A1220

The European corn borer

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Common name—
European corn borer
Scientific name—*Ostrinia nubilalis*

Appearance

Full-grown larvae of the European corn borer range in length from ¾ to 1 inch and vary in color from gray to creamy white. The body is covered with numerous dark spots and the head is black. Adults are straw-colored moths with a 1-inch wingspread. Male moths are slightly smaller and distinctly darker than females. Adult females lay eggs on the underside of leaves near the midvein. These egg masses are ⅛–3⁄16 inches long and contain approximately 20–30 eggs which overlap like fish scales. As they develop, the eggs change from white to a creamy color. Just before hatching, the black heads of the larvae become visible. This final egg stage is referred to as the "black-head" stage.

Life cycle

European corn borers pass the winter as full-grown larvae, usually living inside old corn stalks, in the stems of weed hosts, or in vegetable stems left in the field. Spring development begins when temperatures exceed 50°F. The larvae pupate during May, and moths appear in June. Cool weather or drought may delay spring development of borers while warm weather and adequate moisture may accelerate it. Due to the lake influence and other moderating factors, spring moth appearance lingers into July in the eastern and northern portions of Wisconsin. Hot, dry spring weather may kill pupae.

After emergence, moths spend the daylight hours in sheltered areas (weeds and grasses) in or bordering corn fields. On warm, calm evenings, they fly about in corn fields and deposit eggs. Below-normal temperatures will reduce flight activity thereby reducing mating and egg laying. High temperatures and low humidity will increase moth mortality. The number of viable eggs laid depends upon the availability of drinking water. (Dew is considered a source of drinking water.) Heavy rains interfere with moth activity, but showers do not.

The first moths of the year are attracted to the tallest corn for egg laying. Female moths deposit egg masses on the underside along the midrib of lower leaves of young corn plants. It takes approximately 6 days for eggs to hatch at typical late-June temperatures in central Wisconsin.

Upon hatching, these first-generation larvae move almost immedi-

European corn borer egg mass shortly before hatching.

European corn borer larva.

"Pin-hole" damage caused by first-generation European corn borers.

ately to the plant whorl where they begin to feed. As the leaves lengthen, this damage begins to look like pinholes. Larvae from one egg mass will scatter over several adjacent plants. By the third stage (instar) of development, larvae tunnel into the midrib of the leaves, eventually burrowing into the stalk of the plant. It takes approximately 22 days for borers to reach the full-grown (fifth instar) stage.

Larvae that mature early in the season pupate inside the green corn stalk. Approximately 12 days later moths emerge to mate and lay eggs for the second generation. First-generation larvae that mature later in the season do not pupate. Instead, they enter a diapause condition (physiological arrest) and overwinter as full-grown larvae. Most corn borers in northern Wisconsin follow this latter pattern.

The summer moth flight, which leads to second-generation larvae, peaks around mid-August in central Wisconsin. In tasseling corn, approximately 90% of the eggs are laid on the two nodes directly above and below the ear (four nodes total). Young larvae hide behind leaf sheaths and under ear husks. They enter the silk channel at the tip of the ear. Larvae that hatch after tasseling enter the stalk or ear. The larvae that reach the fifth instar during September and October will overwinter along with those larvae that diapaused in August.

Heavy rains occurring before the young borers tunnel into leaves and stalks will kill many larvae either by washing them from the plant or by drowning them in the whorl or leaf collar area.

Damage

The major injury to field corn is stalk tunneling which impairs plant growth and reduces potential yield. Second-generation larvae cause additional yield losses from broken stalks and dropped ears. Although canning and fresh market sweet corn also suffer from stalk tunneling, the major damage in sweet corn is to the ears. Because borers damage the kernels, corn intended for canning or freezing must be handled and trimmed prior to processing. This type of damage in fresh market sweet corn results in loss of the entire ear because of consumer rejection.

Most of the ear damage occurs from infestations arising during the row tassel (RT) stage†. This is when tassels have emerged on most of the plants and pollen or silks are present on 10% of the crop.

Scouting suggestions

Fresh market sweet corn

Fresh market sweet corn in southern Wisconsin may be tasseled in late June when egg masses for the first-generation borers start to hatch. Monitoring for early evidence of borer attack is crucial as treatments must be properly timed to keep the developing ears essentially free of borers.

Blacklight traps attract moths and can help you monitor population intensity and activity. Contact your county Extension office for trap data.

- Begin checking plants for egg masses by June 15 in southern Wisconsin. Examine 10 plants in at least five different areas.
- Through early silk stage, treat if 5% of the plants have egg masses, larvae, or leaf-feeding damage.
- Repeat treatment every 3–5 days if more than one unhatched egg mass remains per 20 plants.

Processing sweet corn

First-generation borers require less monitoring on processing sweet corn than fresh market corn. Since the corn matures later, leaf whorl feeding can be used as a sign of infestation.

- Sample 10 plants in each of five different areas in a field.
- During the whorl stage, treat if 25% of the plants are infested with live larvae or eggs, or show signs of leaf feeding.
- During the late-tassel to silk stages, treat if you find live larvae or eggs on 4–5% of the plants.
- Repeat treatments every 3–5 days if you continue to find live larvae or eggs on 4–5% of the plants. Two to three applications may be necessary during years with heavy infestations.

Second-generation borers attack late-planted processing corn. Blacklight insect traps provide useful records in June for first flight, and are even more worthwhile in August for monitoring the second flight. Scout areas that have different planting dates or varieties separately because these differences can affect the extent of egg laying.

- Scout every 5–7 days. Sample at least 10 plants in each of five areas of a field.
- Examine leaves for egg masses and larvae; also look on husk leaves arising from the ear tip.
- Check emerging tassels and in leaf collars for larvae; treat if you find live larvae or eggs on 4–5% of the plants.
- Repeat treatments every 3–5 days if you continue to find live larvae or eggs on 4–5% of the plants. Two to three applications may be necessary during years with heavy infestations.

†From *Vegetable Insect Management—With Emphasis on the Midwest* edited by Rick Foster and Brian Flood. Meister Publishing Company, Willoughby, OH. 1995

Field corn

Field corn that's been planted early attracts egg-laying moths in June. The guideline for determining treatment needs for first-generation borers depends on the number of plants with fresh whorl feeding. Do not wait until plants show signs of severe leaf feeding before applying an insecticide. By this time the borers are larger and more difficult to kill and, more importantly, they have already tunneled inside the stalk and are protected from the insecticide.

Both first- and second-generation borers reduce potential yield by tunneling in the stalk. However, most of the damage—broken stalks and dropped ears—found at harvest time is caused by second-generation borers. Due to the extended egg-laying period in August, you'll need to sample fields weekly for an accurate picture of the potential damage.

Control

Natural control

Natural control plays a key role in moderating European corn borer populations. Weather conditions, predators, parasitoids, and diseases take their toll on borer populations. Given ideal conditions, natural controls can kill off approximately 80–90% of the eggs and larvae. Although augmentative releases of predators and parasitoids cannot be solely relied upon to keep populations at acceptably low levels, conservation of these natural enemies is an important part of pest management programs. We typically have 5–7 years of relatively low borer populations separating outbreak years, and this is primarily a result of natural control. Using insecticides only when absolutely necessary is an important step in conserving natural enemies.

Cultural control

European corn borers overwinter in corn stalk residue. Therefore, removing corn by harvesting it for silage will kill a high percentage of the borers, perhaps as much as 80%. Deep moldboard plowing (where soil erosion is not a major concern) and stalk shredding will also substantially reduce within-field populations of borers. However, these procedures will not eradicate European corn borer because it also infests numerous non-cultivated plants. Also, the potential for soil erosion and the costs involved with extra equipment and trips over the field limit the usefulness of plowing and stalk shredding.

Borer-resistant varieties

Two types of borer-resistant corn plants are commercially available: plants with native resistance and plants that have been genetically altered (transgenic).

Native resistance refers to naturally occurring plant chemical compounds that can either repel or kill an insect. It is important to remember that resistance does not necessarily mean that the plant is immune to insect damage. Some seedlings, for example, produce DIMBOA, a chemical that is lethal to first-generation borers. However, by the time the plant reaches an extended leaf height of 17–24 inches, the chemical is sufficiently diluted for borers to feed safely. Check with your seed supplier for information on the relative native resistance or susceptibility of the varieties you are considering.

Transgenic Bt corn hybrids are an example of genetically modified organisms (GMOs) in which corn has had a gene inserted from an unrelated organism, in this case Bt. Bt is an abbreviation for *Bacillus thuringiensis*, a naturally occurring soil bacterium.

Spores produced by the bacterium contain a protein which, when ingested by a susceptible insect, ruptures the gut lining, ultimately killing the insect. There are many different strains of Bt, each with specificity toward a particular group of insects.

Bt has been commercially available as a foliar insecticide for lepidoptera larvae such as European corn borer for decades. Transgenic Bt corn hybrids with activity against European corn borer larvae have been commercially available since 1996. Incorporation of the Bt toxin into the corn plant overcomes some of the difficulties associated with conventional insecticides (human exposure to toxic chemicals associated with mixing and loading procedures, death of beneficial insects, etc.).

Unlike Bt microbial sprays, which have a field residual measured in days, the Bt toxin in transgenic Bt corn is expressed throughout the life of the corn plant. This gives more consistent and economic control when European corn borer populations reach threshold levels. However, there is a significant risk that with constant exposure of target insects to Bt toxins, resistant pest populations may develop.

To help protect against rapid development of insect resistance, the U.S. Environmental Protection Agency has mandated that growers follow insect resistance management (IRM) protocols when planting transgenic Bt corn hybrids. A minimum of 20% of each field planted to Bt corn must include a refuge area of non-Bt corn borer corn. This creates a refuge of susceptible European corn borers that have not been exposed to the Bt toxin. Susceptible moths from the refuge area mate with resistant individuals that potentially could emerge from the Bt corn, passing along susceptibility to the Bt toxin to their offspring.

Planting options that may be used to meet the IRM planting requirement: (1) plant the refuge as a large block within or next to the Bt corn field, (2) split the planter to alternate four or more rows (six or more preferred) of non-Bt corn with Bt corn, (3) plant field perimeters or end rows to non-Bt corn equal to 20% of the entire field, or (4) plant the refuge area within ½ mile (preferably within ¼ mile) of Bt corn fields. **Note:** Mixing non-Bt seed with Bt corn seed for use in the refuge is *not* permitted.

For more information and recommendations, refer to UW Extension publication *Pest Management in Wisconsin Field Crops* (A3646).

Chemical control

For economic treatment thresholds and insecticide recommendations for sweet corn, potatoes, snap beans, and peppers see Extension publication *Commercial Vegetable Production in Wisconsin* (A3422).

On field corn, insecticide treatments are not always warranted for controlling borer damage. Use the following management worksheets to determine whether treating an infestation will save you money. For treatment recommendations, refer to Extension publication *Pest Management in Wisconsin Field Crops* (A3646).

FIELD CORN **Management worksheet for FIRST-GENERATION European corn borer**

_______ % of 100 plants infested x _______ ave. # borers/infested plant[a]

= _______ borers/plant

_______ borers/plant x 5% yield loss/borer = _______ % yield loss

_______ % yield loss x _______ expected yield (bu/a) = _______ bu/a loss

_______ bu/a loss x $_______ price/bu = $_______ loss/a

$_______ loss/a x _____ % control[b] = $_______ preventable loss/a

$_______ preventable loss/a – $_______ cost of control/a

= $_______ gain (+) or loss (–) per acre if treatment is applied

[a] *Determined by checking whorls from 10 plants.*
[b] *Allow 80% for most insecticides or, preferably, consult Extension publication* Pest Management in Wisconsin Field Crops *(A3646) for an insecticide performance update.*

FIELD CORN **Management worksheet for SECOND-GENERATION European corn borer**

_______ number of egg masses/plant[a] x 2 borers/egg mass[b]

= _______ borers/plant

_______ borers/plant x 4% loss/borer[c] = _______ % yield loss

_______ % yield loss x _______ expected yield = _______ bu/a loss

_______ bu/a loss x $_______ price/bu = $________ loss/a

$_______ loss/a x 75% control = $_______ preventable loss/a

$_______ preventable loss/a – $________ cost of control/a

= $_______ gain (+) or loss (–) per acre if treatment is applied

[a] *Use cumulative counts, taken 7 days apart.*
[b] *Assumes survival rate of 2 borers/egg mass.*
[c] *Use 3% loss/borer if infestation occurs after silks are brown. The potential economic benefits of treatment decline rapidly if infestations occur after corn reaches the blister stage.*

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