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Should I Replant My Corn Field, How to Calculate Yield Loss, Economics of Replanting

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NATIONAL CORN HANDBOOK

This corn field was damaged by a hailstorm in late May. Even though many plants suffered damage, the crop regrew and produced a reasonable yield. Guidelines in this bulletin can help you decide whether to replant.

Should I Replant My Corn Field?

How to Calculate Yield Loss, Economics of Replanting

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It is occasionally necessary to replant a damaged corn stand because of poor emergence or damage by frost, flooding, hail, wind or insects. But, it is often a difficult decision, one that shouldn't be made by "eyeballing" a field. This bulletin will help farmers and crop advisors decide whether a field should be replanted.

Factors to consider when making a replanting decision are:

- Stage of corn plant development.
- Estimated yield loss due to reduced stand.
- Estimated yield loss due to leaf loss (defoliation).
- Estimated yield loss due to replanting.
- Cost of replanting.
- Adequacy of herbicides and fertilizers already present.

Stages of development

If you are considering replanting, you should know the growth stage of the crop because the expected yield loss from any type of damage will depend on the crop's growth stage. Corn growth stages before silking (vegetative or V stages) can be identified by the number of leaves that are fully emerged. A leaf is fully emerged when the leaf collar is visible *(Fig. 1)*. The leaf collar appears as a discolored line between the leaf blade and leaf sheath. The characteristically oval-shaped first leaf is a reference point for counting upward to the top visible leaf collar. (For a more detailed description, refer to Extension Bulletin E-1933, "How a Corn Plant Develops.")

Calculating yield loss due to stand reduction

Stand loss or plant death due to adverse environmental conditions (frost, hail, wind) is most likely to occur after the growing point of the plant has emerged above the soil surface. This occurs three to four weeks after planting, when the corn reaches the five- to seven-leaf stage. Before this time, it is less likely that plants will be killed. As long as the growing point remains alive, even if all aboveground tissue is killed, plants can regrow with little yield loss *(Fig. 2)*. There is a chance, even when the growing point is underground, that plants may be injured beyond recovery. Causes may include the rotting of the growing point by disease organisms, or the twisting and knotting of remaining leaves so that newly emerging leaves cannot break through the whorl.

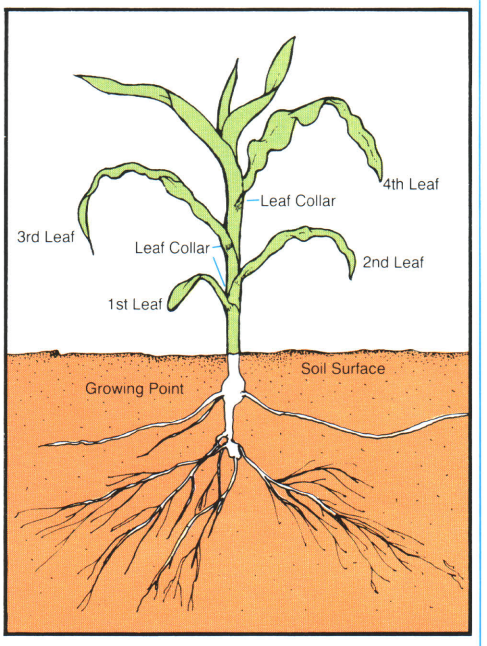

Fig. 1 Corn plant in the 4th-leaf stage (V 4). Note characteristic presence of leaf collars and downward pointed tips of leaves 1-4.

To estimate stand loss, you must count the remaining viable plants and know the plant population before the damage. To determine the healthy plant population remaining, mark off

Fig. 2 To determine if a damaged stand will regrow, examine several damaged plants to see if the underground growing points are alive (see Fig. 3), or wait five to seven days to see if the plants initiate growth.

1/1,000 acre in several locations in the damaged portion of the field or the entire field, if the damage was extensive. Table 1 gives the number of feet of row equal to 1/1,000 acre at various row spacings. Within each 1/1,000 acre, count living plants. The plant population per acre is this number of plants times 1,000.

Table 1. **Row length equivalent to 1/1,000 acre at various row widths**

Row width (inches)	Length in feet for 1/1,000 acre
15	34.8
20	26.1
28	18.7
30	17.4
32	16.3
34	15.4
36	14.5
38	13.8
40	13.0

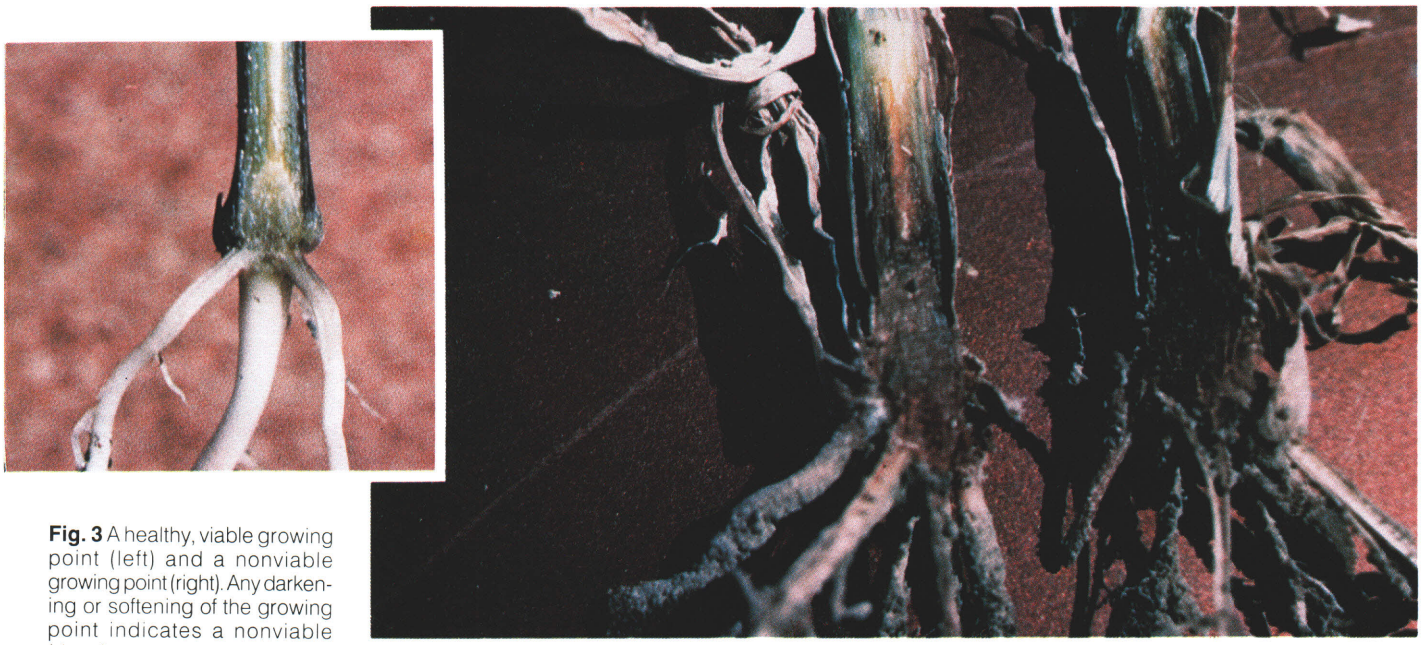

Fig. 3 A healthy, viable growing point (left) and a nonviable growing point (right). Any darkening or softening of the growing point indicates a nonviable (dead) plant.

Next, determine if remaining plants are viable. Plants that have a live growing point (white or cream colored) are considered viable. Dig up a few plants in the damaged area, split each stalk lengthwise with a sharp knife and examine the bottom portion of the stalk to check the growing point. Any darkening or softening of the growing point indicates a nonviable plant. Figure 3 shows a healthy, viable (left) and a non-viable (right) growing point. Since it is sometimes difficult to distinguish a live from a dead growing point immediately after the damage, it may be necessary to wait five to seven days and observe whether plant regrowth has occurred. If no regrowth is visible after seven days, consider that plant dead.

After determining the number of remaining viable plants and comparing this number with the original stand, a yield loss can be estimated. If you don't know the stand before damage, you can use 90 percent of the seeded plant population. Table 2 presents yield loss estimates that are reliable up to the 10-leaf stage only. Beyond the 10-leaf stage, the percent yield loss can be estimated by the percent stand loss—i.e., if one-third of the original plants are gone, one-third of the potential yield is lost.

Plant distribution within the row can influence the yield loss due to stand reduction. Uneven plant spacings will yield less than uniform distributions, and the greater the gaps between plants, the greater the yield reduction. Results from a recent study showed that, compared to a uniform stand, small gaps within the row (14 to 33 inches long) reduced yield by about 2 percent and large gaps (4 to 6 feet) reduced yield by about 5 percent.

Example for Estimating Yield Loss Due to Stand Reduction:

Stand prior to damage
= 26,000 plants/acre.

Stand after damage
= 18 plants per 1/1,000 acre.
= 18,000 plants/acre.

Estimated yield loss = 10 percent.

As the loss chart *(Table 2)* shows, up to the 10-leaf stage, the expected yield loss is less than the stand loss. In the example above, a stand loss of over 30 percent resulted in an expected yield loss of only 10 percent. When a corn stand is thinned early in the season, the remaining plants have greater access to light, water and nutrients, and thus produce greater yields per plant. The reduced interplant competition partially compensates for the reduced number of plants.

Calculating yield loss due to defoliation

Leaf loss or defoliation must also be considered when making a replanting decision. Defoliation refers to the loss of either entire leaves or portions of leaves. Corn plants can compensate for leaf loss early in the season by producing new leaves from the growing point and by increasing dry matter production by the remnant leaf area. Leaf loss later in the season has a greater effect on yield than early season losses. Leaf loss at or near the tasselling stage can be very damaging because no new leaves will develop from the growing point. Reduced assimilation of atmospheric carbon dioxide and production of carbohydrates to set and fill the grain results in lower grain

Table 2. **Estimated Percent Corn Yield Loss Due to Stand Reduction Occurring Through the Tenth-Leaf Stage of Growth***

Original Stand (x 1,000 /acre)	Remaining Stand (x 1,000/acre)																							
	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8
32	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
31		0	1	2	3	4	5	6	7	8	10	12	14	16	19	21	24	27	30	33	36	39	43	47	52
30			0	1	2	3	4	5	6	7	9	11	12	14	17	20	23	25	28	31	34	37	41	45	50
29				0	1	2	3	4	5	6	8	10	11	13	15	18	21	23	26	29	32	35	39	43	48
28					0	1	2	3	5	6	7	9	10	12	14	16	19	21	24	27	30	34	37	41	46
27						0	1	3	4	5	6	7	9	10	12	14	16	18	21	24	28	31	35	40	45
26							0	1	3	4	5	6	7	9	10	12	14	16	19	22	25	29	33	38	43
25								0	1	2	3	4	6	7	8	10	12	14	17	20	23	27	31	36	41
24									0	1	2	3	4	5	6	9	10	12	15	18	22	26	29	34	40
23										0	1	2	3	4	5	8	9	11	14	17	21	25	29	33	39
22											0	1	2	3	4	7	8	10	13	16	20	24	28	33	38
21												0	1	2	4	6	7	9	12	16	20	24	27	32	37
20													0	1	3	5	6	8	11	15	19	23	27	31	36
19														0	2	4	5	7	10	14	17	21	25	30	35
18															0	2	4	6	9	12	15	19	23	26	33
17																0	2	4	7	10	13	17	21	26	31
16																	0	2	5	8	11	15	19	24	29
15																		0	3	5	8	12	16	21	26
14																			0	3	6	10	14	18	23
13																				0	3	6	10	15	20
12																					0	3	7	12	17
11																						0	3	8	12
10																							0	4	8
9																								0	4
8																									0

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Table 3. **Estimated Percent Corn Yield Loss Due to Defoliation Occurring at Various Stages of Growth***

Stage of Growth	Percent Leaf Area Destroyed																		
	10	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
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

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yield. After grain is set and is being filled, however, the effect of leaf loss on yield is minimal. The corn plant can partially compensate for leaf loss late in the season by increasing the movement of dry matter and nutrients from the stalk into the developing ear.

To determine the estimated yield loss from defoliation, you must know both the stage of plant development at the time of defoliation and the estimated percentage of leaf area destroyed. To determine the stage of development, refer to Extension Bulletin E-1933, "How a Corn Plant Develops" ($2.25) or to E-1956, "Applying Herbicides According to Corn Growth Stages." Both of these bulletins are available from your county Extension offices. Use the same 1/1,000 acre areas and estimate the percentage of leaf area that is either missing or no longer green. Defoliation is 100 percent if no leaves are present on the plants.

Once you've determined the growth stage and percent defoliation, you can use Table 3 to estimate yield loss. The percent yield loss due to defoliation can be read directly from Table 3 if there is no reduction in stand. If a yield loss was determined for stand reduction, you must take this into account when estimating yield loss due to defoliation. Any yield loss due to stand loss reduces the estimate of yield loss due to defoliation. After all, if a plant is counted as dead, it makes no sense to reduce its yield because of defoliation. When stand is also reduced, the estimated yield loss due to defoliation *(Table 3)* is adjusted by multiplying the defoliation yield loss estimate by [(100 - stand reduction yield loss estimate)/100].

Example for Estimating Yield Loss Due to Defoliation

In the previous example, assume that 50 percent of the leaf area was destroyed and that plants were in the 10-leaf stage. The estimated loss due to defoliation is 6 percent (from Table 3). The estimated loss due to stand reduction was 10 percent, determined in our example for Table 2.

Percent loss due to defoliation adjusted for stand reduction
= 6% [(100 - 10)/100]
= 5.4%

Total estimated yield loss due to stand reduction and defoliation
= 10% + 5.4%
= 15.4%

Example 1: Corn was planted April 25 with 26,000 plants per acre emerged. A storm on May 31 reduced population to 18,000 plants per acre. The storm also caused 50 percent defoliation of the remaining plants. Should the farmer replant?

Assume:

1. Replant date = June 5.
2. Corn at 10-leaf stage on date of storm.
3. Replanting cost = $20/acre.
4. Anticipated corn yield before damage = 140 bushels/acre.
5. Anticipated corn price = $2.50/bushel.

FIELD NOT REPLANTED		FIELD REPLANTED	
expected loss due to:			
Reduced stand	10 %	Late planting [(1 bu/day x 35 days) ÷ 140]	25 %
Damaged leaves 6% [(100 - 10) ÷ 100]	5.4 %	Replant cost ($20 ÷ $2.50/bu ÷ 140 bu/a)	5.7 %
Total	15.4 %	**Total**	30.7 %

Decision is NOT to replant because yield loss associated with replanting is GREATER than yield loss associated with not replanting.

Economics of Replanting

Any yield loss from a damaged stand must be weighed against the yield loss from late planting *plus* the cost of the replant. A field cannot be replanted immediately after a storm because field operations are often delayed by wet conditions, and an accurate estimate of damage cannot be made for five to seven days.

When evaluating the economic

ther to Replant
amples

Example 2: Corn was planted May 5 with 25,000 plants per acre emerged. Cutworms reduced the population to 12,000 plants per acre on May 20. Should the farmer replant?

Assume:

1. Replant date = May 20.
2. Replanting cost = $18/acre.
3. Anticipated yield before damage = 120 bushels/acre.
4. Anticipated corn price = $2.60/bushel.
5. No further damage from cutworms is expected.

FIELD NOT REPLANTED		FIELD REPLANTED	
expected loss due to:			
Reduced stand	23 %	Late planting [(1 bu/day x 15 days) ÷ 120]	12.5 %
Damaged leaves	0 %		
		Replant cost ($18 ÷ $2.60 ÷ 120 bu) (bu / a)	5.8 %
Total	23 %	**Total**	18.3 %

Decision is to REPLANT because yield loss associated with replanting is LESS than yield loss associated with not replanting.

Use the Following Worksheet to Evaluate the Economics of a Decision to Replant.

FIELD NOT REPLANTED		FIELD REPLANTED	
expected loss due to:			
Reduced stand	____ %	Late planting	____ %
Damaged leaves	____ %	Replant cost	____ %
Total	____ %	**Total**	____ %

practicality of replanting, you need several items of information, including:

1. Plant population
   a. What was the initial or target population?
   b. What is the percent stand loss?
   c. What yield loss due to reduced stand is expected?
2. Defoliation
   a. How much leaf area on the remaining plants has been lost?
   b. What yield loss from loss of leaves is expected?
3. Planting date—for each day corn is planted after May 1, corn yield will be reduced by approximately 1 bushel/acre.
4. Anticipated yield and price of the crop.
5. Cost of replant—seed, fuel, chemicals, labor.

Considerations if Replanting

Several other considerations should be taken into account. These include herbicides already present, seed availability and additional fertilizer applications.

Herbicides

Herbicides applied to the original corn crop often limit the crops that can be replanted in the field that spring. Over 50 percent of the corn acreage in Michigan is treated with a triazine herbicide such as atrazine, simazine *(Princep)* or cyanazine *(Bladex),* which restricts replanting options to corn or sorghum and eliminates the opportunity to switch to soybeans or field beans. If herbicide programs are used that do not include triazine herbicides, however, replanting with soybeans or field beans may be an option. Table 4 gives details on replanting options with corn herbicides. Use this table as a guide for replanting, but always

Table 4. **Replant options with corn herbicides.**

HERBICIDE	REPLANT OPTION
Atrazine *(Aatrex, Atrazine)*	Corn, sorghum
Simazine *(Princep)*	Corn, sorghum
Cyanazine *(Bladex)*	Corn, sorghum
Alachlor *(Lasso)*	Corn, soybeans, field beans, sorghum
Metolachlor *(Dual)*	Corn, soybeans, field beans, sorghum
Butylate+ *(Sutan+/Genate+)*	Corn, soybeans*
EPTC *(Eradicane/Eradicane Extra)*	Corn, soybeans*
Dicamba *(Banvel)*	Corn
Pendimethalin *(Prowl)*	Corn**, soybeans

*A time interval between herbicide application and planting of three weeks for the 4 lb/A rate, five weeks for higher rates, is required.

**See the Prowl label for specific instructions on tillage prior to replanting.

consult the herbicide label for specific instructions and limitations.

Two questions often asked about herbicides and replanting are: should the field be tilled before replanting? And, should additional herbicide be applied? These questions are best answered on a case by case basis. Many herbicide labels contain specific instructions on replanting, so read herbicide labels and follow directions closely when replanting. Generally, the following guidelines will apply.

When replanting a field with the same crop, it is usually best to replant the field without any tillage. Replanting with minimum soil disturbance will help retain herbicide effectiveness. If the field must be reworked to prepare an adequate seedbed, till the field shallowly to minimize herbicide dilution in the soil.

Whether additional herbicide will be needed depends on the herbicide used and the length of time the herbicide has been in the field. Also, take care to avoid exceeding the maximum labeled rate for one growing season with any herbicide used. Herbicide labels often address this subject, and logic often dictates the best approach. For example, additional herbicide will probably not be needed, with more persistent herbicides, such as atrazine, especially if the field is not reworked. However, with less persistent herbicides, such as butylate *(Sutan+/Genate+)* or EPTC *(Eradicane/Eradicane Extra),* it may be necessary to apply additional herbicide for adequate grass control. In either case, fields should be monitored closely and cultivation or postemergence herbicides used if needed to maintain adequate weed control.

Seed

Replanting is often being considered at a date that is late for corn planting. If this is the case, switch to an earlier maturing hybrid than the one initially planted. Seed availability may be a problem, of course, especially if the same storm hit a large area. Be sure to locate seed of the desired hybrid before making the final replanting decision.

When planting late, there is no need to increase the seeded population. The recommendation for optimum planting dates should be followed—plant 10 percent more seed than the desired plant population. June 15 is the last day recommended for corn planting in most parts of Michigan.

Fertilizer

In most cases, the fertilizer applied to the initial crop will still be available for the replanted crop, and there should be no need to refertilize. Any planned sidedressing of nitrogen should still be done so the replanted crop receives the recommended rate of nitrogen fertilizer (see Extension Bulletin E-550, "Fertilizer Recommendations for Vegetable and Field Crops" ($1.00).

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