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EC126

Evaluating Hail Damage to Corn

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Hail affects corn yields in three ways: plant stand reduction, direct damage, and leaf defoliation. Any crop damage will reduce the plant's ability to compete with weeds, but the greatest losses are caused by defoliation, especially during the pollination growth stage.

Being able to determine corn growth stage and accurately estimate the amount of defoliation are essential to accurately assessing hail loss. Using the methods described in this resource will produce a reasonable estimate of yield loss. These methods also can be used in other situations where corn has been defoliated, and are a valuable tool in making cropping systems decisions.

In the U.S. over 50 percent of the hail storms occur from March to May, yet the largest corn loss from hail occurs from June to September when only about one-third of the hail storms occur. Until the V6 growth stage (described later in detail), losses from leaf defoliation are usually minor with most loss occurring from stand reduction. At the V6 growth stage the growing point breaks the soil surface. With a mid season hybrid it takes about 475 growing degree days (GDD) to reach V6. (This point can vary between areas due to season length.)

Estimating Growing Degree Days

The GDD method of measuring heat units was developed to estimate the rate of corn growth. In calculating GDD, daily average temperatures (Fahrenheit) are accumulated for the growing season by applying the following formula to each day's maximum and minimum temperatures.

$$GDD = \frac{(\text{Max } ^{o}\text{F} + \text{Min } ^{o}\text{F}) - 50}{2}$$

Maximum temperatures higher than 86°F are entered as 86 and temperatures below 50°F are entered as 50 in the formula.

Corn Growth Stages

The amount of yield loss is directly related to the crop's stage of growth when the hail occurs. Therefore, it is extremely important to stage the corn correctly to determine potential loss.

The two main methods of staging corn differ in how they describe its vegetative stages.

The Iowa State University (ISU) leaf collar method uses a system that counts “collared” leaves (when the leaf partially unclasps the stem or culm) during the vegetative growth stages and includes the first emerging round-tipped leaf in the count. This is the most commonly used staging method. (See the ISU Extension publication, *Corn Growth and Development*, PMR 1009, for more detailed descriptions of corn growth stages.)

A second method is more commonly used by the crop insurance industry [National Crop Insurance Services (NCIS)]. With this method, all visible leaves are counted. The youngest leaf is the leaf whose tip is pointed to the ground. This ignores the collar so the number of leaves used by NCIS is usually one more than the number indicated in the Iowa system. *Table II* uses the NCIS system so, for example, if you’re using the ISU system with V6 corn, you would use the 7-leaf line in *Table II.*

Reproductive stages and kernel development are the same for the two staging systems.

Vegetative Growth Stages of Corn Using the Iowa System

Germination and Emergence (VE)

Corn seed begins germination when the seed contains at least 30 percent moisture. The first seedling structure to emerge from the corn seed is the radicle (root), followed by the coleoptile (shoot) with the enclosed plumule (first leaves and growing point). Emergence of the radicle first allows the young seedling to anchor in the soil and obtain an adequate supply of water and later obtain both water and nutrients. To emerge, the first internode on the corn plant (the mesocotyl) elongates toward the soil surface and continues until the coleoptile reaches light. At the VE stage, the growing point is normally 1-1.5 inches below the soil surface. The growing point remains below the soil surface for three to four weeks, protected from physical injury from frost, surface insects, and grazing animals. Emergence for a mid season maturity corn hybrid occurs when it has accumulated about 120 GDD.

V1-V2

At this stage, since the root system is relatively small and the soil is cool, nutrient uptake is slow and only possible from soil within 2 inches of the seed. Providing supplemental fertilizer nutrients may help early plant growth; however, the amount of nutrients required is relatively small. Effective fertilizer uptake can occur if the fertilizer is placed in a band in contact with the primary roots. (See NebGuide G361*, Using Starter Fertilizer for Corn, Grain Sorghum and Soybeans.*) The roots of the corn plant in the first node are elongating. To reach the V2 growth stage requires about 200 GDD for a mid season corn hybrid.

V3-V5

About two weeks after the plant emerges, the V3 stage begins. A frost (light freeze) or hail may destroy the exposed leaves but will not damage the growing point below the soil surface, so damage to the plant above the soil surface usually results in minimal, if any, yield reduction. This is because the amount of leaf area exposed at this time is a small percentage of the total leaf area. Yield losses can occur from a reduction in plant stand with reduced plant competition. Weeds may be a much bigger problem. Growth of the seedling root system has essentially ceased. Root hairs are present on nodal roots. The roots of the second node are elongating. The nodal roots now form the major part of the root system. Leaf and ear shoots are being initiated and will be complete by V5 (potential ear shoot number is determined). Also by V5 (*Figure 1*), a small tassel (seen only through a microscope) is initiated at the growing point. Plant height is typically about 8 inches when the tassel is initiated, the growing point is still at or below the soil surface.

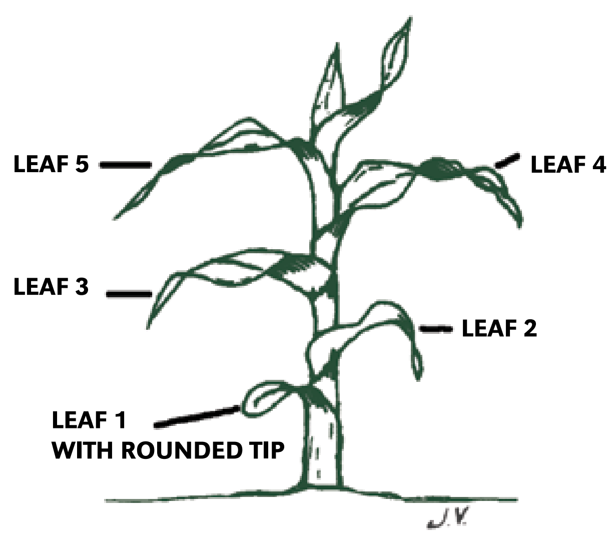

Figure 1. Corn plant in the 5-leaf growth stage. (Tip of Leaf 5 no longer points upward so it is the “indicator leaf.”)

V6-V7

At this growth stage the root system is well distributed in the soil and extends about 18 inches in depth and 48 inches in diameter. The third root whorl is elongating. The growing point is now above the soil surface and rapid stem elongation begins. Some tillers (suckers) may have initiated. Tiller development varies with hybrid, plant density, fertility, and other environmental conditions. It takes about 475 GDD for a mid season hybrid to reach the V6 growth stage.

V8-V9

At the V8 growth stage, which requires about 610 GDD for a mid season hybrid, the fourth whorl of nodal roots is elongating. Several ear shoots are present. A potential ear shoot will form at every above-ground node except the upper six to eight. Initially, each ear shoot develops faster than the one above, but growth of the lower ear shoots slows. Only the upper one or two ear shoots eventually form harvestable ears. Prolific hybrids tend to form more than one harvestable ear, especially at lower plant populations. If all the unfurled leaves are removed (by frost or hail) at this stage, final grain yield could be reduced by 10-20 percent.

V10-V11

After about 740 GDD a mid season corn hybrid enters V10. During this period new leaves develop more quickly, usually every two to three days. Demand for soil nutrients and water is relatively high in order to meet increased plant needs due to the growth rate. A lack of moisture or nutrient deficiencies at this stage will markedly reduce ear growth and development.

V12-V13

In the V12 growth stage (about 870 GDD for a mid season hybrid) any stress, such as from moisture or nutrient deficiencies, may seriously reduce the number of seeds and ear size. The maximum size of these two yield components is set during the V10 to V17 stages. The length of time the plant has to develop through these stages affects harvestable yield. Early maturity hybrids normally progress in less time and have smaller ears than later maturity hybrids. Higher plant populations are needed for earlier hybrids to produce grain yield similar to normal maturity hybrids in the adapted region. Yield components for corn are seed size, number of seeds, number of ears, and number of plants. This can be shown as:

Yield =

Seed size X seeds/ear X ears/plant X plants/unit area

V14-V15

Approximately 1,000 GDD are required for a mid season maturity corn plant to reach the V14 growth stage. The corn plant at V15 is only 12 to 15 days (one to five vegetative stages) away from R1 (silking). This vegetative stage is the most critical period for seed yield determination. The number of ovules that develop silks, indicative of the number of kernels, is being determined. Any stress will significantly reduce the number of kernels that develop. The tassel is near full size but not visible from the top of the leaf sheaths. Silks are just beginning to grow from the upper ears. Upper ear shoot development has surpassed that of lower ear shoots. A new leaf stage can occur every one to two days. Brace roots from the sixth leaf node are developing and the permanent roots have continued to elongate and proliferate, eventually reaching a depth of 5 to 8 feet and spreading several feet in all directions. In some hybrids, brace roots also will develop from the eighth and ninth leaf nodes or even higher.

V16-V17

Total leaf numbers vary as the corn plant enters the late vegetative stages. During this time, plant stress can greatly affect yield. Moisture stress two weeks before or after silking can cause a large grain yield reduction. In general, this is true for other types of environmental stresses (hail, high temperature, nutrient deficiencies) during this time. The four-week period around silking is the most effective time for irrigation if water supply is short. Tips of upper ear shoots may be visible at the top of leaf sheaths by V17 in hybrids which develop more than 16 leaves. The tip of the tassel also may be visible by V17 in more prolific-leaf hybrids. The V16 growth stage takes about 1135 GDD for a mid season hybrid.

V18 and Later Numbered Vegetative Stages

The vegetative plant is reaching full size in prolific-leaf hybrids. Silks from the basal ear ovules are the first to elongate, followed by the silks from ear tip ovules. Brace roots are now growing from above-ground nodes. These brace roots provide support to the plant and obtain water and nutrients from the upper soil layers during the reproductive plant stages. Ear development is continuing rapidly with the plant only one week away from viable silking.

Successful pollination occurs when the silks are receptive, and pollen is shed at the same time. Stress at later vegetative stages delays silk emergence more than it delays the beginning of pollen shed. When silk development is delayed and pollen shed goes on normally, incomplete pollination may result. Unfertilized ovules result in missing kernels on the ear, especially at the ear tip. Yield of prolific-eared hybrids (two or more ears per plant) is more stable under stress conditions. Non-prolific hybrids (strongly single-eared) often will out yield prolific hybrids under non-stress conditions.

VT Tasseling

Stage VT occurs two to three days before silking, when the last branch of the tassel is completely visible but silks have not yet emerged from the ear shoot. The plant has reached full height and pollen shed begins. The time between VT and R1 can vary with hybrid and environmental conditions, but generally a mid season hybrid needs about 250 GDD. Pollen shed (pollen drop) normally occurs in late morning or early evening. Hail damage at this stage is more serious than at any other growth stage. All leaves have already emerged and complete loss of a pollen source would result in no grain formation. About 1150 GDD are required for a mid season maturity corn hybrid to reach tasseling.

Reproductive Stages and Kernel Development

R1 Silking

This stage begins when silks are visible and pollination occurs. Pollination is when pollen grains contact the new, moist silks. A grain moves down a silk to fertilize the ovule in about 24 hours. Upon this fertilization, the ovule is a kernel. Silks grow about 1 to 1.5 inches per day. Normally, it takes two to three days for all silks on a single ear to emerge and be pollinated. Moisture stress or nutrient deficiency will result in poor pollination and seed set. The largest yield reduction occurs with stress at silking (early R1). About 1400 GDD are needed for a mid season corn hybrid to silk.

R2 Blister

In the R2 stage the kernels are white and shaped like a blister. The cob is close to full size. Silks darken and dry. Hot, dry conditions will cause the silks to darken even more. Irrigation, if needed, can insure adequate moisture for grain production. Kernels are in a steady and rapid period of seed-fill. (This continues to R6.) Starch is just beginning to accumulate in the watery endosperm and kernels are about 85 percent moisture.

R3 Milk

In this stage kernels are beginning to yellow on the outside but contain a milky white inner fluid. (With this starch accumulation, the kernel is now about 80 percent moisture.) Most of the kernels have grown out from the surrounding cob material. The endosperm cell division in each seed is complete and growth will now be due to cell expansion and starch accumulation. Stress is not as yield limiting at R3 as it is at R1; however, yield reduction can occur due to a reduction in the number of kernels which ultimately develop and the size and weight of the kernels. Very little root growth occurs after R3.

R4 Dough

Starch has continued to accumulate in the kernel and moisture content has decreased so that now the kernel has a pasty (doughy) consistency. The embryo of the seed is growing while the kernels are just beginning to dry at the top (dent). Kernels have accumulated 50 percent of their dry weight and are about 70 percent moisture. Unfavorable environmental conditions or nutrient deficiencies can still result in unfilled kernels and "chaffy" ears. About 1925 GDD are required for a mid season corn hybrid to reach the dough stage.

R5 Dent

Nearly all kernels are dented or denting. Drying kernels show a small, hard, white layer on top. A white line (known as the milk or starch line) can be seen across the kernel shortly after denting. Starch line will advance toward the kernel tip as the plant matures. Stress at this point can reduce kernel weight but not the number of kernels. Kernels have about 55 percent moisture. A hard frost can stop dry matter accumulation and cause a premature black layer formation. Grain quality may be affected after a frost at this stage since frost-damaged ears are slower to dry and delay harvest. To avoid this select hybrids that reach maturity at least 10 days to three weeks before the average first killing frost date. A mid season corn maturity hybrid requires about 2450 GDD to reach the dent growth stage.

Table I lists the approximate growing degree days required for the various growth stages.

Table I. Approximate growing degree days (GDD, base 50) required for a midseason maturity corn hybrid to reach different growth stages from the time of planting.

Stage	*GDD*
Emergence	120
2-leaf (V2)	200
V6 (tassel initiation)	475
V10	740
V14	1,000
VT (tassel emergence)	1,150
Silking	1,400
R4 (kernel dough stage)	1,925
R5 (kernel dent stage)	2,450
R6 (physiological maturity)	2,700

Data are from University of Nebraska and other sources.

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 or stalk damage from deep bruises.)

To accurately estimate the extent of damage, observe and sample plants from at least three parts of affected /fields, totaling about 1/100 acre. Use *Table II* to determine how many feet of row are required to make 1/100 acre at various row spacings. If you use 1/1000 acre, take 1/10 of the distance; however, the greater the distance you use, the better the accuracy. Divide that figure by the number of sampling locations to determine how many feet to sample at each location.

Table II. Total feet of row required to make 1/100 acre at various row spacings.

Row Spacing (inches)	*Row Length (feet)*	*Row Spacing (inches)*	*Row Length (feet)*
15	348	30	174
18	290	32	163
20	261	34	154
22	238	36	145
24	218	38	138
26	201	40	131
28	187		

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," for example, the leaves fail to expand in a normal manner from the whorl. Since it cannot be determined until much later whether 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 original plant population with yield potential of the now-reduced population. *Table IV* has estimates for 25 original and remaining populations in 1/100 acre. When determining the advisability of replanting, consider yield reduction due to late planting, availability and cost of adapted hybrid seed, replanting costs, calendar date, and the possible need for additional pest control.

Determining Yield Loss Due to Defoliation

In corn most yield reduction due to hail damage results from a loss of photosynthetically active leaf area. The degree of yield loss depends on the crop growth stage and the amount of leaf area removed (*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 due to increased dry matter production in the remaining leaf area and movement of dry matter from other plant parts into the developing ear. Corn generally has excess leaf area at the bottom of the plant that's not reached by sunlight, and thus, is not fully functional. After defoliation light can reach these leaves and they photosynthesize.

To determine yield loss due to defoliation:

1. Establish the stage of plant growth at the time of the storm.
2. Estimate percent of leaf defoliation. 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. Look at each leaf on the plant, write down the percent of leaf defoliation relative to a healthy plant at that stage. Average the percent defoliation for all leaves.

   Note: It is easy to overestimate loss by only looking at the damaged leaves.
3. With the corn growth stage established and amount of leaf area loss estimated, use *Table III* to predict yield reduction from defoliation.

Determining Yield Loss Due to Direct Damage

When hail occurs during the later reproductive stages, direct damage to the ear has to be considered. The force of a hail storm will damage the ear below the husks. Corn ears should be examined and the number

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

	Percent Leaf Area Destroyed																		
State of Growth	*10*	*15*	*20*	*25*	*30*	*35*	*40*	*45*	*50*	*55*	*60*	*65*	*70*	*75*	*80*	*85*	*90*	*95*	*100*
	Percent Production Lost																		
7-leaf	0	0	0	0	0	0	1	1	2	3	4	4	5	5	6	7	8	9	9
8-leaf	0	0	0	0	0	1	1	2	3	4	5	5	6	6	7	8	9	10	11
9-leaf	0	0	0	1	1	2	2	3	4	5	6	6	7	7	9	10	11	12	13
10-leaf	0	0	0	1	2	3	4	5	6	7	8	8	9	9	11	13	14	15	16
11-leaf	0	0	1	1	2	3	5	6	7	8	9	10	11	12	14	16	18	20	22
12-leaf	0	0	1	2	3	4	5	7	9	10	11	13	15	16	18	20	23	26	28
13-leaf	0	1	1	2	3	4	6	8	10	11	13	15	17	19	22	25	28	31	34
14-leaf	0	1	2	3	4	6	8	10	13	15	17	20	22	25	28	32	36	40	44
15-leaf	1	1	2	3	5	7	9	12	15	17	20	23	26	30	34	38	42	46	51
16-leaf	1	2	3	4	6	8	11	14	18	20	23	27	31	36	40	44	49	55	61
17-leaf	2	3	4	5	7	9	13	17	21	24	28	32	37	43	48	53	59	65	72
18-leaf	2	3	5	7	9	11	15	19	24	28	33	38	44	50	56	62	69	76	84
19-21 leaf	3	4	6	8	11	14	18	22	27	32	38	43	51	57	64	71	79	87	96
Tassel	3	5	7	9	13	17	21	26	31	36	42	48	55	62	68	75	83	91	100
Silked	3	5	7	9	12	16	20	24	29	34	39	45	51	58	65	72	80	88	97
Silks brown	2	4	6	8	11	15	18	22	27	31	36	41	47	54	60	66	74	81	90
Pre-blister	2	3	5	7	10	13	16	20	24	28	32	37	43	49	54	60	66	73	81
Blister	2	3	5	7	10	13	16	19	22	26	30	34	39	45	50	55	60	66	73
Early Milk	2	3	4	6	8	11	14	17	20	24	28	32	36	41	45	50	55	60	66
Milk	1	2	3	5	7	9	12	15	18	21	24	28	32	37	41	45	49	54	59
Late Milk	1	2	3	4	6	8	10	12	15	18	21	24	28	32	35	38	42	46	50
Soft dough	1	1	2	2	4	6	8	10	12	14	17	20	23	26	29	32	35	38	41
Early dent	0	0	1	1	2	3	5	7	9	11	13	15	18	21	23	25	27	29	32
Dent	0	0	0	1	2	3	4	6	7	8	10	12	14	15	17	19	20	21	23
Late dent	0	0	0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nearly mature	0	0	0	0	0	0	0	0	1	2	3	4	5	5	6	6	7	7	8
Mature	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*Reprinted from the *Corn Loss Adjustment Standards Handbook FCIE-2508 (11-2009) 2010 and Succeeding Crop Years,* National Crop Insurance Services. This system counts a leaf as fully developed when the leaf tip points to the ground (not fully developed collar).

of damaged kernels should be calculated as a percent of total kernels. This is a direct loss, similar to stand reduction.

Estimating Total Yield Loss

Total corn yield loss from hail damage is estimated by combining the expected yield losses from stand reduction, direct damage, and defoliation. Consider the following examples.

Example A

A July 1 hail storm damages corn at the 11-leaf stage. The farmer counted plants in 174 ft (1/100 of an acre) of 30-inch row and determined that 200 plants remained. He had planted enough seed that with emergence losses he expected 28,000 plants per acre or 280 in 1/100 of an acre. When assessing plant defoliation, he calculated that there was an average of 65 percent defoliation.

What is the predicted percent yield reduction?

Table IV. Estimated percent corn yield loss due to stand reduction occurring through the tenth-leaf stage of growth (1/100 acre area).*

	Remaining Plants in Sample (1/100) Acre																															
*OS**	*390*	*380*	*370*	*360*	*350*	*340*	*330*	*320*	*310*	*300*	*290*	*280*	*270*	*260*	*250*	*240*	*230*	*220*	*210*	*200*	*190*	*180*	*170*	*160*	*150*	*140*	*130*	*120*	*110*	*100*	*90*	*80*
400	0	0	1	2	2	3	3	3	4	5	6	8	9	11	13	14	16	18	20	22	24	26	28	31	33	36	39	42	45	48	52	57
390	0	0	0	1	2	3	3	3	4	5	6	7	9	11	13	14	16	18	20	22	24	26	28	31	33	35	38	41	44	47	51	56
380		0	0	1	1	2	2	3	4	5	6	7	9	11	13	14	16	18	20	22	24	26	28	31	33	35	38	41	44	47	51	56
370			0	0	1	1	2	3	4	5	6	7	8	10	12	14	16	18	20	22	24	26	28	31	33	35	38	41	44	47	51	56
360				0	0	1	1	2	3	4	6	7	7	9	11	13	15	17	19	22	24	26	28	31	33	35	38	41	44	47	50	54
350					0	0	1	1	2	3	4	5	6	8	10	12	14	16	19	21	23	25	27	29	31	34	36	39	42	45	49	53
340						0	0	1	1	2	3	4	5	6	8	10	12	15	17	19	21	24	26	28	31	33	36	39	42	45	49	53
330							0	0	1	2	3	4	5	6	8	9	11	14	16	18	20	22	25	27	30	32	35	38	41	45	49	53
320								0	1	2	3	4	5	6	7	8	9	11	13	16	18	21	23	26	29	32	35	38	41	45	49	53
310									0	1	2	3	4	5	6	7	8	10	12	14	16	19	21	24	27	30	33	36	39	43	47	52
300										0	1	2	3	4	5	6	7	9	11	12	14	17	20	23	25	28	31	34	37	41	45	50
290											0	1	2	3	4	5	6	8	10	11	13	15	18	21	23	26	29	32	35	38	43	48
280												0	1	2	3	5	6	7	9	10	12	14	16	19	21	24	27	30	34	37	41	46
270													0	1	3	4	5	6	7	9	10	12	14	16	18	21	24	28	31	35	40	45
260														0	1	3	4	5	6	7	9	10	12	14	16	19	22	25	29	33	38	43
250															0	1	2	3	4	6	7	8	10	12	14	17	20	23	27	31	36	41
240																0	1	2	3	4	5	6	9	10	12	15	18	22	26	29	34	40
230																	0	1	2	3	4	5	8	9	11	14	17	21	25	29	33	39
220																		0	1	2	3	4	7	8	10	13	16	20	24	28	33	38
210																			0	1	2	4	6	7	9	12	16	20	24	27	32	37
200																				0	1	3	5	6	8	11	15	19	23	27	31	36
190																					0	2	4	5	7	10	14	17	21	25	30	35
180																						0	2	4	6	9	12	15	19	23	28	33
170																							0	2	4	7	10	13	17	21	26	31
160																								0	2	5	8	11	15	19	24	29
150																									0	3	5	8	12	16	21	26
140																										0	3	6	10	14	18	23
130																											0	3	6	10	15	20
120																												0	3	7	12	17
110																													0	3	8	12
100																														0	4	8
90																															0	4
80																																0

***OS = Original Stand**
Reprinted from the *Corn Loss Adjustment Standards Handbook FCIE-2508 (11-2009) 2010 and Succeeding Crop Years.*

1. Stand loss is 10 percent (*Table IV*). This is a direct loss so it is subtracted from 100 percent yield, leaving 90 percent yield.
2. Defoliation was estimated to be 65 percent. At the 11-leaf stage 65 percent defoliation produces a 10 percent loss (*Table III*). Multiply the remaining 90 percent yield (Step 1) by the 10 percent loss (90 x 0.10 = 9 percent). The result is a yield loss estimate of 9 percent. The two losses are added together (10 plus 9) to get a 19 percent yield loss This is slightly different than just adding the two losses (10 percent plus 10 percent). The difference is more when the numbers are larger.

Example B

An early August hail storm strikes corn at the soft dough stage. There is defoliation and severe bruising of the ears. The defoliation is calculated at 90 percent.

1. Ten ears are stripped of their husks and the row number and kernels/row are counted. There are approximately 300 kernels per ear, and on average 30 of these are bruised. This 10 percent direct damage is subtracted from 100 percent, as in the first example with stand reduction.

2. Defoliation yield reduction (*Table III*) for the remaining 90 percent at soft dough is 35 percent.

3. To calculate yield loss at this point the 10 percent from direct damage is subtracted (100 - 10 = 90 percent). The remaining 90 percent is multiplied by 35 percent (90 x 0.35 percent loss). The result is 31.5 percent defoliation loss. The total loss would be from direct damage (10 percent) and defoliation loss (31.5 percent) for a total of 41.5 percent.

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.

Remedial Actions

Many times producers ask: "Can a hail-damaged crop be improved by extra management?" Usually the answer is "No," but there are some management aspects that should be considered.

- A moderate defoliation will likely result in less crop water use because of reduced leaf area. To avoid overwatering, it's a good idea to actually check soil moisture instead of relying on general ET estimates.
- Extra nitrogen or sulfur fertilization usually is not needed. Research has shown that adding nitrogen increased yields of the hailed crop as well as the control crop, indicating there was a general nitrogen need unrelated to the hail loss. If the yield potential is reduced, nitrogen needs also are reduced.
- Normally, scheduled nitrogen applications through the pivot need to be reconsidered, depending on estimated yield loss. With light to moderate losses, change may not be needed, but with severe losses, nitrogen need should be examined on a case by case basis.
- Diseases controlled by foliar fungicides do not need wounds to infect plants. Conversely, Goss's Wilt and common smut take advantage of wounds created by hail, but are *not* controlled by foliar fungicides. Fungicide application decisions should be made after evaluating disease pressure, as you would any field. Scout fields for stalk rot symptoms and prioritize harvest to avoid further losses. For more information on corn diseases, visit the UNL Plant Disease Center Website at *pdc.unl.edu*.
- When hail reduces plant competition, more sunlight reaches the soil. This may result in increased competition from weeds. Also, the moisture received with the hail can germinate additional weeds. Consider postemergence, layby, and harvest aid treatments for the possible increased weed pressure.

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