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No. 580 April 17, 2014

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CUTWORMS IN HIGH TUNNELS - (Rick Foster, rfoster@ purdue.edu, 765-494-9572 and Dan Egel, egel@purdue. edu, 812-886-0198) - One of the main reasons growers use high tunnels is to modify the environment so that they can grow crops during weather conditions when they could not grow them outside. This can be a big advantage because it allows growers to sell their produce during market windows when the crops may be in short supply. However, one of the disadvantages is that the modification of the environment will sometimes also make it possible for insects to survive and thrive at times when they would not normally be a problem outside. Last week, Dan found a claybacked cutworm cutting off tomato plants in his high tunnel at the Southwest Purdue Ag Center near Vincennes (see Figures 1 and 2). The black cutworm is often the one that causes us the most problems, but it doesn't overwinter in Indiana. The claybacked cutworm, however, overwinters as large larvae, so they could be present in our high tunnels and become problematic when tomatoes or other crops are planted. See pages 131-2 in the Midwest *Vegetable Production Guide* (*ID*-56) for recommendations for control but also check on page 40 to make sure the insecticide can be used in a greenhouse or high tunnel. Some of this information was posted at veggiediseaseblog.org.





Figure 1. Claybacked cutworm damage on tomato. (*Photo by Dan Egel*)



Figure 2. Claybacked cutworm found on tomato transplant. (*Photo by Dan Egel*)

**ETHYLENE** - (Dan Egel, egel@purdue.edu, 812-996-0198 and Liz Maynard, emaynard@purdue.edu, 219-531-4200) - I received a call from a greenhouse grower recently with a tomato transplant problem. The grower described yellow seed leaves and curled foliage. The grower was able send an excellent photo (see Figure 3). There were a few clues that the symptoms might be due to a heater problem. In Figure 3, some of the seedlings have leaves that are curled down and stems that are twisted (epinasty in botanical terms). Epinasty is a common symptom of ethylene damage. Ethylene is a common by-product of incomplete combustion of several different types of fuel. Incomplete combustion is often the result of heaters that are not working efficiently or do not have enough fresh air. Tomatoes are very sensitive to ethylene damage.

A second clue is to take a closer look at the yellow seed leaves (see Figure 3). Ethylene damage does not include yellowing. Furthermore, there is a spotting on the lower leaves that is not typical ethylene damage. I believe that the symptoms on seed leaves were as a result of a different compound, perhaps sulfur dioxide, a compound heavier than air that would remain relatively close to the heaters. The grower confirmed that the yellowing leaves were close to the heater, while the curling leaves, caused by ethylene gas, were spread throughout the greenhouse.

While some greenhouses are heated with a furnace outside the greenhouse, or a heater inside that is exhausted to the outside, many greenhouses are heated with a standalone unit inside the structure with no exhaust to the outside. In the example above, the grower stated that the heater was of this latter type - a standalone unvented unit with no exhaust to the outside. While this type of heating is not recommended, natural gas, propane and kerosene generally burn clean and may not cause a problem. However, even units that burn clean fuels may cause problems if out of adjustment, or if adequate fresh air (oxygen) is not available (see citation below).

I cannot prove that the symptoms in Figure 3 above are caused by ethylene. But a few years ago, we witnessed ethylene-like damage at a greenhouse here at the Southwest Purdue Agricultural Center (See article in the November 2007 *Vegetable Crops Hotline, Issue 487 http:// vegcropshotline.org/VCH2007/VCH487.pdf*). Therefore, we were able to confirm that ethylene was the cause of the symptoms shown in Figure 4. Given the similarities of the two examples and the circumstantial evidence, I believe the example given in Figures 3 was due to a heater malfunction. The grower reports that after the heater was serviced, the plants began to look healthier.

Unvented heaters can also add water to the greenhouse air - as much as 22 gallons of water a night! This unwanted moisture can lead to disease problems.

To avoid damage from ethylene and other air pollutants:

 Have unit heaters checked by a professional and follow maintenance recommendations. •Assure adequate air supply for complete combustion. For each 2500 BTU's of heater output, 1 sq. in. of vent cross section is needed.

• Prevent back drafts. Make sure the chimney extends 2 ft. above the ridge of the greenhouse, or 2 ft. above a 10-ft. line to any part of the structure.

• Install an inexpensive carbon monoxide detector. If carbon monoxide levels rise it's likely ethylene and other pollutants are present also. And if carbon monoxide levels are high it is a significant human health hazard.

• Scout for possible growth effects of ethylene and investigate right away if you see anything.

Additional Resources: Bartok, J.W. Problems With Using Unvented Greenhouse Heaters

http://extension.umass.edu/floriculture/fact-sheets/ problems-using-unvented-greenhouse-heaters

A version of this article originally published at the VeggieDiseases blog **http://veggiediseaseblog.org**.



Figure 3. Tomato seedlings above exhibit downward curled leaves (red arrows) which may be a symptom of ethylene damage and yellow seed leaves with lesions (red circles), a possible symptom of sulfur damage. (*Contributed photo*)



Figure 4. These tomato plants are exhibiting epinasty or a downward growth of the leaves in response to ethylene produced from a malfunctioning heater in a greenhouse. The topmost leaves are growing normally because the plants were removed to a separate greenhouse after exposure to ethylene. (*Photo by Dan Egel*)

## THE BORDER

SEED AND ROOT MAGGOTS - (*Rick Foster, rfoster@ purdue.edu*, 765-494-9572) - Given the cold, wet start to spring, there is a good chance that we will see more than our usual amount of damage from the root and seed maggots. Three species of seed and root maggots attack vegetables in Indiana. The seedcorn maggot feeds on seeds and seedlings of sweet corn, cucurbits, lima and snap beans, peas, and other crops. Cabbage maggots can cause serious damage to transplants of cabbage, broccoli, cauliflower, and Brussels sprouts and make the fleshy roots of radishes, turnips, and rutabagas unmarketable. Onion maggots are pests of seedling onions, developing bulbs and onions intended for storage.

Seedcorn maggot flies emerge in April and May and lay eggs preferentially in areas with decaying organic matter. Fields that are heavily manured or planted to a cover crop are more likely to have seedcorn maggot injury. Maggots burrow into the seed and feed within, often destroying the germ. The seeds fail to germinate and plants do not emerge from the soil, leaving gaps in the stand. When infested seeds germinate, the seedlings are weak and may die. Maggots also will feed within the stems of transplants.

Any condition that delays germination may increase damage from this pest. Damage can be reduced by planting into a well-prepared seedbed, sufficiently late to get rapid germination. The slower the rate of growth, the greater the likelihood of seedcorn maggot injury. For any type of early season transplant, soil temperatures

should reach at least 70° F or more for 4-5 days in a row to avoid maggot injury. Anything that raises soil temperature (black or clear plastic mulch) will increase soil warming and decrease the possibility of seedcorn maggot injury. Once damage is observed, the only management strategy available is the decision to replant or not. If you decide to replant, be sure to use treated seed. When resetting transplants be sure to wait 5 days from the first evidence of wilted plants before you reset. Unfortunately, we don't have any insecticides that can be applied at planting time that will provide good control of seedcorn maggots. Admire Pro® and Platinum®, which both provide several weeks of excellent systemic control of striped cucumber beetles when applied at planting, are not labeled for seedcorn maggots and the control is marginal at best. Capture LFR<sup>®</sup> is labeled for control of wireworms, grubs, and other soil insects on cucurbits but not for seedcorn maggots. I have one year of data with Capture<sup>®</sup> that showed fairly promising results, but more data are needed.

Cabbage maggot injury is also favored by cool, wet conditions. The flies, slightly smaller than a housefly, emerge in late April or early May and lay white eggs at the base of newly set plants. Larvae from this first generation tunnel in the roots of small plants, causing the plants to appear sickly, off color or stunted, and may cause them to die. Early cabbage and turnips are particularly vulnerable to damage. Control of first generation maggots can be achieved using soil insecticides such as Capture LFR<sup>®</sup>, Lorsban<sup>®</sup> or diazinon at planting or transplanting. For short season crops such as radishes and turnips, long-residual insecticides cannot be used. Cabbage maggots usually do not affect later planted crucifers.

Onion maggot flies emerge throughout May and lay eggs at the base of onion plants. The maggots attack the underground portions of the onion plants and cause plants to wilt and die. Seeded onions are more susceptible than transplanted onions. Do not overseed to compensate for losses to onion maggots. The flies do not space their eggs evenly, so you may end up with smaller bulbs because the plant spacing is too close. The second-generation flies emerge during July and the third generation emerges during late August and early September. Each generation will damage onions.

Removing cull onions after harvest and planting as far as possible from fields planted to onion the previous year can reduce damage. Soil drenches of Lorsban<sup>®</sup> (dry bulb only) or diazinon at planting will effectively control first generation maggots and provide some control of the second generation. The use of FarMore<sup>®</sup> seed treatments, with or without Lorsban<sup>®</sup>, have been effective in trials conducted by Dr. Brian Nault at Cornell. Sepresto<sup>®</sup> seed treatments (on Nunhems varieties) have not performed as well. Trigard<sup>®</sup> seed treatments with a Lorsban<sup>®</sup> drench continue to be the standard treatment option in New York onion production and is working well. As the onions begin to mature, they become physically resistant to attack from onion maggots, unless they have been injured in some way. Be careful during field operations not to damage the growing plants in any way. A nick in an onion bulb allows the maggots to enter and begin feeding. Also, the flies are attracted to damaged onions to lay eggs. Reducing the amount of physical damage to the onions at harvest as much as possible will also reduce the amount of injury from the third generation. Do not apply foliar sprays to kill flies before they lay eggs.

# - Petersenet

**PHEROMONES AND PHEROMONE TRAPS - (Rick Foster,** rfoster@purdue.edu, 765-494-9572) - One way insects communicate with individuals of the same species is with pheromones. Pheromones are volatile chemicals released by an insect that usually can be detected only by individuals of the same species. There are a number of different types of pheromones, but the most common type is the sex pheromone. Usually the females will emit a tiny amount of a chemical that attracts the male to her and increases the likelihood of mating. Because the chemical is volatile, air currents carry it. The male detects the pheromone in the air with receptors on his antennae. He then flies upwind to find the source of the pheromone, a prospective mate. The chemical compositions of pheromones for a number of pest species have been identified and synthetic copies can be produced in the laboratory. Synthetic pheromones can be used in conjunction with traps to catch male insects.

Listed below are some, but certainly not all, of the suppliers of pheromones and traps.

Alpha Scents, Inc. 1089 Willamette Falls Drive, West Linn, OR 97068. 503-342-8611; www.alphascents.com Gempler's; P. O. Box 270; 100 Countryside Dr.; Belleville, WI 53508; 800-382-8473; www.gemplers.com Great Lakes IPM; 10220 Church Rd., NE; Vestaburg, MI 48891; 517-268-5693; www.greatlakesipm.com Insects Limited Inc.; 16950 Westfield Park Rd.; Westfield IN 46074-9374; 317-896-9300; www.insectslimited.com Pacific Biocontrol Corporation; 620 E. Bird Lane, Litchfield Park, AZ 85340; 623-935-0512 or 800-999-8805; www.pacificbiocontrol.com

Scentry Biologicals Inc.; 610 Central Ave.: Billings MT 59102; 800-735-5323; www.scentry.com Trece Incorporated; P. O. Box 129. Adair, OK 74330; 866-785-1313; www.trece.com

You can buy most pheromone traps from these suppliers, but for corn earworm/tomato fruitworm, I recommend that you use the wire mesh trap which is

available from:

**Bob Poppe's Service**; 25738 N. 3200 Road; Lexington, IL 61753; 309-723-3201.

The wire traps catch more moths and last longer than the nylon traps.

To get the most from your pheromone traps, they must be used properly:

• Place the traps and the pheromones out before you would normally expect the insect pest to be active. That way you can monitor the adult activity, which will warn you that damage from the larvae may be coming soon. Corn earworm pheromone traps should go out about June 1.

• Be careful how you store pheromones. Ideally, they should be frozen until ready for use. At the very least, they should be refrigerated. If you keep them on the dashboard of your truck, they won't work well when you place them in the trap.

• When handling pheromone lures, do not touch them with your hands. Use a pair of forceps or wear latex gloves. This is especially important when you are using pheromones for more than one pest. Contamination of a lure with another pheromone will likely reduce the effectiveness.

• Lures usually should be changed every 3-4 weeks, although this will vary for individual lures.

• Check traps regularly, at least weekly. Daily would be better.



**MELCAST 2014** - (*Dan Egel, egel@purdue.edu, 812-886-0198*) - Those growers who saw one of my Extension presentations this winter probably heard me talk about how important timely fungicide applications are for the management of anthracnose, Alternaria leaf blight and gummy stem blight of cantaloupe and watermelon. In particular I spoke about how quickly the disease anthracnose of watermelon spread in 2013 in fields where fungicides were not applied frequently enough.

How does one know when to apply fungicides every 5 days and when it is OK to wait 14 days between fungicide applications? Applying fungicides according to a weather-based system is easy for cantaloupe and watermelon growers. **MELCAST** was developed at Purdue University by Rick Latin to allow growers to apply foliar fungicides to control Alternaria leaf blight, anthracnose and gummy stem blight. When **MELCAST** is followed, fungicides are applied when they are most needed depending on leaf moisture and temperature. Details are listed below or in the extension bulletin, *Foliar Disease Control Using MELCAST*, BP-67-W. Download the bulletin at http://www.extension.purdue. edu/extmedia/BP/BP-67-W.pdf or contact Dan Egel for a copy.

The **MELCAST** program uses weather information from one of the 12 sites located around Indiana: Daviess County, Decker, Elkhart County, Gibson County, Jackson County, Oaktown, Richmond, Rockville, Sullivan, SW Purdue Ag Center, Vincennes, and Wanatah. **MELCAST** also serves growers in Kentucky, Missouri, Illinois and Arkansas. Cantaloupe and watermelon growers should farm within about 50 miles of a **MELCAST** site. If rain events, dew formation, and temperatures at one of the **MELCAST** sites are similar to your farm, **MELCAST** should be effective for you.

Cantaloupe and watermelon growers using **MELCAST** apply foliar fungicides every 14 days unless the weather thresholds described below indicate that an application should be made sooner. Below find more details.

- 1. Apply the initial fungicide application at or before vines touch within a row.
- 2. Check the Environmental Favorability (EFI) value for the day of fungicide application.
- 3. Calculate the threshold for the next application by adding 20 (cantaloupe) or 35 (watermelon) to the EFI value in step 2. It is important for cantaloupe and watermelon growers to use the EFI values designed for their crop. To get a **MELCAST** calendar to keep track of EFI values, call Dan Egel. Alternatively, a **MELCAST** spreadsheet can be downloaded from **http://melcast.info**.
- 4. Apply the next fungicide application 14 days after the first, or sooner if the EFI threshold has been reached.
- 5. Check the EFI values on the day you make your next fungicide application and re-calculate the threshold for the next application.

A few things to remember: It is best to apply fungicides before the threshold has been reached rather than wait until after the threshold has been exceeded. So, for example, if you are a watermelon grower, the EFI threshold has reached 33 and a rain is expected soon, then go ahead and apply a fungicide. Use the thresholds of 20 and 35 EFI values as guides. Use a lower threshold if you feel that disease pressure is high. Finally, note that fungicide applications for downy mildew and powdery mildew cannot be scheduled with **MELCAST**.

Keeping track of **MELCAST** values is similar to keeping track of oil changes in a car or truck. When one changes oil, the mileage is written down and the oil is changed again at the next threshold (3,000 miles or 35 EFI values). EFI values, like mileage of a truck, continue to increase.

Check EFI values by using the toll-free phone number 800-939-1604 Monday though Friday; check the website 7 days a week http://btny.agriculture.purdue. **edu/melcast/** (or remember melcast.info); and/or sign up for the free *MELCAST Update* that comes once a week during the season. Please call Dan Egel with any questions.



### MIDWEST VEGETABLE PRODUCTION GUIDE UPDATE -

(*Dan Egel, egel@purdue.edu, 812-886-*0198) - Hard copies of the *Midwest Vegetable Production Guide for Commercial Growers 2014* have been available since early January. However, this guide, also known as the *ID-56*, is also available in an on-line version at http://mwveguide.org. One advantage of the online version is that it is free versus the \$10 price for the hard copy. Another advantage of the on-line version is that updates can be added when needed. Updates and changes that have been made since the printing of the ID-56 are listed below. If you are unable to access the on-line version of the *Midwest Vegetable Production Guide for Commercial Growers 2014* or have any questions, please contact me. Or visit this article on the VeggieDiseases Blog http://veggiediseaseblog.org/ and share your comment online.

#### Fruiting vegetable chapter.

• The rate for Fontelis<sup>®</sup> on tomato for Botrytis gray mold and for early blight/Septoria leaf blight was changed to 16-24 fl. oz./A on page 123.

• The fungicide Priaxor<sup>®</sup> was added for anthracnose, Botrytis gray mold (suppression only), early blight and Septoria leaf blight, late blight (suppression only) and white mold. The rate for all the diseases above is 4-8 fl. oz./A except for late blight, which is 8 fl. oz./A. Note that Priaxor<sup>®</sup> is the only foliar fungicide listed for tomatoes and white mold. However, Priaxor<sup>®</sup> is not labeled for the greenhouse. Applicators must be in possession of the supplemental label.

#### Cucurbit chapter.

•In the watermelon variety resistance to Fusarium wilt table on page 97, the watermelon variety Distinction now has a rating of '++++', meaning it has an excellent Fusarium wilt resistance rating.

•Proline 480 SC<sup>®</sup> is now labeled for Fusarium wilt of watermelon at 5.7 fl. oz. per acre. May be applied by ground or chemigation application equipment. Do not use in water used for hand transplanting.

Proline<sup>®</sup> product has been labeled as a result of research performed at Purdue University and elsewhere. The Proline<sup>®</sup> label allows one drip application. If Proline<sup>®</sup> is used as a drip application for Fusarium wilt, use it at transplant. I have been able to show that Proline<sup>®</sup> can lessen the severity of Fusarium wilt of watermelon. However, the results depend on many factors including the amount of the Fusarium wilt fungus in the soil and the host resistance of the variety used. If you have any questions or thoughts about using this product for Fusarium wilt of watermelon, please contact me at the phone number or email above.

• The fungicide Merivon<sup>®</sup> was added to several diseases in the chapter at 5.5 fl. oz./A: anthracnose, gummy stem blight, powdery mildew and Plectosporium blight. Alternaria leaf blight was added at 4-5.5 fl. oz./A. Applicators must be in possession of the supplemental label.

I had the opportunity to use Merivon<sup>®</sup> on powdery mildew of cantaloupe a few years ago: I had excellent results. However, Merivon<sup>®</sup> has active ingredients in groups 7 and 11. My research has shown that in the past, group 7 active ingredients work well on powdery mildew (for example, Pristine<sup>®</sup> and Fontelis<sup>®</sup>). Group 11 products have not worked well for powdery mildew of cucurbits in Indiana.

#### Sweet corn chapter.

• The fungicide Priaxor<sup>®</sup> was added for use on several diseases-page 188.

#### Onion chapter.

• The fungicide Merivon<sup>®</sup> was added for use for Alternaria purple blotch, Botrytis leaf blight and downy mildew. Page 161.

#### Legume chapter.

• The fungicide Priaxor<sup>®</sup> was added for use on several diseases. Pages 146-147.

NRCS PROGRAMS IN NEW FARM BILL - (*Liz Maynard*, *emaynard@purdue.edu*; 219-531-4200) - Jane Hardisty, State Conservationist with USDA's Natural Resources Conservation Service (NRCS) recently announced information about the Conservation Title of the new Farm Bill (http://www.nrcs.usda.gov/wps/portal/ nrcs/news/in/newsroom/releases/). NRCS provides financial and technical support to help farmers conserve natural resources. Projected dates for various programs mentioned in the announcement are listed below, but note these are tentative; check with your local NRCS office for the most current information and details about the programs.

**Environmental Quality Incentives Program** (**EQIP**). Applications submitted by May 16, 2014 will be evaluated to be considered for funding in fiscal year 2014. Applications received after that date will be accepted and evaluated for future rounds of funding. EQIP initiatives include on-farm energy, organic production, and seasonal high tunnels, in addition to other conservation practices.

**Conservation Stewardship Program (CSP).** Applicants can expect to be notified of funding decisions by early June. Contracts for 2010-01 and 2010-02 sign-ups will have an opportunity to re-enroll for an additional five years, under certain conditions and specified criteria. NRCS will begin implementing this option by September 30th.

Agricultural Conservation Easement Program (ACEP). Applications for agricultural land easements will begin to be accepted by April 30, with applicants notified of funding/enrollment decisions by July 31, and contracts/agreements in August. Wetland Reserve Easement applications are currently being accepted. Funding decisions are also expected by July 31.

**Regional Conservation Partnership Program** (**RCPP**). A request for proposals will be issued in May, with proposal selection and agreements with partners expected by September 30th. RCPP consolidates several existing programs including: Cooperative Conservation Partnership Initiative (CCPI), Agricultural Water Enhancement Program (AWEP), and the Great Lakes Basin Program.

For more information about NRCS programs, contact your local district conservationist http://www. nrcs.usda.gov/wps/portal/nrcs/main/in/contact/local/ or visit the Indiana NRCS website: http://www.nrcs. usda.gov/wps/portal/nrcs/main/in/programs/farmbill/. Contact the state conservationist at 317-295-5801.

**SWPAC HORTICULTURE SPECIALIST INTERVIEWS** -(*Dan Egel, egel@purdue.edu; 812-886-0198*) - Last fall, Horticulture Specialist Dr. Shubin Saha left Purdue for a position at the University of Kentucky. While we wish Shubin the best of luck, we also need to hire his replacement. Three individuals have been identified to interview for the position. The search committee invites interested growers and industry members to meet and talk with the candidates at round table discussion events listed below. To participate, show up at the Southwest Purdue Ag Center (SWPAC), 4369 N. Purdue Rd., Vincennes, IN or call 866-808-9158. The round table discussions are at 9:30 A.M. Eastern time on Wednesday, April 30; Tuesday, May 6; and Friday, May 9. If you have any questions or concerns, please contact Dan Egel.



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