matter from other plant parts into the developing ear.

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### Table II. Estimated Percent Corn Yield Loss Due to Stand Reduction Occurring Through the Tenth-Leaf Stage of Growth (1/100 Acre Area).*

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*Reprinted by permission from the National Crop insurance Association's "Corn Loss instructions" (Rev 1975).*
1. The first step in assessing yield loss due to defoliation is to establish the stage of plant growth at the
time of the storm.

*Growth stages BEFORE tasseling* are defined in terms of the number of leaves exposed--e.g., 7-leaf
corn, 13-leaf stage, etc. Counting of leaves starts with the lowermost leaf, which has a rounded tip
(Leaf 1 in *Figure 1* and continues up to the "indicator leaf", which is the uppermost leaf that is 40-50
percent exposed from the whorl and whose tip points below a horizontal line (Leaf 5 in *Figure 1*). In
some situations (particularly as the plant nears tasseling), Leaf 1 may have been removed, in which
case the lowermost leaf will not have a rounded tip. By splitting the stalk, you can positively
identify leaf location, since Leaf 5 is attached to the top of the first noticeably elongated internode
(*Figure 2*). Growth stage can then be determined by counting upward from the fifth leaf to the
indicator leaf. If, for example, this indicator leaf is the eleventh above Leaf 5 (the leaf attached to
the top of the first elongated internode), the corn is considered to be in the 16-leaf stage of growth
(i.e., 11 + 5).

*Growth stages AFTER tasseling* are identified according to development of the ear shoot and kernels
as follows:

- Silked stage--silks have emerged and tassel is shedding pollen.
- Silks brown stage--75 percent of silks on ear shoot show purple to brown color but are not dry
to the touch.
- Pre-blist er stage--silks all brown but not dry; no fluid in kernels, which look like pimples.
- Blister stage--kernels look like white, watery blisters; fluid is colorless.
- Milk stage--roasting ear stage, with cob at its maximum length and kernels yellow in color
and containing only milky fluid (no solid substance).
- Late milk stage--milky fluid thickening and solids forming in base of kernels.
- Soft dough stage--kernels contain semi-solid substance, but still produce thick milky material
when squeezed; kernels near butt end of ear beginning to dent.
- Early dent stage--all kernels beginning to dent and containing thick gummy substance; but
many still squirt "milk" when mashed.
Dent stage—kernels denting or dented and can be cut easily with fingernail.
Nearly mature stage—kernel hull on opposite side of embryo has shiny appearance halfway to cob.
Mature stage—black layer formed at base of kernels; kernel moisture 35-40 percent.

2. The next step in determining yield reduction due to defoliation is to estimate percent of leaf area destroyed per plant. In making this estimate, consider both leaf area removed and leaf area still attached to the plant but no longer green. Live green tissue remaining on the plant, even though mutilated, should not be considered as leaf area destroyed. Examine plants in each of at least three areas of a damaged field to be assured of an accurate estimate.

3. With the corn growth stage established and amount of leaf area loss estimated, use Table III to determine likely yield reduction from defoliation.

**Estimating Total Yield Loss**

Total corn yield loss from hail damage is estimated by adding the expected yield loss caused by stand reduction and the expected loss caused by defoliation. Remember, however, that this is only an estimate of the percent yield loss. As with undamaged corn, extremely favorable weather during the rest of the growing season can cause actual yields to be higher than expected. Likewise, unfavorable weather can cause greater-than-anticipated reductions.

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**File G803 under: FIELD CROPS**  
**C-10, Corn**  
*Issued July 1986; 12,000 printed.*

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Elbert C. Dickey, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

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