

IOWA STATE UNIVERSITY  
University Extension



## FIELD GUIDE



*A reference for identifying  
diseases, insect pests,  
and disorders of corn.*

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**Note:** Information in this guide may be specific to Iowa. Those using the guide from outside Iowa should check with their extension service for local recommendations.



# CORN PRODUCTION

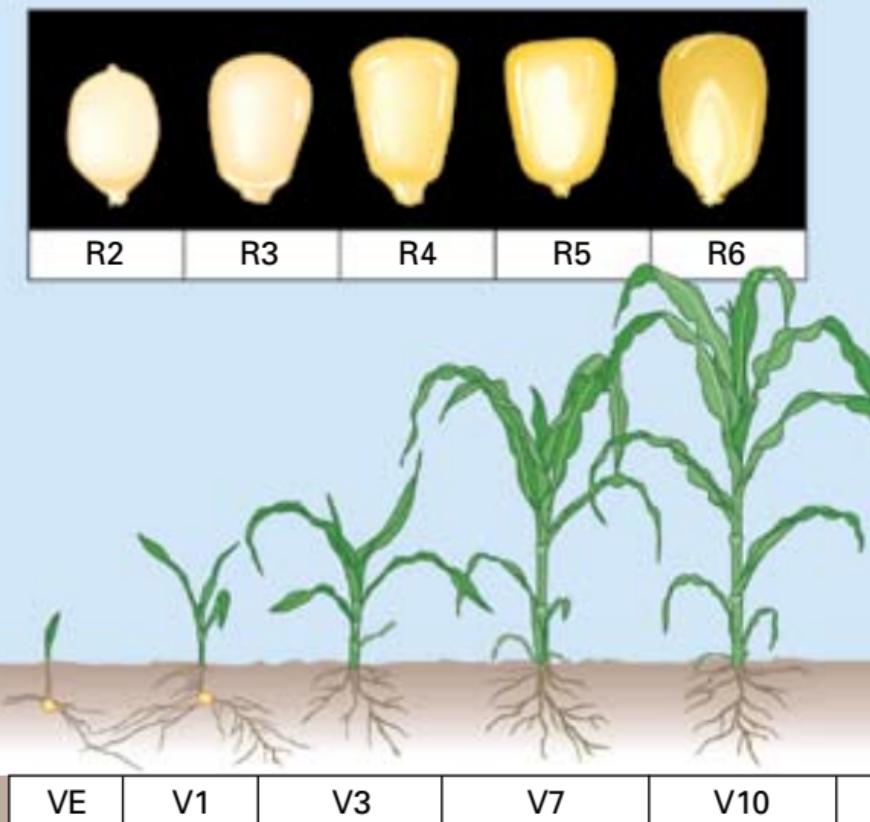
*Maximizing corn yields and grain quality demands proper in-season diagnostic and management skills.*

# DEVELOPMENTAL STAGES

Vegetative and reproductive stages are determined on a whole-field basis when at least 50 percent of the plants have reached or are beyond a particular stage.

## Vegetative stages

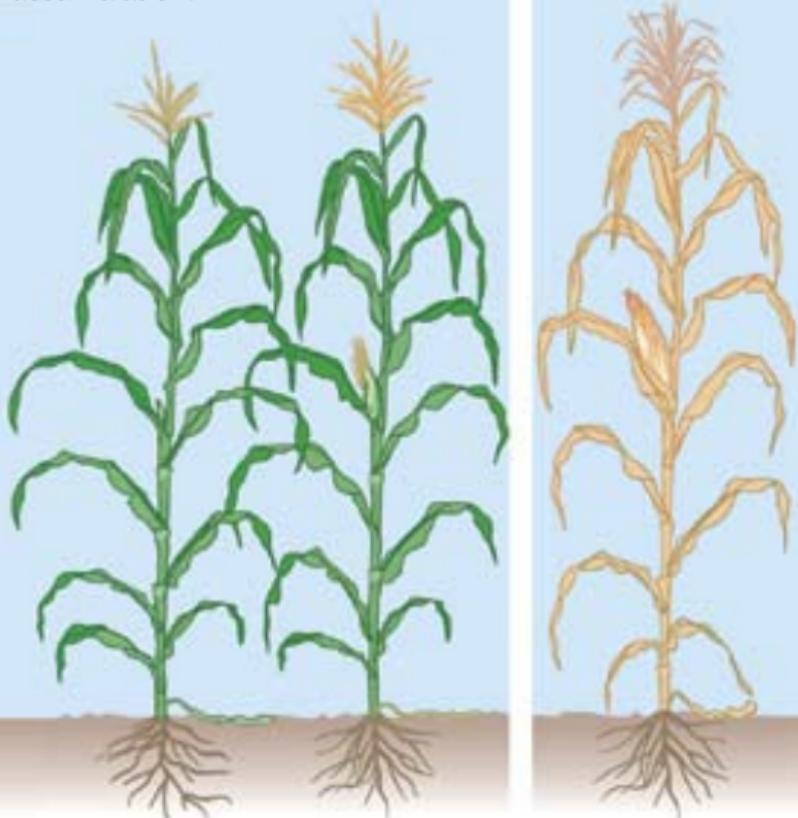
- **VE:** emergence of the shoot from the soil.
- **V1:** lowest leaf has a visible collar; this leaf has a rounded tip, unlike subsequent pointed leaves.
- **V2:** two lowest leaves have a visible collar.
- **V(n):** “n” leaf collars present; there are 17 to 22 V stages before tassel emergence.
- **VT:** lowest branch of the tassel is visible, but silks have not emerged.



Source: Pocket Guide to Crop Development © 2003 University of Illinois.

## Reproductive stages

- **R1 (silk):** any silk is visible.
- **R2 (blister):** kernels are small and white; the endosperm (kernel fluid) is clear.
- **R3 (milk):** kernels are yellow with milky white fluid.
- **R4 (dough):** kernel contents are pasty as starch accumulates.
- **R5 (dent):** most kernels are dented due to the starch hardening at the top of the kernel. As maturity progresses, the starch hardens and the milk line moves toward the cob.
- **R6 (black layer or physiological maturity):** the milk line is no longer visible; a black layer forms at the kernel's attachment, which signifies the end of dry matter accumulation.

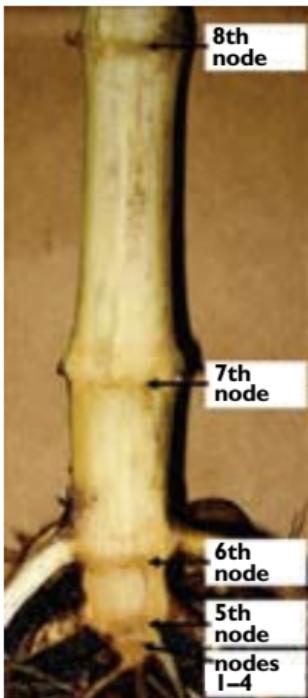
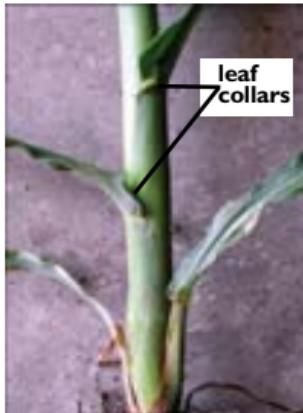


VT	R1		R6
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## **Leaf collar method for determining vegetative stage**

Vegetative (V) stages are determined by the total number of leaves with visible collars (e.g., a plant with three visible leaf collars is at V3). A collar is the off-white band at the base of the leaf blade where it extends away from the stalk. A new leaf appears every three to four days with good growing conditions until tasseling.

As the plant grows, lower leaves are lost. These leaves must be counted; otherwise, the development stage will be misidentified. Split stalks to accurately determine the leaf stage. Each leaf is attached to a single node, and nodes are visible as lines across the split stalk. The first four nodes are usually indistinguishable within the crown. The fifth node is about one-half inch above the area that contains the first nodes. The node corresponding with the uppermost leaf with a visible collar defines the vegetative stage.



## **Stress effects at key growth stages**

**V6:** The growing point is above ground. Ear shoots and tassel are initiated (visible with a hand lens). The potential row number (ear girth) is determined and, although strongly influenced by genetics, can be reduced by stress.

**V12–VT:** Potential kernels per row (ear length) are determined but can be reduced by stress.

### **Emergence of the ear**



**Late vegetative** ————— ► **R1** ————— ►

**R1:** Silks emerge and stress (especially drought) can interfere with pollination. Stress is most yield limiting at this stage compared to other growth stages.

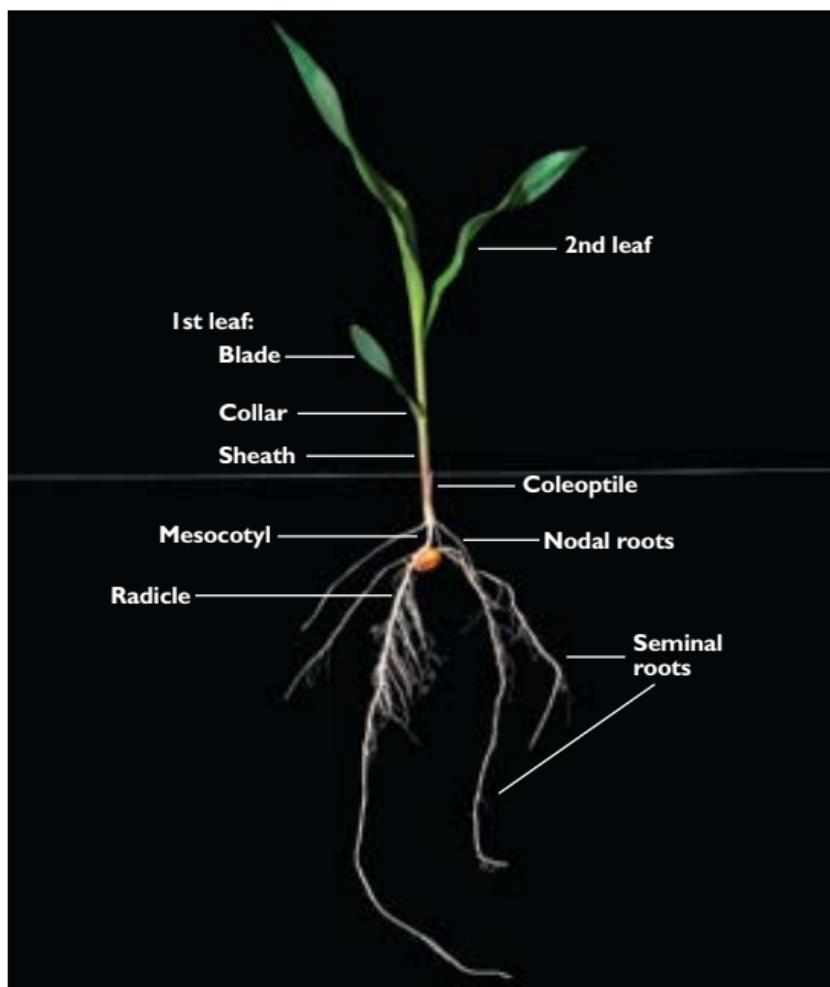
**R2–R3:** Stress causes kernel abortion starting from the ear tip. Severity of stress will determine the extent of kernel loss.

**R4–R5:** Kernel moisture declines as starch content increases. Stress typically reduces kernel weight.

**R6:** A black layer forms at the kernel's attachment, blocking movement of dry matter to the kernel. Stress has no yield effect unless plants lodge or ears are damaged, e.g., from high winds or insect feeding.

# ROOT SYSTEMS

Corn has two identifiable root systems, seminal and nodal. The initial (seminal) root system helps anchor seedlings and provides nutrients and water for early plant growth. The secondary (nodal) root system forms where the mesocotyl and coleoptile meet. The nodal root system is visible by approximately V2 and becomes dominant by V6. Seeds should be planted approximately two inches deep for proper nodal root formation.



# DEGREE DAYS

Corn development can be predicted by tracking degree days (DD), which measure heat accumulation based on daily air temperatures. For example, shoot emergence occurs when approximately 125 DD accumulate after planting. The base temperature for corn development is 50°F. Development of some insect species also may be predicted by using degree days, but the base temperature may differ (page 26).

## **Estimate daily heat accumulation for corn:**

- Collect the daily high and low air temperatures and adjust (if necessary) for the base (50°F) and maximum (86°F) temperatures. If the low is under 50°F, use 50°F to calculate DD for that day. If the high exceeds 86°F, then use 86°F to calculate DD.
- The average of the adjusted high and low temperatures minus the base temperature equals the daily DD accumulation.
- Add DD gained for each day to estimate the accumulated DD over time.

### ***Example of calculating degree days***

**Day 1:** the high temperature is 80°F and the low is 55°F.

**Day 2:** the high temperature is 66°F and the low is 40°F (change 40 to 50 in the equation).

**Day 3:** the high temperature is 92°F and the low is 72°F (change 92 to 86 in the equation).

**Calculation for Day 1:**  $[(80 + 55)/2] - 50 = 17.5 \text{ DD}$

**Calculation for Day 2:**  $[(66 + 50)/2] - 50 = 8 \text{ DD}$

**Calculation for Day 3:**  $[(86 + 72)/2] - 50 = 29 \text{ DD}$

**Total for three days:**  $17.5 + 8 + 29 = 54.5$  (round up) = 55 DD

# PRODUCTION DECISIONS

## Seeding rate

Optimal seeding rates vary in Iowa from 28,000 to 42,000 seeds per acre based on specific field conditions, genetics, and environments. Generally, a seeding rate of 35,000 seeds per acre will maximize yield. Reduce seeding rates if water is limiting or if soil conditions are poor.

## Planting date

- Corn should be planted when soil temperatures are near 50°F and are expected to rise. In soils below 50°F, seeds readily absorb water but will not initiate root or shoot growth. This may lead to increased early season diseases, insect feeding, and herbicide injury if poor seedbed conditions persist. Therefore, it is better to wait until seedbed conditions are suitable for planting to ensure good germination and seedling establishment.
- Ideally, the best time to plant in Iowa is approximately April 20 to May 5.
- Yields are reduced more when corn is planted too late rather than too early. If you do not plant in the optimum April 20 through May 5 window, consider that yields are generally reduced less from plantings 10 days before the optimum period than 10 days after. Yields increasingly drop off once planting is delayed past mid-May.
- Consider changing to shorter maturity hybrids if planting is delayed until early June.

## **Estimating population**

- Measure 1/1,000 of an acre (the table below is a guide for the length of row needed).
- Count the number of plants in the measured area.
- Count in at least six representative places across the field. Do not intentionally avoid areas in rows with gaps; include these in areas assessed.
- Multiply the average number of plants by 1,000 to obtain the final plant population per acre.

**Feet of row representing 1/1,000 of an acre at different row widths**

<b>Row Spacing</b>	<b>Row Length</b>
15"	34' 10"
20"	26' 2"
30"	17' 5"
36"	14' 6"
38"	13' 9"

## **Replant decisions**

Replanting may be necessary following seedling damage or loss caused by early season diseases, prolonged cold soils, frost, flooding, hail, or insect damage. Two scenarios typically exist in fields with problematic stands:

- non-uniform emergence resulting in different plant heights or developmental stages
- a significantly lower population than desired

Typically, replanting is beneficial only with reduced plant populations, not with uneven emergence. To decide whether to replant:

- Estimate the remaining plant population (page 11). Do not count plants in the affected area that are severely injured.
- Calculate expected yield from the existing stand (table below).
- Compare yield potential of the replanted crop with the potential yield of the existing crop.
- Estimate replant costs. Replant costs include tillage, seed, fuel (for tillage and planting), additional pesticides, labor, etc. The probability of fall frost damage to late planted corn also is greater. Consider shorter maturity hybrids in very late replant situations.

**Relative yield potential of corn by planting date and population**

Population (Plants/Acre)	Planting Date				
	April 20– May 5	May 5– May 15	May 15– May 25	May 25– June 5	June 5– June 15
Percent Maximum Yield					
45,000	97	93	85	68	52
40,000	99	95	86	69	53
35,000	100	96	87	70	54
30,000	99	95	86	69	53
25,000	95	91	83	67	51
20,000	89	85	77	63	48
15,000	81	78	71	57	44
10,000	71	68	62	50	38

**Note:** Values based on preliminary Iowa research and modeling;  
100% yield potential is estimated to occur with 35,000 plant population  
and early planting.



*Typically, replanting is beneficial only with reduced plant populations (top), not with uneven emergence (bottom).*

## Estimating yield potential

Yields can be estimated starting at R2, but the accuracy will vary depending on actual kernel weight. Yield is overestimated in fields with poor grain-fill conditions and underestimated in fields with above average grain-fill conditions.

- Estimate the number of harvestable ears per 1/1,000 acre (page 11 for length of row needed).
- Count the number of rows of kernels per ear on every fifth ear in the measured section and calculate the average.
- On these ears, count the number of kernels per row and calculate the average.
- Estimated yield (bushels per acre) = (number of harvestable ears  $\times$  number of rows per ear  $\times$  number of kernels per row) divided by 90.
- For more accurate estimations, repeat this process several times in a field.



Sixteen rows per ear



Forty kernels per row



## Cutting silage

In a typical season, chop corn at about 60 to 70 percent moisture (60 to 65% for upright silos and 65 to 70% for bunker silos and silage bags where packing is more difficult). Corn will be approximately at R5, between  $\frac{1}{3}$  and  $\frac{2}{3}$  milk line.

Corn that is chopped when it is too wet will lose nutrients through seepage. Corn that is chopped when it is too dry is difficult to pack, which allows oxygen to enter and disturb fermentation. This enables yeasts and molds to grow and increases heating.

Frost may force the decision to harvest corn as silage with late maturing hybrids or late plantings. If frost comes during the  $\frac{1}{3}$  to  $\frac{2}{3}$  milk line period, the whole-plant moisture content should be sufficient for normal ensiling.

Using a commercial laboratory to test the silage moisture is always ideal but is most critical with corn that has died prematurely.

## Dry down after black layer

Kernel moisture is about 30 percent at R6. Then, drying rates are normally 0.4 to 0.8 percent moisture per day. Ideal harvest moisture for field corn is 15 to 20 percent, which typically occurs 2 to 4 weeks after R6. The rate of dry down when estimating time to harvest depends on the following:

### Weather

- Cool, wet weather can lower daily drying rates to less than 0.3 percent per day.
- Warm, dry weather can raise daily drying rates to 1 percent per day.

### Hybrid

- Late maturing hybrids dry slower than early maturing hybrids.
- Hybrid traits associated with faster drying include thinner, fewer, and loose husk leaves; ears with tips that protrude beyond the husks; early ear drop from an upright position; and thinner, more permeable seed coats.

### Planting date

- Late planted corn dries slower than early planted corn.

### Field harvest losses

Adjust harvest equipment to minimize grain loss.

Two kernels per square foot left behind the combine represents one lost bushel per acre. One full ear lost per 1/1,000 acre represents 6 to 7 bushels per acre left in the field. Losses can be considerable in lodged or hail-damaged fields.

A photograph of a man in a white shirt and blue overalls standing in a field of young corn plants. He is holding a red clipboard and looking down at the plants. The field is lush and green. In the top right corner of the image, there is a vertical black bar containing the letters "IPM".

IPM

# INTEGRATED PEST MANAGEMENT

*Integrated pest management (IPM) protects crops through assessment of disease and insect risks. IPM emphasizes scouting and detailed record keeping and may include the use of thresholds based on specific field and environmental information.*

# SCOUTING

## Scouting for corn injury and pests

### Examine problem area

- Is the problem scattered randomly through the field or occurring in a pattern?
- Is the problem more prevalent at a field entrance or along a fence, field edge, or waterway?
- Is the damage more severe in low areas or on exposed slopes?
- Does the pattern correspond to planting, spraying, or other field activities?

### Check individual plants for symptoms and signs

Compare damaged plants with healthy plants. Check the entire plant, including leaves, stems, roots, and internal tissues for feeding injury or disease symptoms. A small hand lens, a pocket knife, and a shovel are valuable tools.



Washing roots to estimate insect damage

## Gathering information

### Check the prevalence and severity of the problem

Damage from diseases and most insects progresses with time. If most of a field is affected uniformly at the same time, the problem may not be a disease or insect. Herbicide injury development rate may vary depending on the herbicide involved and environmental conditions.

### Check plant species affected

Several insects and many diseases are specific to corn or closely related plants. Similar symptoms appearing on different crops or weeds in the same area may suggest a non-biological problem, such as herbicide injury.

Answer these questions when scouting weed problems:

- Is there only one weed species that is not controlled or are there several different species present?
- Are some plants of a weed species not affected by a herbicide application, while other plants of the same species are controlled?
- Are uncontrolled plants of the same species all of similar size and growth stage?

### Consider specific pest monitoring

Some insect pests can be monitored using pheromone traps.



Checking a pheromone-baited trap

## **Consider time of year**

Some diseases and insects appear at different, yet often predictable, times during the season. In general, scouting for insects is based on the time of year and crop development stage, but scouting for many diseases is based primarily on the developmental stage of the crop.

## **Consider recent weather**

Environmental stresses may damage corn directly or make it more susceptible to certain diseases, insects, or herbicide injury.

## **Collect background information for the field, such as:**

- Previous crops
- Previous insect, weed, and disease problems
- Planting date, depth, and seedbed conditions
- Hybrid information, including resistance to insects, diseases, and herbicide tolerance
- Chemicals used on or near the crop including herbicides, fertilizers, fungicides, and insecticides; indicate when applied, how applied, rate of application, and weather conditions during and following application
- Additives and adjuvants used on the crop
- Current soil-test information (e.g., soil fertility, pH)
- Soil moisture and compaction
- Topography of the field
- Recent weather events
- Adjacent crop and non-crop areas

# DIAGNOSTIC CLINIC

## ISU Plant and Insect Diagnostic Clinic

If you are unsure of the cause of the problem, symptomatic corn can be sent to the Iowa State University Plant and Insect Diagnostic Clinic. Weed and insect samples also can be sent in for identification.

ISU Plant and Insect Diagnostic Clinic

327 Bessey Hall, Ames, IA 50011

E-mail: [sickplant@iastate.edu](mailto:sickplant@iastate.edu)

Web site: [www.plantpath.iastate.edu/pdc](http://www.plantpath.iastate.edu/pdc)

Phone: 515-294-0581

### Submitting plants

- Provide plenty of fresh material. When possible, send the entire plant, including roots and top growth. Stalks can be folded to fit the entire plant into a box. Include enough plant material to show a range of symptoms.
- Provide appropriate background information for the field (pages 19 and 20).
- Include photos when possible.
- Wrap specimens in dry paper towels or clean newspaper (do **not** add moisture).

### Submitting insects

- Collect multiple (6–12) intact specimens of all available life stages, not just body parts.
- Include intact plant material showing typical damage, packed as described above.
- Place hard-bodied insects (e.g., beetles, grasshoppers) in plastic bags, pill bottles, or vials.
- Place soft-bodied insects (e.g., caterpillars, aphids) in a vial with rubbing alcohol or hand sanitizer.
- Submit insect samples in a padded mailer or box.

## **Submitting soil samples for corn nematode testing**

Soil samples can be taken any time from mid-July to early October. In Iowa, the greatest number of corn nematodes typically are found midseason.

- Collect a soil core or  $\frac{1}{4}$  cup of soil (a subsample) from 10 to 20 different locations within an area no larger than 20 acres using a soil sampling probe, hand trowel, or shovel.
- Sample in a zigzag pattern taking care not to sample only from areas of severely damaged plants.
- Collect soil from the top 12 inches.
- Combine all subsamples in a bucket and mix thoroughly.
- Place approximately 1 to 2 pints of mixed soil into a plastic bag or paper soil-test bag, then seal and label with a permanent marker.
- Store samples in a cool, dark place until shipping.



*Collecting soil samples during the season*

# FUNGICIDE DECISIONS

Fungal foliar diseases can be managed with resistant hybrids, crop rotation, tillage, and foliar fungicides. The decision to apply a fungicide to manage a disease should be based on disease identification, developmental stage at which disease occurs, and the current and forecasted weather. Most fungicides approved for use on corn in Iowa are either strobilurins or triazoles. Some premix products contain a combination of the two.

## **Considerations before using a foliar fungicide:**

- Cropping history and percent surface crop residue affect the risk of disease. Many pathogens survive in crop residue, which can be a source of inoculum.
- Disease presence before or at stage VT may result in greater yield loss than disease that occurs later during grain fill.
- Hybrids vary in their susceptibility to foliar diseases.
- Development of many foliar diseases is favored by warm, wet weather.
- Use of an adjuvant in fungicide applications prior to VT may result in abnormal ear development.
- Fungicides do not affect bacterial diseases such as Holcus leaf spot, Goss's wilt, and Stewart's disease.
- Profitability of a fungicide application depends on the price of grain and the cost of application.



*Fungicides are often aerially applied.*

# HERBICIDE DECISIONS

Herbicide programs typically include soil-applied and foliar-applied (postemergence) products. Soil-applied herbicides prevent early weed competition and protect yield potential. Postemergence applications target weed species that are not controlled by soil applications. Some postemergence herbicides only control weeds emerged at the time of application. Others control emerged weeds and provide residual herbicide activity against later emerging weeds.

A well-designed weed management plan protects corn from weed competition, minimizes herbicide injury potential, and delays or prevents herbicide-resistant weed development.

## **Factors to consider when developing a weed management plan:**

- Weed escapes or problems the previous year
- Environmental conditions the previous year including conditions favorable for herbicide carryover
- Herbicide-tolerant hybrids used the previous year that may lead to a volunteer corn problem
- Herbicide-tolerant hybrids planted this season
- Tillage plans for this season
- Using herbicides with different sites of action to delay or prevent herbicide-resistant weed development
- Using timely herbicide applications that prevent early season weed competition and provide residual control for late emerging weed species
- Postemergence herbicide label restrictions based on corn and weed growth stage or height



### **Postemergence herbicide application timing factors:**

Fields should be scouted during the first two weeks after crop emergence to determine the need and appropriate timing of postemergence weed control. Weed density and growth rates are critical factors influencing how long weeds can compete with the crop before yields are reduced. Treat fields with heavy infestations as soon as possible after weed emergence.

The initial growth of weeds is relatively slow, but their growth rate increases rapidly after a few weeks. Weeds as small as 2 inches can reduce corn yields if they are present at high densities (greater than 10 per square foot). The crop yield loss per day increases as control tactics are delayed due to the increasing growth rate and greater impact of large weeds (table below).

#### **Example: Giant foxtail growth rates and impact on corn yields as affected by plant height**

Weed Height (Inches)	Growth Rate (Inches per Day)	Yield Loss <sup>a</sup> (% per Day)
2–4	0.4	0.5
4–6	0.5	0.8
6–8	0.7	1.5

<sup>a</sup>Adapted from Gower et al. 2003. *Weed Technol.*

# INSECTICIDE DECISIONS

Insect pests can be managed with resistant hybrids, crop rotation, tillage, beneficial insects, and insecticides. The decision to use an insecticide depends on proper insect identification, understanding the insect's life cycle, and how season, crop stage, and environment contribute to crop loss.

## Considerations before using an insecticide:

- Some insecticides may reduce beneficial insect populations and cause secondary problems; e.g., a flare-up of spider mites.
- Preharvest intervals may limit the choice of insecticide.
- Proximity to residential areas, bee yards, and organic or other sensitive crops may limit choice of insecticide and application timing.
- For some pests, economic thresholds are coupled with pest development markers based on degree day accumulations to target scouting and improve decisions (table below).

Pest	Base (°F) <sup>a</sup>	Use of Degree Days (DD)
Seedcorn maggot	39	Adults emerge at about 200, 600, and 1,000 DD.
Black cutworm	51 <sup>b</sup>	Larvae start cutting at 300 DD after eggs are laid.
Stalk borer	41	When 1,300–1,400 DD have occurred in an area, scout by pulling whorls to determine if larvae are present.
Western bean cutworm	50	Fifty percent of adult emergence and egg laying occurs at 1,422 DD after May 1.

<sup>a</sup>Maximum temperatures are not applied for most insect species on corn.

<sup>b</sup>Previously 50°F.

# DISEASES

*Diseases can cause stand loss, reduce photosynthesis, increase lodging, and lower yields and grain quality. Diseases vary from year to year because they are strongly influenced by weather.*

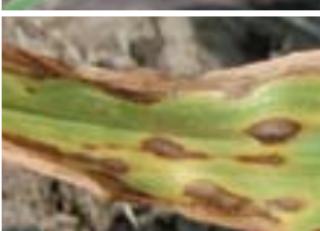
# FOLIAR DISEASES

## **Anthracnose leaf spot**

**Description:** Leaf lesions (spots) are oval, tan, or brown with a dark brown or purple margin. Lesions range up to 1 inch long and  $\frac{1}{2}$  inch wide and primarily occur on the lowest leaves. On severely infected leaves, the lesions can grow together forming large dead areas. These leaves may turn yellow and die.

**Best time to scout:** V2 through V8

**Scouting tip:** This is typically the first foliar disease to occur during the growing season. Disease may be more prevalent in fields where previously infected corn residue is present.



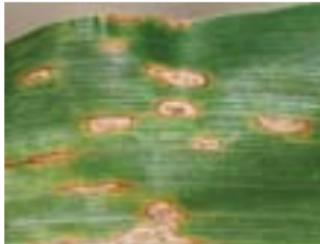
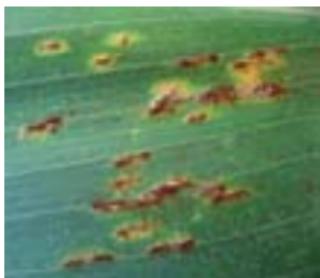
## **Gray leaf spot**

**Description:** Lesions are long (up to 2 inches), narrow, rectangular, and are usually restricted by leaf veins. Lesions initially are light tan and later turn gray. Lesions can grow together and kill entire leaves.

**Best time to scout:** VT through R4; earlier in seed production fields

**Scouting tip:** Disease may be more prevalent in fields where previously infected corn residue is present. High relative humidity (above 90%) during silking and early kernel-fill stages can lead to increased disease.





### Common rust

**Description:** Brick-red pustules (raised bumps) are oval or elongated, approximately  $\frac{1}{8}$  inch long, scattered sparsely or clustered together on both upper and lower leaf surfaces in the mid- to upper canopy. The leaf tissue surrounding the pustules may become yellow. Severely infected leaves can die.

**Best time to scout:** V12 through R4; earlier in seed production fields

**Scouting tip:** Occurs in most Iowa corn fields. Raised, brick-red pustules are diagnostic for common rust.



### Southern rust

**Description:** Southern rust appears as numerous small, orange pustules that are densely clustered predominantly on the upper leaf surface. Disease is first seen on leaves in the mid- to upper canopy.

**Best time to scout:** VT through R4; earlier in seed production fields

**Scouting tip:** Southern rust can easily be confused with common rust, so verify location on the leaf and color of the rust pustules. Southern rust is favored by very warm temperatures and is more aggressive than common rust.

### Common rust and southern rust



Southern  
rust

Common  
rust

## Northern leaf blight

**Description:** Symptoms usually appear first on the lower leaves. Lesions are 1 to 6 inches long and cigar-shaped. Lesions initially are grayish-green and later turn gray or tan.

**Best time to scout:** VT through R4; earlier in seed production fields

**Scouting tip:** Disease may be more prevalent in fields where previously infected corn residue is present.



## Carbonum leaf spot

(Previously called *Helminthosporium* leaf spot or northern leaf spot)

**Description:** Both size and shape of lesions may vary depending on the strain (race) of the fungus and corn inbred or hybrid genetics. Lesions can be rectangular brown spots, or long, narrow lesions (sometimes called a "string of pearls") that are light tan surrounded by a darker border. Lesions also may be tan, oval to circular in zones with a common center. Some lesions may appear on sheaths and husks. Lesions range from  $\frac{1}{4}$  to  $\frac{1}{2}$  inch wide by 1 inch long.

**Best time to scout:** VT through R4; earlier in seed production fields

**Scouting tip:** Disease is found more often in the lower canopy and may be more prevalent in fields where previously infected corn residue is present and when unusually high rainfall occurs in late summer.



Race 3



Race 2; rarely seen in Iowa



### Southern leaf blight

**Description:** Lesions are  $\frac{1}{2}$  inch wide by up to 1 inch long. They are oblong with rounded ends that are tan with brown borders. Size and shape of lesions may vary between inbreds and hybrids with different genetics.

**Best time to scout:** VT through R4; earlier in seed production fields

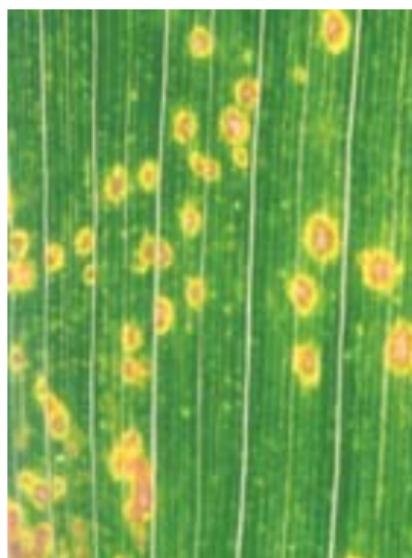
**Scouting tip:** Southern leaf blight is rare in hybrid corn in Iowa, occurring predominantly in seed corn fields. Extended periods of cloudy weather with frequent rains increase disease.

### Eyespot

**Description:** Lesions are very small ( $\frac{1}{8}$  to  $\frac{1}{4}$  inch diameter) circular to oval spots that have a tan center with a brown ring and yellow halo. Lesions often occur in clusters.

**Best time to scout:** V6 through R4

**Scouting tip:** Disease may be more prevalent in fields where previously infected corn residue is present. Each spot is surrounded by a yellow halo that can be seen clearly when the leaf is lighted from behind.



Leaf with eyespot on left without backlighting; on right with backlighting

## **Physoderma brown spot**

**Description:** Very small (approximately  $\frac{1}{4}$  inch diameter) lesions are round to oval and yellow to brown. Numerous lesions occur in broad bands across the leaf, including the midrib. Symptoms also may occur on the stalk, leaf sheath, and husks.

**Best time to scout:** V12 through R1

**Scouting tip:** Often misdiagnosed as eyespot or southern rust. Disease may be more prevalent in fields where previously infected corn residue is present.



## **Holcus leaf spot**

**Description:** Holcus leaf spot is a bacterial disease that appears as light tan (sometimes nearly white), round to oval spots that may appear water soaked at the margins or have a light brown border. The lesions are initially about  $\frac{1}{4}$  inch in diameter but often enlarge and grow together into irregular spots and streaks of dead tissue. Lesions eventually dry and turn light brown with a papery texture.

**Best time to scout:** Prior to R1

**Scouting tip:** Holcus leaf spot may be confused with eyespot. It usually occurs a few days after a strong thunderstorm that causes hail or wind damage to leaves.





Feeding scar in middle of lesion



### **Stewart's disease**

**Description:** This bacterial disease spreads from corn flea beetle (page 47) feeding scars and initially appears as pale green to yellow streaks, later turning brown as the tissue dies. The margins of the streaks are usually wavy but generally follow leaf veins. Entire leaves can be affected late in the season.

**Best time to scout:** Initially when corn flea beetle feeding is apparent from VE to V5 (Stewart's wilt) and again after R1 (Stewart's leaf blight)

**Scouting tip:** Can be confused with northern leaf blight. The bacteria survive the winter in the corn flea beetle. Warm air temperatures in December, January, and February increase the survival of the corn flea beetle in Iowa and result in greater transmission of the bacterium the following growing season.



### **Goss's wilt**

**Description:** Goss's wilt is a bacterial disease that appears as long, grayish-green to black, water-soaked lesions with wavy edges. Lesions exude ooze that dries, leaving crystalline deposits (freckles) on the leaf surface. Lesions may grow together. Some plants have discolored vascular tissue; a wet, slimy stalk rot; and may wilt.

**Best time to scout:** VE through R6

**Scouting tip:** Disease typically starts in the middle to upper canopy, usually a few days after a strong thunderstorm that causes hail or wind damage to leaves. It is more common in western Iowa.

# OTHER ABOVEGROUND DISEASES

## Common smut

**Description:** Swollen, distorted white growths called galls can form on ears, tassels, stalks, and leaves. Galls eventually rupture to reveal a mass of dark powdery spores. Infections are localized, so some ears may be uninfected or galls can form on individual kernels.

**Best time to scout:** V6 through R6

**Scouting tip:** Incidence is higher among plants grown in soil high in nitrogen or injured by hail, wind, insects, cultivation, or detasseling.



## Head smut

**Description:** Galls form on the tassels and ears but rarely on the leaves. Ears are almost always smutted and the entire ear shoot becomes a large gall covered only by the husk leaves. Galls eventually break open and expose black spore masses. Also, leaf-like proliferations may develop on the tassels. Plants may be severely stunted.

**Best time to scout:** R2 through R6

**Scouting tip:** Head smut is more severe when nitrogen is deficient and when fields are dry. However, it rarely occurs in the United States.





### **Anthracnose top dieback**

**Description:** Early symptoms are a yellow, purple, or dead flag leaf (surrounding the emerging tassel) on scattered plants. Black lesions form between the leaf sheath and the stalk at the top of the plant and are easily seen when the leaf sheath is peeled back. In moist conditions, a pink gel exudes from the lesions. The pith is rotted or discolored in the upper internodes of split stalks.

**Best time to scout:** R3 through R5

**Scouting tip:** Disease may be more prevalent in fields where previously infected corn residue is present and when plants are stressed.



### **Crazy top**

**Description:** Symptoms include distortion and/or stunting of the plant. The tassel may proliferate, resulting in a very bushy appearance at the top of the plant. Internodes may be shortened or lengthened and there may be a proliferation of ear shoots, narrow leaves, excessive tillering, or a complete lack of ear and tassel formation.

**Best time to scout:** V4 through R6

**Scouting tip:** Disease may be found where prolonged flooding (24 to 48 hours) or intense rain has occurred during early vegetative stages.



### **Maize dwarf mosaic**

**Description:** Yellow spots and streaks initially appear and can develop into a mottle or mosaic pattern. Susceptible hybrids may be stunted when infected early.

**Best time to scout:** After an aphid outbreak because several aphid species transmit the virus

**Scouting tip:** Disease is more common in fields with nearby Johnsongrass (also a host of the virus and only found in southern Iowa) and on late planted corn. However, this disease is not common in Iowa.

# STALK ROTS

## **Anthracnose stalk rot**

**Description:** Symptoms include narrow, water-soaked lesions that grow together to form large, shiny, black blotches or streaks on the stalk rind. The interior stalk tissue may be blackened and shredded.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease may be more prevalent in fields where previously infected corn residue is present and when plants are stressed. Split stalks lengthwise to see the extent of infection.



## **Diplodia stalk rot**

**Description:** Diplodia stalk rot appears as numerous black dots about the size of a pinhead or smaller that are embedded in the lower internodes of infected stalks. These black dots cannot be scraped easily from the stalk surface. Under very wet conditions, a white mold may develop on the stalk surface. Inside the stalk is discolored and shredded.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease may be more prevalent in fields where previously infected corn residue is present and when plants are stressed. Split stalks lengthwise to see the extent of infection.





### Fusarium stalk rot

**Description:** Fusarium stalk rot is difficult to distinguish from other stalk rots in the field. Under moist conditions, pink spore masses may be present at the nodes. Inside the stalk, the rotted pith may be tan to very light pink and shredded.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease may be more prevalent in fields where previously infected corn residue is present and when plants are stressed. Split stalks lengthwise to see the extent of infection. Fusarium stalk rot can be confused with Diplodia, Gibberella, and charcoal stalk rots. It is often diagnosed by the absence of the distinguishing characteristics (e.g., dark dots) of the other stalk rots.

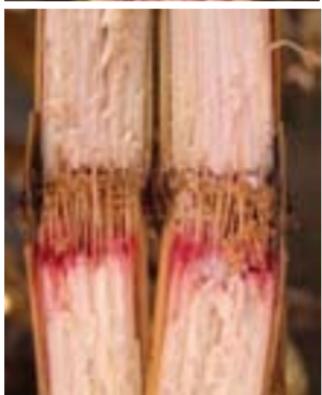


### Gibberella stalk rot

**Description:** Dark brown streaks may form on the lower internodes. Black dots may develop at the nodes and can easily be scraped off. Inside the stalk, the rotted pith is light to dark pink and shredded.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease may be more prevalent in fields where previously infected corn residue is present and when plants are stressed. Split stalks lengthwise to see the extent of infection.



## Charcoal rot

**Description:** The pith and stalk rind of plants affected with charcoal rot appear gray because of the development of numerous tiny black structures called microsclerotia. The pith tissue is disintegrated and the vascular tissue appears granular and gray.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease may be more prevalent in fields where previously infected corn residue is present. This disease is not common in Iowa except in drought conditions especially during R2 through R6.



## Pythium stalk rot

**Description:** Pythium stalk rot usually causes decay of the first aboveground internode. The rind and the pith become soft, brown, and water soaked. The stalk typically twists and falls over; but the plant may remain green for several weeks because the vascular tissue remains living.

**Best time to scout:** Unlike other stalk rots, Pythium and bacterial stalk rot can cause premature death at any growth stage.

**Scouting tip:** Pythium stalk rot predominantly occurs after extended periods of hot, wet, or very humid weather and is rarely seen in Iowa.



## Bacterial stalk rot

**Description:** Bacterial stalk rot usually causes decay of one or more internodes above the soil. The rind and pith become soft, brown, and water soaked. The decayed tissue usually has an unpleasant odor.

**Best time to scout:** Unlike other stalk rots, Pythium and bacterial stalk rot can cause premature death at any growth stage.

**Scouting tip:** Bacterial stalk rot may occur after extended periods of flooding or high temperatures and high humidity, or when corn is sprinkler irrigated with surface waters. This disease is rarely seen in Iowa.



# EAR ROTS



## Fusarium ear rot

**Description:** Symptoms include a white to pink, cottony mold that can begin anywhere on the ear but often begins with insect-damaged or split kernels. Usually the entire ear is not rotted and affected kernels are scattered across the ear. Infected kernels are usually tan or brown or have white streaks. The fungus produces the mycotoxin fumonisin.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease may be more prevalent with hot and dry weather at and after R1. Fusarium ear rot is more common in fields that have a high incidence of insect-damaged ears and where previously infected corn residue is present. Fusarium ear rot is more common in non-BT corn because of greater insect damage to ears.



## Gibberella ear rot

**Description:** Gibberella ear rot develops as a red or pink mold that almost always begins at the tip of the ear. The silks and husks may stick to the ear due to mold growth. In severe cases, the pink mold is visible on the outside of the husks at the ear tip. The fungus produces the mycotoxin vomitoxin.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease may be more prevalent with cool and wet weather just after R1. Disease may be more prevalent in fields where previously infected corn residue is present.



## Diplodia ear rot

**Description:** Diplodia ear rot initially appears as a white mold beginning at the base of the ear but eventually becomes grayish-brown and rots the entire ear. The mold may be apparent on the outside of the husk or on the shank. There may be raised black bumps on the moldy husk or kernels.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease may be more prevalent when wet weather occurs after R1. Disease may be more prevalent in fields where previously infected corn residue is present. The ear leaf usually dies prematurely on infected ears.



## Aspergillus ear rot

**Description:** Aspergillus ear rot appears as a grayish-green powdery mold that may begin at the tip of the ear or follow insect injury tracks. Infected kernels are brownish, lightweight, and shrunken. The fungus produces the mycotoxin aflatoxin.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease may be more prevalent with hot, droughty weather during grain fill. Disease is more common in fields that have a high incidence of insect-damaged ears and where previously infected corn residue is present. Aspergillus ear rot is more common in non-BT corn because of greater insect damage to ears.



## Penicillium ear rot

**Description:** Penicillium ear rot is a green or blue-green, powdery mold that occurs between the kernels usually at the ear tip. Infected kernels can appear bleached or streaked.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease occurs primarily on ears damaged mechanically or by insects. Penicillium ear rot is more common in non-BT corn because of greater insect damage to ears.





### Nigrospora ear rot

**Description:** Ears affected by Nigrospora ear rot are lightweight and chaffy. Kernels are slightly bleached or streaked and may have gray to black fungal growth and be peppered with masses of tiny black spores. This ear rot is usually not apparent until harvest. Cob tissue (typically at the shank) shreds when ears are picked mechanically.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease is occasionally found in fields with low fertility levels or where corn is prematurely killed.



### Cladosporium ear rot

**Description:** Cladosporium ear rot is a dark green or black, powdery mold that also causes black streaks on kernels. It usually forms first where kernels are attached to the cob.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease often infects kernels that are damaged by insects, hail, or frost.



### Trichoderma ear rot

**Description:** Trichoderma ear rot is a dark green mold that grows on or between kernels and often covers the entire ear. This disease typically is not economically damaging because it only occurs on scattered ears.

**Best time to scout:** R5 through R6

**Scouting tip:** Disease is primarily found on scattered plants under severe stress; associated with injury to developing ears.

# SEED AND ROOT DISEASES

## Seed decay and seedling blight (damping off)

**Description:** The first indication of seed decay is often poor or no stand. Decayed seeds are very soft and may be covered with fuzzy fungal growth and are difficult to locate if badly rotted. Seedlings that do not emerge generally have water-soaked, brown or black mesocotyl and/or seminal roots.

Damping off first appears as yellowing and wilting. The seedlings soon collapse and die. The nodal roots may show the same decay symptoms as the seminal roots and mesocotyl. If the nodal root system survives, the plant may live but could be stunted.

**Best time to scout:** VE through V6

**Scouting tip:** Seed decay and damping off are more prevalent in cool and wet soils, particularly in fields with reduced tillage and greater residue cover.



## Root rots

**Description:** Root rot causes poor, uneven stands. Infected plants develop lesions on their roots disrupting their function. Infected plants may appear yellow and/or stunted and later have poorly filled ears.

**Best time to scout:** VE through R2

**Scouting tip:** Root rots are most prevalent in wet areas of fields. Corn rootworm (page 53) feeding also can lead to subsequent root rot development.



# NEMATODES



## Nematodes

**Description:** Symptoms can occur any time during the season and are often attributed to other causes such as poor weather or soil conditions. Often, the symptoms occur in patches in the field where numbers of these microscopic worms are highest. Fields may have poor or uneven stands. Plants may appear yellow and stunted and have small or poorly filled ears. Root damage depends on the species of nematode present; damage includes stunting, malformation, and discolored lesions. Every corn field in Iowa has some nematodes feeding on the plant roots, commonly including dagger, lesion, and spiral nematodes. Damage is determined by the nematode species present, their population densities, and the environmental conditions.

**Best time to scout:** Midseason

**Scouting tip:** Collect multiple 12-inch-deep soil cores from the root zone of sick, but not dead, plants (page 22). Nematodes are more problematic in dry fields with low fertility. Nematodes can be more of a concern in sandy areas.



# DISEASE LOOK-ALIKES

## Purple leaf sheath

A harmless discoloration sometimes occurs when saprophytic (non-disease causing) fungi and bacteria develop on pollen and other debris that collect between the stalk and leaf sheath. The stalk under the sheath is not discolored or infected. Purple leaf sheath typically shows up between R2 and R6 when weather is warm, wet, and humid.



## Genetic stripes, leaf spots, and flecks

Some symptoms may be confused with infectious diseases, especially viruses and eyespot. Affected plants often are scattered throughout the field.



# INSECTS



Insects

*Timely recognition and correct identification are crucial steps when managing insect pests of corn.*

# INSECT PESTS

## Seedcorn maggot

**Description:** The larvae (maggots) are up to  $\frac{1}{4}$  inch long dirty white, narrowly pointed at the head end, legless, and have two dark spots on the broader tail end. Larvae may be found with the seed or dark, reddish-brown cocoons may be in the soil nearby. The adult resembles a small house fly.

**Damage:** Larvae feed on germinating seeds, partially hollowing the seed out and killing the plant embryo.

**Best time to scout:** From planting to VE

**Scouting tip:** Scout for injury in fields where spring-applied animal manure or living weeds were incorporated prior to planting because adult flies lay their eggs in the decaying organic matter and the larvae then attack the seeds.



## White grubs

**Description:** The larvae or grubs are white with brown heads and six small legs. The hind part of the body is smooth and shiny with dark body contents showing through the skin. Grubs may be over an inch long when fully grown and often curl into a "C" shape. The true white grub has a three-year life cycle whereas the annual white grub has a one-year life cycle. The true white grub has two parallel rows of small, stiff hairs (called the zipper) on the belly side of the tail. The annual white grub has small scattered hairs with no distinctive pattern.

**Damage:** True white grubs eat the roots. The annual white grub is not usually an economic problem in field corn.

**Best time to scout:** From planting to VE

**Scouting tip:** Infestations are most common in fields two years following pasture (because of the three-year life cycle) or in fields adjacent to cottonwood or willow trees. Look in areas where emergence is poor; dig in the seed furrow and look for larvae.



True white grub (left) and annual white grub (right)



## Wireworms

**Description:** Larvae are either hard bodied and yellowish-orange or soft bodied and primarily white except for a dark head and tail section, which is scalloped. Wireworm larvae can be up to  $1\frac{1}{2}$  inches long.

**Damage:** Larvae bore into the seed before or during germination and hollow it out. Death of a seedling also can occur when wireworms tunnel into the base of the small plant. Sometimes wireworms burrow into the stalks of larger plants several inches above the soil.

**Best time to scout:** From planting to VE

**Scouting tip:** Look for missing plants. Where plants have not emerged, dig up seeds or adjacent plants and check for wireworm larvae. Injury is more common in corn planted following pasture.



## Corn flea beetle

**Description:** Adult beetles are very small ( $\frac{1}{16}$  inch), shiny, and black, brown, or gray. They jump readily if disturbed.

**Damage:** Adults scrape long scars into the leaf surface of seedling plants, which may cause a bleached appearance. Injury is most severe during cool springs. They also transmit the Stewart's disease bacterium (page 33).

**Best time to scout:** During the first three weeks after VE and again in early R stages

**Scouting tip:** Look for plants that are lighter colored or have wilted leaves.



## **Black cutworm**

**Description:** Larvae are up to 1 $\frac{3}{4}$  inches long, nearly uniform light gray to almost black with grainy-textured skin. Each body segment has two pairs of dark tubercles (bumps) on the back; the front pair is smaller and closer together than the back pair.

**Damage:** Small larvae chew holes in the leaves. Older larvae are capable of cutting small plants through V5.

**Best time to scout:** Mid- to late May until corn reaches V5 (table on page 26)

**Scouting tip:** Look for missing and injured plants, especially in weedy or low-lying, damp areas. Larvae may hide adjacent to cut plants in the soil and under crop residue. Larvae feed at night or during cloudy days but hide in the soil during bright daylight.



## **Dingy cutworm**

**Description:** Larvae are up to 1 $\frac{3}{4}$  inches long. Paired tubercles (bumps) on each body segment are approximately the same size.

**Damage:** Larvae eat small holes in leaves or along the leaf edges but rarely cut the stem. Injury is usually not economically important.

**Best time to scout:** As early planted corn emerges

**Scouting tip:** Look for injured plants, especially in weedy or low-lying, damp areas. Larvae may hide adjacent to injured plants in the soil.



## Glossy cutworm

**Description:** Larvae are milky white with internal organs that can be seen through the skin. The head is solid orange.

**Damage:** Injury to seedlings resembles that caused by other cutworm species.

**Best time to scout:** VE through V4

**Scouting tip:** Scout fields that are planted following grass pasture or Conservation Reserve Program (CRP). Look for plants with leaf feeding or that are cut. Dig damaged plants and look through the soil for larvae.



## Bronzed cutworm

**Description:** The larvae have seven stripes, four brown and three light orange, running the length of the body. The body has a bronze sheen.

**Damage:** Larvae feed on seedlings, eating irregularly shaped holes in the leaves and cutting plants.

**Best time to scout:** VE through V4

**Scouting tip:** Larvae are most likely found in fields that were previously in grass pasture. Look for plants with leaf feeding or that are cut.



## Sandhill cutworm

**Description:** Larvae are light tan, translucent, and have two thin dark stripes along the back. Larvae hatch in the fall and overwinter.

**Damage:** Sandhill cutworms injure leaves and cut plants. Most of the cutting occurs underground.

**Best time to scout:** As plants emerge

**Scouting tip:** Can be a problem in very sandy fields. If plants are missing or plants have holes in the leaves, carefully look for larvae in the soil.

## **Slug**

**Description:** Slugs are similar to snails but without shells. Slugs have a "foot" that produces a slimy trail.

**Damage:** Slugs strip the leaves of young plants by eating the softer leaf tissue, leaving only the veins.

**Best time to scout:** VE through V4

**Scouting tip:** Slugs are more likely to cause damage in northeastern Iowa, most often in no-tilled fields with heavy residue or in fields following alfalfa.



## **Billbug**

**Description:** Billbugs are gray, brown, or nearly black beetles with a long snout. Adults of the several species range from  $\frac{1}{8}$  to  $\frac{3}{4}$  inch long. Billbugs hide at the base of plants during the day, are frequently covered with soil, and play dead when disturbed. The larvae are dull white, legless, brown- to yellow-headed, humpbacked grubs.

**Damage:** Adults chew through young plants forming rows of oval holes across emerging leaves. Larvae feeding inside the base of the stem and roots cause serious injury; feeding by several larvae on a single plant may prevent ear development. Injured plants are usually tillered (multiple shoots) and stunted with twisted leaves.

**Best time to scout:** VE through V4

**Scouting tip:** Scout in low-lying, wet areas of the field that have weedy grasses or yellow nutsedge. Check plants with injured leaves and look at the base of plants for beetles hiding in the soil or in crop residue.





### Brown stink bug

**Description:** Adults are slightly more than  $\frac{1}{2}$  inch long triangular, and dull brown with yellow undersides. Nymphs are greenish-brown and slightly oval on the tail end.

**Damage:** Brown stink bug injects a plant toxin while feeding on sap. Injured seedlings may die and older plants may tiller. Expanded leaves are wrinkled with holes that range from pinhole to 2 inches long. The holes are either scattered randomly or are in repeating patterns often with a yellow halo. Tightly wrapped whorl leaves may fail to expand.

**Best time to scout:** VE through V4; noticeable symptoms persist long after feeding.

**Scouting tip:** Fields with spring broadleaf weed growth, especially shepherd's purse, are more likely to have brown stink bugs.



### Hop vine borer

**Description:** Larvae are cream colored with dark brown to purple square spots along the back. Each spot has two black tubercles (bumps). The head is solid orange.

**Damage:** Larvae tunnel into young plants attacking the underground portion of corn and tunneling up from underneath the plant to hollow out the base of the stalk. Plants damaged before V8 often die; after V8, plants become stunted with wilted whorls.

**Best time to scout:** VE through V10

**Scouting tip:** Damage is most common in border rows adjacent to grassy areas. Look for wilted plants and plants with newly emerged central leaves that are dying. Dig injured plants to find larvae that have burrowed into the stalk underground. Infestations in Iowa have only occurred in the northeastern quarter of the state.

## Armyworm

**Description:** Larvae have dull orange stripes along each side of the body. Fleshy prolegs on the abdomen have dark bands along their sides.

**Damage:** Armyworms feed on the leaves of both seedlings and mature plants and can cause severe defoliation. They consume the softer leaf tissue, leaving the tougher midribs and stalk. Larvae typically start feeding on the lower leaves before moving to the upper leaves. The head is brown with a network of dark lines (page 58).



**Best time to scout:** June or when grassy weeds are killed with herbicides

**Scouting tip:** Early season problems occur in no-tilled fields that were in pasture or sod previously or that have heavy grassy weed populations. Late season problems occur when small grain crops mature and the armyworms migrate into adjacent corn.



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## Stalk borer

**Description:** Young larvae have cream-colored stripes that alternate with dark brown to purple stripes. A dark purple section occurs laterally directly behind the true legs. The dark stripes and purple section fade as larvae age. All larvae have a black stripe on each side of the head.

**Damage:** Larvae attack plants from about V5 to V10. Larvae may feed in the whorl or burrow directly into the stalk, sometimes killing the growing point. Emerging leaves often have numerous large holes in a repeating pattern across the leaf and may be cut completely. Infested plants are often stunted.

**Best time to scout:** Larvae normally move from grass into corn in June (table on page 26). Stalk borers are unlikely to kill corn beyond V7.

**Scouting tip:** Stalk borers are more common in border rows next to grassy areas such as waterways and fence lines.





## Corn rootworm (western and northern)

**Description:** Western corn rootworm adults are yellow with black stripes or may have nearly solid black wing covers. Northern corn rootworm adults are solid yellow, tan, or green. Adults of both species are about  $\frac{1}{4}$  inch long. Larvae of both species are white with three pairs of very small legs, a dark brown head, and a brown plate on the top of the last abdominal segment.

**Damage:** Larvae chew on roots, which can lead to lodged plants. Adults of both species feed on silks, which may reduce pollination. Adult western corn rootworms also feed on leaves.

**Best time to scout:** A majority of larvae can be found on roots during June. Adults begin emerging from the soil during early July. Peak adult populations typically occur the last week of July through the first two weeks of August.

**Scouting tip:** Dig roots in late June and wash off the soil in a pail of water. Larvae will float on the water. Adults can be visually counted on the plant and are usually more numerous on silks.



## Grape colaspis

**Description:** Larvae are off white,  $\frac{1}{8}$  to  $\frac{3}{16}$  inch long, comma-shaped grubs. The tan heads help differentiate them from other grubs. Adults are yellow-brown,  $\frac{1}{5}$ -inch-long beetles with wing covers that appear striped due to longitudinal rows of shallow pits.

**Damage:** Larvae feed on root surfaces and remove root hairs, which reduces plant uptake of water and nutrients and may cause aboveground symptoms resembling potassium deficiency (page 68).

**Best time to scout:** VE through V8

**Scouting tip:** Dig plants and carefully remove them from the ground with the roots and soil ball intact. Examine the soil for larvae, which are usually found close to the roots. Most damage in Iowa has been in seed production fields.

## European corn borer

**Description:** Young larvae are dull white, while older larvae are dirty white to light tan with darker, halo-shaped spots and a dark line down the center of the back. Except for the sod webworm (uncommonly found in Iowa corn), European corn borer larvae are the only caterpillars on corn with a dark brown or black head. There are two, or rarely three, generations a year.

**Damage:** Larvae feed on any aboveground portion of corn. Newly hatched larvae eat leaf tissue or pollen that has collected in leaf axils. Before tasseling, larvae feed deep inside the whorl. They also may tunnel inside the leaf midrib. Older larvae tunnel into the developing tassel, the stalk near leaf collars, the ear shank, and/or the ear.

**Best time to scout:** First-generation egg masses are laid during June. Second-generation egg masses are laid in late July and August.

**Scouting tip:** European corn borers prefer to lay their eggs on the undersides of leaves. First-generation larvae can be found by removing the whorl and unrolling the new leaves. Second-generation larvae are very difficult to find; focus on eggs laid on leaves near the ear.



## Grasshopper

**Description:** Adults are dark yellowish-green and up to  $1\frac{3}{4}$  inches long. Nymphs resemble adults but lack fully developed wings.

**Damage:** Nymphs may consume seedling plants, but this is rare. Adults consume all leaf tissue except the midrib and may chew into the husk and feed on developing kernels.

**Best time to scout:** July to September

**Scouting tip:** Damage is more likely to occur along border rows near weedy or grassy areas. Outbreaks are more likely after two or more years of dry weather.





### **Two-spotted spider mite**

**Description:** Adults are the size of salt grains and are greenish-yellow to brown with two dark spots. First stage immature mites (nymphs) have six legs; older nymphs and adults have eight legs.

**Damage:** Spider mites remove liquids from leaves causing premature drying, which results in the loss of leaf tissue, stalk breakage, and kernel shrinkage. Damaged leaves turn yellow and are stippled on the upper surface and grayish on the under surface.

**Best time to scout:** July, particularly during drought stress

**Scouting tip:** Scout field edges and spots within the field that border perennial vegetative cover. To scout, shake plants over white paper and look for moving specks. Use a hand lens to assist with identification.



### **Corn leaf aphid**

**Description:** Adult aphids are either winged or wingless, less than  $\frac{1}{25}$  inch long (pinhead size), greenish-blue with black legs and cornicles (tailpipe-like structures). Nymphs look similar to adults but are smaller, lighter green, and wingless.

**Damage:** Aphid feeding removes moisture and nutrients from the upper leaves and tassels. Aphids secrete honeydew (sugar water), which may cover tassels and drip onto leaves and silks. The corn leaf aphids also may transmit viruses. Some hybrids are more susceptible than others.

**Best time to scout:** Just before VT

**Scouting tip:** Corn leaf aphid is most problematic during periods of moisture stress. Scout the entire field to determine the extent of infestation.

## **Western bean cutworm**

**Description:** Larvae are dark brown when small, becoming light tan when fully grown at 1½ inch. Older larvae can be distinguished from other corn caterpillars by two dark-brown stripes behind the head. The head is solid orange.

**Damage:** Prior to VT, newly hatched larvae move to the whorl and feed on the flag leaf, tassel, and other tissue. Once tasseling begins, they move to the green silks. Older larvae feed primarily on the ear tip, but some larvae move outside of the ear; chew through the husk, and feed on the kernels on the side or shank end of the ear. Unlike corn earworm, more than one larva may be found in an ear.

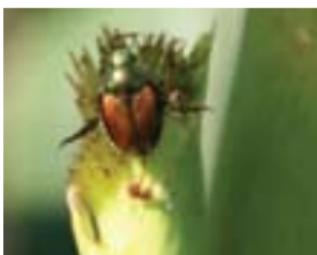
**Best time to scout:** Initiate scouting based on local pheromone trap captures of adults. If trap data are unavailable, begin scouting at VT.

**Scouting tip:** Examine the top surface of the upper leaves for egg masses.



Hatching larvae





### Japanese beetle

**Description:** Adults are  $\frac{3}{4}$  inch long and iridescent copper and green. White tufts of hair are on the sides and tip of the abdomen. Larvae are  $\frac{1}{2}$  to  $\frac{3}{4}$  inch long grubs found in the soil.

**Damage:** Adults may clip silks. Leaf injury is uncommon but consists of parallel holes between leaf veins.

**Best time to scout:** Adults are present from mid-June through August. Larvae are present from late summer through the following June.

**Scouting tip:** Adults may be found anywhere on the plant but tend to aggregate on silks. Scout the whole field to determine the extent of an infestation. Problems are more likely on lighter textured soils.

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### Corn earworm

**Description:** Larval color is extremely variable; they can be dark brown, green, light purple, or yellow. Alternating dark and light stripes run the length of the body. The skin has numerous tubercles (bumps), each with an erect hair. The head is mostly orange, or occasionally green, and freckled (page 58).

**Damage:** Larvae feed in the whorl, on silks, or inside developing ears. Larvae that tunnel through the developing silks may interfere with pollination and destroy kernels at the tip.

**Best time to scout:** Arrival of adult moths from southern states varies each year. Corn at VT to RI is most attractive to egg-laying females. Scout at RI or when a significant moth flight is captured in pheromone traps.

**Scouting tip:** Look for small larvae in the silks. Scout each hybrid within a field separately.



## Fall armyworm

**Description:** Larvae vary from tan to black with three light yellow stripes down the back. There is a wider dark stripe and a wavy yellow-red blotched stripe on each side. Each body segment has six distinctive black tubercles (bumps), each spiked with a long slender hair. The head is dark brown with a prominent inverted "Y" (below).



**Damage:** Larvae feed deep inside the whorl on developing leaves, occasionally killing the tassel before they emerge and sometimes causing "windowpane" damage to the leaves. If the tassel is not killed, the plant can outgrow the feeding injury. After VT, larvae feed on the ear.

**Best time to scout:** Mid- to late June; continue checking until silks begin to dry.

**Scouting tip:** Look in whorls a few days before tasseling for small larvae. Larvae are rarely a problem in Iowa, but they may cause damage in late planted (June) corn in the southern counties.

## Identification of three caterpillars on corn



**Armyworm:** Brown head with network of dark lines (left)

**Fall armyworm:** Dark brown head with prominent inverted "Y" (center)

**Corn earworm:** Orange, freckled head (right)

# BENEFICIAL INSECTS



## Lady beetles

### Lady beetle larvae

**Description:** Larvae are soft bodied and shaped like miniature alligators. Young larvae are gray or black with no bright markings. Older larvae are gray or black but also have bright yellow or orange markings.

**Beneficial notes:** Larvae feed on aphids and other soft-bodied insects.



### Seven-spotted lady beetle

**Description:** Beetles are  $\frac{1}{8}$ -inch long and have dark reddish wing covers with seven black spots. The head is black except for a white square mark behind each eye.

**Beneficial notes:** These predators feed primarily on aphids.



### Multicolored Asian lady beetle

**Description:** Adults are  $\frac{1}{8}$ -inch long. Their wing covers vary from red to yellow and may or may not contain spots. The area directly behind the head has a distinctive black M-shaped marking.

**Beneficial notes:** These predators feed primarily on aphids.

## **Crane fly larvae**

**Description:** Crane fly larvae are sometimes mistaken for black cutworms and therefore unnecessarily treated with insecticides. They differ from cutworms by lacking three pairs of true legs behind the head and also have no abdominal legs on the mid- and tail sections of the body. Crane fly larvae are cylindrical, light gray or brown, and have fleshy projections on the tail.

**Beneficial notes:** Crane fly larvae do not feed on other insects but do feed on decaying organic residues and do not injure seeds or young plants.



## **Green lacewing larvae**

**Description:** Larvae are small, grayish-brown, and have pincher-like mouth-parts that are used to suck the body fluids out of prey.

**Beneficial notes:** Larvae feed primarily on aphids, but they also eat insect eggs, small caterpillars, leafhoppers, and spider mites.



## **Insidious flower bug**

**Description:** Adults are very small,  $\frac{1}{16}$  inch long, and black with white markings. They will bite people.

**Beneficial notes:** This insect feeds on spider mites, aphids, small caterpillars, and insect eggs.





# DISORDERS

*Corn plants sometimes display symptoms that are not related to diseases or insects. These problems are important to identify and understand when developing an effective corn management program.*

# HERBICIDE INJURY

## ALS (acetolactate synthase) inhibitors

**Description:** Symptoms are slow to develop and may appear on any part of the plant (roots, leaves, ear) that undergoes rapid growth following exposure. Soil applications may result in short lateral roots (bottlebrush roots). Leaves emerging after postemergence applications may be yellow or have bands of yellow or deformed tissue. Stalk internode elongation may be suppressed, resulting in stunted plants. Applications after V6 can result in ear deformations (pinched ear). Symptoms may be subtle and difficult to differentiate from other stresses.

**Scouting tip:** Injury may be caused by direct application, drift, or carryover. ALS herbicides may interact with organophosphate insecticides to increase injury risk.

**Products:** Accent, Basis, Classic, Pursuit, Resolve Q, Scepter, Steadfast, and others





## Root (microtubule) inhibitors

**Description:** Dinitroaniline (DNA) herbicides primarily affect the roots, resulting in swollen root tips and poorly developed root systems. Root stunting may result in reduced shoot growth, purple coloration of leaves, and wilting.

**Scouting tip:** DNA herbicides may injure corn from carryover or direct application. Placement of the product relative to seed is important. Roots should grow below the depth of the herbicide. Shallow planting, failure to close seed furrow, or other factors that result in roots contacting the herbicide can result in injury.

**Products:** Prowl, Treflan, several generic and private-brand labels



## Pigment inhibitors (bleachers)

**Description:** The predominant symptoms are leaf yellowing and bleaching (whitening) of tissue. Injury typically develops on leaves emerging shortly after exposure to the herbicide.

**Scouting tip:** Injury occurs primarily from direct application to corn. Balance Pro injury often occurs in areas with coarse-textured or low organic matter soils.

**Products:** Balance Flexx, Balance Pro, Callisto, Impact, and Laudis



## **Plant growth regulators**

**Description:** Preemergence applications may result in failure of shoots to emerge properly (corkscrewing) or leafing out underground. Late applications or excessive rates can result in leaning, brittle stalks, buggy whipping, or fused root systems.

**Scouting tip:** Injury occurs primarily from direct application to corn. Injury is typically related to application rate, timing, and environmental conditions.

**Products:** 2,4-D, Banvel, Clarity, Distinct, Status, several generic and private-brand labels



## **ACCase (acetyl-CoA carboxylase) inhibitors**

**Description:** At lethal concentrations, ACCase inhibitors cause the growing point to rot in the whorl. Damage at lower concentrations includes yellow bands of tissue on leaves. These abnormal bands occur closer to the leaf tip on leaves higher on the plant. Similar symptoms may appear with other herbicides (ALS inhibitors, glyphosate).

**Scouting tip:** Injury usually is related to drift from adjacent soybean fields or from contaminated sprayers. ACCase inhibitors are systemic herbicides and symptoms develop on tissue formed following application.

**Products:** Assure II, Fusilade DX, Fusion, Poast Plus, Select, several generic and private-brand labels





### Seedling growth inhibitors

**Description:** Injury symptoms include improper leaf unfurling and leafing out underground. Injury may be more pronounced on certain soil types.

**Scouting tip:** Injury is from direct application to corn. Injury is primarily related to application rate, soil type, and environmental conditions (more injury potential under cold, wet conditions).

**Products:** Cinch, Dual II Magnum, Harness, INTRRO, Micro-Tech, Outlook, Surpass, TopNotch, and others



### Glutamine synthetase inhibitors

**Description:** Symptoms appear within a few days of application as yellowish-green lesions on leaves, which turn brown and die. Injury may resemble frost damage. Glufosinate injury develops quicker than glyphosate injury (page 66), particularly in cool weather; however, warmer weather causes injury to progress faster for both. Glufosinate is not readily translocated.

**Scouting tip:** Injury may be caused by drift, tank contamination, or misapplication to non-tolerant corn.

**Products:** Ignite and Liberty



## **PPO (protoporphyrinogen oxidase) inhibitors**

**Description:** Foliar applications of PPO inhibitors commonly result in the rapid death of tissues contacted by the spray. Occasionally, leaves within the whorl at the time of application are damaged, which interferes with unfurling of newer leaves. Carryover of Flexstar and Reflex may cause veins to yellow or die.

**Scouting tip:** Direct application of PPO inhibitors to corn is the most common cause of problems, but some PPO inhibitors used in soybean occasionally cause carryover injury.

**Products:** Aim, Cobra, Flexstar, Phoenix, Reflex, UltraBlazer, Valor, and others



## **EPSPS (enolpyruvyl shikimate phosphate synthase) inhibitors**

**Description:** EPSPS inhibitor (glyphosate) injury causes yellow bands on leaves of non-tolerant hybrids. As symptoms progress, the entire plant may appear yellow. Another symptom is wilted leaves, which then turn brown and die. Injury symptoms usually develop slowly but may be accelerated with hot weather. Once absorbed by foliage, glyphosate is readily translocated throughout the plant. Plants usually die in 7 to 14 days.

**Scouting tip:** Injury may be caused by drift, tank contamination, or misapplication to non-tolerant corn.

**Products:** Roundup, Touchdown, generic glyphosate, and others



Products that are premixes representing more than one herbicide class are not included in this field guide.

Neither endorsement nor criticism is implied by Iowa State University of products mentioned or not mentioned in this publication.

# NUTRIENT DEFICIENCIES



## Nitrogen deficiency

**Description:** Nitrogen deficiency causes pale, yellowish-green plants with spindly stalks. Because nitrogen is mobile in the plant, symptoms begin on the older leaves and progress up the plant if the deficiency persists. Deficiency appears on leaves as V-shaped yellowing starting at the tip and progressing down the midrib toward the leaf base.

**Scouting tip:** Nitrogen deficiency is caused by inadequate fertilization, leaching following heavy rainfall, or denitrification from flooding with warm soil temperatures. Symptoms are more common on cold or saturated soils, sandy soils, and dry soils particularly after midseason.



## Phosphorus deficiency

**Description:** Symptoms usually are visible on young plants. Plants are dark green with reddish-purple leaf tips and margins on older leaves. Newly emerging leaves will not show the coloration. Phosphorus-deficient plants are smaller and grow slower than plants with adequate phosphorus. Deficiency symptoms nearly always disappear by the time plants reach three feet tall.

**Scouting tip:** Phosphorus deficiency is favored by cold soils that are too wet or too dry and where compacted soils, root rots, insects, herbicides, fertilizers, or cultivation have restricted root development.



## Potassium deficiency

**Description:** Symptoms first appear as yellowing and dying of lower leaf margins. Plants with impaired root systems are most likely to show symptoms after about V6 when plant potassium uptake increases. Potassium is mobile in the plant. If the deficiency persists, symptoms develop on higher leaves. Potassium-deficient corn tends to lodge late in the season.

**Scouting tip:** Potassium deficiency is favored by conditions that limit early root growth—root pruning, root rots, dry soils, compacted soils, and seed-trench sidewall smearing. Symptoms also are associated with low-potassium testing soils, sandy soils, and are more common in reduced tillage systems, especially in dry seasons.



## Magnesium deficiency

**Description:** Initial symptoms are yellow to white interveinal stripes on the lower leaves. Dead, round spots sometimes follow, which look like beaded streaking. Older leaves become reddish-purple and the tips and edges may die if the deficiency is severe. Magnesium is mobile in the plant.

**Scouting tip:** Magnesium deficiency is favored by low pH, sandy soils in regions of moderate to high rainfall where magnesium has been extensively leached from the soil profile. On soils marginal with crop-available magnesium, deficiency can be induced by high soil potassium levels or high rates of applied potassium.





### Sulfur deficiency

**Description:** Deficiency appears on smaller plants as general yellowing, similar to nitrogen deficiency. Yellowing of the upper leaves is more pronounced with sulfur deficiency than with nitrogen deficiency because sulfur is not easily translocated. Interveinal yellowing of the youngest leaves may occur.

**Scouting tip:** Deficiency is favored by low pH, sandy soils, low soil organic matter; eroded soils, side-slope landscape position, no-till systems, and cold, dry soils in the spring that delay the release of sulfur from organic matter. Early season symptoms may disappear as temperature and moisture conditions improve for mineralization of sulfur from organic matter or as roots reach plant-available sulfate.



### Zinc deficiency

**Description:** Symptoms appear as interveinal, light striping or a bleached band beginning at the base of the leaf and extending toward the tip. The margins of the leaf, the midrib area, and the leaf tip usually remain green. Internodes may be shortened. Zinc is relatively immobile in the plant. Severe zinc deficiency may result in new leaves that are nearly white, an effect called "white bud."

**Scouting tip:** Zinc deficiency is favored by high soil pH, especially on cool and wet soils that have low organic matter. Zinc deficiency is more common where high rates of phosphorus are applied on soils with low zinc availability. However, high soil-test phosphorus alone does not create zinc deficiency.

# FERTILIZER INJURY

## Anhydrous ammonia ( $\text{NH}_3$ )

Vapor damage can occur when ammonia escapes during sidedressing. Tissue that contacts the ammonia is scorched and dies, but plants usually survive if only a portion of the leaves is damaged.

Anhydrous ammonia injury to roots results in uneven seedling emergence, slow growth, plants with a spiky and blue-green appearance, and wilting of seedlings. Injury causes brown roots and if severely injured, roots die and turn black back to the seed. Ammonia injury is seen more frequently in dry weather because roots are slow growing and water uptake is limited.



## Broadcast urea-ammonium nitrate solution (28% or 32% UAN)

UAN can burn leaf tissue when broadcast on top of growing corn. UAN solutions tend to move toward the leaf tip and margins, resulting in greater burning of those areas. Plants usually outgrow the damage if only a portion of the leaves is injured. However, leaf damage and potential yield impacts increase with higher application rates and larger plants.





### Urea

Granular urea broadcast across the top of growing corn results in some granules falling in the whorl and lodging in leaf axils. Tan to white burn spots appear on leaves where granules lodge. Leaf margins also may be burned. Plants outgrow this injury unless a large amount of material lodges in the whorl, severely damaging leaves or injuring the growing point.

Urea-containing fertilizers banded with or near the seed can result in uneven seedling emergence, stand loss, slow growth, and damaged roots as free ammonia is released during its conversion to ammonium.



Biuret, which is an impurity in urea, can cause deformed plants or leaves that do not unroll when urea is placed with seed.

# EARLY SEASON STRESSES

## Frost

Frost results in the death of exposed plant tissue and occurs when air temperatures drop below 29°F. Initial damage is wilted, water-soaked tissue. The growing point is underground until V6; therefore, seedlings can recover from frost except when the soil is frozen. Plants with only leaf damage will likely resume growth. With good growing conditions, seedlings should develop a new leaf 3 to 4 days after the frost. Seedlings may rot if poor weather follows. Assess replant options based on surviving stands and date (pages 11–12). Seedlings with dark, water-soaked growing points will not survive.



## Reddish-purple leaves

Leaves of young seedlings exposed to cool air and soil temperatures along with wet conditions may exhibit a purplish tint. Most often this coloring is related to stress to the young seedling and/or restricted root development (compacted soils, etc.). Purpling from restricted root development caused by cold temperatures or seedbed problems is often temporary and plants recover as weather improves. As such, yield should not be affected. Leaf purpling is more pronounced in some hybrids.





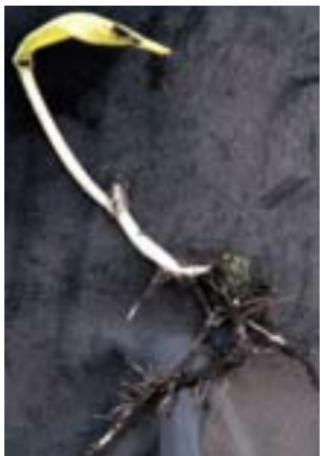
### **Rootless corn syndrome**

Rootless corn appears between V3 to V8 when most or all nodal roots are missing. Existing nodal roots may be stubby and not anchored to the soil. Without an adequate root system, affected plants may lodge, wilt, be stunted, or die. Rootless corn is attributed to many things, including hot and dry surface soils, excessive rainfall that erodes soil near the plant base, or strong winds that break upper roots or inhibit establishment of a strong root system. Rootless corn is more likely with shallow plantings, compact soils, and loose or cloddy soils. In loose soils or with rotary hoeing, shoots are exposed to light sooner than normal, causing nodal roots to form closer to the surface. Plants can recover if rainfall promotes nodal root development. Row cultivation to move soil over exposed roots can aid in recovery but may not be an option if plants are lodged or in no-till situations.



### **Crusting and “leafing out” underground**

Crusting is caused by planting in wet soils, intensive tillage over the row, and heavy rains after planting. It is worse when these factors are coupled with fine-textured soils. Crusted soils can delay or inhibit seedling emergence, and limit nodal root growth.



Count the number of emerged plants and determine if struggling seedlings will reach the soil surface. Assess replant options based on surviving stands and date (pages 11–12). Consider rotary hoeing for breaking crust in some situations, although hoeing may reduce stands by 5–10 percent.



### **Flooding or prolonged saturated soils**

Plants growing in flooded soils may turn yellow, wilt, and eventually can die. Soil oxygen needed for the plant to survive is depleted within about 48 hours of soil saturation. Things to consider when assessing the risks of damage or death from flooded soils include:

- Flooding before V6 is more damaging than later.
- Completely submerged plants are at higher risk for damage than those partially submerged.
- The longer flooding persists, plant damage and death increases.
- Soil temperature affects how quickly plants are damaged by flooding. Seedlings can survive up to four days of flooding when temperatures are relatively cool (mid-60°F or cooler) but fewer days if temperatures are warm (mid-70°F or warmer).
- Flooding damages roots, making plants more susceptible to stresses later in the season.
- Substantial amounts of nitrogen can be lost from flooded soils due to denitrification and nitrate leaching.
- Flooding or wet soils favor the development of seed decay and seedling blights (page 42) as well as crazy top (page 35).
- As flood water subsides, mud deposits on plants can reduce photosynthesis.
- As the soil dries, a crust may form and cause emergence problems for replanted crops.

Assess replant options based on surviving stands and date (pages 11–12).

# MIDSEASON STRESSES



## Drought

Corn uses approximately  $\frac{1}{3}$  inch of water per day at R1, which is the highest water need of the season. When plants are moisture stressed, silk emergence can be delayed. A lack of synchronization between pollen shed and silk emergence can result in poor pollination, reducing yield potential.

Corn leaves roll during major moisture stress to reduce water loss. Leaf rolling reduces carbohydrate production, which may be associated with yield reductions.





### Hail damage

Hail damage is estimated from stand loss (page 11) and leaf area loss (table below) relative to the developmental stage at the time of the hail storm. Waiting 7 to 10 days after a hail storm can improve damage appraisal. Hail damage that occurs before V6 rarely affects yield.

#### Estimated percent yield reduction caused by hail damage

Stage	Percent Leaf Area Destroyed									
	10	20	30	40	50	60	70	80	90	100
V7	0	0	0	1	2	4	5	6	8	9
V10	0	0	2	4	6	8	9	11	14	16
V13	0	1	3	6	10	13	17	22	28	34
V16	1	3	6	11	18	23	31	40	49	61
V18	2	5	9	15	24	33	44	56	69	84
VT	3	7	13	21	31	42	55	68	83	100
R1	3	7	12	20	29	39	51	65	80	97
R2	2	5	10	16	22	30	39	50	60	73
R3	1	3	7	12	18	24	32	41	49	59
R4	1	2	4	8	12	17	23	29	35	41
R5	0	0	2	4	7	10	14	17	20	23
R6	0	0	0	0	0	0	0	0	0	0

Source: USDA



### Root lodging

Root lodging occurs when a plant with a shallow or small root system leans from wind, especially in saturated soils. Shallow root systems are associated with poor seed placement and cool, wet soils during vegetative stages. Small root systems are associated with corn rootworm larvae feeding, root rots, compacted soils, and overall poor root development. Root lodging may be partially compensated if the plant resumes vertical growth (goosenecking).

#### Approximate yield loss from root lodging

Developmental Stage	Approximate Percent Yield Loss <sup>a</sup>
V10 to V12	Less than 5
V13 to V15	5–15
V17 or later	Up to 30

<sup>a</sup>All plants lodged.

Adapted from Carter and Hudelson. 1988. *J. Prod. Agric.*



Goosenecked corn plants

## Buggy whipping

As leaves emerge, they may become trapped in the whorl or twisted and fail to unfurl. This is referred to as buggy whipping, rapid growth syndrome, roping, wrapped whorls, onion leafing, or twisted whorls. Leaves typically unfurl within a week or two and will be very yellow and appear crinkled. The cause can vary, but hail damage, herbicide injury (page 64), and the plant transitioning to rapid growth at V6 are all factors. Unless leaves never unfurl, there likely will be little effect on yield.



## Greensnap

Greensnap is midseason stalk breakage. Plants normally break at a node below the primary ear. Greensnap is most likely to occur from about V10 until just prior to VT. Broken plants still may produce a small ear with or without kernels. If the plant breaks too low or too late to produce an ear, yield loss will be directly related to the number of plants broken.

High nutrient levels, high organic-matter soils, and tillage all favor rapid growth and increase susceptibility to greensnap. Some hybrids may be more prone to greensnap than others.



# STALK LODGING



Plants that lodge late in the season typically lean or break near the soil. Stalks prone to lodge may seem hollow when pinched. This is from the inside tissue rotting (stalk rot).

Stresses during the growing season can favor stalk rot development. These stresses include severe leaf diseases or hail damage, drought or soil saturation, lack of sunlight, extended cool weather, low potassium in relation to nitrogen, and insect damage.

Ideally, scout fields about 40 to 60 days after R1 and pay special attention to areas that experienced stress during the growing season. Pinching the lowest aboveground internode is a quick way to check for stalk rot. Split stalks lengthwise to see the extent of stalk rot infection. Check at least 100 plants scattered throughout the field.

Harvest losses increase dramatically as lodging increases. If more than 10 percent of the stalks are rotted (stalks are very soft), schedule harvest as early as possible to reduce significant lodging. However, there may be an economic trade-off because drying costs for early harvested grain are often higher.



# ABNORMAL EARS

## 1. Tip dieback

**Symptoms:** Lack of or poor kernel development on the last inch or more of the ear tip. Affected kernels may be dried up and often are light yellow.

**Causes:** Drought and high temperatures, foliar diseases, cloudy weather, and possibly nitrogen deficiency during R2 and R3

## 2. Chaffy ears

**Symptoms:** Ears are lightweight with shrunken kernels that leave spaces between kernels from poor fill.

**Causes:** Frost damage, premature plant death from drought, foliar disease, severe potassium deficiency, or hail from R4 through R5

## 3. Zipper ears (banana ears)

**Symptoms:** Partially to completely missing kernel rows on the underside of the ear from kernel abortion and/or lack of pollination. Ears often bend (like a banana) due to differential kernel formation along ear.

**Causes:** Often associated with nitrogen deficiency, severe drought stress, or defoliation following pollination



Adapted from Thomison and Geyer 2007. Abnormal Corn Ears. The Ohio State University ACE-1.

#### **4. Ear pinching**

**Symptoms:** Kernel row number may be decreased by half somewhere between the ear shank end and tip, while ear length is usually normal.

**Causes:** Severe stress during V7 through V10 and/or late broadcast application of some ALS herbicides (page 62)

#### **5. Blunt ear syndrome**

**Symptoms:** Ears are markedly short with fewer kernels per row but with normal numbers of rows per ear. The ear tip is extremely small compared to the lower portion of the ear. Husk length may be normal.

**Causes:** Multiple possibilities are proposed; temperature stress (brief cold shock) during V8 through V12 or applications of pesticides before VT are often contributing factors.

#### **6. Drought-damaged ears (nubbin ears)**

**Symptoms:** Small, misshaped ears with poor kernel set, especially at ear tip. Ears can have fewer kernel rows or kernels per row, depending on when drought occurs.

**Causes:** Severe drought from mid-vegetative stages through R3. Nitrogen deficiency and excessive plant populations can contribute to damage.



Adapted from Thomson and Geyer 2007. Abnormal Corn Ears. The Ohio State University ACE-1.

## **7. Poor, incomplete kernel set**

**Symptoms:** An ear formed with reduced kernel set because of poor pollination. When severe, ears have scattered kernels or no distinct kernel rows (right).

**Causes:** Poor pollination is due to mistiming of pollen shed and silking, often caused by drought and high temperatures, uneven crop development, herbicides, insect feeding and silk clipping, and phosphorus deficiency.



## **8. Multiple ear syndrome (bouquet ears)**

**Symptoms:** Multiple ears (up to 5 or 6) at one node. Kernel set may be poor on some or all of the ears.

**Causes:** Often hybrid specific although exact cause is unknown; similar to those noted under "Blunt ear syndrome" (page 81)



## **9. Tassel ears**

**Symptoms:** A tassel ear contains both male (tassel) and female (ear) flowers. Only a few kernels develop on the ear. Tassel ears often appear on tillers (suckers).

**Causes:** Tillers are produced when the growing point is injured by hail, frost, flooding, herbicides, and mechanical injury. Some hybrids are more prone to tiller in field edges when early season soil compaction and saturated soils occur.



Adapted from Thomison and Geyer. 2007. Abnormal Corn Ears. The Ohio State University ACE-1.

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# CORN FIELD GUIDE

*A reference for identifying diseases,  
insect pests, and disorders of corn.*

IOWA STATE UNIVERSITY  
University Extension  
**Integrated Pest Management**



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