

## Conventional and Organic Insect Management for Peppers and Eggplant

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I can't go over all the insect pests in the 25 minutes that are allotted for my presentation, but I'll cover the most common ones. For peppers, that means **European corn borer**, **pepper maggot**, and **aphids**. For eggplant, I'll cover **Colorado potato beetle** and its close look-alike (false potato beetle), **potato leafhopper** and **flea beetles**.

I'll start with a quick reminder that I emphasize integrated pest management; using multiple techniques to handle pest problems, not just react and spray. A good program would include 1) Regular **monitoring** of the field at times when pest problems might be expected, 2) **Suppressive or preventative methods**, to reduce the chances you'll need to spray an insecticide. For organic growers, these are the main line of defense. 3) **Controls** most commonly mean insecticides, but spunbonded row covers, biological insecticides, or even handpicking may be appropriate.

Preventative/suppressive measures that help for several of these pests include crop rotation. Think of it in either in space or time. If you've got serious problems with a pest that overwinters here (pepper maggot) rotating in time is frequently overlooked. By that I mean consider not growing the affected crop **at all** the next year. If your fields are isolated from others that host this pest, this is a very effective method to reduce problems in the second year, when you re-introduce the crop. Also overlooked: dumping infested fruit. Pepper maggot is a good example for this, too. If you just discard infested fruit, the pest will survive very well and hit you next year again. If you destroy infested fruit (disk under, bury, etc), the insects inside them die, reducing the population for next year.

### Peppers:

To me, **European corn borer** is the most important of our pepper pests. It hits a wide variety of plants including corn, peppers, chrysanthemums, potato, and many weeds like pigweed, ragweed, barnyard grass and others. In southern New England there are two distinct generations per year. In northern VT, NH and Maine, there's just one. In southern NH where I am, egg laying is usually June 15<sup>th</sup> to July 15<sup>th</sup>, and August 5-30<sup>th</sup>. If fruit 3cm or larger in diameter are on the plant during those periods, they are subject to attack.

When are these times on your farm? Extension people have had sweet corn insect monitoring programs for years, that included detailed information on when ECB was flying (that's egg-laying time) in their areas. For CT, Jude Boucher has had a recorded telephone pest message for ECB and other sweet corn insects (860 870-6954) since 1986. For the last five years the info has also been at the web site, at (<http://www.hort.uconn.edu/ipm/>). The web site has archived messages, too. Two years ago George Hamilton set up a web site for New Hampshire monitoring data, mostly Hillsborough County: <http://extension.unh.edu/Agric/SCIPM/index.htm>. Ruth Hazzard (U. Mass) has been reporting ECB and other sweet corn pest monitoring for years as well. Their sweet corn data is posted through the Vegetable Notes newsletter, which can be obtained through an email subscription (free), by hard copy, or on the website at

[www.umassvegetable.org](http://www.umassvegetable.org). It is also posted on the Pest Watch website run by Penn state. (By the way, Pest Watch is an excellent place to connect to New England ECB data in one location, at <http://www.pestwatch.psu.edu/>.) To sign up for the UMass email subscription, send a request to [umassvegetable@umext.umass.edu](mailto:umassvegetable@umext.umass.edu). The form for hard copy (\$40 per year) is on the website. David Handley (U Maine) has been monitoring sweet corn pests for years in Maine, and has a weekly newsletter with data and other information. If you send David your email address, he will mail the newsletter directly to you at no charge. It is also available in hard copy form for Maine residents. It is also on the website, but sometimes delayed a day or two.

<http://pmo.umext.maine.edu/swetcorn/CORN.HTM>

I usually don't recommend that pepper growers do trapping to monitor ECB, because you need to use two traps, one baited with the lure for the NY strain, and the other baited for the Iowa strain. Both strains occur here, and look identical. Most of you are just doing too many things to add that to your list. If you have significant sweet corn acreage, trapping makes more sense. ECB flight is fairly predictable year to year.

European corn borer attack rate varies among pepper varieties. Generally, the hot peppers are less frequently attacked than the sweet varieties, and large fruited varieties are hit more than small fruited plants. Fruit over 3cm in diameter are vulnerable to attack. ECB **lays its eggs in masses**, not individually. That means an infested plant is likely to have several larvae, not just one. They bore into stems as well as fruit. The caterpillars are cream colored, with dark brown heads. Once the caterpillars are inside the fruit, there's not much you can do, so protecting the fruit with insecticide is the main line of defense for this species. There is usually very little evidence of injury on the outside of the fruit --- perhaps a small hole or a tiny bit of frass. The current New England Vegetable Management Guide gives details on the many insecticide choices. There are lots of them, especially pyrethroids. The pyrethroids and Lannate are probably the things most likely to create aphid problems, especially if sprayed early. In my opinion, Entrust, Spin-tor, Intrepid, Confirm and *Bacillus thuringiensis* (*B.t.* for short) products are the least likely choices to create aphid problems. Read more about *B.t.* below.

ECB overwinters as a caterpillar, in the stalks of infested plants (corn and many others), so chopping and disking in corn stubble and tall weeds may significantly reduce numbers for next year. This is one technique organic growers in particular may wish to use. Other organic options include using row covers. They protect, but at some logistics costs. An additional concern is that it could get too hot under the covers. Pepper flowers abort at 85 F or higher.

*Bacillus thuringiensis* products aren't too effective on ECB on pepper, yet they are very effective on this same insect when applied to the whorl stage of corn. To me, that suggests that 1) the material is rapidly degraded by sunlight or washed off of peppers or 2) the borers very quickly bore into the fruit, rather than feed for a relatively long time on sprayed surfaces (as is the case in the corn whorl). Entrust is a pesticide that is approved for certified organic operations, and fair results are reported for controlling ECB on pepper.

One option few growers think of may hold promise for controlling the insect at reasonable cost: follow an Entrust spray with a *B.t.* spray the next day. The two materials have different modes of action. Here in NH, Jim Bowman did testing on diamond-back moth on cabbage, and found that he could get excellent control by alternating *B.t.* sprays with a very low dose (1/4 rate?) of standard insecticides. Others have confirmed it with other caterpillars, too.

**Aphids** are regularly reported as pests on pepper, but I see problems sporadically. Early season broad-spectrum pesticide use often creates these aphid problems, by killing the natural enemies (ladybugs, syrphid flies, parasitic wasps). Green peach aphid is the most common species by far, but few of us take the critters to a microscope to see which one it is. Potato aphid and melon aphid also attack peppers here. If there are nearby infested plants, the peppers can quickly get infested, too. Hot, dry weather sometimes allows aphid numbers to rapidly build, and this may be in part because there are natural enemies that are affected (fungi?). Aphids often transmit viruses, and this can be a concern in peppers.

Management: try to avoid relying on broad-spectrum insecticides early in the season. Apply insecticides on peppers only if needed (for ECB for example). Spraying for aphids should be done only if the numbers are high; 10 per leaf prior to fruit set, or 5 per leaf after fruit set. Coverage of leaf undersides is very important, and adding a spreader-sticker can help. For organic growers, insecticidal soap and Pyganic are spray options. Bottom line for all pepper growers: aphid problems are usually created by spraying, not solved by spraying. Ladybugs quickly move in and control them, if you give them a chance. Multi-colored Asian ladybug is our most common species here, a good aphid predator.

## Pepper Maggot

In New England, pepper maggot occurs sporadically in Connecticut, Rhode Island, Massachusetts, and southeastern NH. There is only one generation per year. Adults are about ¼ inch long, with prominent yellow marks on the thorax, and dark bands on the wings. The females lay eggs in the fruit, leaving dimples on the outside. Look for a round whitish scar in a small depression. On the inside of the fruit, in that depression, there's a long egg. The maggot hatches from that and feeds inside the fruit (mostly on seed head). What would your customers say to find maggots in the fruit?

Pepper maggot threatens between ECB generations: about July 15 – Aug 5, with peak activity Jul 20-25. Hot cherry peppers are highly preferred by pepper maggot flies. They're so attractive, you can use them as a perimeter trap crop, and watch them for injury. Combining them with Orthene or dimethoate sprays is very effective, Jude Boucher's "poisoned fence".

Yellow sticky traps combined with a container of ammonia can monitor the adults. Best placement is 20' up a tree at the edge of the field, especially a sugar maple tree. Strangely, traps placed right in the crop don't work!

Hot cherry peppers are the most preferred host. Bell peppers seem to come next. Horsenettle is the wild host here (the fruit). Eggplant is sometimes attacked.

Pepper Maggot management: 1) Monitor your crop for the characteristic injury. 2) Thoroughly destroy infested fruit (don't just dump them!). 3) Eliminate the alternate host (horsenettle) 4) Treat with insecticide 1 week after 1st sting appears on the fruit **or** right after catching the first fly on a trap. You may wish to try the trap crop method mentioned above. Insecticide options: Thiodan, malathion (registered, don't work), Dimethoate 4EC (registered, works, rough on beneficials), Orthene 97, 75S, 75WSP (see recommendation, works, rough on beneficials). Organic growers: rotate in time (skip a year, and eliminate all PM hosts that year, including weeds). Row covers might work, since there is a relatively short attack (flight) period. Surround might offer protection, but I am unaware of any tests to confirm or correct this idea.

## Eggplant:

**Colorado potato beetle** gets my vote as the most serious eggplant insect in New England. There are a couple of generations each year, and they overwinter as adults in the soil, usually at the edge of the field and the woods. That's the reason rotation helps; moving the vulnerable crop to a site far away from where most beetles overwinter, and reducing the number of beetles that find it next spring. Skipping a year (growing no potatoes or eggplant that year) can help you gain ground if the problem is overwhelming. It works best if none of your neighbors grows hosts for CPB. Regular monitoring really helps with this insect, both to see how many are out there, and what stage they're in. You really want to avoid unnecessary spraying, if possible (more on this later).

There is a look-alike to CPB in southern New England. It is called the **false potato beetle**, and adults look very similar to CPB. Larvae have the same size, shape and pattern as CPB larvae, but they look whitish, rather than salmon-colored. It is found on eggplant, horsenettle and nightshade.

I remember a statement from a 1980 conference on Colorado potato beetle, and to my knowledge it is still true: CPB has become resistant to every pesticide ever used on it, anywhere in the world. That emphasizes my first point: when using pesticides on this, rotate between different modes of action, to delay the development of resistance. Remember that small larvae are the stage that is most vulnerable to pesticides.

Prevention/Suppression: rotate fields, consider skipping a year. Perimeter trapping can be an effective technique. Row covers may be a viable alternative. I do not know of any varieties that are resistant. Novodor is one biological insecticide (unfortunately, not approved for certified organic growers). Neemix 4.5 (MOA 18), Entrust (MOA 5), and Pyganic (MOA 3a) are approved for certified organic growers. Surround is listed for use on eggplant, but the label says nothing about CPB, so I suspect it does not work. Handpicking is an option for some small plantings. The trick is to pick times when a little effort goes a long way. When egg laying is under way, one squash of thumb and forefinger can kill many insects, since eggs are laid in groups. Placing transplants in standing stubble may delay the beetles, and thus reduce numbers. This works for potato, but I haven't seen anyone using it on eggplant. The theory is that the debris hides the young plants somewhat. This method was first tried for CPB in the 1970's.

**Potato leafhopper** doesn't overwinter in New England. The adults get blown in from southern states, usually in June. Some years we have a lot, and they are early. Other years, numbers are lower and/or later. In northern New England, this is less likely a problem than southern New England.

This is another pest problem where monitoring can be very helpful. Some growers use the slight yellowing and cupping of leaves on potato or bean to trigger checking leaf undersides on eggplant. Others get better results from regular checking, starting in mid-June, and watching extension newsletters for warnings. The adults are most common on undersides of leaves, and they can often be found first on potato, beans, basil, or alfalfa. They hit lots of other crops, too. On eggplant, treat if there is an average of 1 to 1.5 leafhoppers per leaf. The nymphs look similar to adults (elongated, yellow-green, on leaf undersides), with one exception: they can't fly when you disturb the leaves. As they grow, they leave their shed skins behind, and these stick to the leaf undersides a fairly long time, providing another visible clue to those who look.

Row covers can work for this pest. Did you notice that I said that about CPB too? I'll mention it again under flea beetles. Rotation doesn't help for this pest. Organic growers have Neemix 4.5, SurroundWP and Pyganic EC5.0 as spray options. The Surround label says it "suppresses" populations, verbage that suggests it is less effective. There is also the residue problem on the fruit. Conventional growers have many pesticide choices, and the current New England Vegetable Mgmt Guide lists the options. Decis, Proaxis, Admire, Warrior, Pyrenone, Platinum, Mustang and more are listed.

**Flea beetles** are occasionally a problem on young plants, but not a concern on full sized plants. On newly set plants, 2 beetles per plant is enough to warrant treatment. For plants 3-6" high, the threshold is more than 4 per plant. Rotation helps reduce problems with these insects. When planning rotation, remember that the species of flea beetles that attack eggplant are found on other solanaceous crops, like potato and tomato.

Conventional growers have many pesticide choices, including Capture, Decis, Asana, Proaxis, Warrior, Ambush, Pyganic, Pyrenone and Mustang (all MOA 3a) Kryocide (MOA 9b), Thionex (MOA 2a), Admire and Provado MOA 4). Organic growers can try Surround, Pyganic or row covers. Remember, proper use of row covers requires that you rotate crops and put the covers on before the adults appear.

#### Sources of Information

1. New England Vegetable Management Guide. The 2008-2009 Guide (should be ready for this conference) includes an expanded section of pest photos.
2. Northeast Pepper Integrated Pest Management Manual by Boucher and Ashley, Univ. Conn. Coop. Extension. 136 pages, great color photos. Nice job, Jude!
3. Diseases and Pests of Vegetable Crops in Canada Ed: R.J.Howard, J.A. Garland, W.L. Seaman, Canadian Phytopathological Society/ Entomological Society of Canada ISBN 0-9691627-3-1
4. IPM Newsletters, fact sheets, web sites in New England states
5. <http://pronewengland.org> is a website by pest management staff in the six New England states, and it can connect you to lots of pest management information. Among the functions is a fact sheet search engine that searches pest publications from Cooperative Extension in the region; very helpful.
6. <http://www.pestwatch.psu.edu/> The Pest Watch website includes sweet corn insect trapping results from Maine, Massachusetts and other states, plus other info. You can view a map of the whole region, to get the big picture. It is maintained by Penn. State University.