Vegetable Crops Hotline

A newsletter for commercial vegetable growers prepared by the Purdue University Cooperative Extension Service

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IN THIS ISSUE

Black Rot of Crucifers - (*Dan Egel, egel@purdue.edu, 812-886-0198*) - Cabbage is the crop most often affected by black rot, however, other crucifers such as broccoli, cauliflower, mustard, kohlrabi or Brussels sprouts may be affected. The first symptom one is likely to notice is a 'V' shaped lesion on the margin of the leaf (see Figure 1). However, the symptom on Brussels sprouts observed recently are irregular, jagged lesions on leaves (see Figure 2). The plants represented in Figures 1 and 2 are different varieties of Brussel sprouts. The differences may be due to differences in susceptibility of the two cultivars or the cultivar in Figure 2 may have been infected at an earlier age than the one in Figure 1. Figure 3 shows two severely affected plants next to a relatively healthy plant.

Black rot is most severe in wet, warm weather. The emergence of this disease during a rather cold spring may mean that the disease started in a greenhouse situation.

The bacterium that causes black rot, *Xanthomonas campestris*, survives in crop residue. Thus, crop rotations that avoid crucifers should lessen the severity of the disease. Sanitation in the greenhouse should help to lessen the amount of the bacterium that can cause more disease. The causal bacterium may also be transmitted through seeds, therefore, every effort should be made to plant seed that has been tested and found free of the bacterium. Inspect transplants for symptoms before planting. Avoid practices which add to free water on plant surfaces. Products which contain copper as an active ingredient may help to lessen the spread of the disease. However, copper products may also cause lesions on leaves under some circumstances. Although there may be varietal differences in susceptibility, compete levels of resistance are not available in commercial cultivars. More information about general pest management can be found in the *Midwest Vegetable Production Guide for Commercial Growers, 2015* (**https://btny.purdue.edu/Pubs/ID/ID-56/**).

This article was orignially published at **VeggieDiseaseblog.org**.

Figure 1. Typical symptoms of black rot include 'V' shaped lesions on the margins of leaf. (*Photo by Dan Egel*)

Figure 2. The angular lesions on this Brussel sprouts leaf are not typical of black rot. (*Photo by Dan Egel*)

Figure 3. The two Brussels sprouts plants on the left are severely affected by black rot. (*Photo by Dan Egel*)

Pith Necrosis of Tomato - (*Dan Egel, egel@purdue.edu, 812-886-0198*) - This disease has been reported in two different greenhouse situations. Although the disease is not usually economically important, a brief review of the disease is offered here to help tomato growers differentiate pith necrosis from more important problems.

Tomato pith necrosis causes dark brown streaks on tomato stems and leaf petioles (see Figure 4). Often stems may appear twisted and distorted. When cut open, the stem may appear discolored and chambered (see Figure 5). Eventually, the affected plant may become stunted and wilt. Tomato pith necrosis is usually found in greenhouses or high tunnels.

Because the plant has a discoloration in the stem, it is sometimes confused with bacterial canker, a much more serious disease. A comparison of the two diseases can be found at **https://ag.purdue.edu/arp/swpap/Documents/pith-necrosis%20.pdf**.

It is not clear how pith necrosis spreads or enters the tomato plant, but it is probably best to remove affected plants and avoid using pruning equipment on diseased plants. When removing diseased plants, it is always best to leave as little of the plant behind as possible. A landscape cloth covering can help to keep crop residue out of the soil.

Perhaps since pith necrosis is not economically important and does not appear to spread quickly, not much is listed for the management guidelines. To manage tomato pith necrosis, avoid low night temperatures and excessive nitrogen levels; reduce high humidity in the greenhouse or high tunnel. General pest management guidelines can be found in the *Midwest Vegetable Production Guide for Commercial Growers 2015* (**https://btny.purdue.edu/Pubs/ID/ID-56/**).

This article was originally posted at **VeggieDiseaseBlog .org**.

Figure 4. Pith necrosis of tomato may result in dark, necrotic streaks on stems. (*Photo by Dan Egel*)

Figure 5. Pith necrosis of tomato may cause internal discoloration and a chambered internal stem. (*Photo by Dan Egel*)

EPA's Proposal to Protect Bees - (*Rick Foster, fosterre@purdue.edu, 765-494-9572*) - On May 29, 2015, the EPA issued a proposal to protect bees from acutely toxic pesticides. As stated in the announcement, "EPA is proposing to prohibit the application of pesticides that are highly toxic to bees when crops are in bloom and bees are under contract for pollination services. These restrictions would prohibit application of most insecticides and some herbicides during bloom." The criteria used to determine which products would be prohibited from use during bloom were 1) Liquid or dust formulation as applied; 2) Foliar use (applying pesticides directly to crop leaves) directions for use on crop; and 3) Active ingredients that have been determined via testing to have high toxicity for bees (less than 11 micrograms per bee). To see the details of the proposal including the list of active ingredients that would be affected by this pro-

posal, go to **http://www.epa.gov/oppfead1/cb/csb_page/updates/2015/protect-bees.html**.

These proposed changes have the potential to drastically alter pest management practices for insect pests that must be controlled when crops are blooming, particularly those that bloom over an extended period of time. EPA is accepting comments from interested parties for a period of 30 days after the announcement. Growers who are concerned about the possible effects of these restrictions are encouraged to comment to EPA at **http://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPP-2014-0818**.

Figure 6. Honey bee exiting a melon flower. (*Photo by John Obermeyer*)

Corn Earworms - (*Rick Foster, fosterre@purdue.edu, 765-494-9572*) - After a brief lull in pheromone trap catches, we have resumed catching earworm moths all around the state. Although most of the counts are relatively low (less than 10 per night), remember that for early planted sweet corn that silks before the neighboring field corn silks, the threshold for treatment is 1 moth per night. So, if you have sweet corn that is in the vulnerable stage, green silks present, treatment is justified if you are catching any earworm moths in your trap.

Figure 7. A very heavy night's catch of corn earworm moths. (*Photo by John Obermeyer*)

Striped Cucumber Beetles - (*Rick Foster, fosterre@purdue.edu, 765-494-9572*) - So far it appears that populations of striped cucumber beetles appear to be low to moderate in most areas. The often cool and/or wet weather may be suppressing their activity currently, so be prepared if we get a period of warm, dry weather. Remember that cantaloupes and cucumbers are most susceptible to bacterial wilt, so the threshold for treatment is relatively low, 1 beetle/plant. For watermelons, pumpkins, and most squashes, the threshold is 5 beetles/plant because those cucurbits are less susceptible to bacterial wilt. When treating cucurbits that are in bloom for beetles, growers should wait to begin spraying until the flowers have closed up for the day. Ideally, sprays should be applied late in the evening if possible, because the potential for bee kills are reduced and that will allow for maximum residue levels on the foliage the next day.

Figure 8. Striped cucumber beetles feeding on melon leaves. (*Photo by John Obermeyer*)

Notes on Recent Pollinator Health Initiatives - (*Greg J. Hunt, ghunt@purdue.edu, 765-494-4605*) - Indiana is working on a state pollinator protection plan, which is being spearheaded by the Office of the Indiana State Chemist with input from various stakeholders, including growers, farm chemical company representatives and beekeepers. A large part of the plan will involve protecting bees from pesticides. This plan is part of a national movement initiated by the president last year. A "national strategy to promote the health of honey bees and other pollinators" was released on May 19 by the newly established Pollinator Health Task Force.

The national plan offers an assessment of the decline of honey bees, wild bees and monarch butterflies. The decline in honey bees coincided with the introduction of parasitic mites but other factors including pesticides play a role. Last year the nation lost 40% of its hives.

Beekeepers had to scramble to make new hives to pollinate the nation's crops. The annual loss has been about 30% for the past ten to twenty years. There are over 4,000 species of native bees in addition to honey bees in North America. Honey bees were introduced by the colonists. It is assumed that policies that improve the health of honey bees will also benefit native species but there are some initiatives aimed at native bees. The plan recognizes that the monarch butterfly is only a minor pollinator but that it is a major indicator of ecosystem health. For example, the area covered by overwintering monarchs in Mexico has decreased by about 90% in the last twenty years.

There are three main objectives: (1) returning honey bee colony health to acceptable levels (approximately 15% overwintering loss, a level from which beekeepers are capable of successfully dividing surviving healthy colonies to remain economically viable); (2) increasing monarch butterfly populations to historic averages to ensure successful continuation of annual migrations; and (3) increasing and maintaining cumulative pollinator habitat acreage in critical regions of the country.

Most new funding will be funneled to research on causes and cures for pollinator declines, which will be about $29 million in 2016. This will be a great boon to those who are studying factors influencing bee losses, or those interesting in surveying existing bee and butterfly populations in various habitats, or looking at the value of habitats and other practices as benefits to pollinator populations. The stated goal for objective 3 is to restore or establish 7 million acres of land for pollinators over the next 5 years. There will be some funds for habitat restoration but most of this should be accomplished through changes in policies for federal and state lands, and reallocation of existing funds. There will be opportunities to enhance pollinator habitat in private lands in the conservation reserve program, or CRP. The plan proposes better coordination involving many federal agencies and state agencies to help make this happen. For example, the federal wildlife service will partner with the Association of Fish and Wildlife Agencies to include monarch butterfly and pollinators in their State Wildlife Action Plans. This will allow states to use a portion of their state wildlife grant funds for pollinator conservation.

Another major area discussed in the plan is pollinator public education and outreach. Federal agencies will be encouraged to develop educational websites and the public will be engaged through initiatives such as National Pollinator Week, which is the third week in June. The National Park Service, the DOE and USDA will play important roles in designing educational materials and events. All in all, this plan looks like great news for pollinators, for our food supply and for the health of our environment.

DriftWatch.org Worth the Effort - (*Jeff Burbrink, jburbrink@purdue.edu, 574-533-0554*) - During the past two weeks, I am aware of two beehives that were almost decimated when insecticides were used nearby. In both cases, the commercial applicators had used the DriftWatch program before spraying to look for sensitive crops or bees near the targeted crop. However, neither hive was recorded in DriftWatch.

DriftWatch is a web-based program to help growers of sensitive crops and bees to map their location. Pesticide applicators can bring up maps of the area to be sprayed, warning them of potential issues.

DriftWatch is free of charge. Sign up at **https://in.driftwatch.org/map**. Growers and beekeepers provide information such as name, address, phone number, and the location of the field or hive.

You do not need to have an email address to sign up for DriftWatch. Simply call Beth Carter at the Office of the Indiana State Chemist, 765-494-1585, to get an account set up. If you do not have a computer at home, you can manage your information at public computer sites such as libraries.

Blossom End Rot of Tomato - (Liz Maynard, **emaynard@purdue.edu**, 219-531-4200) - Blossom end rot of tomato has been showing up in some protected growing structures. This article reviews the disorder and summarizes preventive practices.

Blossom end rot is a physiological disorder caused by a deficient supply of calcium to the developing fruit. It is a common problem on tomatoes, but can also occur on peppers, eggplants, and melons. Blossom end rot appears first as a small darkened or water soaked area, usually at the blossom end of the fruit. This spot darkens, enlarges and dries out as fruit matures. The area may be invaded by secondary decay causing organisms. Prevention is the best way to avoid losses from blossom end rot. Prevention strategies emphasize ensuring adequate supply and availability of calcium, and managing plant growth environmental conditions to promote movement of calcium to the developing fruit.

If I could offer just one suggestion it would be to maintain a consistent water supply. In many cases I have seen, this is a key factor. Any interruption of water supply to the roots, for example during hot dry weather, can cause a temporary calcium deficiency in the developing fruit that will lead to blossom end rot. A sudden change to hot sunny weather after a period of cloudiness may promote blossom end rot due to the increase in water demand. In protected culture increasing humidity may reduce blossom end rot because the plant demand for water will be reduced.

Nutrient management is also important. Check that soil calcium levels are sufficient, and in cultural systems where most calcium is supplied through fertigation,

assure that sufficient amounts are being applied. Frequently, calcium levels are sufficient and it is getting the calcium to the developing fruit that is the problem. Avoid excess nitrogen. Nitrogen promotes vegetative growth that can compete with the developing fruit for an adequate supply of calcium, leading to blossom end rot. Avoid excess potassium or magnesium because they can interfere with uptake of calcium. High EC in a soilless culture system can also promote blossom end rot.

In addition to managing nutrients and water, providing conditions for a healthy root system is important. Avoid compaction and provide good drainage.

Varieties differ in susceptibility to blossom end rot. Plum types are often more prone to the disorder; it is virtually unknown in cherry tomatoes.

Blossom end rot can cause significant losses and is a problem that can be avoided with proper management. It may take some investigation to determine what measures will be effective in a particular situation; time well spent if it reduces the loss of marketable fruit.

Boiler Hop Yard Update - (Clayton Nevins, **cnevins@purdue.edu**, 765-592-6270) - Purdue University's Boiler Hop Yard has started its second growing season with the hopes of providing Indiana growers with science-based recommendations for hop production in the Midwest. With summer rapidly approaching, hop bines are now climbing over 10 feet high in portions of Indiana, and the Boiler Hop Yard is no exception.

Downy Mildew - One of the biggest threats to Indiana hop production is downy mildew. Downy mildew (*Pseudopernospora humuli*) can cause hop quality to depreciate, yield to be stunted, and sometimes even plant death. Downy mildew was identified in the Boiler Hop Yard in mid-April this year, and is present in other Indiana hop farms as well. Downy mildew overwinters in the crown of the hop plant, and appears in the early spring on newly emerged primary basal or aerial spikes as a sidearm (see Figure 9). These spikes have irregular growth patterns and are undesirable in hop production. The spikes are distorted in length, containing shortened internodes, sometimes appearing chlorotic with yellow leaves that begin to curl as the disease intensifies. There are lesions that develop on the top and bottom sides of the leaves. The lesions on the top of the leaf can appear yellow and angular and then turn brown, while the bottom of the leaf has dark lesions (see Figure 10). After time, these lesions begin to develop asexual spore masses on the underside of the leaves which can spread to other plants and cones. If the spikes are not removed, the older leaves are consumed by the disease and begin to die back.

Figure 9. Shoots infected with downy mildew. (*Photo by Clayton Nevins)*

Figure 10. Brown lesions on the underside of leaves are signs of the presence of downy mildew. (*Photo by Clayton Nevins)*

One of the best ways to manage downy mildew is through preventative action by planting resistant varieties. Hop varieties that are reported to be susceptible to downy mildew include Cluster, Galena, Centennial, and Nugget, while Cascade, Fuggle, Perle, Tettnanger, Chinook, Columbia and Willamette are reported to be moderately resistant (Johnson et al. 2009). The variety with the most prominent downy mildew presence in the Boiler Hop Yard this season has been Nugget. However, even with resistant varieties, growers need to scout their hop yards regularly to identify and manually remove infected spikes. Scouting has taken place in the Boiler Hop Yard at least twice a week since downy mildew was first identified in early April. Hop plants can also be crowned early in spring to remove infected shoots and encourage development of healthy, vigorous shoots. This mechanical control method removes the top 0.75-2 inches of the crown before buds break through the soil (Darby and Madden 2012). Another way to cope with downy mildew is to develop an effective fungicide spray schedule for your hopyard. It is important to maintain a rotation

in spray schedules by varying modes of action because downy mildew can fairly rapidly develop resistance to fungicides (Johnson et al. 2009). On April 23rd Cuprofix® and Tanos® (common name, famoxadone cymoxanil) were applied at the Boiler Hop Yard before an expected heavy rain. Cuprofix® is a basic copper sulfate. Two weeks later, copper and Zampro® were applied, and on May 18th Aliette WDG® (common name, fosetyl-Al) was administered. Zampro® should not be applied more than two times before alternating to a fungicide with a different mode of action. Most recently, Rampart® was sprayed in the hopyard on June 3rd. Spraying will continue in the hopyard as the summer progresses, likely with longer spray intervals during the upcoming drier weather.

Frost Damage - Frost damage is another challenge Indiana hop growers may face. During May several hop growers reported frost damage in parts of central and northern Indiana. It should be noted that in some cases frost damage can resemble downy mildew (Darby and Madden 2012). The Boiler Hop Yard experienced frost damage that included necrosis of leaves and die back of young shoots (see Figure 11). In the worst cases, the oldest shoots, some of which were "bull" shoots (described below), were stunted and the tip was killed. The plants appear to have completely recovered from the damage, which is usual as frost is often an early season, mild setback.

Figure 11. Shoots that suffer from frost damage are necrotic and black. (*Photo by Clayton Nevins)*

Training - The date that hop bines are strung can have a significant impact on cone yield. The optimal training date varies by site-specific climatic factors as well as hop variety. Consequently, identifying the best training date in Indiana is going to take a bit of trial and error. In the Boiler Hop Yard this year, the large trellis system was strung on May 8th when the bines were ranging from 12-24 inches in height. Once the string was hung, training was started by selecting 3 to 4 of the more mature bines and wrapping them clockwise around each string. It is important to note that the initial shoots that emerge from the ground are not always the best to train. These shoots, sometimes referred to as "bull" shoots, have a hollow center and will not have successful cone production compared to the plant's secondary shoots. The initial shoots, though large, are susceptible to severe spring weather damage, such as heavy wind and rain, due to their brittleness. In the Boiler Hop Yard, it was not uncommon for the hops to produce up to 3 or 4 of these hollow, fibrous shoots at the beginning of the growing season.

The Boiler Hop Yard is also experimenting with a short trellis system (see Figure 12). Unlike the tall trellis, which is 18 feet tall and requires annual stringing and training, the short trellis consists of a net that is 10 feet tall. There has been no need to train the hops on the short trellis system because they naturally wrap themselves around the net. The bines on the short trellis are more mature with regards to height than those on the large trellis. The variety Galena has shown the best initial growth on the short trellis this season, with many of the bines climbing to the top of the trellis by late May. On May 19th the first trimming on the short trellis took place, as there were several plants that had already overgrown the net. By cutting off the tops of the shoots that had overgrown the trellis, the plants began their outward expansion with the growth of lateral shoots which is where hop cones will emerge.

Figure 12. The short trellis system at the Boiler Hop Yard. (*Photo by Clayton Nevins)*

This season there were two new hop varieties added to the yard: Comet and Horizon. Each of these varieties was planted on the large and small trellis systems the first week of June.

Fertilization - Developing a sustainable nutrient management plan depends on routine soil tests and an estimate of the total aboveground biomass (bines, leaves, and cones) hop plants are expected to produce. For example, newly planted hops will not produce a substantial amount of biomass in the first year, and thus their nutritional needs will be lower than fully mature plants 3-4 years after establishment. Nitrogen (N) is generally the most limiting nutrient in hop plants, and the one that is the most difficult to manage because it is highly mobile in soil. Consequently, split applications are highly recommended to help reduce N loss. In the first year, the general N recommendation for hops is

75 lbs. per acre, whereas the rate can vary from 100-200 lbs. per acre in mature plants depending on soil organic matter levels. Other major nutrients required by hops are phosphorous (P) and potassium (K), and recommendations generally range from 20-60 for P, and 80-150 for K. Based on fall soil tests at the Boiler Hop Yard and estimated aboveground biomass, we decided to apply a total of 125 lbs. of N, and 30 lbs. of P, while existing soil K was expected to be sufficient. The Hop Yard had its first fertilizer application in the middle of May when 75 lbs. of N and all 30 lbs. of P per acre was applied. The nutrients were applied through fertigation, the process of administering fertilizer through the irrigation system. This initial fertilizer application was done in May because the hops were beginning to enter their training period. As the growing season continues, the hops will be spoon fed additional N fertilizer through the fertigation system through mid-June. It is important not to continue to supply N after plants have begun flowering as this can result in unwanted vegetative growth at the expense of cone yield. Leaf petioles were just harvested from the Boiler Hop Yard, and will be tested to determine if our plants are in the optimal nutrient range.

Anticipated Future Management - As the growing season continues and growing degree-days increase in central Indiana, the irrigation system will begin to be more active. With the hot and humid Indiana summer weather comes the need to continually scout for downy mildew, which is expected to remain a common nuisance. There will also be continual trimmings of the short trellis system over the summer months in order to continue encouraging outward growth and cone development. Within the next two weeks, the herbicide Aim® will be applied in order to defoliate the leaves on the bottom three feet of the hops. Insect management practices may also be necessary as the summer continues as the presence of potato leaf hoppers are expected to increase in the coming weeks.

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"Planning for Success: Food Safety Plan Writing" began Thursday June 4 and will continue on June 18 and July 1. The program is offered via WebEx, or by phone for audio only. Each program includes a presentation followed by time for discussion and questions and answers.

"The programs are designed so that growers can participate over a lunch hour and get answers to current questions they may have as they work through the plan writing process," says Scott Monroe, Purdue Extension food safey educator and organizer of the series.

The series schedule (all times noon to 1 p.m. EDT):

June 4: "Written Food Safety Plan Basics."

June 9: "Policies, Procedures and Documentation."

June 18: "Food Safety Protocols - What's Out There."

July 1: "Using Templates and Other Resources."

To join the program, go to **http://bit.ly/FSPlanWriting**. To participate by audio only, call 888-854-1541.

Southwest Purdue Agricultural Center Field Day - A field day will be held on July 9 to share with the public the various research activities at the Southwest Purdue Agricultural Center in Vincennes, IN. The day will start at 7:30 a.m. with a health fair. Registration starts at 8:30 a.m. Presentation topics include: managing cucumber beetles while protecting bees, production of vegetables in high tunnels, canola production, hybrid cottonwood as a bioenergy crop, grape production, field crops disease update, soybean production, maximizing seed corn investment and benefits of starter fertilizer. Lunch is free with registration. A PARP class will be offered after lunch. Please contact Barb Joyner at 812-886-0198 or **joynerb@purdue.edu** to RSVP or go on-line at **http://tinyurl.com.2015SWPAC**.