

MU Guide

European Corn Borer: A Multiple-Crop Pest in Missouri

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The European corn borer, *Ostrinia nubilalis* (Hübner), is perhaps the most destructive corn pest in Missouri and the entire Corn Belt. Crop losses and control costs associated with European corn borer infestations can exceed \$1 billion annually in the United States and Canada. This Eurasian species was first observed in the United States near Boston in 1917, and by the 1940s it had migrated into Missouri.

Description and life cycle

This insect overwinters as full-grown, fifth-instar larvae inside the stalks and in field debris of its cultivated and wild host plants. Once a minimum temperature of 50 degrees F is reached, the larva pupates and the adult moth emerges in May. The adults usually mate within 48 hours of emergence in the grassy field margins around crop fields. The female moth has a pale-yellowish color with irregular, wavy, bands on their wings (Figure 1, left). Male moths are smaller and darker and have olive-brown wing markings.

The female moth is an active flier and is capable of traveling 5 miles in a night. At dusk she will begin laying her eggs in masses of five to 50 eggs on the underside of leaves near the leaf midrib. The flattened eggs overlap like fish scales and are initially white before turning yellow (Figure 1, right). Within 3 to 7 days, the young larvae hatch and are initially dull white with several rows of small brown spots. Fully grown larvae are about 1 inch long, light tan to a pinkish gray, and marked with two rows of small, circular, brown spots. European corn borer development rapidly slows in the summer when temperatures exceed 85 degrees F.

Damage

Corn (field)

First-generation European corn borer larvae can damage leaves by removing a thin, transparent layer, or “windowpane,” of tissue. Feeding damage during the mid- to late-whorl stages gives the unfurled leaves a

Facts at a Glance

- This insect pest has many cultivated host plants (e.g., corn, cotton, grain sorghum).
- It feeds primarily on the fruit (e.g., corn, cotton) or stems (e.g., corn, grain sorghum) of its cultivated and wild host plants.
- Typically, two generations per field season occur in Missouri, and a third generation is possible in the south-eastern or “Bootheel” counties.
- Insecticides must be applied in a timely manner to achieve effective control.



Figure 1. European corn borer moth (left) and egg mass (right).

“shothole” appearance. By the third instar (about ½ inch in length), the larvae move from the leaf sheath or midrib and bore into the stalks (Figure 2). When corn plants are small (less than 6th-leaf stage), 70 percent or less of the larvae may die from various causes, including inclement weather conditions and attacks from natural enemies. An important deterrent to European corn borer larvae in young corn plants is DIMBOA, a hydroxamic acid (2-4 dihydroxy-7-methoxy-1, 4-benzoxazin-3-one) that occurs naturally in the corn leaf tissue. Concentrations of DIMBOA decrease as the plant matures.

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Figure 2. European corn borer larva and corn stalk damage.

Second- and third-generation European corn borer larvae may attack corn during the silking and tasseling stages. Second-generation larvae initially feed on pollen and leaves before boring into the ears and stalk (within the ear zone). In fields where the corn kernels are still in the milk stage, third-generation larvae feed on the leaf sheaths and collars, stalks and ears.

European corn borer infestations vary with crop phenology, or life cycles in relation to climate and other environmental conditions, and with the plant's response to damage (Table 1). The yield reduction during ear development is typically 2–4 percent; however, extended periods of moisture stress following European corn borer stalk tunneling can lower yields by about 12 percent.

Table 1. Yield losses caused by the European corn borer at various corn growth stages.

Corn stage	Yield loss (per borer per plant)	
	Percent	Bushels per acre
10-leaf (mid-whorl)	5.9	8.3
16-leaf (green tassel)	5.0	7.0
Pollen shedding	4.0	5.6
Blister	3.1	4.3
Dough	2.3	3.4

Note: Percent losses due to physiological stresses; further losses can occur because of stalk breakage or ear drop.

Corn (sweet)

The European corn borer's feeding damage in sweet corn is similar to that in field corn. Damage to sweet corn ears can reduce both the quantity and quality of the kernels. Also, larval boring damage to the stalk can cause plants to lodge and further reduce yields.

Cotton

European corn borer larvae feed briefly (less than 24 hours) on the leaves and leaf petioles of cotton plants before tunneling into bolls and stems (Figure 3). Unlike damage by the cotton bollworm, *Helicoverpa zea* (Boddie), or the tobacco budworm, *Heliothis virescens* (F.), small European corn borer larvae can penetrate and damage relatively mature, hard bolls (Figure 4). This



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Figure 3. Damage from European corn borer larva on cotton stem.



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Figure 4. European corn borer damage to cotton boll.



Figure 5. European corn borer larva and sorghum stalk damage.

boring damage is recognizable by the characteristic sawdust-like droppings left by the larvae. Interior boll damage is usually less than that by bollworm or budworm larvae; however, bolls partially damaged by European corn borer larvae are more susceptible to fungal infections and boll rot.

Grain sorghum

Late-season European corn borer infestations in grain sorghum can cause the loss of seed heads when larvae tunnel into the stem just below the seed head (Figure 5).

Approximate timing for European corn borer infestations in Missouri.

	1st generation	2nd generation	3rd generation girdling damage	
January – May	June	July – August	August – Sept.	October – December

Scouting procedures and techniques

Corn (field)

Once moths have been detected in traps (blacklight or pheromone-baited) and corn has reached the 6th-leaf stage, fields should be scouted weekly for the next two to four weeks to detect first-generation European corn borer infestations. Monitoring for European corn borer moth dispersal also can be supplemented by field observations and walking through grassy field margins where the moths gather to mate and obtain water. These infestations usually start in late May to early June in central Missouri, and seven to ten days earlier in the southeastern counties (see timeline). Initially, scouting should be concentrated in the fields planted earliest. Focus your efforts around the middle third of the plant because European corn borer eggs are generally deposited on the basal third of the leaf near the midrib. For second-generation European corn borer infestations, fields should be scouted beginning around mid-July and until early August in central Missouri. To determine whether an insecticide treatment is necessary, examine 100 plants (10 per site) per field for signs of feeding damage or larvae.

Corn (sweet)

In sweet corn about 90 percent of the egg masses are deposited on the ear leaf or on the four leaves above and the one below the primary ear.

Cotton

Once corn silks begin to dry and plants mature, European corn borer moths will be highly attracted to flowering cotton plants. Rank cotton with a closed canopy is also more attractive to the moths. The egg masses are generally deposited on leaves deep in the canopy. During the early to middle stages of crop development, boring activity is recognizable by the wilted terminals or leaves. This feeding damage resembles that caused by drought; however, noninfested, adjacent plants remain healthy in appearance. Typically, European corn borer larvae enter the boll near the calyx, whereas cotton bollworm or tobacco budworm larvae bore further up on the boll. Because the egg masses are extremely difficult to detect, scouting efforts should focus on finding the small European corn borer larvae between the bracts and the boll wall.

Grain sorghum

Young larvae usually feed in the leaf axils. Later, the

larvae will bore into the stalk when half grown (approximately ½ inch in length).

Economic thresholds

Corn (field)

For first-generation European corn borer infestations, treatment is recommended when 50 percent of the whorl-stage plants have damaged foliage and live larvae are present. Later in the season, the recommended threshold is when 50 percent of the plants are infested (first leaf above and below the ear) with European corn borer egg masses and larvae.

Corn (sweet)

Blacklight trap counts and field observations are helpful for properly timing insecticide applications. Moth captures of less than 10 per night generally do not justify insecticide treatments. When more than 10 moths are captured per night for three consecutive nights and sweet corn is at the pretassel or later growth stages, an insecticide should be applied. Trap captures greater than 100 per night indicate a reinfestation flight; therefore, insecticide treatments are necessary every five to seven days until the brown silk stage.

Cotton

No established threshold exists in Missouri for European corn borer infestations in cotton. In North Carolina, a recommended threshold is 3 percent or more of the plants infested with young live larvae.

Grain sorghum

No established threshold exists for European corn borer infestations in grain sorghum because of ineffective coverage and small yield losses.

Management

Corn (field)

Various control strategies can be deployed against the European corn borer to lessen the probability of infestations and yield losses. Before the advent of no-till, producers would plow under all crop and weed residue to kill most overwintering larvae. Cultural management practices such as early planting and harvesting can reduce the number of insecticide treatments needed for European corn borer infestations. Even though early-planted corn is more susceptible than late-planted corn to infestation by first-generation European corn borers,

first-generation larvae are easier to scout for than second-generation larvae and easier to control with insecticides (fewer applications and greater coverage).

Precaution: Before you select and apply an insecticide, review the manufacturer's label for information on the safe use of the material.

Insecticides can provide effective control of the European corn borer (particularly for the first generation) if properly timed (within 7 to 10 days of hatching) and applied (down into the whorl) so to penetrate the plant canopy. Granular formulations are more effective than liquid ones for first-generation European corn borer infestations; however, both formulation types are recommended for second-generation infestations. Growers should first consider the following factors when determining whether an insecticide treatment will be profitable:

- Average percent of plants with whorl feeding damage
- Average number of larvae or egg masses per plant
- Corn growth stage
- Presence of European corn borer natural enemies
- Anticipated yield per acre and value of corn per bushel
- Cost of insecticide treatment

Other control tactics include conventional hybrids bred for resistance to the European corn borer. Studies conducted in Missouri with these varieties indicate that 90 percent of these hybrids have some resistance to first-generation European corn borer infestations and 75 percent have resistance to second-generation infestations. But the resistant hybrids generally do not have the yield potential of more susceptible, full-season hybrids.

The new *Bacillus thuringiensis* (Bt) corn hybrids are another management option for European corn borers and other caterpillar species (southwestern corn borer, *Diatraea grandiosella*, Dyar; corn earworm (same as cotton bollworm). In several Missouri corn trials, Bt hybrids have yields equal to or greater than conventional hybrids. The Bt hybrids produce a toxic protein that was originally derived from the soil bacterium *Bacillus thuringiensis*. Growers should note that the current Bt hybrids do not effectively control some pests (e.g., armyworms) nor provide protection against other insect pests (e.g., aphids, cutworms, rootworms, wireworms).

Before growers select and plant a Bt corn hybrid, they should first consider two important factors (variety selection and refuge fields). First, not all transformations

or "events" used to develop the Bt corn hybrids provide equal protection against the European corn borer. For example, BT11 and MON810 events or 'YieldGard' hybrids provide greater full-season protection from European corn borer feeding damage than event 176 hybrids. Second, long-term prevention or suppression of Bt-resistant populations is necessary to maintain the economic viability of this valuable technology. This can be accomplished by planting non-Bt corn that is not treated with foliar Bt sprays as a refuge area to produce Bt-susceptible insects. The susceptible insects in turn mate with Bt-resistant individuals and help slow the overall development of Bt-resistant European corn borer populations. It is important to manage (through fertilization, irrigation, etc.) the refuge and Bt corn fields alike so both European corn borer populations emerge at the same time to mate and produce susceptible offspring. The refuge cornfield(s) also should lie in close proximity (less than 1/2 mile) to Bt fields to increase the chances that Bt-resistant and Bt-susceptible individuals will mate. Additional information regarding Bt corn management can be obtained from North Central Regional Extension Publication NCR 602, *Bt Corn & European Corn Borer: Long-Term Success Through Resistance Management*.

Corn (sweet)

Field corn is the major source of European corn borer infesting sweet corn. When the benefits of treatment exceed the control costs, the recommended European corn borer threshold is 50 percent or more of the whorl-stage plants with damage and live larvae are present. The best time to apply an insecticide is before the tassels emerge.

Cotton

Both light and pheromone-baited traps should be used to monitor moth flights and trigger intensified scouting efforts in cotton. Growers can minimize the attractiveness of their cotton to European corn borer moths with early planting dates, early-maturing varieties, and maintaining uniform plant growth. Avoid excessive irrigation and nitrogen applications that delay crop maturity and increase the crop's window of susceptibility to European corn borer damage.

Grain sorghum

Early crop maturity and uniform plant growth will lessen the attractiveness of grain sorghum to European corn borer moths.