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Assessing Hail Damage to Corn

James J. Vorst, Department of Agronomy, Purdue University

In Indiana, hailstorms can severely affect corn yields by stand reduction, plant defoliation and, occasionally, direct ear damage. Defoliation causes most of these yield losses.

Approximately half of all hailstorms in Indiana occur from March to May and are of only minor importance in terms of crop damage. However, a third of our hail falls between June and September, resulting in losses to corn estimated at $3 million annually.

Knowing how to recognize hail damage and assess probable losses can be a very valuable decision-making aid. For instance, proper assessment of loss after an early storm helps determine whether to replant. An accurate estimate of loss from a late storm is important for making right harvesting and marketing decisions.

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

When Corn Is Most Susceptible to Hail Damage

Prior to and for some time after emergence, the corn plant is relatively immune to hail damage. At emergence, the plant's growing point is below the soil surface and remains there for about 3 weeks, until five or six leaves have fully emerged. Because the growing point is in the leaf whorl and below ground level, plant damage due to hail at these early stages rarely results in any significant yield loss.

Approximately 3 weeks after emergence, all nodes and internodes are developed, and the growing point is elevated above the soil surface. For the next 4-5 weeks, the plant grows rapidly and becomes more and more susceptible to hail damage up through tasseling—the most critical period. Once past tasseling, hail has progressively less effect on yield loss.

Determining Yield Loss Because of Stand Reduction

When a hailstorm occurs early in the growing season, an immediate and accurate stand reduction assessment is important if replanting is still a management option. Such an assessment should be done about a week after the storm.

In the case of pre-tasseled corn, split with a knife the stems of several damaged plants and observe the growing point. If it is whitish-yellow in color, the plant will survive; if it is discolored and soft, the plant is dying.

Some plants may be "tied"—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 when replanting is being considered. Yield loss due to stand reduction is estimated by comparing yield potential of the field at its original population with yield potential at its now-reduced population.

To determine the advisability of replanting, compare the anticipated yield from the remaining stand of damaged corn with the yield you could expect from a replanted crop. In making this comparison, remember that, generally in Indiana, corn yield drops about 1 bushel per acre per day when planted after May 10, and 2 bushels per day beyond May 22. Replanting costs must also be considered in your decision.
Determining Yield Loss Because of Defoliation

The first step in this assessment is to establish stage of plant growth at the time of the storm. Growth stages prior to tasseling are defined in terms of number of leaves exposed—e.g., 7-leaf stage, 13-leaf stage, etc.

Counting of leaves starts with calling the lowest leaf (which has a rounded tip), Leaf No. 1 (Figure 1). If this small leaf cannot be seen, split the stalk to positively identify leaf location. Since the lowermost internodes of a corn plant do not elongate, the fifth leaf attaches 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," which will be 40-50 percent exposed from the whorl and usually the uppermost leaf tip that is pointing below a horizontal line (Figure 1). For example, this indicator is the sixteenth leaf, the corn is in the 16-leaf stage of growth.

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

- Blister stage — kernels on cob appear as watery blisters; kernel is white and fluid colorless.
- Milk stage — roasting ear stage; full yellow color; cob has reached maximum length.
- Dent stage — kernels dented or denting and can be cut easily with fingernail.

With the growth stage established, percent yield reduction due to defoliation can then be determined from Table 1. In estimating amount of leaf area destroyed, consider both leaf area removed from the plant plus leaf area attached but no longer green. Be sure to examine enough plants in the damaged field to get an adequate estimate of extent of damage.

Estimating Total Yield Loss

Total corn yield loss from hail damage is estimated by adding the expected yield loss because of the stand reduction to the expected loss because of defoliation. Remember, however, that this will only be an estimate made at a given point in time and is subject to later influences, particularly weather.

Extremely favorable weather during the rest of the growing season can cut these predicted losses. Likewise, unfavorable weather restricting normal re-growth may mean greater-than-anticipated reductions.

Figure 1. Corn plant in the 5-leaf growth stage. The tip of Leaf No. 5 no longer points upward, so it is the 'indicator leaf.'

Figure 2. Cross section through base of corn plant showing fifth leaf attachment (at top of first noticeably-elongated internode).
Table 1. Estimated Corn Yield Reduction Due to Defoliation at Various Stages of Growth.*

<table>
<thead>
<tr>
<th>Stage of Growth</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>100%</th>
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<td>7-leaf</td>
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<td>0</td>
<td>0</td>
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<td>3</td>
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<td>9</td>
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<td>4</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>13-leaf</td>
<td>0</td>
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<td>3</td>
<td>6</td>
<td>10</td>
<td>13</td>
<td>17</td>
<td>22</td>
<td>34</td>
</tr>
<tr>
<td>15-leaf</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>9</td>
<td>15</td>
<td>20</td>
<td>26</td>
<td>34</td>
<td>51</td>
</tr>
<tr>
<td>17-leaf</td>
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<td>4</td>
<td>7</td>
<td>12</td>
<td>20</td>
<td>27</td>
<td>35</td>
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<td>Tasseled</td>
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<td>13</td>
<td>21</td>
<td>31</td>
<td>42</td>
<td>55</td>
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<td>7</td>
<td>12</td>
<td>18</td>
<td>24</td>
<td>32</td>
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<td>1</td>
<td>3</td>
<td>7</td>
<td>10</td>
<td>14</td>
<td>17</td>
<td>24</td>
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*from National Crop Insurance Association crop loss tables.

(Crops-Corn) NEW 7/79

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