ORGANIC INSECT AND DISEASE CONTROL FOR SWEET CORN

INTRODUCTION

Sweet corn is in the grass family (*Graminaceae*) with other cereal crops. It shares few diseases with other common vegetable crops and may be useful in crop rotations. Sweet corn shares pests with field and silage corn and so proximity to these crops is often a problem for sweet corn producers.

INSECT CONTROL

CORN EARWORM (*Helicoverpa zea*)

The corn earworm (CEW), also known as the tomato fruitworm, is a major pest of sweet corn. The adult moth lays its eggs in the silk **(Photo 5.1)** and the caterpillar crawls down the silk channel and eats kernels from the tip of the ear down **(Photo 5.2)**. The pest does not overwinter in the Northeast US. It is commonly carried into the region each year on weather fronts from more southern regions so crop rotation is not effective. Pheromone traps are useful for detecting CEW flights and helping time control practices.

Cultural Control:

1) Corn varieties with long, tight husks impede the entrance of the worm somewhat, but these provide only partial control. Varieties that have been reported to be less susceptible to damage include: Silver Queen, Stowell's Evergreen, Viking RB, Supersweet JRB, Golden Bantam, Jubilee, Texas Honey June, and Bodacious.

2) Since the pest is usually not a problem until mid to late summer, planting early to schedule harvest before expected arrival of CEW and using short season varieties will help avoid injury.

3) Naturally occurring predators and parasites provide some control, but this is often not sufficient to avoid economic losses. Plantings that increase habitat diversity may help promote establishment of natural enemies, but supplemental control is often needed. One technique for encouraging beneficial insects is to plant long rows of sweet alyssum, which is a flower attractive to parasitic wasps. Release of the parasitic wasp Trichogramma has had mixed results against this pest.

Materials Approved for Organic Production:

1) *Bacillus thuringiensis* var. *kurstaki* (e.g. Dipel®) is a well-known microbial insecticide that targets some caterpillars. Bt has to be ingested to be effective. It is difficult to get placement of the material where it will be eaten since the CEW does not feed outside the ear. A manual applicator ("Zea-Later") has been developed that places 0.5 ml of a Bt and oil mixture (or other treatment) directly into the silk channel. The Zea-Later consists of a "gun" that with a pull of the trigger squirts the mixture. The worker moves up and down the rows of corn inserting the tip of the applicator into the silk near the tip of each ear. The estimated time needed to treat one acre is eight hours.

   Treatment is only necessary when corn is silking and moths are present. Many local Extension programs can provide information about moth activity or farmers can place monitoring traps in their own fields.

   Ears need to be treated only once, but timing is critical. For optimal effectiveness the mixture should be applied when silks have reached full length and just begun to wilt and turn a bit brown, approximately 5-6 days after 50% of the corn has begun to show silk. Earlier treatment may result in "cone tips" where the kernels near the tip do not develop due to the oil interfering with pollen tube development. Later treatment allows the worm to escape and feed (see Hazzard and Westgate 2004).

2) Spinosad also has been shown to work in the Zea-Later and when used as a spray (2 good, 2 fair, and 1 poor result in recent studies).

CORN FLEA BEETLE (*Chaetocnema pulicaria*)

The corn flea beetle **(Photo 5.3)** is usually seen in the spring feeding on young corn plants. Damage on the foliage consists of thin lines etched into the tissue. Host species include corn and some other grasses, but not other vegetables. Different species attack brassicas and solanaceaous crops. Usually the feeding damage is not severe enough to reduce yield, but the beetles can transmit Stewart's wilt (see below).

Cultural Control:

1) Crop rotation works fairly well.

2) Use varieties resistant or tolerant to Stewart's wilt (see Zitter 2002, Cornell 2004a).

Corn flea beetle numbers are greatly reduced by cold winters with little snow cover.

Materials Approved for Organic Production:

None are as effective as the cultural controls.

CORN LEAF APHID (*Rhopalosiphum maidis*)

The corn leaf aphid **(Photo 5.4)** is a small, grayish green, soft bodied insect that can build up in high numbers during hot, dry seasons. The primary damage caused by corn leaf aphids is contamination to the ear due to sooty molds or the presence of the insect. Corn leaf aphids are often seen in mid- to late season if their natural enemies have been killed by broad-spectrum insecticides. They are usually not a problem in organic sweet corn, but in high numbers can drastically reduce the marketability of ears.

Cultural Control:

Avoid rotenone, pyrethrum, or other broad-spectrum insecticides in corn.

Materials Approved for Organic Production:

1) If an aphid outbreak occurs, insecticidal soaps can be used (5 good, 1 fair, and 11 poor results against all aphid species tested in recent studies).

2) Summer oils (2 fair and 3 poor results) will provide some control.

3) Neem products can provide some control (4 good, 6 fair, and 4 poor results in recent studies on all aphid species). Please see the neem chapter for a discussion of the different types of neem products.

4) Kaolin clay will reduce aphid populations but will leave a white residue that may affect marketability.

EUROPEAN CORN BORER (*Ostrinia nubilalis*)

The European corn borer (ECB) overwinters as a full-grown larva in the lower six inches of the corn stalk or in other host plants. The larvae pupate in spring, and moths emerge and mate in grassy or weedy areas around field borders. Eggs are laid on the underside of corn leaves near the midrib **(Photo 5.5)**. The larvae initially feed in the leaf axils and whorl creating a shot hole effect in the leaves. Later they move into the tassel or stalk and their tunneling habit may cause it to break **(Photo 5.6)**. On more mature corn, the caterpillars may enter directly into the ear **(Photo 5.7)**. Though corn plants can tolerate a fair amount of foliar feeding, ear damage directly affects marketability. Contact your local Extension educator for a detailed scouting procedure for ECB (or see Hazzard and Westgate 2004).

Cultural Controls:

1) Sanitation is important to reduce the ECB overwintering sites. Corn stalks should be mowed short and disked into the soil. Since ECB has many other host plants, crop rotation in a particular field may not reduce insect pressure.

2) Release of the parasitic wasp *Trichogramma ostriniae* into sweet corn

looks promising as a biological control agent, however it is not presently available from commercial suppliers. *Trichogramma* should be released into corn early in the season when ECB eggs are present. This species of wasp will then reproduce and can spread to other fields. However, this parasite does not control the other caterpillar pests of corn.

Materials Approved for Organic Production:

1) Bt var. *kurstaki* can be effective against ECB but thorough coverage is needed. Since corn can tolerate high levels of vegetative damage, it is important to spray only when the ears are threatened to avoid economic damage. Applications are usually made starting at early tassel emergence stage if over 15% of the plants in a field are infested. Timing is important to have good coverage before the worms bore into the plant where sprays do not reach. Applications should target tassels just as they start to open so that ECB larvae are exposed to the spray. Bt breaks down rapidly, so frequent applications may be needed. Later applications targeting the ear zone may be needed if pheromone traps indicate that ECB moths are flying when the corn is in the green silk stage.

2) Spinosad sprays have been shown to be very effective against this pest. Spinosad has longer residual activity than Bt, so fewer sprays are required. Recent studies have shown 10 good and 2 poor results against ECB on sweet corn, peppers, and beans.

3) It is recommended to alternate Bt and Spinosad sprays in order to avoid development of insecticide resistance.

4) Since European corn borers often enter corn ears from the side, the Zea-Later is not very effective against this pest.

FALL ARMYWORM (*Spodoptera frugiperda*)

Similar to the corn earworm, the fall armyworm (FAW) does not overwinter in the Northeast US. It usually arrives after mid-summer but in some areas may appear very late or not at all. FAW seems to prefer whorl-stage corn for laying a mass of eggs **(Photo 5.8)**. Their feeding produces large holes and ragged leaves **(Photo 5.9)**. Whorl-infested corn does not need treatment until 15% of the plants in a field are infested. However, larvae can invade ears of silking corn and damage is similar to the corn earworm.

Pheromone traps are useful for detecting flights.

Cultural Control:

None currently known.

Materials Approved for Organic Production:

1) Bt var. *kurstaki* can be used for FAW but is not highly effective and good coverage is needed (1 good result in recent studies).

2) If silking corn is present and numbers of moths are high, then the

Zea-Later will be an effective control for larvae that enter through the silking channel, though not for any larvae that bore in through the side of the ears.

3) Foliar sprays of spinsosad that target the larvae are also effective.

NOTHERN CORN ROOTWORM (*Diabrotica longicornis*), Western Corn Rootworm (*Diabrotica virgifera virgifera*)
Corn rootworm beetles **(Photo 5.10)** feed on corn leaves and clip off silks and thus interfere with pollination. They may also transmit stalk and ear rot diseases. Adults emerge in July. The female lays eggs in the late summer that hatch the following spring. The larvae feed on corn roots, reducing yield and causing stalks to lodge.

Cultural Control:

Crop rotation works very well for control of larval damage. In most cases, adult damage is not severe enough to warrant control, unless rotation of corn is not practiced in or near the sweet corn field.

Materials Approved for Organic Production:

None currently available.

SEEDCORN MAGGOT (*Delia platura*)
Seedcorn maggots **(Photo 5.11)** can greatly reduce stands of untreated seed in cold, wet soils. They are particularly attracted to raw organic matter, so corn planted in such fields is especially susceptible to infestation. The female flies lay eggs near germinating seeds, and the larvae feed inside the sprouting seeds. Feeding damage also leads to rot.

Cultural Control:

Try to create conditions for rapid germination, including using ridges and waiting until the soil has warmed. In cold climates, consider row covers or transplants for your earliest sweet corn. Be sure that raw manure and green plant residues are well incorporated and have time to decompose prior to seeding.

Materials Approved for Organic Production:

None currently available.

DISEASE CONTROL

While diseases of sweet corn do occur annually, they generally do not become so severe that treatment is necessary. However, we have included four common corn diseases in the Northeast for identification purposes. Resistant varieties are available for all of the commonly seen diseases, and should be planted if a particular disease is severe in your area. A list of resistant varieties can be found in the Cornell Cooperative Extension Integrated Crop and Pest Management Guidelines for Vegetables (Cornell 2004a). For additional information on sweet corn diseases or any vegetable disease, visit the Vegetable MD Online website (Cornell 2004b).

DISEASES CAUSED BY BACTERIA

STEWART'S WILT (*Pantoea stewartii*)

This bacterial disease is common in the Northeast. It is spread by the corn flea beetle (*Chaetocnema pulicaria*) that carries the bacterium and introduces it into the plant through feeding wounds. Common symptoms include yellow chlorotic stripes that can run the length of the leaf, with irregular margins **(Photo 5.12)**. If seedlings are infected prior to the 5-leaf stage, they may wilt and die. Plants infected before the late whorl stage may not produce an ear. Because the pathogen overwinters in the flea beetle, it is possible to predict the likelihood of a Stewart's wilt epidemic based on mean monthly temperatures for December, January and February. If these months are very cold, there will be a greater mortality of flea beetles and thus Stewart's wilt will be less likely. The best ways to avoid Stewart's wilt are to plant resistant or tolerant varieties and to utilize crop rotation. The Cornell Vegetable MD website has a list of resistant varieties (Zitter 2002).

DISEASES CAUSED BY FUNGI AND FUNGAL-LIKE ORGANISMS

DAMPING OFF; SEED ROTS; POOR STAND (*Fusarium, Pythium, Diplodia* spp.)

These diseases are common when corn is planted in cold soil. When a seed is planted, it must imbibe (soak up) water prior to germinating. When seeds imbibe water, cell membranes may rupture. At warmer temperatures (above 55°F) cell membranes will be quickly repaired and there will be no effect on germination. At lower temperatures, seed metabolism is very slow and membrane repair will be slowed. Thus, even in the absence of pathogens, germination in cold soil can be poor. Seed with damaged membranes will leak more carbohydrate into the soil and will attract soil-inhabiting pathogens. These pathogens attack seedlings during germination and often result in poor stands.

Cultural Control:

Try to create conditions for rapid germination, including using ridges and waiting until the soil has warmed. Consider row cover or transplants for your earliest sweet corn. Avoid poorly drained soils.

Materials Approved for Organic Production:

Biological seed treatments such as Kodiak® (*Bacillus subtilis*) or Plant Shield® (*Trichoderma*) may be effective.

COMMON RUST (*Puccinia sorghi*)

Common rust is appropriately named as the fungus causes the leaves of infected corn plants to look rusty. Oval-shaped pustules (rust or cinnamon colored) will be scattered over the leaf surface **(Photo 5.13)**. This disease is favored by heavy dew, moderate temperatures, and high nitrogen. The disease spreads to the Northeast yearly from spores blowing in from Southern regions. Some sweet corn varieties are more

tolerant than others, and should be planted if possible. Staggered plantings should be separated if feasible so that fungal spores from earlier plantings are less likely to infect later plantings.

COMMON SMUT (*Ustilago maydis*)
Smut is usually found on the ears, but can also be seen on tassels and stems. This fungal disease is very dramatic and easy to identify, as large galls are produced **(Photo 5.14)**. A young gall appears white and smooth, and black fungal spores develop inside as it ages. An older gall will split open revealing thousands of spores. Removing galls before they break open can reduce inocula. Young galls can be eaten, and are considered a delicacy in some cultures (they taste a bit like mushrooms). Some corn varieties are more resistant to smut than others, and these should be planted if smut has been a problem in previous years.

REFERENCES

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CHAPTER 5 - SWEET CORN

Photo 5.1 Corn earworm eggs (small spheres) on corn silks.

Photo 5.3 Corn flea beetle adult and damage.

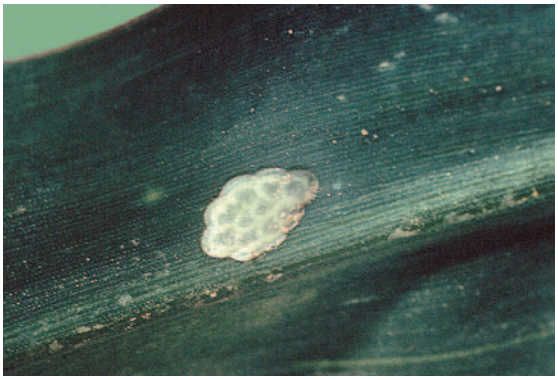

Photo 5.5 European corn borer egg mass.

Photo 5.6 European corn borer damage to the tassel.

Photo 5.2 Corn earworm larva and damage to the ear.

Photo 5.4 Corn leaf aphid colonies on corn.

Photo 5.7 European corn borer larva in ear.

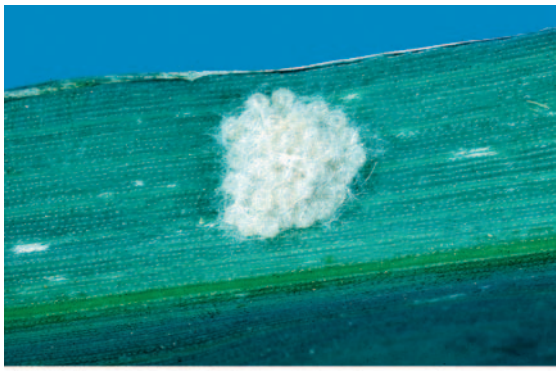

Photo 5.8 Fall armyworm egg cluster.

Photo 5.9 Fall armyworm larva.

Photo 5.10 Corn rootworm adult.

Photo 5.11 Seed corn maggot larva (courtesy of B. Nault).

Photo 5.12 Severe Stewart's wilt symptoms.

Photo 5.13 Common rust symptoms.

Photo 5.14 Typical symptom of common smut.