UK COOPERATIVE EXTENSION SERVICE
University of Kentucky – College of Agriculture

LEXINGTON, KY 40546

Corn & Soybean Science Group

Newsletter

Available online at: www.uky.edu/Ag/CornSoy

June, 2004
Volume 4, Issue 3
Editor: Dr. Chad Lee

Cooperating Departments:
Agronomy, Agricultural Economics, Biosystems and Agricultural Engineering, Entomology, Plant Pathology

In this Issue:

1. Determining Vegetative Growth Stages of Corn

Chad Lee, Agronomy

Knowing the growth stage of corn is critical to understanding the management practices and potential yield impact from wet weather and/or hail damage.

There are a couple methods for determining vegetative growth stages in corn. These different staging methods are used by different disciplines and often occur on different herbicide labels. Knowing the differences between these staging methods will help to reduce confusion when determining corn growth and development. These stages are determined either by the number of visible leaf collars or the number of leaves.

Collars and V-Stages

The collar is the part of the leaf that wraps around the sheath of the plant. A corn plant with one collar visible is at V1. The first leaf of the corn plant is usually oval-shaped, while all subsequent leaves will be longer and come to a sharper point. The V1 corn plant may have three or four leaves visible. However, only one collar is visible. Similarly a corn at V6 will have six collars visible. However, 8 or 9 leaves may be visible on the V6 corn plant.

Once the corn plant reaches V6, the stalk will grow rapidly. This rapid growth often tears some of the lower leaves and collars off of the plant, making staging more difficult. Vegetative stages can be determined at these later stages with some practice. Corn plants must be dug and the stalk split lengthwise through the roots. The first elongated internode is usually 0.4 inches in length. The first node above this internode is often connected to the fifth leaf (fifth collar). Once this node has been determined as a reference point, the remaining visible collars can be counted.

Leafs and Leaf Stages

Hail adjuster's determine vegetative stages by counting the number of leaves that are bending over. The last leaf to bend over is referred to as the indicator leaf. The first leaf of a corn plant likely will not be long enough to bend over, but each subsequent leaf will start to bend over. For example, a corn plant with the first leaf pointing upwards and the second leaf bending over is at the 2-leaf stage. Corn at the 2-leaf stage will have at least two more leaves that are visible. The third leaf and fourth leaves will be pointing upwards.

Just as with the collar method, determining leaf stage becomes more difficult when the lower leaves are torn away from the stalk. Follow the procedures discussed above to find the fifth leaf. Use the fifth leaf as a reference for counting the remaining leaves that are bending over.

Comparing the Methods

Because one method uses collars and the other uses an indicator leaf, the two stages do not equal each other. For example, V1 corn is usually equal to 2-leaf corn. However, V6 corn is usually equal to 8-leaf corn. Corn at the V12 stage is typically equal to 14-leaf corn.

Corn Development

The growing point on most corn hybrids will remain below ground until the V6 growth stage (8-leaf stage). By the V6 growth stage, tassel development and ear shoot development have both started. Once the corn reaches V6, the stalk will begin to grow rapidly. When the corn reaches V12 (usually 14- or 15-leaf), kernel number and size are being determined. When the corn reaches V15, it is passing through the most critical stage for yield determination. Once the corn reaches tasseling, it becomes the most susceptible to hail damage.

Any stress factors that occur during these phases of growth can impact yields. For this reason, many postemergence herbicides have restrictions against certain growth stages. Flooding, hail damage or weed flushes also can impact yields by stressing plants at these different growth stages.

Herbicide Considerations

The wet weather will prevent optimal timing of some postemergence herbicide applications. The wet weather may stunt corn growth, keeping height limits under herbicide label requirements. However, the stage of growth may be past the limit. Drop nozzles will need to be used in some cases. For more details on proper growth stages for herbicide applications, consult pages 38-39 of AGR-6, "Weed Control Recommendations for Kentucky Farm Crops 2004" as well as the respective herbicide labels.

2. Assessing Damaged Corn Populations

Chad Lee and Jim Herbek, Agronomy

Determining how many corn plants survived wet weather and/or hail damage will be one of the first steps taken to consider management options. The following information also occurs in the last newsletter regarding stand counts.

Estimated stand of surviving plants should be measured about 5 days after the weather event. Waiting 5 days should allow time for new growth to appear on the surviving plants. Multiple stand counts should be made in both injured and non-injured areas of the field. Use Table 1 to determine how long of a row to count to estimate plant stand. Compare the number obtained in Table 1 to the population numbers in Table 2 to help determine maximum yield. The information in Table 2 was obtained and adapted from the *National Corn Handbook,* NCH-30, "Guidelines for Making Corn Replanting Decisions" and is Table 5 in ID-139, "A Comprehensive Guide to Corn Management in Kentucky".

Table 2 should be viewed as a general guide. Most of the data in the table is averaged across the Midwest and may need adjustment for your particular area. For example, populations above 25,000 plants per acre should provide yields comparable to stands at 25,000 plants per acre based on Kentucky research.

Table 1. Estimating Corn Stand. Determine the length of row to count. Count the plants within that row. 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 areas and non-injured areas.

Row Width (inches)	Length of Row to Count	Number of Plants in Row	Multiplication Factor	Estimated plants / acre
38	13' 9"		x 1,000	
36	14' 6"		x 1,000	
30	17' 5"		x 1,000	
20	26' 2"		x 1,000	
15	34' 10"		x 1,000	

Table 2. Grain yields for various planting dates and population rates, expressed as a percent of optimum planting date and population rate (uniformly spaced within row).

Planting date	Plants per acre at harvest						
	12,000	14,000	16,000	18,000	20,000	22,500	25,000
	(% of optimum yield)						
May 6	78	83	88	92	95	98	100
May 11	77	83	88	92	95	98	99
May 16	75	81	86	90	93	96	98
May 21	73	78	83	87	91	94	95
May 26	69	75	80	84	87	90	92
May 31	64	70	75	79	82	85	87
June 5	59	64	69	73	77	80	81
June 10	52	58	63	67	70	73	75

3. Assessing Corn Hail Damage

Chad Lee, Agronomy

Assessing hail damage on corn requires a knowing several factors, such as the growth stage, leaf area destroyed and surviving stand.

Growth Stage

See the related article in this newsletter for determining growth stages. The growing point usually begins to move above ground as corn approaches the V6 growth stage. Corn is highly tolerant to hail damage at these early stages of growth. As the growing point moves above ground and the corn plant gets closer to tasseling, it becomes more susceptible to hail damage. Corn is most susceptible to hail damage just prior to tasseling through early milk. Once corn passes through the early milk stage, it becomes more tolerant to hail damage.

Percent Leaf Area Destroyed

Estimate the amount of leaf material that is missing or no longer green. Shredded leaves that are still green are considered viable. Any green leaf material should not be counted as destroyed. Refer to Table 1 to estimate yield losses. Table 1 is adapted from the National Crop Insurance Association's "Corn Loss Instructions" (Rev. 1984). The entire table can be found in a Nebraska Extension publication (Vorst, 1986). The 8-leaf stage as determined by a hail adjuster is usually equal to a V6 leaf stage (six collars visible), whereas the 10-leaf stage is usually equal to V8 corn. The

numbers in Table 1 assumes that the corn population was not reduced by hail.

For farmers raising corn for silage, the actual yield losses may be slightly less than the estimated yield losses for grain yield. Corn damaged at early stages will have the opportunity to produce more leaves and add to the total dry matter yields.

Table 1. Estimated percent yield loss occurring from defoliation.

	Percent Leaf Area Destroyed									
Growth Stage*	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
7-leaf	0	0	0	1	2	4	5	6	8	9
8-leaf	0	0	0	1	3	5	6	7	9	11
9-leaf	0	0	1	2	4	6	7	9	11	13
10-leaf	0	0	2	4	6	8	9	11	14	16
11-leaf	0	1	2	5	7	9	11	14	18	22
12-leaf	0	1	3	5	9	11	15	18	23	28
13-leaf	0	1	3	6	10	13	17	22	28	34

*Hail adjusters' method for staging corn. (8-leaf stage is usually similar to V6 corn, where 6 collars are visible).

Estimating Population

Reductions in corn stand may reduce yields. For most of Kentucky, stands ranging from 22,000 to 30,000 plants/acre are ideal. Stands below 22,000 plants/acre will cause yield reductions in most cases. The article "Assessing Damaged Corn Populations" in this newsletter provides more details regarding stand assessment.

Tied Whorls and Silking

Corn plants damaged by hail early in the season usually recover from tied whorls and bruised stalks. The corn will usually grow through these tied whorls within 3 or 4 weeks (Mangen and Thomison, 2000). Stalk bruising had little impact on lodging. Silking will be delayed on severely damaged corn plants. Corn from V5 through V7 that received 100% leaf damage from hail had a 1 to 1.5 week delay in silking compared with plants that received 80 to 90% leaf damage.

Final Thoughts

Hail damage early in the growing season almost always looks worse than it really is. Wait about five days before making any kind of stand assessment. If replanting does become necessary, then switch to an earlier hybrid.

References:

Vorst, J. J. 1986. Assessing Hail Damage to Corn, G86-803-A: http://ianrupus.unl.edu/fieldcrops/g803.htm

Mangen, T. and P. Thomison, 2002. Early season hail damage in corn: effects of stalk bruising and tied whorls. Agronomic Crops Team On-Farm Research Projects 2000. Special Circular 179-01. http://ohioline.osu.edu/sc179/sc179_16.html

4. Corn Flood Survival

Chad Lee, Agronomy

Corn in some fields across Kentucky were completely submerged for several hours to several days. The question now is whether or not these plants will survive. When soil temperatures are in the higher 70's F, then corn will survive about 24 hours of submersion (Thelen, 2001). Corn can survive submerged conditions for up to four days in cooler soil temperatures. Water over the top of corn for a few hours likely will do little harm to the crop.

Corn that was submerged may show yellowing and/or stunting symptoms. These symptoms are likely due to an inability to uptake N in saturated conditions (Nafziger, 1998). These symptoms are prolonged even after water has receded from the field because the soils will remain saturated. The length of time required for the soil to dry out, and allow oxygen back into the root zone will affect the rate of recovery. Mud and other debris on the corn can delay recovery as well.

To determine if the corn is surviving, select several plants and cut down the length of the stalks to the growing point (at or below the soil surface on V6 and younger corn). Healthy growing points will be white or cream-colored. Darkening and/or flaccid growing points indicate death of the growing point and the plant. The darkening or flaccid growing points will not occur for several days after the flooding.

Surviving plants could suffer a yield loss from flooding conditions. The lack of oxygen experienced by the plant could stunt root and shoot development during critical stages of development. The stage of growth affected by the flooding event could affect ear development (usually V6 corn) or kernel size and number (usually V12 corn). As mentioned earlier, the yellowing and stunting often are result of a lack of N. This does not mean that all the N has been removed from the soil, but that the corn cannot take up N in saturated conditions. Much of the N is still available to the corn once the soils dry out. See the article on "N Losses in Wet Soils" for more information about N management options following a flood.

References:

Nafzinger, E. 1998. Water- and wind-damage corn. Illinois Pest and Crop Development Bulletin. No. 15. http://www.ag.uiuc.edu/cespubs/pest/articles/v9815g.html

Thelen, K. 2001. Managing corn and soybean fields submerged by recent heavy rains. Field Crop Advisory Team Alert. Vol. 16 no. 6. http://www.ipm.msu.edu/CAT01_field/FC05-17-01.htm

5. Estimating N Losses from Wet Soils

Greg Schwab and Lloyd Murdcok, Agronomy

How much N was lost from corn fields which were fertilized before the heavy rains? Because of the high intensity of the rain (high runoff), leaching losses will probably be low. Therefore, the main N loss mechanism to be concerned with is denitrification, which occurs when soil nitrate is converted to nitrogen gas by soil bacteria. Well drained upland soils which have been wet from a series of rains probably have not experienced much denitrification because it takes 2-3 days of saturation for the bacteria to begin the process. For lower landscape positions that stay saturated for less than five days, the amount of N lost is still not as great as one might assume. Applications up to an additional 50 lb N/acre is the most economical in these situations.

If the soil says saturated for an extended period, you can calculate the amount of N lost. First, estimate the amount of applied N that was in the NO_3-N form when the flooding occurred (Table 1). Second, assume that 3 to 4 % of the NO_3-N is lost by denitrification for each day of saturation beyond 2 days. Table 1 and the example below will help with calculations

Table 1. Estimated NO_3-N remaining after fertilizer application.

N Source	% of Fertilizer as NO_3-N Weeks After Application		
	0	3	6
Anhydrous Ammonia (AA)	0	20	65
AA with N-Serve	0	10	50
Urea	0	50	75
Urea with N-Serve	0	30	70
UAN (solution 28 and 32%)	25	60	80
Ammonium Nitrate	50	80	90

Example

A farmer applied 175 lbs N/acre as urea to corn grown on poorly drained soil. Three weeks after application due to a series of heavy rains, the field became saturated and remained saturated for 7 days. How much N was lost?

Step 1. Determine the amount of applied N in the nitrate form. According to the table, 50% of the urea will be in the NO_3 form 3 weeks after application. 175 x 50% = 88 lbs N.

Step 2. Determine the amount of nitrogen lost. Remember that it takes approximately 2 days for the bacteria to begin growing – therefore denitrification occurred for 5 days. With 4% lost each day, 20% would have been lost. 88 lbs x 20% = 18 lbs N lost.

From this example, the N loss is probably not as high as one might think. A soil N test can verify this estimation. The sample should be taken to a depth of one foot in several locations within the field. The samples should be mixed well and a subsample sent for nitrate analysis. If NO_3-N is 0-10 ppm, a full rate of N for the crop should be added. At 25 ppm, no additional N would be needed. One would extrapolate between these two figures, keeping in mind the amount of NH_4-N left in the soil from the first application based on the calculations made using the table above.

Nitrogen Broadcast Prior to Rain

Some farmers broadcast nitrogen fertilizer on some fields within 24 hours of the heavy rains. How much of this was lost by run-off? In most cases, it is not much, especially if it was no-till. The nitrogen begins to dissolve almost immediately after being applied to the soil surface and will dissolve in

a short period of time. Water from the first part of the rain moves into the soil, taking most of the fertilizer with it. Once in the ground, most of the fertilizer is protected from runoff. The only exception would be a very intense rain soon after application that erodes topsoil from the slopes. Even with minor erosion, the loss would probably be less than one third of that applied.

6. Delayed Corn Planting Could Increase Several Diseases

Paul Vincelli, Plant Pathology

If the recent wet weather resulted in a delay in planting corn or a replanting of corn, be aware this could result in increased outbreaks of several diseases.

1. The "virus complex". This is caused by infections of maize dwarf mosaic virus and maize chlorotic dwarf virus, viruses which overwinter in johnsongrass rhizomes and which are spread by aphids and leafhoppers, respectively. Compared to corn planted on time, late-planted corn is at an earlier stage of crop development during periods of peak vector activity. Earlier infection of corn usually results in more severe disease symptoms. Also, research by UK entomologists has shown that vector populations can be higher on late-planted corn.

2. Fungal diseases of foliage. Several leaf diseases, especially gray leaf spot may be more severe where corn is planted late. This risk is especially high for fields in continuous no-till corn. Late-planted crops will be at a comparatively earlier stage of development during periods of high spore activity if weather is conducive for these diseases. Leaf infection early in plant development will reduce yields by decreasing photosynthetic capability and will increase susceptibility to stalk rots.

3. Fungal ear rots. Growers who plant full-season hybrids for grain production (maturing in 120-130 days) after June 1 increase the risk of fungal ear rots, because ears may not have sufficient time to dry adequately before harvest. Planting a shorter-season hybrid after June 1 helps assure maturity before frost and a lower grain moisture content at harvest. Also, fall armyworm can be more severe on late-planted corn. Feeding by this insect in the ear can increase the incidence of ear rot diseases by providing wounds allowing fungal invasion.

4. Fungal stalk rots. Increased stalk rot diseases could result from delayed planting. The shorter daylength and drier weather late in the season both may favor stalk rots, as these can result in decreased carbohydrate levels in the stalk and more plant stress, which can favor infection.

Growers who are still looking to plant should seek hybrids with resistance to these diseases. This is particularly important for mid-season hybrids (maturing in 108-120 days) and short-season hybrids (maturing in less than 108 days), which are recommended if planting is delayed beyond June 1. Disease resistance is not as common in mid-season and short-season hybrids as in full-season hybrids. So growers are advised to be sure mid- and short-season hybrids have resistance to the above diseases, particularly since they could become more severe than normal.

7. Corn Herbicides Affect Replanting Options

J. D. Green and Jim Martin, Agronomy

A significant consideration before replanting corn or an alternative crop following corn losses due to flooding is that herbicides have already been applied to corn fields. In most years, soil-applied herbicides containing atrazine have been the primary concern when replanting to grain sorghum or soybean. However, in some cases where a postemergence treatment has been applied to corn, several of these herbicides can cause significant injury to the alternative crop. Table 1 includes corn herbicides and the potential risk associated with replanting corn, grain sorghum or soybean. Consult the label of herbicide products used for more details on crop rotation limitations.

Table 1. Risk potentials for crop replanting following use of corn herbicides.

Herbicide	Risk Potential and Minimum Waiting Period* Before Replanting		
	Corn	Grain Sorghum	Soybean
Accent	No Risk	High: 10 months; 18 months if soil pH >7.5	Slight: 14 days
Accent Gold	No Risk	High: 12 months	High: Wait 10.5 months; 18 months under dry conditions and less than 2% O.M.
Aim	No Risk	No Risk	No Risk
Atrazine	No Risk	No Risk	Moderate Risk; Slight Risk in River Bottoms following a flood.
Basis Gold	No Risk	High: 10 months	High: 10 months
Beacon	Slight: Clearfield hybrids may be replanted immediately; 14 days for other field corn hybrids	High: 8 months	High: 8 months
Bicep II Magnum, Cinch ATZ	No Risk	No Risk; Plant sorghum treated with a seed safener	Moderate Risk
Callisto	No Risk	High: 10 months	High: 10 months
Celebrity Plus	Slight: 7 days	High: 10 months; 18 months if soil pH > 7.5	Moderate: 4 months
Dicamba [Clariety, Banvel, etc.]	No Risk	Slight to Moderate: 15 days to 4 months depending on rate	Slight to Moderate: 15 days to 4 months depending on specific product, use rate, and rainfall
Distinct	Slight: 7 days	Moderate: 4 months	Moderate: 4 months
2,4-D	Slight: 7 days	Slight to Moderate: 3 months	Slight: 7 to 30 days depending on amount used
Equip	Slight: 15 days	High: 9 months	High: 9 months
Exceed	Slight: 1 months, Clearfield hybrids may have more tolerance than regular hybrids	High: 10 months	High: 10 months, STS-soybean varieties have more tolerance
Expert	No Risk	No Risk: plant sorghum treated with a seed safener	Moderate Risk
Glyphosate (Roundup, Touchdown, etc.)	No Risk	No Risk	No Risk
Gramoxone Max	No Risk	No Risk	No Risk
Harness Xtra, Degree Xtra, FulTime, Keystone	No Risk	Moderate Risk	Moderate Risk
Hornet WDG	No Risk	High: 12 months	High: 10.5 months; 18 months under dry conditions and less than 2% O.M.
Liberty (LL-corn only)	No Risk	Slight: 70 days	No Risk
Liberty ATZ (LL-corn only)	No Risk	Moderate Risk	Moderate Risk
Lightning (Clearfield corn only)	High risk for conventional corn, Roundup Ready corn, and Liberty Link corn (8.5 months); Clearfield corn may be planted anytime	High: 18 months	Moderate: 9 months
Lumax	No Risk	High: 10 months	High: 10 months
Marksman, etc.	No Risk	No Risk	Moderate Risk
Option	Slight: wait 7 days	Moderate: 2 months	Slight: 14 days
Permit	Slight: 1 month; Clearfield hybrids may be replanted anytime	Moderate: 2 months	High: 9 months
Princep	No Risk	Moderate Risk	High Risk
Prowl	High Risk	High Risk	No Risk
ReadyMaster ATZ	No Risk	No Risk	Moderate Risk
Spirit	Slight: 1 month, Clearfield hybrids may have more tolerance than regular hybrids	High: 10 months	High: 10 months, STS-soybean varieties have more tolerance
Steadfast	No Risk	High: 10 months, wait 18 months if soil pH >7.5	Slight: 15 days
Steadfast ATZ	No Risk	High: 10 months	Moderate: 10 months

* Waiting period is defined as the time between herbicide application and replanting.

8. Corn Hybrid Decisions for Replanting

James Herbek, Agronomy

Late planted corn will not result in optimum yield potential. There is a 1 to 2% per day yield loss for corn planted after early to mid-May. Thus, corn plantings made in early to mid-June can result in yield losses of 20 to 40%.

Late planted corn will have a shorter growing season and growers should switch to hybrids of earlier maturity to avoid the risk of fall freeze injury to immature corn. Although the yield potential for late, medium, and early maturity hybrids is very similar for plantings made in early June or later, there will be differences in grain moisture content among the hybrid maturities as planting is delayed. A switch to earlier maturity hybrids will reduce grain drying costs at harvest.

Bt hybrids should be planted after mid-May in Kentucky to reduce corn borer infestations, reduce lodging and minimize yield losses from late plantings.

For early to mid-June plantings, hybrid maturities of 113 to 116 days are still probably "safe" to use. For plantings made after mid-June, hybrid maturities of 110 to113 days or less are "safest" for most of Kentucky.

Chad D. Lee, Grain Crops Extension Specialist

Cooperative Extension Service
University of Kentucky
Department of Agronomy
Ag Distribution Center
229 Stadium View Road
Lexington KY 40546-0229

Official Business