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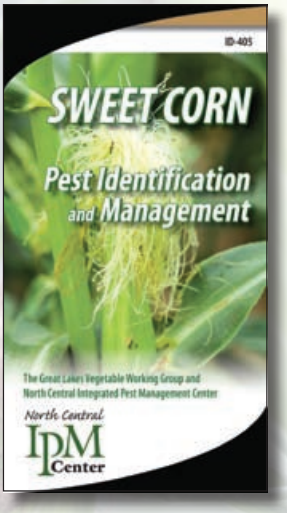

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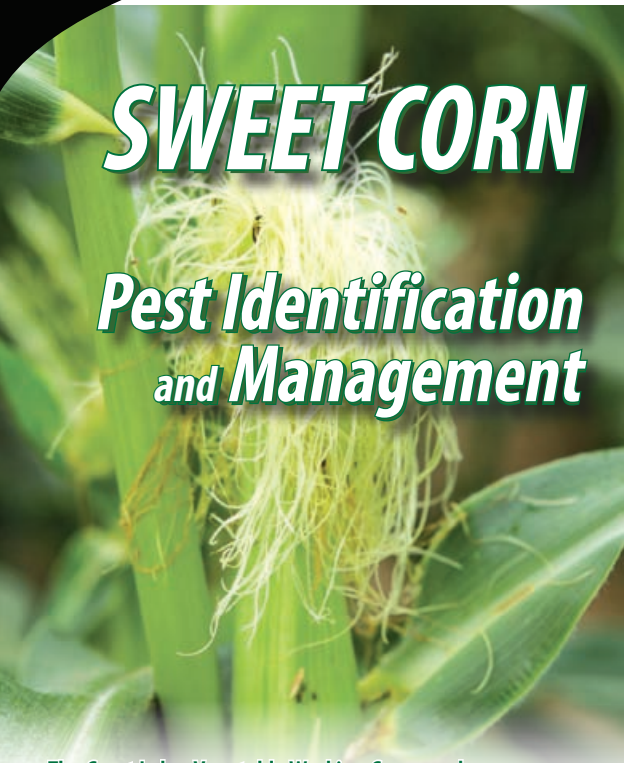

SWEET CORN

Pest Identification and Management

The Great Lakes Vegetable Working Group and
North Central Integrated Pest Management Center

North Central IPM Center

This guide was created by the Great Lakes Vegetable Working Group and North Central Integrated Pest Management Center.

The Great Lakes Vegetable Working Group is a communication network for vegetable specialists throughout the Great Lakes region that addresses current priorities for growers and the vegetable industry. Members of the group represent the following universities:

Cornell University
University of Guelph
University of Illinois
University of Kentucky
Michigan State University
University of Minnesota
Ohio State University
Pennsylvania State University
Purdue University
University of Wisconsin

More information is available at:
http://glvwg.ag.ohio-state.edu.

The North Central Integrated Pest Management Center is one of four centers in a national network established to strengthen the USDA's connection with production agriculture, research, and extension programs throughout the United States.

More information is available at www.ncipmc.org.

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Preface

This *Sweet Corn Pest Identification and Management* pocket guide is a quick, colorful, and handy reference for sweet corn growers, extension educators, crop consultants, and industry field representatives who work in the North Central Region and Ontario, Canada.

The information presented here is brief and cannot include every possible pest or management option in fresh market or processing sweet corn production in these areas. So, this guide focuses on the most critical pests and management options.

This guide contains pictures, basic descriptions, and management tips of economically important weeds, diseases, pest insects, and vertebrates. It also includes sections that describe beneficial insects, common types of herbicide injury, and general horticultural practices.

Reference to products in this publication is not intended to be an endorsement to the exclusion of others that may be similar. Persons using such products assume responsibility for their use in accordance with current directions of the manufacturer. Due to rapid changes in pesticide labels, always seek product recommendations from publications specific to your state or province.

Acknowledgements

The development of this regional guide would not have been possible without the devotion and expertise of many individuals and the support of the North Central Integrated Pest Management Center. Images for this guide were provided by the authors, plus:

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Table of Contents

Diagnostic Laboratories

To properly identify weeds, insects, or diseases, contact the diagnostic laboratory in your state or province for proper submission procedures and current fees. The contact information for selected labs appears below:

Illinois
University of Illinois Plant Clinic
(217) 333-0519
http://plantclinic.cropsci.uiuc.edu

Indiana
Purdue Plant and Pest Diagnostic Laboratory
(765) 494-7071
www.ppdl.purdue.edu

Kentucky
University of Kentucky Plant Disease Diagnostic Laboratories
(859) 257-8949
www.ca.uky.edu/agcollege/plantpathology/extension/pdd_lab.html

Michigan
Michigan State University Diagnostic Services
(517) 355-4536
www.pestid.msu.edu

Minnesota
University of Minnesota Plant Disease Clinic
(612) 625-1275
http://pdc.umn.edu

New York
Cornell University Plant Disease Diagnostic Clinic
(607) 255-7850 or
http://plantclinic.cornell.edu

Ohio
The C. Wayne Ellett Plant and Pest Diagnostic Clinic
(614) 292-5006
http://ppdc.osu.edu

Ontario, Canada
University of Guelph Laboratory Services
(519) 767-6299
www.uoguelph.ca/labserv

Pennsylvania
Pennsylvania State University Plant Disease Clinic
(814) 865-2204
www.ppath.cas.psu.edu/Plant_Disease_Clinic.htm

Wisconsin
University of Wisconsin Plant Disease Diagnostics Clinic and Insect Diagnostic Lab
(608) 262-2863
www.plantpath.wisc.edu/pddc
www.entomology.wisc.edu/entodiag.html

Production and Culture

Sweet Corn Genotypes

Sweet corn varieties are categorized by their genotypes. The most common varieties are:

Normal or sugary (su) — Standard hybrid sweet corn is a mutant type of corn that differs from field or dent corn by mutation at the sugary (se) locus. The standard hybrid sweet corn accumulates about two times more sugar than field corn. Refrigeration after harvest is essential to maintain quality

Sugar enhanced (se) — There are two distinct groups of cultivars containing the se gene. There are the homozygous se (or se+) cultivars that have higher sugar levels in 100 percent of their kernels. There also are heterozygous se cultivars that have higher sugar levels in only 25 percent of their kernels; the other 75 percent contain the normal su gene with lower sugar levels. Refrigeration after harvest is essential to maintain quality.

Supersweet or shrunken (sh_2) — The sugar content of kernels is twice as high as standard su sweet corn. It is essential to isolate these varieties from all other corn types. These varieties have a slow sugar conversion to starch, so ear quality at harvest will hold for seven to 10 days. Refrigeration after harvest will help extend quality.

Other varieties include:

- Insect protected (*Bacillus thuringiensis (Bt*) breeds (se)).
- Sweet breeds (su.se and sh_2).
- Synergistic or sweet genes (su.se and sh_2).
- Improved supersweets, augmented supersweets (sh_2).

Isolation Requirements

To avoid starchy kernels, sh_2 varieties need to be isolated at least 300 feet from non-sh_2 varieties or, planted so there is at least 12 days between silking of neighboring varieties. Su and se varieties can be planted side-by-side without this occurring. All sweet corn must be isolated from field and popcorn varieties.

Here are some general rules of thumb for isolating these genotypes:

- Grow all normal, se varieties (heterozygous and homozygous, like Table Sweet) apart from sh_2 and augmented shrunken varieties.
- Grow all sh_2 (100 percent supersweet) varieties apart from su, all se, and all su.se varieties.
- Grow all su.se varieties (Sweet Breed, Triple Sweet, Syngergistic-homozygous se with *Bt*) apart from all sh_2 and augmented shrunken varieties.
- Grow all augmented shrunken varieties (Gourmet Sweet, Multisweet, Xtra Tender) apart from su, all se, and all su.se types.
- Isolate all sweet corn varieties from field, ornamental, and popcorn varieties.
- Su and se varieties can be planted side-by-side.

Planting

Plastic Mulches

Using clear, plastic mulch will speed the maturity of early plantings. When using plastic mulches, seed two weeks earlier than usual in double rows spaced 14 to 16 inches apart on 5- to 6-foot centers. In-row-spacing should be 8 to 12 inches between plants. Apply herbicide and cover with 1 to 1.25 mil-thick clear plastic mulch that is 4 feet wide.

Keep the plastic over plants for approximately 30 days or until daytime temperatures consistently exceed 75°F. At that time, cut the plastic and remove it from the field, usually when plants are 6 to 12 inches tall. Plant cold-tolerant varieties to avoid uneven stands and uneven vigor.

Clear, plastic mulch speeds the maturity of early plantings.

Row Covers

Another approach to accelerating maturity is to apply a polyester or polypropylene row cover (floating) after planting. Although this method does not increase soil temperatures as quickly as plastic mulch, using row covers does have advantages. Floating row covers allow the use of standard row spacing, pose less danger of plant injury from high temperatures, are easier to use, and allow for the reuse of row covers for several seasons.

Sh_2 varieties are also more difficult to establish than se and su types. Sh_2 varieties germinate poorly below 60°F and rough handling easily damages their seeds.

Plant Spacing

Row spacing for most sweet corn varieties is commonly 30 to 36 inches between rows, with plants spaced 8 to 12 inches within the row. Closer in-row spacing may be used in early plantings, while wider in-row spacing is used for late plantings.

Plant Populations

The recommended plant population of sweet corn is between 15,000 to 21,000 plants per acre. Higher populations require more water and fertilizer during the growing season to maintain ear size and increase the number of marketable ears per acre.

Soil pH and Lime

Maintain a target soil pH of 6.5 and lime fields when the soil pH falls below 6.0. If soil magnesium is less than 100 pounds per acre, use high magnesium or dolomitic lime to adjust pH.

Recommended Nutrients Based on Soil Tests

If using drip irrigation to provide water to the corn crop, apply 40 pounds of nitrogen (N) per acre injected into the drip tape in 10 to 15 pounds of actual N per application. Use water soluble forms of granular or liquid fertilizer.

Zinc

If the soil test for zinc is between 0.5 and 1 pound per acre, broadcast 0.5 pound of zinc per acre for long-term benefits. If the zinc in the soil is less than 0.5 pound per acre, apply 1 pound of zinc per acre. When zinc levels are marginal, applying 1 pound of zinc in the fertilizer band may be helpful.

Boron

Apply 1 to 2 pounds of boron per acre with broadcast fertilizer.

Pre-Sidedress Soil Nitrate Test (PSNT)

The pre-sidedress soil nitrate test (PSNT) is an in-season soil test that provides information about the soil's N supplying capacity. Unlike a traditional soil test, the soil sample for a PSNT is collected from the top 12 inches of

Recommended Nutrients Based on Soil Tests

N Pounds/ Acre	P_2O_5 Pounds/Acre Soil P Level			K_2O Pounds/Acre Soil K Level			Comments
	Low	Med.	High	Low	Med.	High	
120-140	**120**	**80**	**40**	**120**	**80**	**40**	**Total Recommended**
40	80	40	0	80	40	0	Broadcast and disk-in.
40	40	40	40	40	40	40	Band place with planter.
40-60	0	0	0	0	0	0	Sidedress when corn is 6-12 inches high.[1]

[1] A second sidedressing could replace the preplant, broadcast N application if it is made before corn is 12 inches tall. This is preferable on leachable soils.

soil when corn plants are 12 inches tall. When the fertilizer releases mineral N into the soil, it accumulates as nitrate (NO_3). The concentration of soil NO_3 increases during the spring and generally peaks at about the 12-inch corn growth stage. When plants reach this size they rapidly take up and remove NO_3 from the soil. The PSNT, therefore, measures the soil NO_3 concentration at a key growth stage.

Growers may use the PSNT to determine whether they need sidedress N. The test is effective for sweet corn grown on soils with loamy-textures, with high organic matter, or where manure has been applied. The PSNT determines the N available from manures, cover crops, and previous crops. Contact your local extension educator for more details concerning specific test results.

Petiole Sap Testing

Another method for testing NO_3 levels in the soil involves collecting petiole sap from corn plants for analysis with a Cardy meter. Because plant tissue testing is destructive, soil testing is preferred for routine analysis. However, tissue testing is useful when more information on the plant nutrient status is required.

To test petiole sap, collect the 6-inch pieces from the main stalks of a representative sample of sweet corn plants in a field (about 15 to 20 plants). Cut a thin section from the center of each of stalk and express the juice from these small sections for analysis. Pour a small amount of the sap

from the cup onto the sensor of the Cardy meter for analysis. This test can be conducted during the entire season, with no additional N fertility needed if test results for NO_3-N are in the 600 to 700 ppm range.

Chlorophyll meters also can be used to help determine nitrogen needs.

Typical Mineral Deficiency Symptoms

Phosphorus Deficiency

Symptoms: Purpling of older leaves, usually on young plants.

Causes: Acid and cold soils.

Potassium Deficiency

Symptoms: Leaf margins are tan, scorched, or have necrotic spots.

Causes: Acid soils.

Harvesting

Under normal temperatures, most sweet corn varieties reach maturity 18 to 21 days after silking. Supersweets (sh_2) have a wider "harvest window" than normal or sugary (su) and sugar enhanced (se) varieties.

Sweet corn is considered mature for fresh market consumption when:

- The pollination silks are dried.
- The kernels are still immature but are plump and appear "milky," not doughy, when squeezed.

At this point the water content of su kernels is 70 percent to 75 percent; the water content of sh_2 is 77 percent to 78 percent.

Fresh market sweet corn quality is based on the following criteria:

- Freshness.
- Uniform appearance.
- Uniform and well-filled rows.
- Plumpness of kernels.
- Milky kernel contents.
- Freedom from damage and defects, including discoloration, harvest injury, worm damage, live insects, and decaying silks or kernels.

Post Harvest

Store harvested corn between 32°F and 40°F at 98 percent relative humidity. Sweet corn is generally hydrocooled and packed with ice or top-iced. After thorough cooling and icing, be sure storage and transit temperatures hold slightly above 32°F (0°C).

Weed Biology and Seedling Identification

Broadleaf Weeds

Apple of Peru

Family: Nightshade (Solanaceae).
Life Cycle: Annual that reproduces by seed.

Chickweed

Family: Pink (Caryophyllaceae).
Life Cycle: Annual that reproduces by seed.

Common Cocklebur

Family: Aster (Asteraceae).
Life Cycle: Annual that reproduces by seed.

Common Groundsel

Family: Aster (Asteraceae).
Life Cycle: Annual that reproduces by seed.

Clammy Groundcherry

Family: Nightshade (Solanaceae).
Life Cycle: Perennial that reproduces by seed and rhizomes.

Common Mallow

Family: Mallow (Malvaceae).
Life Cycle: Annual or biennial that reproduces by seed.

Common Lambsquarters

Family: Goosefoot (Chenopodiaceae).
Life Cycle: Annual that reproduces by seed.

Common Ragweed

Family: Aster (Asteraceae).
Life Cycle: Annual that reproduces by seed.

Common Purslane

Family: Purslane (Portulacaceae).
Life Cycle: Summer annual that reproduces by seed.

Eastern Black Nightshade

Family: Nightshade (Solanaceae).
Life Cycle: Annual that reproduces by seed. Rarely, a short-lived perennial.

Giant Ragweed

Family: Aster (Asteraceae).
Life Cycle: Annual that reproduces by seed.

Hairy Galinsoga

Family: Aster or Sunflower (Asteraceae).
Life Cycle: Annual that reproduces by seed.

Henbit

Family: Mint (Lamiaceae).
Life Cycle: Winter annual that reproduces by seed and rooting stems.

Horsenettle

Family: Nightshade (Solanaceae).
Life Cycle: Perennial that reproduces by seed and rhizomes.

Redroot Pigweed

Family: Amaranth (Amaranthaceae).
Life Cycle: Annual that reproduces by seed.

Smooth Groundcherry

Family: Nightshade (Solanaceae).
Life Cycle: Perennial that reproduces by seed and rhizomes.

Velvetleaf

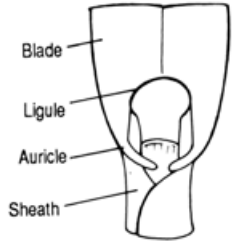
Family: Mallow (Malvaceae).
Life Cycle: Annual that reproduces by seed.

Wild Buckwheat

Family: Smartweed (Polygonaceae).
Life Cycle: Annual that reproduces by seed.

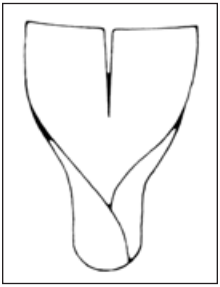
Grass Weeds

All grasses in this section are from the family Poaceae.



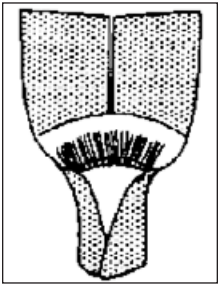
Barnyardgrass

Sheath: Smooth and flattened.
Blade: Rough margin and prominent mid-vein.
Ligule: None.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



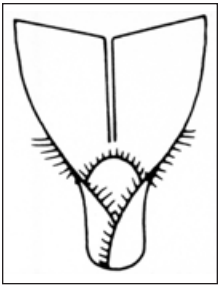
Fall Panicum

Sheath: Slightly flattened, smooth to occasionally hairy.
Blade: Smooth, dull above, glossy below, underside may have hair.
Ligule: Short fringe of hairs.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



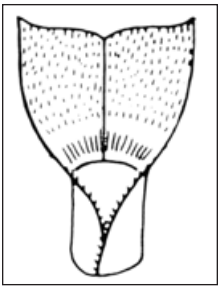
Field (Longspine) Sandbur

Sheath: Flattened with little or no hair, fringe of hairs on sheath margin at the leaf collar.
Blade: Little or no hair, twisted.
Ligule: Short fringe of hairs.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



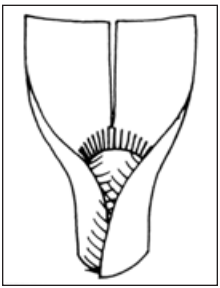
Giant Foxtail

Sheath: Round with hair on margins.
Blade: Short hairs cover the upper surface.
Ligule: Fringe of hairs.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



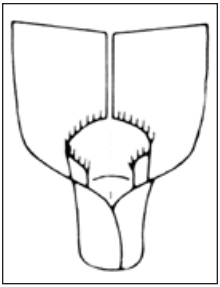
Green Foxtail

Sheath: Round with hair on margins.
Blade: Hairless.
Ligule: Fringe of hairs.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



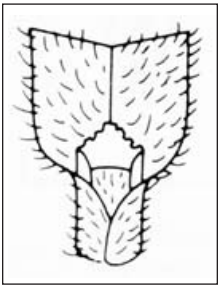
Johnsongrass

Sheath: Rounded to flattened and smooth.
Blade: Smooth to sparsely hairy above and smooth below.
Ligule: Long, rounded, and possibly hair-like on tip.
Auricles: None.
Life Cycle: Perennial that reproduces by seed and rhizomes.



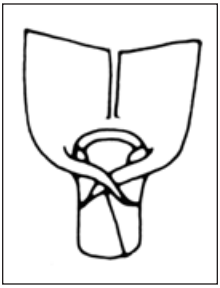
Large Crabgrass

Sheath: Flattened with long scattered hairs.
Blade: Sparse hairs above and below.
Ligule: Long, membranous with notched margins.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



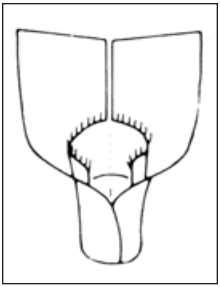
Quackgrass

Sheath: Rounded and smooth to sparsely hairy.
Blade: Rough above, below, and on the margins.
Ligule: Short and membranous.
Auricles: Long, slender, clasping.
Life Cycle: Perennial that reproduces by seed and rhizomes.



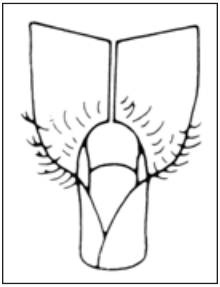
Shattercane

Sheath: Rounded and smooth.
Blade: Smooth but occasionally with spare hairs above.
Ligule: Long, membranous, and rounded. May be jagged or hair-like on tip.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



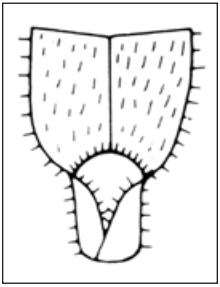
Smooth Crabgrass

Sheath: Flattened with a smooth margin.
Blade: Long hairs near the ligule and a rough margin.
Ligule: Long, membranous, and rounded.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



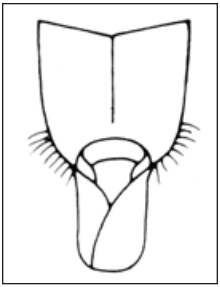
Wild Proso Millet

Sheath: Slightly flat with dense, stiff hairs that stick straight out.
Blade: Dense, stiff hairs above and below
Ligule: Short fringe of hairs.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



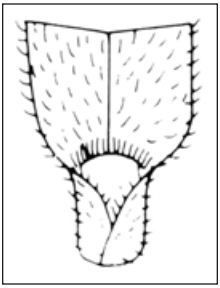
Wirestem Muhly

Sheath: Flattened and smooth.
Blade: Rough above, below, and on the margins.
Ligule: Short and membranous with toothed margins.
Auricles: None.
Life Cycle: Perennial that reproduces by seed and rhizomes.



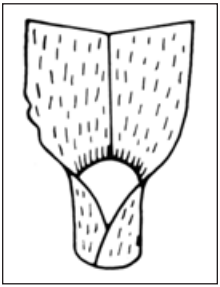
Witchgrass

Sheath: Slightly flat with dense, soft hairs.
Blade: Dense, soft hairs above and below, midrib is white and prominent.
Ligule: Short fringe of hairs.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



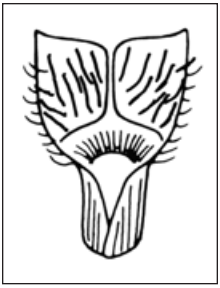
Woolly Cupgrass

Sheath: Slightly flat and densely hairy.
Blade: Dark green, soft hairs, margin distinctly wavy on one side.
Ligule: Short fringe of hairs.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



Yellow Foxtail

Sheath: Flat, smooth margins.
Blade: A few long hairs near the base.
Ligule: Fringe of hairs.
Auricles: None.
Life Cycle: Annual that reproduces by seed.



Herbicide Injury Diagnosis

Herbicides can drift, carry over, or injure the crop directly sprayed. Diagnosing herbicide injury can help determine the source of injury. Remember, herbicide injuries often resemble other kinds of injury (environmental, mechanical, insect predation), so be sure to correctly diagnose any injury.

Herbicide injury symptoms can be categorized by the product's class or mode of action. The most common herbicide classes and the injury symptoms they cause are described in more detail on the following pages.

Acetolactate Synthase Inhibitors

Common (Trade) Names: nicosulfuron (Accent®), nicosulfuron + isoxadifen-ethyl (Accent Gold®), imazethapyr (Pursuit®), and chloromuron-ethyl (Classic®).

Symptoms: Yellowing and discolored leaves or bleaching near the whorls, stunting of seedlings, onion-leafing, and purpling of the stem or leaves. Herbicide carryover may result in shortening of secondary roots, causing the roots to look like a bottlebrush.

Auxin or Growth Regulators

Common (Trade) Names: 2,4-D, dicamba (Banvel®), clopyralid (Stinger®), dicamba + diflufenzopyr (Distinct®), and dicamba + diflufenzopyr + isoxadifen-ethyl (Status®).

Symptoms: Rolled "buggy-whip" whorls and twisted or flattened brace roots that do not grow into the soil to support the plant.

Bleaching Herbicides

Common (Trade) Names: tembotrione + isoxadifen-ethyl (Laudis®), topramezone (Impact®), clomazone (Command®), and mesotrione (Callisto®).

Symptoms: Bleached leaves develop between the 2-leaf and 4-leaf stages on sensitive hybrids, up to 7-leaf stage on less sensitive hybrids. Leaf bleaching is more pronounced near the midrib, and the bases of leaves may turn purple.

Chloroacetamides

Common (Trade) Names: s-metolachlor (Dual II Magnum®), acetochlor (Harness®, Surpass®), and dimethenamid-p (Outlook®).

Symptoms: Ruptured coleoptiles leafing out underground, shortened leaves, leaf tips stick and fail to unfurl (laddering, onion-leafing). Excessive plant stress will reduce metabolism and result in greater injury.

Contact Herbicides

Common (Trade) Names: gramoxone (Paraquat®).

Symptoms: Chlorosis and necrosis of the leaf tissue within three to seven days of drift. Symptoms will appear on leaves that were emerged at the time of drift but not on new leaves that emerge after the drift.

Dinitroanilines

Common (Trade) Names: pendimethalin (Prowl®) and trifluralin (Treflan®).

Symptoms: Root tips thicken to form short, club-like roots. Top growth is stunted and leaves are purplish. Plant sweet corn 1 to 1.5 inches deep and avoid applying Prowl® on sandy soils.

EPSP Inhibitors

Common (Trade) Names: glyphosate (Roundup®).

Symptoms: Yellowing in the whorl and near the growing point. Injury takes about a week to develop and is not reversible.

Glutamine Synthetase Inhibitors

Common (Trade) Names: glufosinate (Liberty®).

Symptoms: Leaf tissue shows signs of necrosis within a couple of days of the drift event. Symptoms will appear on leaves that were emerged at the time of drift but not on new leaves that emerge after the drift. Direct application will kill non-GMO sweet corn.

Photosynthesis Inhibitors

Common (Trade) Names: bentazon, (Laddok®, Pardner®).

Symptoms: Leaves show signs of chlorosis and necrosis, particularly where spray particles have contacted the surface. Symptoms will appear on leaves that were emerged at the time of drift but not on new leaves that emerge after the drift. Injury potential is greater during warmer periods or if the herbicide is used with crop oil concentrates.

Pest Insects and Slugs

Armyworm

Description: Larvae are striped and feed on foliage during pre-whorl and whorl stages.

Time of Attack: An uncommon sweet corn pest in most years. Infestations occur in no-till corn planted into grass and in corn that borders mature wheat. Infestations tend to

occur during cool, wet springs. Rarely, summer larvae enter ears, just as European corn borer (see page 62) and fall armyworm (see page 64) do.

Sampling: Inspect 20 plants in five locations per field at least weekly, and then determine the percentage of damaged plants.

Threshold: Treat with insecticide if more than 35 percent of the plants are infested during the seedling or early whorl stages. If 10-35 percent of the plants are infested, inspect the field again in three days.

Management: Scouting followed by rescue treatments (as needed) is preferred over preventive treatments, because armyworm is relatively easy to control if detected early.

Black Cutworm

Description: Larvae are dark with minimal markings. Stages that damage corn range from 0.5 inch to 2 inches long.

Time of Attack: An occasional sweet corn pest. Stands can be lost before emergence or from seedling injury because of aboveground cutting or belowground tunneling. Black cutworm injury is greater where reduced tillage practices are used and abundant broadleaf weeds are present prior to planting.

Sampling: From emergence through 6-leaf stage, check 100 plants in three locations per field at least weekly for injury. If an injured plant is found, dig around the base of the plant to find the cutworms and determine whether they are small (less than 0.5 inch long) or large (more than 0.5 inch).

Threshold: Treatment is justified if small larvae have caused a 3 percent stand loss, or if large larvae have caused a 5 percent stand loss.

Management: Preventive treatment may be warranted in reduced tillage or no-tillage fields with substantial broadleaf weed infestations; however, scouting for injured plants and cutworm larvae is still necessary. Rescue treatments may be applied if infestations exceed the threshold. Early tillage and good weed control before planting can reduce infestation.

Common Stalk Borer

Description: Larvae have white and purple-brown stripes that turn mostly white when they are fully mature. Fully-grown larvae are about 1.5 inches long.

Time of Attack: An uncommon sweet corn pest. This pest is associated with grassy weeds and giant ragweed. Herbicide applications often trigger larvae to move from grasses and other weeds to sweet corn.

Sampling: From emergence through 6-leaf stage, check 100 plants in three locations per field for stalk injury and larvae. Scout weekly or more often if burn-down herbicides kill weeds and trigger larvae to move to corn.

Threshold: Treatment is justified if small larvae cause 3 percent stand loss, or if large larvae cause 5 percent stand loss.

Management: Good grass control prior to planting will reduce stalk borer incidence.

Larva and adult (inset)

Corn Earworm

Description: Moths are tan, with one dark spot on the middle of each forewing, and a dark band at the end of each hind wing. Moths lay eggs singly on silks. Larvae vary greatly from yellow to green to pink. However, the head is always light brown and unmarked, and there are always microscopic spines covering the body.

Time of Attack: A key sweet corn pest in the Midwest, where it overwinters only in the very southern portions of Ohio, Indiana, Illinois, Missouri, and Kansas. It migrates from the southern United States into the Midwest and

Canada as the season progresses, often arriving in northern regions in August or September but sometimes as early as June or July.

Sampling: Bait a cone-shaped Heliothis trap with a Hercon Zealure® pheromone strip and place it near silking corn. Make sure the trap's bottom and pheromone lure are at ear height. Count and remove moths daily; change the lure every 10 to 14 days.

Threshold: Recommended thresholds vary between states and provinces. For fresh-market sweet corn, control is generally advised if the traps are catching moths during silking. Processor thresholds may vary according to hybrid and processing practices.

Management: When moth counts and temperatures are low, spray intervals may be as great as four to five days. When moth counts and temperatures are high, spray intervals should be reduced to two to three days. *Bt* sweet corn hybrids reduce, but do not eliminate, corn earworm infestation and do not prevent infestations of sap beetles (see page 67) or rootworm beetles (see page 60).

Corn Flea Beetle

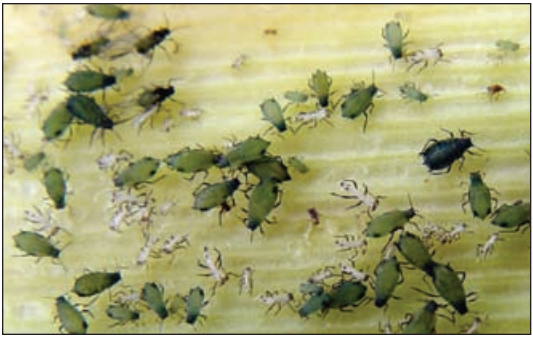
Description: These tiny black insects are less than 1/8 inch long and feed on corn foliage. Feeding activity is evident from scratchy "windowpane" damage on leaves. These insects jump away when disturbed and they hide in cracks in the soil on cold or windy days.

Time of Attack: They are most damaging to newly emerging seedlings. Corn flea beetles also transmit Stewart's bacterial wilt (see page 93).

Sampling: For plantings where systemic insecticide was not used on seed or in soil at planting, scout three times per week during the seedling stage. Examine 10 sets of 20 consecutive plants per field.

Threshold: For hybrids very susceptible to Stewart's wilt, treat if there are six or more corn flea beetles per 100 plants. For wilt-tolerant hybrids, treat only when there is an average of at least two corn flea beetles per plant and 25 percent of the seedlings are severely damaged.

Management: Primary protection includes using soil or seed insecticide. Apply foliar insecticides if thresholds are exceeded. Control is unnecessary after the 7-leaf stage.



Corn Leaf Aphid

Description: Winged or non-winged blue-green aphid colonies on tassels produce honeydew that can disrupt pollination.

Time of Attack: Winged adults migrate from the South and are common pests during July and August. Corn leaf aphid feeding can delay corn development under drought stress. The presence of aphid colonies on husk leaves is undesirable in some markets.

Sampling: Inspect 100 plants as tassels emerge (20 plants from five locations).

Threshold: If 50 percent of plants have more than 50 aphids per plant, consider applying pesticide to protect pollination.

Management: Natural predator activity and fungal disease often control infestations.

Corn Rootworms (Larvae)

Description: Western and northern corn rootworm larvae are similar in appearance. They are less than 3/8 inch long, white to cream-colored, and have three pairs of short legs on the thorax, a dark head, and posterior plate.

Time of Larval Attack: Northern and western corn rootworm larval injury occurs in June and early July following the hatch of larvae from overwintered eggs in the soil. Over the entire region, if corn is planted after corn, larval injury is likely. In the majority of the Great Lakes region where female western corn rootworm beetles lay eggs only in corn, no larval damage should be expected to the roots if corn is rotated with other crops. In portions of Illinois, Indiana, Michigan, and Ohio, root damage is likely where female western corn rootworm beetles lay eggs in

other crops, such as soybeans. Larval feeding can scar or destroy individual roots or entire nodes, leading to lodging and yield loss.

Sampling: Scout fields in July and August to determine if larval control will be necessary the following spring. Count adult beetles on 50 corn plants (two plants each from 25 sites) or place 12 unbaited yellow Pherocon AM® traps per soybean field.

Threshold: To prevent larval damage in next year's sweet corn field, treat if there is an average of 0.5 beetle per plant in first year corn or if there is an average of 0.75 beetle per plant in rotated corn. In soybean, treat next year's field if there are more than five western corn rootworm beetles per trap per day from late July through the third week of August. These population densities will produce enough eggs to damage sweet corn the following year. If sweet corn begins to lodge from June through August, carefully dig and inspect root systems for feeding injury or missing roots. Wet soils and heavy winds often cause lodging unrelated to insect feeding.

Management: No rescue treatments for larval feeding are available. Crop rotation prevents corn rootworm larvae damage in much of the region. Where larval control is necessary, applying a soil insecticide at planting is the only effective option. Currently there are no rootworm *Bt* sweet corn hybrids.

Southern corn rootworm

Northern corn rootworm

Female Western corn rootworm

Male Western corn rootworm

Corn Rootworms (Adult Beetles)

Description: Western corn rootworm adults have striped or mostly black elytra. Southern corn rootworm adults are spotted. Northern corn rootworm adults are light yellow or green. The adults of all three beetles are 0.25 inch long.

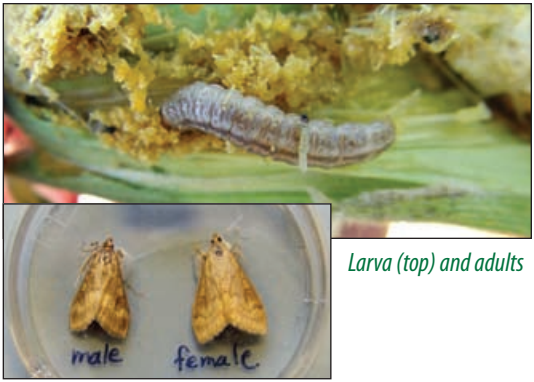
Time of Beetle Attack: Significant injury to silks by clipping is common where population densities of any species are high. In some years, large beetle populations feed heavily on the leaves of whorl-stage corn.

Sampling: During early silking, inspect 100 ears per field (20 ears from five locations). Count rootworm beetles and observe silk clipping.

Threshold: To protect pollination, treat if infestations exceed five rootworm beetles per ear or silk clipping is evident before pollination. On whorl stage corn, treat if more than 35 percent of the plants are damaged by beetle feeding.

Management: Apply a foliar insecticide as silks emerge to protect pollination.

Silk clipping damage from corn rootworm adults.



Larva (top) and adults

European Corn Borer

Description: Moths are yellowish (female) to brown (male), and marked with zigzag patterns. Eggs are white, flat, and glued in irregular masses on the undersides of leaves. Larvae are dirty white to slightly pinkish, with numerous dark spots, but no obvious hairs.

Time of Attack: A key sweet corn pest throughout the Midwest. Two or three generations develop each year, depending on latitude and temperature. Small larvae feed by removing the upper epidermis of the leaf (called windowpane feeding). Small larvae feeding deep in the whorl cause damage that looks like shot holes when the leaves expand. Larger larvae tunnel into stalks and ears.

Sampling: *Pretassel:* Scout 100 plants (20 plants in five areas of the field) at whorl stage. *Silking:* Beginning when tassels are visible, use a black-light trap or Heliothis-style

pheromone trap baited with "Iowa strain" lures to determine flight activity. Position pheromone traps 2 to 3 feet high over grassy areas near sweet corn, and change lures as directed by supplier.

A Heliothios-style pheromone trap.

Threshold: Check individual state and provincial recommendations for thresholds based on whorl-stage infestations or moth trap counts.

Management: Adequate control can be achieved by applying insecticides at five- to seven-day intervals from row tassel until seven to 10 days before harvest. Continue to spray on a five- to seven-day schedule if traps continue to catch moths. If corn earworm control is also necessary (see page 54), a shorter spray interval is required. *Bt* sweet corn should completely prevent ECB damage.

Windowpane feeding by larvae.

Larva (top) and adult

Fall Armyworm

Description: Medium to large larvae are brownish, have white lateral lines, and dark-colored spots on the top portion of the body. The "face" of the mature larva is dark brown on the outer sides and light brown in the center, and usually marked with an upside-down white "Y" between the dark and light brown areas. Male moth forewings have triangular white spots near the tips and centers. Female moth forewings may be uniformly grayish brown or may have oval or rounded spots. Females lay eggs in masses of 100 or more attached to leaf surfaces.

Scales among the eggs and on the egg mass surface give them a fuzzy or moldy look.

Time of Attack: Fall armyworm does not overwinter in the Midwest but migrates from the South each season and may begin feeding on corn by late June or early July. Foliage feeding is often concentrated in the whorl and infested plants appear ragged, with abundant fecal material evident on the leaves. Larvae also enter ears, often leaving entrance and exit holes in the husks.

Sampling: Examine 20 plants from at least five locations per field for ragged feeding damage. Before tasseling look for large larvae in the whorls and continue to examine plants for this insect until silks begin to dry. Use pheromone traps to monitor moth flights.

Threshold: No definitive thresholds have been established for fall armyworm control decisions. Check individual state and provincial recommendations.

Management: In addition to foliar insecticides, *Bt* sweet corn hybrids decrease, but do not eliminate, fall armyworm infestations.

Japanese Beetle

Description: Adult beetles are metallic green and bronze and have a row of five white tufts of hair along each side of their bodies. Larvae (also known as white grubs, see page 74) are C-shaped grubs that feed on the roots of grasses.

Time of Attack: Beetles begin emerging from the soil by early June in the southern Midwest, and adults may be present well into September in most of the region. This pest feeds on the foliage of more than 400 broadleaf plant and grass species. In sweet corn, their feeding sites include the silks. Silk clipping may prevent pollination and ear fill.

Sampling: From June through early September, examine at least 20 plants each from five sites for adult beetles on the ear tips and evidence of silk clipping.

Threshold: Control may be warranted if infestations on silks exceed two beetles per ear before pollen shed.

Management: Most products labeled for corn earworm or European corn borer also control other silk clipping insects such as Japanese beetle and corn rootworm beetles.

Adults

Larvae

Sap Beetles

Description: All sap beetles have "knobbed" antennae. The adult dusky sap beetle is about 1/8 inch long with short wing covers and is a uniform dull black in color. Larvae are white with brown heads and two short brown appendages at the tips of their abdomens. Pupae are white, turning cream-colored and later tan before adult emergence.

Time of Attack: Adults emerge in June and July. Newly emerged adults are a general nuisance and are attracted to damaged ears. Larvae also contaminate ears, usually at the tip.

Sampling: Examine 100 ears in each field (20 ears in five locations).

Threshold: Treatments for other corn ear pests if present (caterpillars and beetles) may also control sap beetles. If those treatments do not work, spray every four to five days during silking if more than 10 percent of the ears are infested with sap beetle adults or larvae. If no other corn ear pests are present, then two sprays four days apart starting when 75 percent of the field has fresh silks can be effective.

Management: Current *Bt* hybrids do not control sap beetles, so *Bt* hybrid fields infested by sap beetles can require insecticide spray during early silking.

Seedcorn Maggot

Description: Larvae that feed in and destroy seeds are legless, headless, cream-colored maggots. Dark brown puparia contain the pupal stage.

Time of Attack: Infestations are most common when cool, damp soils delay emergence in fields high in organic matter, especially in fields where cover crops, weeds, or manure have recently been incorporated into the soil.

Sampling: Uncover seed rows where emergence is spotty. Look for larvae in decaying seeds or dark brown puparia that contain the pupal stage.

Threshold: None established.

Management: No rescue treatments are available. Effective seed treatments and soil insecticides are available. Avoid planting during cool, wet periods, or within three weeks of incorporating cover crops or weeds.

Slugs

Description: Slugs range from pale cream to gray to shiny black. Adult length ranges from less than 1 inch to more than 2 inches.

Time of Attack: Uncommon sweet corn pests in the Great Lakes region but sometimes problematic in reduced tillage fields. Slugs damage seeds and seedlings, reduce stands, and defoliate established stands (delaying plant development).

Sampling: Inspect 20 plants in five areas of each field and determine both the percentage of injured plants and percentage of defoliation. Pay particular attention to areas near waterways and field edges. Slugs are nocturnal, so inspecting fields at dusk or after dark may be necessary. Look for slime trails.

Threshold: Treatment may be necessary if defoliation is more than 40 percent on slow-growing plants, or if more than 3 percent of the plants are killed.

Management: Slug baits labeled for use in food crops contain the active ingredients metaldehyde or iron phosphate.

Larva

Adult

Western Bean Cutworm

Description: Three distinct stripes right behind the head of medium to large larvae distinguish this pest from other cutworms and caterpillars. Adult flight generally occurs from early to late July. Moths are 0.75 inch long with a 1.5 inch wingspan. Forewings are brown with a whitish stripe that runs across the leading edge. There is a white spot just below this stripe and about halfway across each wing. Further out on the wing is a white, crescent-shaped mark. Eggs are laid in masses on leaves. At first, eggs are whitish with a thin red ring around the tops. After a few days, eggs turn purple.

Time of Attack: Western bean cutworm has been a serious sweet corn pest in the Western plains. More recently, it has caused damage as far east as Michigan and

Ohio. Adult flight begins in late June, peaks in mid- to late July, and ends during mid-August. Larvae feed on tassels, foliage, and within ears on kernels.

Sampling: Pheromone trap lures are available to determine the presence and relative density of moths. Use weather data to determine degree-day accumulations after May 1. Hang traps in fields before 1,150 degree days have accumulated after May 1. Adult flight peaks at approximately 1,425 degree days.

Thresholds: None established. Insecticide application may be warranted if moth captures indicate that eggs are hatching and larvae are feeding while ears are present.

Management: Adequate control can be achieved by applying insecticides at five- to seven-day intervals from row tassel until seven to 10 days before harvest. This pest can seriously damage *Bt* sweet corn hybrids, so protect these plants with insecticides.

White Grubs

Description: White grubs are the C-shaped larvae of scarab beetles. They have a brown head capsule and three pairs of thoracic legs. Near the end of the abdomen, the cuticle (skin) is translucent, so the gut's contents make this portion of the body appear dark. Adults are heavy-bodied beetles, and most are tan to dark brown (although the Japanese beetle is more colorful, see page 66).

Time of Attack: Uncommon pests in sweet corn production. Larvae feed on the roots of grasses, including sweet corn, reducing plant vigor or stand. Some species require three years to develop from egg to adult, and these species are most damaging to sweet corn planted where grasses were abundant one or two years earlier.

Sampling: Dig soil samples and sift them to look for grubs before planting in the spring. White grub populations may be spotty within fields, and no statistically based sampling plan has been developed for sweet corn.

Threshold: No definitive threshold has been developed for grubs in sweet corn. Stand losses may occur where there is more than one perennial white grub per cubic foot of soil.

Management: There are no effective rescue treatments for white grubs. Effective seed treatments and soil insecticides are available. To avoid infestations, do not plant sweet corn within two years after fields have been used for pasture or other grasses.

Wireworms

Description: Yellow-brown larvae with a partially hardened or rigid exoskeleton (skin). Can attack seeds or seedlings.

Time of Attack: Significant losses are not common in Midwest sweet corn production. Direct feeding can destroy the seed, and feeding at a seedling's base may kill the growing point. Wireworms are most common in corn following sod, in old hay fields, or in grassy fields.

Sampling: Establish bait stations at least two weeks before planting by placing grain at the base of a shallow hole, covering the hole with soil and black plastic, and then marking it with a flag. Examine the baits 10 to 14 days later (before planting).

Threshold: Significant damage may occur where there is more than one wireworm per bait station.

Management: Insecticide-treated seed, insecticide seed box treatments, and at-planting insecticides reduce losses to wireworms. Rescue treatments are not effective.

Beneficial Insects

Beneficial insects are natural enemies that help control pest insect populations for you — without pesticide costs affecting your bottom line.

So, remember to use caution with pesticides. Broad spectrum insecticides can reduce the field populations of these beneficial organisms.

Eggs

Larva

Pupa

Adult

Ladybugs

Pests Controlled: Ladybugs are generalist predators. Adult beetles and larvae feed primarily on aphids, mites, and insect eggs. Some species are known to feed on pollen and nectar.

Green lacewing

Brown lacewing

Green lacewing larva

Green and Brown Lacewings

Pests Controlled: The larvae of both green and brown lacewings are such voracious aphid predators that they are sometimes called "aphid lions." Adults can be predaceous or feed on nectar and pollen. The eggs of these insects are attached to the plant either by a stalk or laid singly.

Parasitoid Wasps

Pests Controlled: These tiny insects are parasitoids of aphids, caterpillars, and other insects. Parasitoids lay one or more eggs inside their hosts. When the eggs hatch, the larvae feed inside their hosts, which kills them. The larvae mature and eventually emerge as adults. Adult wasps feed on nectar in nearby flowers. These wasps are very small and do not sting people.

Syrphid or Hover Flies

Pests Controlled: The larvae of these insects are maggots and are voracious aphid predators. Adults feed on nectar.

Insidious Flower Bug

Pests Controlled: Adults and nymphs are voracious aphid and caterpillar predators. They also attack the eggs of other pest insects, particularly corn earworm and European corn borer.

Damsel Bug (Nabids)

Pests Controlled: Adults and nymphs have raptorial or grasping front legs, and are efficient aphid and caterpillar predators. They are generalist predators, attacking many insects, including corn earworm, European corn borer, and green cloverworm.

Diseases

Anthracnose Leaf Blight

Description: Anthracnose leaf lesions vary greatly in size and shape, but are generally less than 1 inch long and have dark tan centers, brown borders, and yellowish to orange halos. Generally, lesions first appear near the tip and midrib of the leaf. Lesions coalesce to produce large dead areas and blotches. Black, hair-like structures (setae) emerging from fruiting bodies (acervuli) can be seen with a hand lens during periods of high humidity.

Time of Attack: Rainy weather any time between seedling emergence and maturity favor this disease.

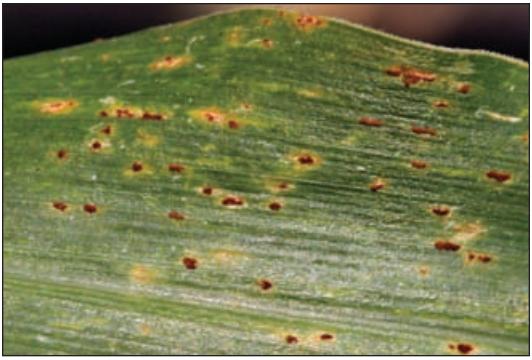
Management: Select resistant hybrids, rotate crops, and till residues.

Anthracnose Stalk Rot

Description: Shiny black areas or streaks develop on the outer surfaces (rinds) of the stalks. The entire stalk of susceptible hybrids may turn black. Several internodes may be rotted. Plants may be prematurely killed above the ear.

Time of Attack: Rainy weather any time from seedling emergence to maturity favor disease. New infections can spread from infected crop residues on the soil surface.

Management: Select resistant hybrids, till residues, and use crop rotation.



Common Rust

Description: Small (1/8 to 1/4 inch long), reddish brown, oblong pustules are scattered over the leaf surface. Rust often occurs in bands across leaves because plants are infected where moisture accumulates in leaf whorls.

Time of Attack: Rust can occur in early June if growing conditions are cool and wet. Juvenile leaves are most susceptible. Rust continues to spread throughout the season during periods of cool weather with light rain or heavy dew.

Management: Select resistant hybrids. If rust develops on early plantings, consider fungicide applications for later plantings of susceptible hybrids.

Common Smut

Description: Gray to white enlarged galls develop on ears, leaf surfaces, stalks, or tassels. Ear galls often are associated with poor pollination conditions.

Time of Attack: Spores overwinter in the soil and are spread to plant surfaces by wind and splashing rain. Insects, hail, or mechanical injuries increase disease incidence. Infection is not systemic, so galls on one plant part do not mean galls on other plant parts.

Management: Avoid ear galls by enhancing conditions that favor the synchrony of pollen production and silk emergence.

Crazy Top

Description: Affected plants show excessive tillering, leaf rolling, bolting, or proliferating husks because of abnormal tissue growth.

Time of Attack: Saturated soils or ponded water from excessive rainfall during the plant's early growth stages favor infection. Plants become infected as seedlings, and the fungus grows systemically in the plant causing abnormal plant tissue development. Symptoms are most recognizable from the mid-whorl stage to maturity.

Management: Select resistant hybrids and improve soil drainage.

Gray Leaf Spot

Description: Lesions have straight, parallel sides and resemble elongated rectangles on leaf surfaces. Susceptible lesions may be tan to gray with no borders, and 0.5 to 4 inches long. On some hybrids, yellow halos surround small lesions (this is the chlorotic lesion type).

Time of Attack: Symptoms first appear two to four weeks after infection. Heavy dew, fog, or light rain favor the disease. Drying periods between these wet periods also are important. Generally, lesions first appear near tasseling, and the disease increases until maturity.

Management: Select resistant hybrids, till crop residues, use crop rotation, and apply fungicides to susceptible hybrids.

Maize Chlorotic Dwarf Virus

Description: Very fine chlorotic stripes develop adjacent to the secondary veins on leaves during the whorl stages of growth. Older plants become yellowed with severe stunting.

Time of Attack: The virus overwinters in Johnsongrass (see page 36), and leafhoppers feeding on the grass transmit the virus to corn plants. Young plants may develop symptoms, but the disease is easier to diagnose in the mid- to late whorl development stages than later in the season.

Management: Select resistant hybrids. Destroying nearby Johnsongrass is more effective than controlling leafhoppers.

Maize Dwarf Mosaic Virus

Description: A mosaic of, or mottled streaks of, light and dark green areas develop in young leaves within the whorl. Plants may develop leaves that become yellowed or stunted, but these symptoms are not diagnostic.

Time of Attack: There are two types of this virus: A and B. The A type overwinters in Johnsongrass (see page 36). The B type (also known as sugarcane mosaic virus) does not. Aphids (see page 57) vector both virus types to young plants. Symptoms develop on young plants, and are easiest to diagnose in the mid- to late whorl stages.

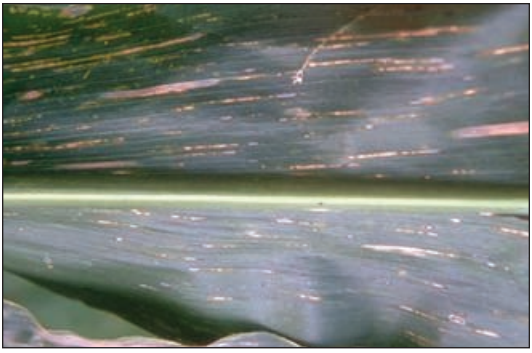
Management: Select resistant hybrids. Destroying nearby Johnsongrass is more effective than controlling aphids.

Northern Corn Leaf Blight

Description: Lesions are large (1 to 6 inches long, 0.5 to 1 inch wide), cigar-shaped, and brown to tan. During periods of high humidity, lesions may have grayish-green centers because dark spores form on dead tissue.

Time of Attack: Wet, humid weather favors disease development. Symptoms may occur before silking, but are more prevalent during later development stages.

Management: Select resistant hybrids, use crop rotation, and till residues. If lesions are found on lower leaves during wet weather, fungicides may be used to control the spread of the disease.



Northern Corn Leaf Spot

Description: Lesions are small (1/8 to 1/2 inch long), oval, and tan to brown with dark brown borders. The lesions often form a line within leaf veins causing a characteristic "string of pearls" symptom. The disease is generally associated with continuous corn, especially in reduced tillage.

Time of Attack: Lesions are detected from after tasseling to crop maturity.

Management: Select resistant hybrids, use crop rotation, and till residues.

Seedling Blights

Description: Young seedlings that wilt and die during and after emergence are the first signs of blight. A soft watery rot of the roots, mesocotyl, and crown are typical symptoms. Seeds with white or pinkish mold indicate seed rot. Various seedborne and soilborne fungi cause seedling blight.

Time of Attack: Blights occur when seedlings are under stress or subjected to conditions that limit rapid growth. Wet, cool conditions favor some blights (*Pythium, Fusarium*); hot, dry conditions favor others (*Penicillium*).

Management: Use fungicide-treated seed, improve drainage, and plant into well-prepared seedbeds.

Southern Corn Leaf Blight

Description: Lesions are small (0.25 to 1 inch long, 0.25 inch wide), tan, and may be oval or have parallel sides. On some hybrids, yellow halos may surround lesions. Lesion borders may be reddish brown on se hybrids but not on sh_2 hybrids.

Time of Attack: Warm, wet, humid weather favors disease development, especially periods of heavy dew and fog. Symptoms may occur as early as silking, but are more prevalent during later growth stages.

Management: Select resistant hybrids, use crop rotation, and till residues.

Stewart's Bacterial Wilt

Disease Description: Lesions are long, chlorotic, water-soaked, have wavy margins, and become necrotic with age. On susceptible hybrids, some lesions may extend the entire length of the leaf. Overwintered adult corn flea beetles (see page 56) carry the bacterium and transmit it while feeding on leaves. Small, thin feeding scars are evidence of flea beetle injury. Systemic infection during the seedling wilt phase can cause considerable yield loss. Sweet corn is less damaged by the leaf blight phase.

Time of Attack: Adult corn flea beetles transmit the bacterium soon after seedlings emerge in the spring (see page 56). A second generation of beetles feeds on plants in mid- to late June. Beetles feeding throughout the summer continue to spread the disease. Average temperatures in December, January, and February affect flea beetle winter survival and subsequent levels of Stewart's wilt. If the average temperature from December through February is:

- Less than 27°F: wilt will likely be negligible.
- 27-30°F: wilt will likely be light to moderate.
- 30-33°F: wilt will likely be moderate to severe.
- More than 33°F: wilt will likely be severe.

These are approximations and do not account for different levels of host resistance and susceptibility, or weather conditions after planting.

Management: Select resistant or moderately resistant hybrids, or use a seed treatment insecticide on moderate or susceptible hybrids if Stewart's wilt is likely. A summary of hybrid reactions to Stewart's wilt is available at www.sweetcorn.uiuc.edu/stewarts.html.

Controlling flea beetles is secondary to selecting the appropriate hybrids. Corn flea beetle control is unnecessary after the 7-leaf stage.

Vertebrate Pests

Blackbirds

Identification and Incidence: Blackbirds form large flocks after nesting. Most often, they roost in cattail marshes at night and move to cornfields to feed during the day. Because they are larger and have stronger bills, males open most corn ears. Birds will shred the husk, starting at the tip, and then work down the ear toward the stalk. Once the ear tip is opened, females and juvenile males forage on the ear and increase the damage.

Time of Attack: Blackbirds feed on insects and weed seeds in small grain or cornfields before these crops are vulnerable to damage. They become used to feeding in a certain location, and then include corn in their diet as the ears mature. Efforts made to remove birds from a field are often unsuccessful because the birds have a habit of feeding there.

Management: If possible, do not plant cornfields near cattail marshes or woodlots. Leave access trails every 200 to 300 feet in large fields to help scare birds from the center of the field. Plant at the same time as neighbors because earlier ripening and later ripening fields suffer more damage.

Use bird-resistant hybrids in high-risk fields. Choose corn varieties with good tip cover. Blackbirds can more easily open ears with poor tip cover, so are more likely to be damaged.

Control insects early, as they are often an attractive food source for blackbirds before the corn reaches a susceptible stage. Once blackbirds have developed feeding patterns, they will begin to include maturing corn in their diet.

The most successful method is to scare birds out of cornfields as soon as the birds are seen in the vicinity, regardless of their diet. A combination of harassment devices usually provides the best results. Some common devices are described below.

Pyrotechnic devices, including cracker shells, whistlers (fired or pistol launched), and firecrackers, are commonly used and effective in startling birds. However, they may threaten personal safety and pose a fire hazard during dry periods. Wear safety glasses and hearing protection since these devices occasionally detonate prematurely.

Devices that broadcast blackbird distress calls are quite effective for two to three weeks after installation, but they

are expensive and have a limited range. Furthermore, their batteries and electronics make them targets for vandals.

Bird-scaring cannons automatically detonate gases that produce extremely loud explosions. Of course, the loud noise often results in complaints from neighbors. Place these devices on a stand above the crop and adjust them to fire slowly — about every four to five minutes. Turn the cannons on after birds begin to arrive from their roosting area at sunrise and as long as birds are in the field. Shut them off at night when they are not needed. Move the cannon every two or three days to keep birds from getting accustomed to the noise. One cannon can protect 10 to 20 acres, especially if used with other devices.

Deer

Identification and Incidence: Crop damage from deer has increased in the last two decades because deer populations have grown, human populations have shifted to rural areas, and abandoned agricultural lands have reverted back to forest. Deer frequently feed on fruits and vegetables, including sweet and field corn.

Deer have no upper incisors, so they leave ragged edges when tearing plants such as young corn shoots. Usually, deer tracks and roughly torn plants distinguish deer damage from rodent damage.

Time of Attack: Deer may attack corn at almost any growth stage; however, research shows that the most critical time for protection is during silking and tasseling.

Deer feeding damage.

Deer like to eat corn silks, which will reduce ear growth and yield. Corn plants often can recover from foliage browsing earlier in the growing season.

Management: Deer are game animals, so can be killed only during legal hunting seasons by those holding a valid license. However, state and provincial wildlife agencies can issue permits that allow landowners to destroy deer when they become a nuisance or destructive. State and provincial wildlife agencies may issue crop damage permits for the harvest of a specified number of deer outside the regular hunting season. Getting these permits can be time-consuming and often has little effect on reducing damage.

A variety of frightening devices including lights, whistles, cannons and scarecrows have been used to prevent deer

damage. However, audio and visual scare devices will disturb neighbors, can violate local noise ordinances, and aren't necessarily effective. Deer habituate to scare devices and are rarely disturbed by noises after a few days of exposure.

Repellents are best for small home-garden plantings, but limited on large-acreage fields because of their high costs, use limitations, and variable results. Repellents are most effective when integrated in a damage abatement program that combines repellents with one or more other techniques such as fencing or herd management.

Temporary electric fences can protect cornfields during the growing season. They are easy to construct, do not require rigid corners, and use readily available materials. Install fences before deer damage is expected to prevent them from establishing feeding habits. Temporary electric fences require weekly inspection and maintenance. Most fences consist of poly-tape or poly-wire supported by insulators on 3/8-inch fiberglass poles. One strand placed 30 inches high is sufficient for deer control. Growers also can install wire strands 5 and 10 inches high to prevent woodchuck and raccoon damage.

Electric fences can be made more effective by combining them with attractants or repellents. For example, peanut butter can be spread to 3-inch wide by 4-inch long foil strips and attached to the wire at 3-foot intervals with strips of cloth adhesive tape. Apply a mixture of equal parts peanut butter and vegetable oil to the strips and fold

them over the electrified wire. Deer are attracted by the peanut butter, which encourages them to make nose-to-fence contact. After being shocked, deer learn to avoid fenced areas.

Egg-based repellents sprayed on cloth strips and tied to electric fencing, also can increase fence effectiveness. This method may be even more effective than peanut butter because the repellent's offensive odor reinforces the fence's electric shock.

Raccoons

Identification and Incidence: Distinctive raccoon tracks often provide evidence of their involvement in a wide range of situations. They can damage vegetable gardens and crops, particularly sweet corn. Partially eaten ears

with the husks pulled back, and broken stalks (caused by climbing) are common signs of raccoon damage.

Time of Attack: Raccoons often feed on corn that is ripe and ready for harvesting. Often, the most severe damage is just a day or two before the anticipated harvest.

Management: Consult your state or provincial wildlife agency about the laws and regulations pertaining to raccoons before shooting or trapping nuisance animals. In many states and provinces, raccoons that injure crops on occupied farmland may be trapped or shot by the property owner, occupants, or those with written authorization.

Raccoons are easily trapped. Live traps should be made of sturdy metal and be at least 10 inches tall, 12 inches wide, and 32 inches long. Use commercial sweet baits or pastes to lure raccoons and reduce non-target mammal captures. Landowners often must euthanize raccoons captured on their property or release them elsewhere on the property.

Body-gripping traps (#160 or #220) can also capture raccoons. These traps kill quickly and should not be used in areas where there is a chance of catching pets or other non-target animals. Body-gripping traps can be placed in a special set called a "raccoon box" to eliminate the risk to non-target animals. The raccoon box is a wooden box that has an entrance hole on the bottom and is mounted on a tree trunk 6 inches above the ground, keeping dogs safer from accidental capture.

The best way to prevent or reduce raccoon damage is exclusion. A two-wire electric fence (with wires 5 and 10 inches above the ground) can protect sweet corn. Fences can be turned off during the day or left on continually if woodchuck damage also is a problem. Install electric fences at least two weeks before the corn reaches vulnerable stages so raccoons will not develop the habit of feeding in that location.

Raccoons also are a vector of rabies. Anyone routinely trapping or handling raccoons should have rabies pre-exposure immunization. If anyone is bitten or scratched by a raccoon, wash the wound thoroughly with soap and water and contact a physician immediately. In such cases, rabies post-exposure vaccinations may be necessary, so consult your local health department.

Raccoon feeding damage.

Sweet!

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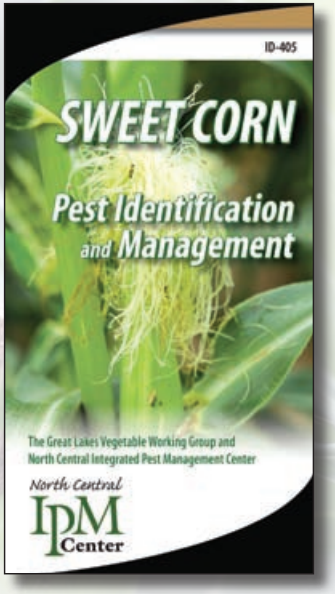

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