service in ACTION

Colorado State University Cooperative Extension

no. 5.537

European corn borers:

characteristics and control

Stan Pilcher and Frank B. Peairs[1]

Quick Facts

- European corn borers are a problem in the northeastern part of Colorado.
- European corn borers usually go through two generations each year; on rare occasions there may be a partial third generation.
- Eggs hatch in mid to late June; larvae feed first on the leaf where they hatched then move to the leaf sheath area producing a "shothole" feeding sign on the leaves.
- The female summer moth prefers to lay eggs in corn that is taseling and in the green silk stage; corn planted late is more severely damaged.
- Controls must be applied before the larvae are protected by the leaf sheaths or stalks.
- Corn borer damage can result from leaf feeding, stalk tunneling and ear damage which weaken plants and reduce yields.
- Chemical controls require accurate timing and placement.
- Natural control of the corn borer is assisted by hot, dry weather, heavy rainfall just after egg hatch and natural occuring protozoa and predators.

The European corn borer has been an economic problem in Colorado since 1978. The main area of infestation seems to be confined to the northeastern quarter of the state. It may eventually spread to all corn growing areas of the state. In 1980, this insect caused a loss estimated at 20 percent of the yield in 275,000 acres (10,000 hectares) of heavier infested corn.

Life History

The European corn borer usually goes through two generations each year in Colorado. There are four stages in each generation: egg, larva (borer), pupa and adult (moth). On rare occasions there may be a partial third generation.

The borer overwinters as a full-grown larva in corn stalks, cobs and plant debries in corn fields. Most of the overwintered larvae will go through the pupal stage and change into the spring moths by the middle of June.

On warm, calm evenings in June, the adults fly from weedy or grassy margins into corn fields and lay eggs, usually when the corn is in the early whorl stage. The eggs are usually laid near the mid-rib on the underside of corn leaves in clusters of 15 to 25, overlapping like fish scales.

The eggs hatch in about five to seven days in mid to late June. The young larvae feed first on the leaf near where they hatched. As the larvae grow, they move to the whorl or leaf sheath area and feed. When leaves emerge, the "shot-hole" feeding signs in the leaves can be seen.

Insecticides should be applied prior to larval entry into the stalk. Larvae also may feed in the leaf mid-rib. Most of the mature larvae will bore

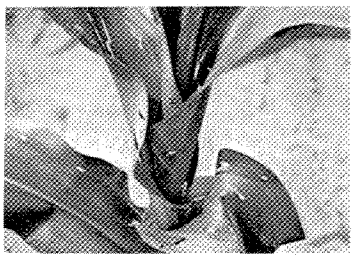

Figure 1: European corn borer (early leaf feeding).

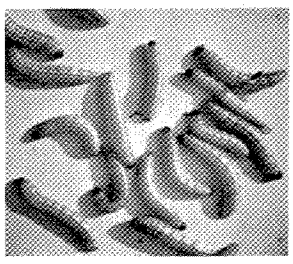

Figure 2: Mature corn borers.

[1]*Stan Pilcher, CSU Cooperative Extension entomologist, Golden Plains Area, and Frank B. Peairs, CSU Cooperative Extension entomologist and assistant professor (revised 12/86)*

into the stalks, feed, and finish development there. Occasionally a larva will complete its development on the outside of the stalk.

The mature first generation larva changes into the pupal stage from which the summer moth emerges in mid to late July, thus beginning the second generation.

The female summer moth prefers to lay eggs in corn that is tasseling and in the green silk stage. Corn planted unusually late is more severely damaged. Eggs are laid on the underside of the leaves. Eggs about ready to hatch have a black center, which is the black head of the larvae showing through the egg shell. Depending on temperature, the eggs will hatch in two to five days. Second generation larvae may bore into the stalk at an earlier stage of development than first generation. Therefore, controls must be applied before the larvae are protected by the leaf sheaths or stalks.

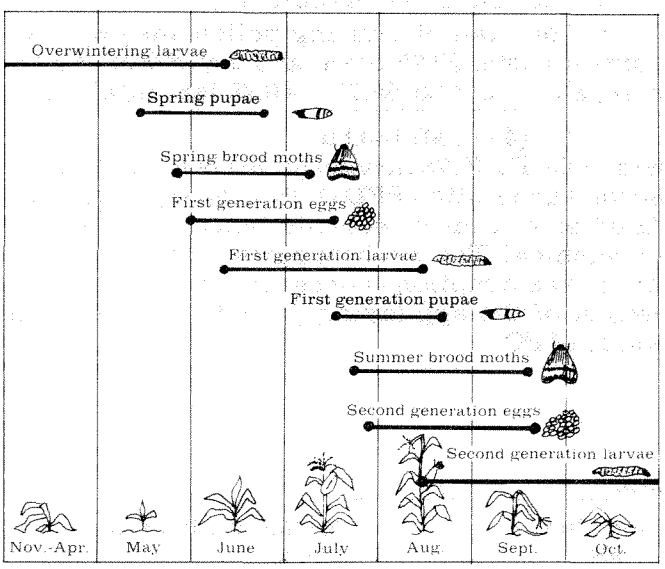

Figure 3: Seasonal history of corn borer.

Damage

Corn borer damage results from

- Leaf feeding (first generation) resulting in loss of leaf tissue, interference in the movement of plant nutrients and mid-rib breakage. If extensive, such injury causes substantial reduction in yield.
- Stalk tunneling (all generations) resulting in destruction of food-conduction channels. This weakens the plant, resulting in stalk breakage, smaller ear size and weight, and reduced yield. Tunneling also makes the plant vulnerable to organisms that cause stalk rot.
- Ear damage (second generation) tunneling in the shank and feeding on silks, kernels and cobs result in yield loss, quality impairments, dropped ears and broken shanks.

Chemical Control

Insecticides for control of both generations are given in Table 1. **Be sure to read and follow all label instructions.**

First generation larvae feed in the whorls and later enter the stalk. Granules applied by ground and air as well as some center-pivot applied liquids have given the best results in university tests. The second brood feeds in leaf axils and the ear tip, and later enters the stalk or the ear. Second brood damage increases the possibility of lodging and ear drop losses, so heavily infested fields should be harvested early.

Aerially-applied and center-pivot applied liquids have performed better than granules for control of second generation larvae in university tests. **Monitor treated fields for spider mites as applications for control of second generation are often associated with mite outbreaks.**

The need to treat European corn borer can be determined by a simple method based on average Colorado conditions, or by a more complex method that takes into account treatment costs, individual field yields and current market conditions. *Incorrect treatment decisions, by either method, are much more likely with second generation infestations.* This is partly due to the second generation egg laying period, which can last up to four weeks and thus makes proper treatment timing very difficult.

By the **simple method** chemical control of the first generation is economical when 25 percent of the plants have feeding damage and larvae are present in the whorls. Once larvae have entered the stalk, control is impossible. Survival of second generation larvae is highest during pollination, so treatments should be considered when weekly scouting has an **accumulated** total of 25% plants with egg masses. This percentage should be raised to at least 50% after pollination. If egg laying continues after the treatment, a second application may be justified under some circumstances.

The **complex method** requires the calculation of the **potential population density (PPD)** of the corn borer from scouting data and comparing that to the **economic threshold (ET)** calculated from control costs, corn prices, and crop stage. *Keep in mind that these calculations assume 100% control, which is often not feasible, particularly with the second generation.* The **PPD** can be reduced according to the percent control that you expect. The **PPD** is calculated differently for each generation:

First generation

1. Determine the percent damaged plants in the field.

2. Determine the number of live larvae per plant. Avoid counting newly hatched larvae as their mortality is very high.

3. The **PPD** = (percent damaged plants) x (average larvae/plant). For example, if 50% of the plants were damaged and there was an average of

3 larvae/plant, then the first generation **PPD** is 1.5.

Second generation

1. Scout the field weekly for borer egg masses, including those already hatched.

2. Begin counts of egg masses per plant with the first sign of eggs in the field. It is unlikely that eggs will be detected until 5% of the eggs have been deposited.

3. **PPD** = $\frac{(SV)\ (23)\ (EM)}{PO}$ where

SV = the average proportion of individuals surviving through the damaging stage. A value of 0.2 is recommended.

EM = the number of egg masses per plant, which is multiplied by the average number of eggs per mass (23).

PO = the proportion of eggs that already have been deposited. This is based on the length of the egg-laying period. On the first scouting day 0.05 is used because this is the amount of egg-laying that usually occurs before eggs can be detected.

4. Resample the field and recalculate the PPD after 8 days. At this time use a PO of 0.50. (Assuming a 3-week egg-laying period, 50% of the eggs would have been laid by this time.)

5. For example, the second generation PPD from step 4 if there were 15 egg masses in 100 plants would equal $\frac{(0.2)\ (23)\ (0.15)}{0.50}$ = 1.38 larvae/plant.

Estimate the ET by:

1. Estimate control costs in dollars per acre. This is the total of the insecticide cost and the application cost.

2. Estimate market value of the crop and the yield at harvest.

3. **ET** = $\frac{CC/MV}{(DL/100)EY}$ where

CC = control costs ($/acre)

MV = market value ($/bu)

DL = percent yield lost to each borer per plant at the time of infestation. These will change with the crop stage as follows:

Crop Stage	DL
Early whorl	5.5
Late whorl	4.4
Pre-tassel	6.6
Pollen shedding	4.4
Kernels initiated	3.0

EY = Estimated yield (bu/acre).

4. For example, during pollen shed with $14 control costs, $2.75 corn, and a yield of 160 bu/acre, **ET** = $\frac{\$14.00/\$2.75}{(4.4/100)\ 160\ bu}$ = 0.72 larvae/plant.

Since the **ET** (0.72 larvae/plant) is lower than the second generation **PPD** (1.38 larvae/plant) calculated above, an insecticide treatment would be economical. The weakest parts of this procedure are the assumptions concerning SV, DL, and the length of the egg-laying period that affects the value of PO.

Table 1: Insecticides for control of European corn borers.

Insecticide	Active ingredient per acre	Application methods*	Preharvest interval (days)
	First and Second Generation		
Ambush[R]	1/10-2/10 lb	A, I	**
Diazinon 14G	1-2 lb	A, C	10
Dipel 10G	See label	A, C	0
Dipel ES	See label	A, I	0
Dyfonate 10G	1 lb	A, C	30
Dyfonate 20G[R]	1 lb	A, C	30
Furadan 15G[R]	1 lb	A, C	—
Lorsban 15G	3/4-1 lb	A, C	35
Lorsban 4E	3/4-1 lb	A, I	35
Penncap M[R]	1 lb	A, I	12
Pounce 1.5G[R]	1/10-2/10 lb	A, C	**
Pounce 3.2EC[R]	1/10-2/10	A, I	**
Pydrin 2.4EC[R]	15/100-2/10 lb	A	21
Rampart 10G[R]	1 lb	A, C	30
Thimet 20G[R]	1 lb	A, C	30
	Second Generation Only		
EPN EC[R]	1/2 lb	A	14
Furadan 4F[R]	3/4-1 lb	A	30
Parathion[R]	1/2 lb	A	12

[R] = *Restricted use*

**A* = *aerial application, C = application with cultivator-mounted equipment, I = registered for application through center-pivot irrigation systems.*

***Apply prior to the brown silk (blister) stage. This usually will preclude use against the second generation.*