European Corn Borer (*Ostrinia nubilalis* Hubner)

Insect Fact Sheet | University of Illinois IPM integrated pest management

The European corn borer can be found in areas east of the Rocky Mountains from the Gulf Coast to southern Canada. Its host range has more than 200 species of plants, including both agronomic and horticultural crops and many common weeds. It is one of the major economic corn pests in Illinois. Losses due to European corn borer damage and control costs often exceed one billion dollars in the United States. However, the impact of this insect on corn yield is often underestimated due to the plant's ability to tolerate feeding, lack of scouting efforts, and fluctuations in corn borer densities from year to year.

Description

Early instars of European corn borers are tiny larvae, approximately 1/32 to 1/16 inch long, with translucent white bodies and brown heads. As the larvae mature, the become flesh-colored with blackish heads. Larvae are ¾ to 1 inch long and have two distinct brown spots (tubercles) on each abdominal segment. European corn borer larvae have three pair of true legs behind the head and five pairs of prolegs on their abdomen. Pupae are brown, ½ to ¾ inch long, and have a rounded head region and abdomen area tipped with a tiny hook. Male and female corn borer moths are similar in appearance. moths have alternating yellow and brown wavy lines across each wing, although the males have a darker wing pattern. Females lay eggs in clusters (average 23 eggs per cluster), but they may lay as many as 60 eggs per cluster. One egg is about the size of a pinhead. Egg masses are creamy white when first laid, but become more translucent as time goes on. As larvae mature in the egg, the black/brown color of the head capsule is visible through the egg. This is known as the blackhead stage.

European corn borer larva

European corn borer adult

European corn borer egg masses

Life Cycle

Mature larvae (fifth larval instar) overwinter in corn stalks, stems of plants, or plant debris in or on the soil. They pupate in the spring when temperatures reach 50° F and emerge as adults in late spring. Females lay eggs for the first-generation in cornfields or on secondary grass hosts. Eggs hatch in approximately 5 to 7 days. Young larvae move to and, depending on the growth stage of the corn plant, feed in the whorl, ear, or leaf collar. As borers mature to the 3rd or 4th instar, they begin to bore into the stalk and midribs or leaves where they develop and pupate. They emerge as moths in a week to ten days after pupation. Moths gather around field edges and grassy areas, referred to as "action sites." Action sites are areas that contain dense vegetation and are very humid; these conditions are optimal for moths to mate, rest and drink water. Moths begin to lay eggs for a second generation in cornfields that are tasseling and on late-planted corn. Approximately 90% of eggs are deposited on the undersides of the ear leaf and the three leaves above and below the ear. The second generation larvae pass through the same stages as the first generation. A third generation may occur in the southern third of Illinois. However, the fifth instar of the second generation generally enters diapause to overwinter. Diapause is an inactive stage where no growth occurs and can be induced by a combination of factors such as decreasing day length, temperature, and food quality.

Biology of European corn borer	
Moth longevity	1 to 2 weeks
Pre-oviposition period	2 to 3 days
Egg-laying period	7 to 10 days
Each moth lays..	~2 egg masses/night
One egg mass	~23 eggs
Eggs/female	~400
Larval hatch	3 to 7 days
Larval survival	10 to 20%
# larval instars	5

Injury

Corn that is less than 15-18 inches tall is not very susceptible to corn borer injury. Plants this height possess a compound called DIMBOA that prevent larvae from establishing. Larvae that feed on small corn generally fail to establish and wander off the plants and die. As plants mature, the concentration of DIMBOA decreases, and they become more susceptible to corn borer injury. Early planted corn is most susceptible to larval feeding by first-generation of borers.

First generation ECB injury

Corn borer larvae feed on all parts of the corn plant except the roots. First-generation larvae are found feeding on the leaves of corn in mid-to-late whorl stages. They chew small holes in the leaves creating a "buckshot" effect. As corn borers mature they leave the whorl and begin tunneling in leaf midribs and sheaths. After reaching approximately 1/2 inch in length (third instar) borers tunnel into the stalk, and feed until full grown. The second generation is present on corn after tassels have emerged. They feed on pollen in leaf axils or on leaves. As they get larger, they feed on leaf sheaths, collars, and midribs until they eventually enter the stalk. Second generation corn borers also may enter the ear or earshank.

Tunneling in the stalks by larvae affect the plant's ability to transfer nutrients. This often reduces grain weight and kernel number. Yield losses are due primarily to physiological damage. Stalk breakage and lodging, ear droppage and secondary invasion of stalk rots into susceptible varieties also contribute to yield loss.

Scouting Procedure

Degree Days

Degree day accumulations can be used to predict biological events such as the life stages of the European corn borer. The accumulation of degree days (base 50° F) begins with the initial capture of moths in the spring. Degree days can be an effective tool to provide assistance when scouting for European corn borer.

First Generation European Corn Borer

Accumulated Degree-Days	First occurrence	Days to first occurrence	General activity
0	First spring moth	-	-
212	Larval hatch (1st instar)	16.3	Pinhole leaf feeding
318	2nd instar	6.6	Shot-hole feeding
435	3rd instar	6.5	Mid-rib & stalk boring
567	4th instar	6.6	Stalk boring
792	5th instar	10.2	Stalk boring
1002	Pupa	7.6	Changing to adult

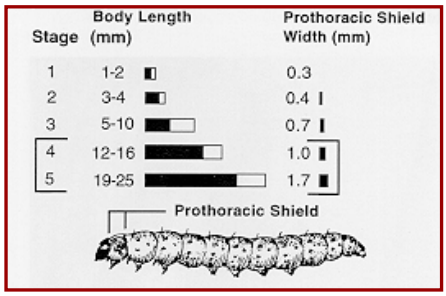
Second Generation European Corn Borer

Accumulated Degree-Days	First occurrence	Days to first occurrence	General activity
0	First spring moth	-	-
1,404	Larval hatch (1st instar)	8.2	Pollen & leaf axil feeding
1,510	2nd instar	4.1	Leaf axil feeding
1,627	3rd instar	4.3	Sheath, collar, & midrib feeding
1,759	4th instar	5.1	Stalk boring
1,984	5th instar	9.0	Stalk boring

First-Generation

The easiest method of scouting for first generation European corn borer is to look for larvae and whorl damage after the eggs have hatched. Examine 100 plants (5 sets of 20) and record the percentage with whorl feeding. Dissect two damaged plants per set and record the total number of larvae found on 10 plants. Younger larvae may be found by unrolling the leaves of the whorl or looking behind the leaf sheaths. Older larvae may be found by splitting the stalk. Larvae should be separated and counted by instar. Early planted corn is more susceptible to damage by first-generation European corn borer.

To decide whether it would be profitable to treat a field infested with first generation corn borers, the use of a threshold guide may be useful to help determine whether a potential yield loss may occur.



European corn borer head capsule gauge

Management Worksheet for First-Generation European Corn Borer

_____	Larvae found	X	_____	Expected Survival [1,2]	=	_____	Surviving larvae
_____	Surviving larvae	÷	_____	Plants examined	=	_____	Larvae per plant
_____	Larvae per plant	X	_____	Yield loss per larvae[3]	=	_____	Yield Loss
_____	Yield Loss	X	_____	Expected yield (bu/A)	=	_____	Loss (bu/A)
_____	Loss (bu/A)	X	$____	Price per bushel	=	$____	Loss per acre
$____	Loss per acre	X	_____	Control[4]	=	$____	Preventable loss per acre
$____	Preventable loss per acre	-	$____	Control of cost per acre	=	$____	Gain (+) or loss (-) per acre if control applied

Notes:

[1] Record all percentages as decimals (for example, 20% = 0.2)

[2] If larvae are newly hatched (1st instar), it is likely that only 20% will survive to maturity, depending on environmental stress. If larvae are 2nd instar, the survival rate may increase to 50%. Adjust this number accordingly.

[3] Use 0.06 for V10 corn, or 0.05 for V16 (green tassel) corn. When borer numbers reach or exceed 3 per plant, the loss caused by each additional borer will decrease.

[4] 80% control with granules (aerial or ground application) and with sprays directed over the whorls (ground application); the more effective insecticides provide comparable control when applied as broadcast sprays (aerial application)

Scouting Procedure

Second-Generation

For the second-generation, egg mass counts are the preferred method of scouting. Start checking for egg masses in corn when corn borer moths are being collected in light or pheromone traps. Fields most likely to be infested are those where the corn is green, succulent, shedding pollen, or has green silks in late July and early August. Look for egg masses on the underside of leaves above and below the ear zone. If time permits, check all leaves on a plant for egg masses. Egg laying by the second brood may extend over a period of 3 to 4 weeks.

Count the total number of egg masses on 50 random plants. The masses are usually laid on the under-surface of the leaves near the midrib. These leaves can be most easily examined by stripping them from the plant to look for the egg masses. Late planted corn is more susceptible to damage by second-generation European corn borers. Record the number of egg masses found and multiply by 2 to obtain the number per 100 plants. If needed, treatments should be applied at the time when most of the eggs are hatching or in the black head stage.

If some of the eggs have hatched, it may be necessary to dissect the stalk to determine if the borers have entered the stalk and cannot be reached with an insecticide. Usually there will be sawdust-like frass left at the entry hole in a leaf axil or behind a leaf sheath. Do not confuse an empty first-generation cavity on the lower portion of the plant with a new cavity from the second generation.

Management Worksheet for Second-Generation European Corn Borer

_____	Egg masses found[1]	÷	0.91 (If only ear zone sampled)	=	_____ Adjusted egg masses
_____	Adjusted egg masses	÷	_____ Plants examined	=	_____ Egg masses per plant
_____	Egg masses per plant	X	4 Larvae per egg mass[2]	=	_____ Larvae per plant
_____	Larvae per plant	X	_____ Yield loss per larvae[3,4]	=	_____ Yield loss
_____	Yield loss	X	_____ Expected yield (bu/A)	=	_____ Loss (bu/A)
_____	Loss (bu/A)	-	$____ Price per bushel	=	$____ Loss per acre
$____	Loss per acre	x	0.75 Control	=	$____ Preventable loss per acre
$____	Preventable loss per acre	-	$____ Cost of control per acre	=	$____ Gain (+) or loss (-) per acre if control applied

Notes:

[1] Counts may be cumulative if taken a few days apart.

[2] Four larvae per egg mass assumes 20% survival of 20 eggs per mass; increase if conditions are favorable to corn borer survival.

[3] Record all percentages as decimals (for example, 20% = 0.20).

[4] Yield loss per borer per plant at two corn stages:

Average number of egg masses	Pollen shed	Blister stage
Two or fewer per plant	0.04	0.03
More than two per plant	0.03	0.02

Management

Managing the European corn borer is a very difficult task. Adult corn borers are very mobile, thus making strategies such as crop rotation and tactics that isolate the crop ineffective. It is also difficult to predict accurately economic levels of European corn borer from year to year. Cultural practices such as stalk shredding or plowing in the fall may reduce the survival of overwintering larvae; however, due to the mobility of moths, this practice is not recommended as a management practice.

A resistant or tolerant hybrid also may be a consideration in management planning. Some "conventional" hybrids are resistant to first generation borers while others have some degree of tolerance to corn borer injury. Most seed corn companies have hybrids with some type of resistance to leaf feeding caused by the European corn borer. However, since the late 1970's, fewer acres have been planted to these hybrids. The inbred line B73, which is widely used in hybrid combinations because of its high yield potential, also is susceptible to corn borer feeding.

Since the mid-1990's, transgenic hybrids have become commercially available. These hybrids that have been genetically transformed to include a gene from a naturally occurring soil bacterium *Bacillus thuringiensis* (Bt). The gene produces protein crystals (Cry proteins) that are toxic to corn borer larvae. Once ingested, the Cry proteins break down and produce a toxin that ruptures the lining of the insect's gut. This causes the borers to stop feeding and die within a few days. Bt hybrids offer season long protection against the European corn borer.

The decision to use insecticides to manage corn borers is often decided with the use of management worksheets. Scouting is key to determining corn borer populations. Controlling first-generation corn borers in the whorl can be an effective management approach. Timing of insecticide applications for second generation is more difficult. Once larvae begin boring into the stalk, insecticide applications are ineffective.

See also fact sheets on Bt Corn and Resistance Management Plans

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