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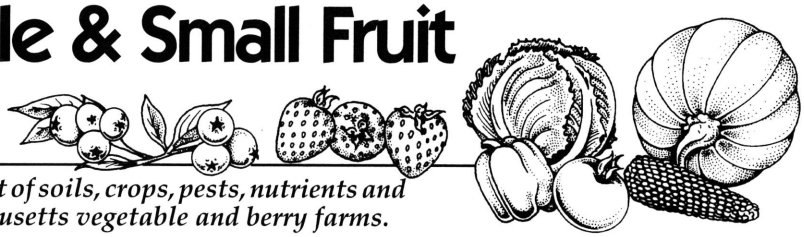

# Biointensive Insect Management in Sweet Corn

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**Biointensive pest management** relies upon an array of non-chemical methods to reduce pest populations below economically damaging levels. These may include cultural practices such as crop rotation or planting date, resistant or tolerant varieties, microbial pesticides, mechanical barriers, conservation of existing beneficial organisms, or releases of mass-reared beneficials.

For sweet corn insect control, several biointensive methods are currently available that can provide good control of key pests. This fact sheet will describe three key caterpillar pests of sweet corn, and how they can be controlled using bio-intensive pest management.

These recommendations are based on research conducted by the Vegetable ICM Program at the University of Massachusetts and at other institutions in recent years. Research on additional methods is continuing.

## EUROPEAN CORN BORER

European corn borer (*Ostrinia nubilalis*, ECB) is a resident pest which has two generations per year in most of New England. It overwinters as a late-instar caterpillar in stalks of corn and other host plants, and emerges in late May or early June as an adult moth. Mating occurs in grassy or weedy areas near corn fields. One to two weeks after flight begins, females start to lay eggs on the underside of corn leaves in flat, white masses. Eggs hatch in about one week, depending on temperature. Larvae feed in the whorl and in the succulent emerging tassel. As the corn matures, they move downward, bore into the stalk and tunnel into ears through the side or down the silk channel. Larvae are light colored, often tinted pink, tan or gray, with a pattern of small dark spots on each segment. The head capsule is black or dark brown. Full grown larvae are 3/4 to 1 inch long.

Flight can be monitored with two Scentry[tm] *Heliothis* net traps baited with E (II) or Z (I) lures, placed at least 50 feet apart in weedy or grassy borders of corn fields with the bottom at weed height. Two sources for these traps are Great Lakes IPM (1-517-268-5693) and Gempler's (1-800-382-8473).

Once flight is detected, pretassel and tassel stage corn should be scouted weekly by inspecting the tassels of 50-100 plants, in groups of ten, for the presence of ECB larvae. If at least 15% of the plants have one or more larvae present, then ear damage will result if the population is not controlled. Ideally, foliar sprays should be applied at pretassel or tassel stage, before larvae move into the ear or stalk.

**Using BT's.** Products containing *Bacillus thuringiensis* subspecies *kurstaki* give good control of ECB. Currently registered products for sweet corn include Mattch or MVP II (Mycogen Corp.), Dipel ES (Abbot Laboratory) and Javelin WG (Sandoz). In three years of on-farm trials in which farmers compared Bt products to conventional, broad-spectrum insecticides, the Bt products controlled ECB in early-season corn as well as conventional materials.

Here are some things to keep in mind when using Bt products for ECB in corn:
1. Apply when infestation exceeds 15%; rescout after 1 or 2 applications to determine the need for further sprays.
2. Apply at 5-7 day intervals. (Shorter intervals are not necessary).
3. Use at least 1/2 to 2/3 the maximum label rate. Low rates could result in poor control.
4. Design your sprayer to get good coverage of the tassel, foliage and ear zones. Test with water-sensitive cards.

5. Using a spreader-sticker may give you slightly better control, especially with Dipel ES.
6. If moths are active (>5 captures per week) during silking, continue weekly applications.
7. Bt products can be used whenever ECB is the target pest, regardless of the time of season or stage of crop growth. However, they will not control corn earworm, and may not give complete control of fall armyworm (see below).

**Floating Row Covers.** Spun-bonded row covers are often used to create a warmer micro-climate and an earlier harvest in spring corn. These also serve as a barrier that prevents female moths from laying eggs. We have often observed in grower's fields that ECB infestations are delayed and fewer sprays are needed when row covers are left over early blocks into mid-June. A 1996 study at UMass showed that the total number of egg masses laid on plants was greatly reduced if the cover was left on until the oviposition period was partially or completely over. This usually occurs by the second to fourth week of June, depending on the year and location. However, if the cover was removed just as oviposition began, the total egg load was actually higher than on corn that had never been covered. Local monitoring of ECB flight would help to determine the best time to remove the cover. Covers should be sealed with soil along the edges, but applied loosely so that corn can grow to 2-3 feet tall without being cramped.

## CORN EARWORM

Corn earworm *(Helicoverpa zea,* CEW*)* is a widespread pest which is also known as tomato fruitworm on tomato, and cotton bollworm in cotton and tobacco. Corn earworm moths migrate annually into New England, primarily from mid-July through September. Large numbers of moths can arrive suddenly on storm fronts that move up the northeastern coastline. The heaviest numbers are found in coastal areas, but corn earworm can be a devastating pest in late-season corn anywhere in New England.

Adult moths are about 1 1/4 inches in length, covered with light tan scales. Distinctive features are a dark dot on the forewing, a dark band near the margin of the hindwing, and bright green eyes.

Female moths attract males for mating by emitting sex pheromones. Pheromone-baited traps which capture male moths are a good measure of population density, and a good predictor of how serious the ear damage will be. The recommended trap that is commercially available is the Scentry *Heliothis* net trap, baited with Hercon™ luretapes for corn earworm. This trap should be placed with the base at about ear height in freshly silking corn. Move the trap to a new block when the silk dries out.

Female moths are attracted to the odor of corn silk, and lay eggs singly on the silk as well as other parts of the plant. Females lay on the average about 5.5 eggs per day over their 7-14 day life span. After silks have been pollinated and dry up, they are no longer attractive as ovipositional sites. Eggs hatch in 3-7 days, depending on temperature. Newly-hatched larvae move down the silks and into the ears to begin feeding at the tip of the ear. Unlike European corn borer and fall armyworm, earworm larvae do not tunnel through the husk at the side of the ear. Feeding is usually limited to the ear tip, which is why the earworm is also called "tipworm."

Corn earworm larvae may be brown, tan, green, or pink, with light an dark longitudinal stripes. The head capsule is always a plain golden brown, and there are small bumps and hairs which give the body a rough texture. Caterpillars reach 1 1/2 to 2 inches when full grown. Frass and feeding damage make the ear unattractive to consumers and unacceptable in most markets.

Currently, the most widely-used method for controlling earworm is to apply broad-spectrum insecticides, directed at the ear zone, every 3-6 days during the silking period. Alternatives must also target the ear zone and prevent entry of larvae into the ear before damage occurs. Any method for corn earworm must be responsive to the sudden arrival of large populations.

**Silk Growth in Sweet Corn.** When corn plants begin to produce silk, the growth of the fresh silk is very rapid. About 75% of the growth occurs in the first day, and growth is 95% complete in 2 days. However, not all plants in a stand produce silk at that same time. Given a relatively even stand, 60-80% of silk emergence is concentrated in a 3-4 day period. Pollen release coincides with silk growth, and pollination occurs while the silk is fresh and green. About 4 days after the initiation of silk growth, and 2 days after growth is complete, the

silk begins to turn brown at the tips and dry up. Ears are mature about 18-21 days after silk initiation.

**Direct Silk Application of Oils.** Corn earworm larvae enter the ear via the silk channels at the neck of the ear. Oil which is applied directly to the silks in the neck acts as a barrier and kills the larvae, probably by suffocation. This technique was widely used by sweet corn growers before the development of effective foliar insecticides.

Research conducted at the University of Massachusetts in cooperation with farmers and with Hampshire College has re-examined this technique and developed some improvements on previous methods. Here are several recommendations, based on this work:

**1. Vegetable and mineral oil are equally effective.** Mineral oil is more viscous than corn oil, but this does not seem to affect control. We have used corn oil extensively, as well as canola oil and cottonseed oil. Mineral oil is a petroleum product and may not be acceptable under some organic certification standards. *Note:* Vegetable oils (including corn, soybean and cottonseed oil) are on a list of materials that exempt from FIFRA (the federal law which regulates pesticides) under section 25b and therefore can be used on food crops without a pesticide label or registration. Mineral oil is not on the 25b list and therefore is not exempt. If you wish further clarification of their regulatory status, contact your state pesticide regulatory agency or regional EPA office.

**2. Mixing a BT product with the oil improves control.** This is probably because, when larvae begin to feed on the silk or ear tips, they ingest Bt and die. Use a product that is labeled for sweet corn (such as Dipel ES™, Mattch™, or Condor OF™) and do not exceed label rates per acre. A ratio of 1 part Bt to 20 parts oil is as good as more concentrated solutions of Bt. Test the product to be sure it will dissolve or at least be suspended in oil. Continuous agitation may be needed.

**3. The best time to apply oil is 4 days after silk growth starts, or 2 days the silk is fully grown.** At this time, the tips of the silks are just beginning to turn brown and dry up. *Earlier* applications do not appear to give better control, but result in a higher rate of "cone" tips. This occurs when oil interferes with pollination, and the last half-inch of the tip is shrunken with no filled kernels. Applying at 4 days will produce some cone tips, but much less than at 2 days. Oil at 4 days reduces ear fill by 6-8% compared to non-oiled ears. Oil applied *later* than 4 days after silk initiation can result in poorer control. This is especially true when corn earworm populations are high.

**4. Use 0.3 to 0.5 ml per ear.** This is approximately the same as 3-5 drops. Apply it directly to the tip of the ear. Higher quantities do not appear to give better control, but may cause slightly oily ears at harvest.

**5. One application to each block of corn is adequate.** Treat all ears that are close to the ideal age. If the silk emergence is very uneven, it may be necessary to go through the stand twice to achieve optimal control without tip fill problems.

**6. A hand-held applicator is needed to deliver oil to each ear.** There is no way to avoid taking time to apply the oil to each ear. Oil sprays are phytotoxic and result in brown husks. More efficient applicators can reduce the labor time and cost for this method. Currently there is no commercially available applicator; growers need to devise one themselves. An oil can set to deliver the proper amount is one option. A hand-held applicator is under development at UMass.

**7. The cost of this method** includes labor and materials. Labor ranges from 5.5 to 10 hours per acre (depending on the applicator used), which at $7.50/hour would cost $41.25 to $75.00 per acre. Materials include about 2 gallons of oil and 1 pint BT per acre.

## FALL ARMYWORM

Like corn earworm, fall armyworm (FAW) moths do not overwinter in New England, but migrate into the area in mid to late summer. The simplest way to monitor for FAW is to watch whorl-stage corn for signs of ragged feeding damage and to look for larvae in both

whorl and pretassel stage corn. Larvae are smooth, brown or dark green with lengthwise stripes, and the head capsule is dark with a distinctive light-colored marking in the form of an inverted Y. Full-grown larvae reach 1 1/2 inches.

FAW feeding produces large, ragged holes and large quantities of brown frass, or droppings. If one finds feeding damage with no caterpillar present, it is likely that it has completed its growth and dropped to the soil to pupate. FAW which is still present at the tassel stage may tunnel into the ear at the tip or side and cause extensive damage.

The threshold for FAW is the same as for ECB: 15 % of plants infested. If both are present, combine the two to determine infestation rate.

Fall armyworm is less susceptible to *B.t. kurstaki* than are the other two species. Foliar applications of the above-mentioned materials may not give complete control. New products are being developed which contain strains which are more active against FAW, but are not commercially available yet.

## INTEGRATED CONTROL OF LATE-SEASON CATERPILLARS

During August and September it is not uncommon to have two or three of the key caterpillar pests in the field at the same time. ECB and FAW may be feeding at the tassel stage and can move into ears during silking. Some enter ears through the tips and some through the side. CEW enters only through the tip, and only during silking. Use of foliar Bt applications or the oil direct silk treatment as a single strategy may not give adequate control. Using them together controls insects entering through the tip or the side of the ear. An integrated strategy that has worked well in experimental trials is the following:

1. Pretassel/tassel stage: Scout for ECB and FAW, if infestation is >15%, make two foliar applications of BT.
2. Use the oil method to control all caterpillars that enter through the tip.

## REFERENCES

The following references are available from the UMass Bulletin Distribution Center, Draper Hall, Box 32010, U. Mass. Amherst, MA 01003-2010. 413-545-2716.

**Managing Sweet Corn Pests in Massachusetts** by David N. Ferro and Donald C. Weber. 1988. UMass Extension Bulletin AG-335:/88-2M. $1.50 Life cycle, monitoring, management of key insect pest; color photos; sprayer design.

**Using *Bacillus thuringiensis* (Bt) Products for European Corn Borer Control in Sweet Corn; 1994-1996 On-Farm Trials Final Report.** By Ruth Hazzard, Jeffrey Lerner and Suzanne Lyon. 1997. UMass Extension Bulletin #C-220. #3.00. Results of 3 years of trials with 17 farmers; recommendations on how to use BT.

**Sweet Corn IPM Field Scouting Forms** (pack of 25). Three-part carbonless forms, used for field scouting and reporting on pest conditions in sweet corn. $5.00

**VIDEO: Sweet Corn IPM: Insect Management. 1995.** Demonstrates monitoring with traps and field scouting, thresholds. $15.00

**VIDEO: Vegetable Farmers and their Weed |Control Machines. 1996.** Farmers demonstrate a wide variety of cultivation equipment used in vegetable crops. $10.00

**Other References:**

**Northeast Sweet Corn Production and Integrated Pest Management Manual.** 1996. Roger G. Adams and Jennifer C. Clark, Editors. Univ. of Conn. Cooperative Extension. 120 pg. manual covers all aspects of sweet corn management. $19.50, Resource Center, U-35, 1376 Storrs Rd., Univ. of CT, Storrs, CT 06260-4035.

**Proceedings of the Northeast Farmer to Farmer Information Exchange.** Ruth Hazzard, Editor. 1994. In three annual meetings, farmers discussed all aspects of organic and transitional sweet corn production. These proceedings summarize their methods and views. NOFA-VT, PO Box 697, Richmond VT 05477, $5.36 including shipping. (Available from all state NOFA offices.)

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