

# VEGETABLE CROPS HOTLINE

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



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## Spider Mites

(Rick Foster, [fosterre@purdue.edu](mailto:fosterre@purdue.edu), (765) 494-9572)

We have received a number of reports of outbreaks of spider mites, primarily in watermelons in the field and cucumbers in high tunnels. Spider mite damage can be recognized by the chlorosis often observed on older leaves (Figure 1). Plus, the underside of leaves affected by spider mites often appears 'dirty' due to the debris caught by the webbing (Figure 2). The problems in high tunnels are not unexpected because one of the primary causes of mortality in mite populations is rainfall washing them off the plants and, of course, that is lacking completely in high tunnels. In addition, the warmer temperatures present in high tunnels allow mites to complete generations faster so populations can build to high levels quickly. The hot weather recently is helping to drive population increases in fields as well.



Figure 1. Spider mite damage can be recognized by the interveinal chlorosis on the leaves, such as on these watermelon plants. (Photo by Dan Egel)



Figure 2. The underside of leaves affected by spider mites, such as this watermelon leaf, often appear 'dirty' since the webbing traps debris. (Photo by Dan Egel)

In both scenarios, we don't really have treatment thresholds for mites. Generally speaking, if populations are increasing, they need to be controlled. Once the decision to treat has been made, that's where things get very different. In watermelons, we have a variety of pesticide choices. See page 117 of the [Midwest Vegetable Production Guide \(ID56\)](#) for the list of options. Most of these miticides will provide good to excellent control of spider mites.

In high tunnels, the choice of a pesticide is a little more complicated. First, you need to find the products available for use on your crop. If, for example, tomatoes is the crop of concern, you can find 6 options to choose from on page 137 of the [ID56](#), Acramite®, Agri-Mek®, Nelata®, Oberon®, Portal®, and wettable sulfur. However, since you are growing in a high tunnel (defined as a greenhouse by the Office of the Indiana State Chemist), some of those options are not available to you, namely Nealta® and Portal®. So, you need to choose from the other three options. Sulfur is much less effective than the other two choices and is primarily for organic growers. If you are a conventional grower, your choices would come down to Acramite®, Agri-Mek® and Oberon®, either of which will work well.

## Tomato Disease Update

(Dan Egel, [egel@purdue.edu](mailto:egel@purdue.edu), (812) 886-0198)

Below, I will briefly discuss four diseases that I have observed on tomatoes recently.

**White mold of tomato** - Perhaps the most common symptom of

white mold of tomato is the light brown area on the lower stem (Figure 1). This brown area is essentially dead and will result in the wilt and death of the tomato plant above that point. Either on the outside of this dead area or inside the stem, dark, irregularly shaped fungal bodies can usually be found. These fungal bodies (known as sclerotia) are diagnostic of white mold.



Figure 1. White mold of tomato, AKA, timber rot. Note the dark fungal structures where the stem has been torn away.

The fungal spores responsible for white mold are released early in the spring from a very small mushroom (several mushrooms could fit on a dime). The spores will enter a plant where tissue is dead or senescent, such as old flower petals. Fortunately, white mold, once established, will not spread from tomato to tomato plant. However, growers may observe more symptoms as later infections develop.

White mold is one of the diseases that I observe more in greenhouses than in the field. The reason for this is that greenhouses tend to increase the relative humidity necessary for disease establishment.

Although the disease doesn't spread from plant to plant in the greenhouse, growers may want to remove infected plants. The critical factor in removing infected plants from the greenhouse is not to let the dark fungal structures drop to the ground either inside the greenhouse or outside. The spores from the mushroom that may grow from the sclerotia in the spring may drift 300 feet or more. Take the infected plant well away from any tomato production and destroy if possible.

Anything that can be done to minimize relative humidity and leaf moisture will help reduce the severity of white mold. Therefore, vent the greenhouse in the evening and space the tomato plants far enough apart to allow air circulation.

More information can be found on this disease at <https://vegcropshotline.org/wp-content/uploads/2016/02/VCH583.pdf>.

**Tomato pith necrosis** – We have observed this relatively unimportant disease in our own high tunnel.

Often the first symptom observed is a chlorosis (yellowing) of young leaves. It might be possible to observe stems that appear shriveled. This may be associated with a dark brown necrosis of the lower stem and rotten pith (Figure 2). Low night temperatures, high nitrogen levels and high humidity favor the bacterium that causes pith necrosis. Therefore, it is usually seen in a greenhouse situation. The only management recommendation is to avoid high nitrogen levels in tomato plants as well as high humidity.



Figure 2. Tomato pith necrosis. Note twisted stem and discoloration.

Although tomato pith necrosis is not important, it is useful to be able to recognize the disease.

**Powdery mildew of tomato** – This disease was observed in a greenhouse in southwestern Indiana.

Powdery mildew of tomato has not been an economic problem in Indiana. However, last year there were more reports of this disease than usual. Powdery mildew is more often observed in a greenhouse situation, but last year it was also observed in the field.

The key symptoms of this disease are the talc-like lesions on the upper and lower leaf surfaces (Figure 3). It is important to note that the location of the upper and lower lesions do not correspond with each other. When the lesions are young, it may almost seem as if the lesions can be 'wiped off'.





Figure 3. Powdery mildew of tomato.

Few varieties exist with good levels of host resistance, although growers may notice some difference in susceptibility between varieties.

It may not be necessary to treat tomatoes affected with powdery mildew with fungicides. If fungicide treatment appears to be warranted, a few alternatives are: Fontelis®, Inspire Super®, Quadris Top®, several formulations of sulfur, Switch® and Vivando®. The products listed are all either labeled for the greenhouse or silent about greenhouse use. Check the label carefully before using any of these products.

**Early blight of tomato** – While much of Indiana has been dry, enough leaf moisture has been present for early blight of tomato to get started in a field in southwest Indiana.

Early blight can be recognized by the dark brown to black lesions often with bulls-eye-like rings (Figure 4). Normally, this disease is found in the field, not in a greenhouse situation.



Figure 4. Early blight of tomato lesions often have rings in a bulls-eye pattern

The key to managing this disease is crop rotation. A crop rotation of 3 to 4 years will help to lessen the severity of early blight.

A few varieties have partial resistance to early blight.

A contact fungicide such as chlorothalonil will help lessen the

severity of early blight in the field. Systemic products rated as very good in the [Midwest Vegetable Production Guide](#) include: Aprovia Top®, Cabrio®, Endura®, Fontelis®, Inspire Super®, Priaxor®, Quadris®, Quadris Top®, Reason® and Switch®. Note that some strains of the fungus that cause early blight may be resistant to fungicides in FRAC (MOA) group 11. That would include Cabrio®, Quadris® and Reason®.

## Augmentation Biological Control in High Tunnels

(Laura Ingwell, [lingwell@purdue.edu](mailto:lingwell@purdue.edu)) & (Rick Foster, [fosterre@purdue.edu](mailto:fosterre@purdue.edu), (765) 494-9572)

Supplementing the natural enemy population to control insect pests, i.e. augmentation biological control, is of interest to many high tunnel producers. Augmentation biological control has proven very effective at managing a number of greenhouse pests and there are a variety of commercial suppliers. For high tunnels, the greatest challenge is keeping the released predators or parasitoids inside the tunnels and choosing agents that are effective under high temperatures, during the peak of the growing season. We have evaluated some of the more common control agents in high tunnel cucumber and tomato production.



Figure 1. A ladybug feeding on aphids (Photo by John Obermeyer)

The convergent ladybug, *Hippodamia convergens*, is not grown in a growth facility but rather caught in the wild in the western U.S. (typically California) and shipped throughout the US for control of aphids in particular. They are a fairly inexpensive predator (1500 for about \$15.00), the immature form (larvae) and adults feed on aphids (Figure 1). However, you can only purchase adults and their availability can be limited. Furthermore, they do not stay in tunnels, less than 4% of those released were recaptured in two days.

The predatory stink bug, *Podisus maculiventris*, (Figure 2) is grown in colony for commercial availability. The immature nymphs and adults feed on small caterpillars. They can occasionally be found in tunnels naturally in the region; we have observed them feeding on caterpillars on tomato and cucumber crops. Adults are fairly expensive to purchase (50 count = \$90-150) and have retention rates around 3% two days after release. Eggs may be purchased and released in tunnels (250 = \$60-120) but take 2-3 weeks to hatch before any predation will occur. I would not recommend relying on this predator for control.





Figure 2. A stink bug eating a spined alfalfa weevil larva (Photo by John Obermeyer).

The minute pirate bug, *Orius insidiosus*, eats thrips, mites, aphids and caterpillar eggs and small caterpillars (Figure 3). They are grown in colony for commercial release but are also very common later in the growing season in Indiana. The price ranges from \$55-80 for 500 depending on supplier. Their retention is a bit higher than ladybugs, but can be enhanced by providing extra floral resources and using herbivore-induced plant volatile lures (such as PredaLure®, AgBio®). Use caution if deploying them in tomatoes, they get caught in the sticky hairs on the plant.



Figure 3. A pirate bug feeding on aphids (Photo by John Obermeyer).

The most promising agent to control aphids appear to be green lacewings (Figure 4 and Figure 5), *Chrysoperla carnea*. These are available for purchase as eggs, larvae or adults. The predatory life stage are larvae, which feed voraciously on aphids. If you have a current infestation that you are trying to control, you should purchase this life stage, as they will be able to immediately feed on the aphids. If you are putting them out as a preventative measure, the egg stage is a more economical option (1000 eggs = \$15, 1000 larvae = \$20-38, 100 adults = \$45). If purchasing adults, expect them to leave tunnels at rates similar to ladybugs, but after laying eggs.

Most important when considering using biological control in your high tunnel is the compatibility with growing practices. Heavy

pruning of the lower leaves on both tomatoes and cucumbers may be removing the predators you just purchased, especially lacewing eggs which are preferentially laid on the lower parts of the plant. Routine scouting and monitoring of both pests and beneficial insects will be required to evaluate efficacy and track populations.



Figure 4. A green lacewing adult (Photo by John Obermeyer).



Figure 5. A green lacewing hatching from its egg (Photo by John Obermeyer).

Lastly, we have gained control of both armyworm and hornworm caterpillars on tomato and cucumbers with application of the biological *Bacillus thuringiensis* (Bt). This would be an alternative to conventional chemicals or predatory insects and is effective at suppressing caterpillar pests within days of application.

## Whether to Put Shade Cloth on High Tunnel Tomatoes

(Wenjing Guan, [guan40@purdue.edu](mailto:guan40@purdue.edu), (812) 886-0198)

Last week, the highest temperature reached 110°F for a few successive days inside of our high tunnels. As a result, we observed some blossom drop on tomatoes. More information on high temperature effects on tomato fruit set can be found [here](#). In addition to blossom drop, high temperature and high light intensity contribute to sunscald injury, uneven ripening, and cracking of tomato fruit. To protect tomatoes from damage caused by excessive heat, we placed 30% black shade cloth on top of the high tunnel. By installing the shadecloth, we expect there will be less cracking and more uniformly ripe tomatoes. Tomato marketability will increase. However, using shade cloth also has some negative effects. In this article, we

review the effects of high temperatures on tomatoes, and discuss positive and negative aspects of using a shade cloth.

Excessive high temperature (above 100°F) lasting for a few hours for successive days could cause tomato flower abortion and affect fruit set. Night temperatures above 75°F might also cause tomato fruit set failure. In addition to fruit set, high temperature affect fruit ripening process as well. With temperatures above 93°F, ripening-associated ethylene production was markedly decreased. As a result, we see more yellow-shoulder tomatoes in middle summer. More information regarding yellow shoulder disorder can be found [here](#). Studies showed that shade cloth with 15% to 50% shade reduced temperature for 3-4°F at the time when light intensity was high. However, at night and when light intensity is low shade cloth had little effects on reducing temperatures.

In general, using shade cloth reduces the number of unmarketable fruit. The most significant effect is to reduce skin crack. Tomato skin crack is partially caused by irregular watering, especially when soil-moisture goes from very dry to very wet. Shade cloth reduces water evapotranspiration, thus preventing dramatic variation of soil moistures, especially when plants are not watered frequently. Lower temperature under the shade also help reduce tomato cracking. This is because when temperature is high, the pressure exerted by the pulp on the skin is increased, and at the same time skin strength is decreased.

Using shade cloth does not always generate positive results. When shade level is more than 50%, plants developed larger but thinner leaves, longer internodes and less vegetative biomass. Water, nitrogen and potassium uptake was declined as shade density increase. A study conducted in northeastern United States showed that when 50% shade was applied at the time when greenhouse tomato began to ripe, total yield was reduced after 3 weeks of shade application even though the early yield was not affected. Studies also showed that shade might reduce tomato sugar content because of the reduced photosynthesis rate.

Now the question is whether we should apply shade cloth to the high tunnel tomatoes. Most of us who grow tomatoes in high tunnel target the early market. Having perfect tomatoes in the early season is quite important. To avoid those early season tomatoes that become unmarketable if temperature is too high, my suggestions is to apply shade cloth, but only use the ones that have moderate shade level such as 30% shade or less. It always good to apply shadecloth only in the days when temperatures are extremely high, and take them off in cloudy days. However, this is not always possible. If shadecloth is used till the end of the season, this practice might increase tomato yield in a hot summer, considering there would be less blossom drop because of the lower temperature. But in a mild summer, this practice might turn out reduce overall tomato yield in late seasons. In another case that shade cloth might be more helpful is when indeterminate tomatoes are grown and pruned and trellised to a single stem. Because of less foliage and higher temperature in upper level of high tunnels, those tomatoes are more vulnerable to damage by excessive heat and more likely to produce better fruit under the shade.

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## Veggie Texts

(Dan Egel, [egel@purdue.edu](mailto:egel@purdue.edu), (812) 886-0198)

The vegetable extension team at Purdue University is always looking for innovative ways to get information to clients quickly. For this reason, we are trying out a new program called veggie texts.

The idea is that if we have your mobile phone number and the name of your phone carrier, then we can send you text alerts of 160 characters or less.

What type of information should you expect with veggie tests? We may contact you with weather information such as forecast freezes, disease alerts such as late blight of tomato or insect alerts such as corn earworm populations. Cantaloupe and watermelon growers may be contacted when there is a large increase in **MELCAST** values. Since the alerts are relatively short, we may include links to additional information.

To sign up for the veggie text program, please contact us with -

- Your mobile phone number
- The name of your phone carrier. Common brand names of phone carriers include: AT&T; Verizon; T-Mobile, Sprint PCS; Virgin Mobile; US Cellular; Nextel; Boost; Alltel.

Alternatively, if you would rather receive the same information via email, just contact us with your email address and we will add you to the list. You can call or email Dan Egel at the number above or leave a message with Barbara Joyner at the same phone number with this information.

This program is new and experimental. There may be some technical issues to overcome. As the program progresses, if you have ideas for how to improve information or its delivery, please let us know.

In any case, we look forward to interacting with you in this new way.

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## Upcoming Events

(Wenjing Guan, [guan40@purdue.edu](mailto:guan40@purdue.edu), (812) 886-0198)

### Pickin' and Packin': 2016 Postharvest Produce Workshop

*Date:* July 6, 2016, 9:00 AM - 12:30 PM (EDT)

*Location:* Oaktown Produce Depot. 13990 N. Old Hwy 41, Oaktown, IN 47561

and

*Date:* July 12, 2016, 9:00 AM - 12:30 PM (EDT)

*Location:* Purdue University, Nelson Hall of Food Science, Rm 1195, 745 Agriculture Mall Dr. West Lafayette, IN 47906

Two workshops will be offered for updating produce growers on the Food Safety Modernization Act Produce Rule and other food safety issues. It will also provide practical advice for postharvest handling of produce. The workshop is free. Participants are asked to pre-register at <http://bit.ly/2016PostharvestWorkshop>. For more

information please contact Scott Monroe at (812) 886-0198 or [jmonroe@purdue.edu](mailto:jmonroe@purdue.edu).

### **Beginning Farmer Tours**

June 25, 2016: [Silverthorn Farm](#), Rossville. Organic fruits and vegetables, pastured pork and working with restaurants.

July 14, 2016: [Melon Acres](#), Oaktown. Community-supported agriculture and agritourism.

Sept. 29, 2016: [River Ridge Farm](#), Roann. Four-season vegetable farming, operating an on-farm store, and farm-to-school programs.

The tours are free, but registration is required. Registration at

[https://mdc.itap.purdue.edu/wk\\_group.asp?wk\\_group=BeginFarmer](https://mdc.itap.purdue.edu/wk_group.asp?wk_group=BeginFarmer)

For more information about the Beginning Farmer and Rancher program, or the farm tour schedule, contact Kevin Gibson at (765) 496-2161 or [kgibson@purdue.edu](mailto:kgibson@purdue.edu).

### **Illinois Pumpkin Field Day**

*Dates:* August 31, 2016

*Location:* Ewing Demonstration Center, 16132 N. Ewing Rd; Ewing, IL 62836

For more information, contact Nathan Johanning at (618) 687-1727 or [njohann@illinois.edu](mailto:njohann@illinois.edu)

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# Pickin' and Packin': 2016 Postharvest Produce Workshop

Following harvest, produce growers face many food safety challenges. Food safety regulations, product flow, washing processes, sanitizer selection, and other factors make postharvest food safety very challenging.

These workshops will update produce growers on the **Food Safety Modernization Act Produce Rule** and other food safety issues, as well as provide practical advice for postharvest handling of produce.

Workshops are offered at two locations:

July 6, 2016  
Oaktown Produce Depot  
13990 N. Old Hwy 41  
Oaktown, IN 47561  
9:00 am – 12:30 pm (EDT)

July 12, 2016  
Purdue University  
Nelson Hall of Food Science, Rm 1195  
745 Agriculture Mall Dr.  
West Lafayette, IN 47906  
9:00 am – 12:30 pm (EDT)

There is no cost to attend. Participants are asked to pre-register at:

<http://bit.ly/2016PostharvestWorkshop>

**\*\*\* No high heels. Closed-toe shoes and long pants required at all locations!!!**

If you need a reasonable accommodation to participate in this program, prior to the meeting, contact Scott Monroe at (812) 886-0198 or Amanda Deering at (765) 494-0512, or (888) EXT-INFO.

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