VEGETABLE CROPS HOTLINE

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

Issue: 627
May 11, 2017

In This Issue

Food Safety Considerations for Flooded Fields

(Scott Monroe, jsmonroe@purdue.edu, (812) 886-0198) & (Amanda J Deering, adeering@purdue.edu)

Recent heavy rains across much of the state have resulted in widespread ponding and flooding in fields. This creates multiple considerations for those growing produce for fresh consumption. Flooding and pooling create food safety challenges because of their potential to introduce contaminants (i.e. risk) into the production system. However, with proper management, many of these risks can be mitigated.

Figure 1. Flooding in a field. Flooding, defined as the "Flowing or overflowing of a field with water outside a grower's control" is illustrated in Figure 1. Note that the Wabash River is visible through the break in the trees.

Figure 2. Pooling of water. Pooling is the collection of water in a low area of the field as is shown in a low corner of this asparagus planting.

Following heavy rains, growers should first determine if water in their fields is the result of pooling or flooding. Pooling is more common than flooding. Pooled water generally accumulates in lower areas of the field or between rows, especially if raised beds are used. The **key distinction** between flood water and pooled water is that flood water originates from an uncontrollable source such as a river or creek. Standing water that originated from a river or creek would still be considered flood water. Pooled water can cause damage to crops, but is generally not considered to carry as much risk for microbial contamination as flood water. In the case of pooled water, growers should consider whether or not the water is contacting the edible portion of the crop, how long the water was pooled, previous soil amendments, and whether or not the pooled water has resulted in increased wildlife activity in or near the affected area.

Fields that have experienced flooding present growers with difficult management choices. Flooding is defined (per FDA) as the "Flowing or overflowing of a field with water outside a grower's control". Flooding is associated with streams, creeks, or ponds that overflow their banks and cannot be controlled. The FDA considers food contacted by flood water to be "adulterated" and not fit for human consumption. Due to microbial and other concerns, produce cannot be harvested and sold into the public food supply once it contacts flood water.

Fortunately, most crops are nowhere near harvest and many crops have yet to be planted. In those cases where flooding does occur in or near the crop but does not contact the edible portion of the crop, FDA guidance states that growers should, "Evaluate

on a case-by-case basis for the likelihood of contamination".

The following are considerations for managing flooded fields:

1. Document the extent of any flooding in fields with photos and flags or other markers. This will insure that the flooded area remains defined once flood waters have receded. In the case of planted fields, photos will help other involved parties (ex. Insurance adjusters, third-party auditors) to understand the extent of the issue.
2. Remember that flood water introduces more than microbial risks. Flood water may contain mycotoxins, PCB's, heavy metals, pesticides, or other contaminants. While growers can test for any of these contaminants, tests are not definitive and there is always the chance for a "false negative". Seek technical advice before investing in tests for non-microbial contaminants.
3. Growers should consider planting previously flooded fields to agronomic crops for this season. If this is not possible, another strategy would be to plant previously flooded fields to crops defined by FDA as "seldom consumed raw". These crops include pumpkins, winter squash, and sweet corn. These crops are generally cooked prior to consumption, which mitigates many microbial risks.
4. Once flood water has receded, leave the flooded area undisturbed for as long as possible. Research done at the Southwest Purdue Ag Center in 2015 indicated that the population of microbes introduced into a field through flooding decreased most quickly when the soil was left undisturbed. Allowing undisturbed soil to thoroughly dry on the surface and maximizing exposure to sunlight appears to encourage a decrease in microbes deposited by flood water near the soil surface. Tillage, cover crop establishment, or any other operation that disturbs the soil incorporates oxygen and drives flood-deposited microbes into the soil where they may exist for an extended period of time.
5. Check your well. Any wells affected by flooding that are used to supply agricultural or postharvest water should be tested for generic *E. coli* (CFU/100 ml water) prior to use.

If only part of a field is affected by flooding, growers should manage the flooded portion so that it does not affect the unflooded part. In addition to the above recommendations, growers should do the following to protect unflooded parts of a field:

1. Define a buffer zone beyond the flooded area where produce is not planted. It is recommended that the area be at least 30 ft. wide. This will help to reduce the risk of cross contamination of splashing from overhead irrigation or additional rainfall.
2. If at all possible, avoid traveling through the flooded areas to access the unflooded portion of the field. This helps to insure that microbes don't hitch a ride on boots, shoes, or tires.
3. Wear boots and gloves while working in flooded areas. Be sure to clean them thoroughly before entering the unaffected areas.
4. Any equipment that is used in flooded areas should be thoroughly cleaned prior to entering unaffected areas. Ideally, equipment should be used in unaffected areas first, and flooded areas last.

Remember that these are general recommendations. Growers who undergo third party audits for GAPs certification should consult their particular audit scheme for specific guidance and requirements.

References:

FDA 2011. Guidance for Industry: *Evaluating the Safety of Flood-affected Food Crops for Human Consumption*. http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/EmergencyResponse/ucm287808.htm [Accessed 05/03/17]

Maynard, E.T. 2010. Good Agricultural Practices for Food Safety: Water Quality. GAPs A-Z Curriculum Module.

Monroe, J.S., Deering, A.J., Heo, Y., Schmitz, H.F., and Clingerman, V.A. 2015. The effect of soil remediation treatments on microbial populations following an extreme flooding event. http://www.centerforproducesafety.org/amass/documents/researchproject/401/CPS%20Final%20Report%20RR_S.%20Monroe_Feb%202016.pdf [Accessed 05/03/17].

Effects of the Recent Rain and Cold Conditions on Vegetable Production

(Wenjing Guan, guan40@purdue.edu, (812) 886-0198)

Recent rain and cold conditions have brought detrimental effects to some of the early planted vegetables. In southwest Indiana, air temperatures have dropped into the 40s °F and soil temperatures have dropped into the 50s °F in early May. The low temperatures would have greatly inhibited absorption of water and mineral nutrients for many warm season vegetables. In one of our fields where watermelon and cantaloupe were transplanted on April 26, almost all the plants showed wilt symptoms on May 3. The wilt was caused by decreased water absorption from roots. The plants were dead due to the extended cold weather. Peppers and tomatoes that were planted about the same time maintained turgid and survived the cold period (Figure 1). But they showed symptoms similar to nutrient deficiency due to the reduced function of roots in the cold soil. The plants should start new growth when the temperature rises. Growers using low tunnels are more likely to see the benefits in a year like this.

Figure 1. A tomato plant showing nutrient deficiency symptoms.

What exacerbates the situation is the extended heavy rainfalls since the end of April. Some growers report the running water washed away some of the newly planted seedlings, and flooding occurred in some field. If the soil is flooded, oxygen in the soil would be depleted within 24 hours. Plants are injured in the water saturated soil. Symptoms usually include wilt; yellowing and drop of older leaves; epinastic curvature that is most commonly seen on tomatoes. If flooding lasts for more than 48 hours, there is little chance vegetable crops could recover. Re-planting would be the only option left. On the bright side, the majority of vegetable fields have not been planted although fertilizers were applied and plastic was laid in several fields in the Southwest Indiana. In this scenario, the heavy rainfall did not directly affect plants, but we should caution that they may leach already applied fertilizers that would affect crops in the middle or late of the season. If field were flooded or ponded with water, they may not be replanted right away even after water recedes because of food safety concerns.

Viruses on Greenhouse Tomatoes

(Dan Egel, egel@purdue.edu, (812) 886-0198)

While many virus diseases affect pepper and tomato plants, in the Midwest, the most common virus diseases of these two crops are tomato spotted wilt virus (TSWV) and Impatiens necrotic spot virus (INVV). These diseases are usually observed in greenhouse or high tunnel situations. The two viruses, TSWV and INSV are closely related. In fact, at one time, they were both considered TSWV. Therefore, the symptoms, biology and management of these two diseases are similar. This article discusses the symptoms, biology and management of these two diseases.

Both TSWV and INSV affect many hosts, including vegetables and flowering ornamentals. Symptoms vary according to host, stage of plant affected and environmental conditions. Both diseases can cause stunting, yellowing, necrotic rings, leaf mottle and more. Figure 1 shows a tomato leaf with necrotic rings caused by TSWV. Figure 2 shows a pepper transplant with ring spots caused by INSV. Additional symptoms may be viewed here. Since the symptoms of these two viruses are so varied, plants with suspicious symptoms should be submitted to the Purdue Plant and Pest Diagnostic Laboratory for confirmation of virus symptoms.

Figure 1: A tomato leaf with necrotic rings caused by tomato spotted wilt virus.

Figure 2: Ring spots caused by impatiens necrotic spot virus on pepper.

TSWV and INSV cannot spread without thrips. Thrips are small insects less than 1/20th of an inch long. To detect thrips, tap a flower over a white sheet of paper. Look for the small insects to move quickly around the sheet of paper. A 10X hand lens may help to detect thrips. Yellow or blue sticky cards placed at crop height will help to detect these small insects. Figure 3 shows at least two thrips on a cucumber flower plus damage on one of the petals due to thrips feeding. Thrips feed by scraping the leaf or flower petal surfaces with their mouthparts. Thrips may acquire and transmit either of these viruses by feeding.

Figure 3: At least two thrips (arrows) can be observed on this cucumber flower plus some thrips feeding damage on the lowest petal.Preventing TSWV is easier than halting the spread of this important disease. Avoid planting ornamentals and vegetables in the same greenhouse. TSWV may be introduced on ornamentals

that are propagated by cuttings. The disease can then spread to vegetables.

- Use transplants known to be free of both INSV, TSWV and thrips.
- Plant resistant varieties if possible. For example, there are a few tomato cultivars with resistance.
- Use yellow or blue sticky traps to monitor thrips populations or by direct observations of the flowers.
- Thrips should be managed with insecticides when populations reach an average of 5 thrips per flower. However, if plants show symptoms of INSV or TSWV and thrips are present, control measures should be implemented regardless of number of thrips per flower. Effective insecticides that can be used in the greenhouse include Entrust®. When using insecticides to control thrips, coverage is critical. Thrips are very small and often will hide in seams and crevices, so make sure you have sufficient water and pressure to get the insecticide where it is needed. If INSV or TSWV symptoms are suspected, send samples to the Purdue University Plant Pest and Diagnostic Laboratory.
- Remove symptomatic plants from a greenhouse with INSV or TSWV. Do not compost such plants; instead destroy them. Avoid crop debris in the greenhouse such as older leaves that have fallen or pruned leaves.
- Keep the area clear of weeds that may serve as hosts for INSV or TSWV.

Both INSV and TSWV can be difficult to manage once established in a greenhouse or high tunnel. Pay close attention to the prevention measures discussed above.

Seed and Root Maggots

(Rick Foster, fosterre@purdue.edu, (765) 494-9572)

I received my first report of seedcorn maggot damage on cantaloupes last week (Figure 1 and 2). A grower in northern Indiana reported losing 90-95% of his plants. Given the cool, wet growing conditions, it wouldn't be surprising to see more reports of this type for a number of crops, including melons, beans, corn, onions, and crucifers. Some of these crops have insecticide alternatives that can be used at planting but other, like melons, have no such option. The best approach for melon growers is to either wait for warmer weather or cover the young plants with row covers to physically exclude the flies from laying eggs. If you have had plants killed by maggots, wait at least 3 days before replanting in the same holes to give the maggots time to complete their development. See the article from Issue 625 (published on April 13, 2017) for more details.

Figure 1. Seedcorn maggot in a melon stem

Figure 2. Seedcorn maggot damage on melons.

Tips for Submitting Greenhouse Samples to the Purdue Plant and Pest Diagnostic Lab (PPDL)

(Gail E. Ruhl, ruhlg@purdue.edu, (765) 494-7071)

Samples in plug trays, as well as unrooted and rooted cuttings, and plants in pots require extra care when they are packaged for submittal to a diagnostic lab. Before you mail the next sample, please take a few minutes to review these suggestions for packaging and submitting samples. This will help preserve the integrity of the sample during shipment and increasing the likelihood of a more accurate diagnosis.

Plugs – keep them in the tray

If possible, do not remove the plugs from the plug tray. Submitting either an entire tray or cutting off a section of the tray helps keep the soil off the foliage where most symptoms are observed (Figure 1). Secondary decay often occurs when soil is allowed to come in contact with the foliage, interfering with accurate diagnosis. When possible, submit at least 5-10 cells with plugs. This provides the diagnostician with ample material for microscopic observation, culturing, and virus testing if necessary.

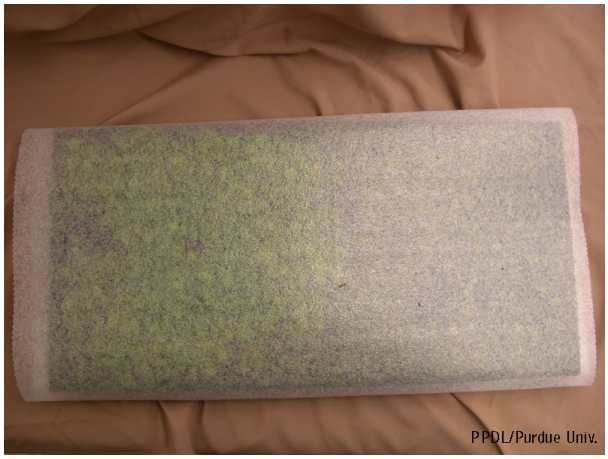

Figure 1. Plug flat wrapped and ready for shipment to the diagnostic lab.

Cuttings – separate foliage from media with a plastic bag

The primary concern is to keep the growing media separate from the foliage to prevent contamination and rotting. Put the cuttings into a plastic bag, and seal the bag with a twist tie (Figure 2) at the soil line. Do **not** seal the foliage in a plastic bag. Next, wrap the sample in newspaper to prevent additional drying out of foliage before it is received. Newspaper is one of the best packing materials for plant samples.


Figure 2. Media and roots properly secured for shipment

Potted Material – pack around the plant

Take into consideration that the mail carrier will not necessarily keep these packages right side up even when those directions are written on the outside of the box. Place plastic wrap, clear packing tape or paper (Figure 3) over the pot surface, or put the pot in a bag and seal it with a twist tie around the base of the plant. Fill any extra space in the shipping box with newspaper, styrofoam peanuts, or another space filling packing material (Figure 4) to prevent jostling of sample during shipment.

Figure 3. Tape keeps soil in the pot during shipment.

Figure 4. Use Styrofoam, packing peanuts, or crumpled newspaper inside a crush proof box to protect the sample during shipment.

If you are delivering the sample to our building…

We welcome delivery of samples in person! However, PLEASE CHECK OUR PPDL WEBSITE FOR UPDATES TO ROAD RESTRICTIONS ON THE PURDUE CAMPUS DUE TO CONSTRUCTION. There are two short-term parking spaces available when you come to drop off samples. They are located on Russell Street across from the west end of our LSPS building (Figure 5). State Street is closed but you may access Russell Street from Harrison Street to the south. The easiest point of entry to south campus for most people will be via Hwy 231 to Martin Jischke Drive then right on Harrison.


Figure 5. Short-term parking spaces located on Russell Street

across from the west end of our LSPS building.

Samples may be dropped off from 8am-5pm in room LSPS 116 in the two-story brick building (Life Sciences Plant and Soils) located in-between Lily Hall of Life Sciences and the Life Science Greenhouses. A completed submission form must accompany all samples. Sample submission forms can be downloaded from our website (**www.ppdl.purdue.edu**) and filled out ahead of time or are available at the drop off point. Information on digital image submissions is also available on our WEBSITE.

Shipping – watch the weekend

Do not mail or ship samples on Friday, as we are not here to receive them over the weekend. Samples can be sent via US mail, UPS, FedEx, etc. We encourage you to send samples with priority or express delivery so we receive them in the best condition possible to provide you with the most accurate diagnosis.

Taking Care of Plant Nutrition in Your High Tunnel – Water Alkalinity

(Petrus Langenhoven, plangenh@purdue.edu, (765) 496-7955)

In the past I have had many conversations with growers about plant nutrition in their high tunnels. A good plant nutrient management plan is an integral part of making a success of the crop you are growing. Plant nutrition is important to grow a strong and healthy seedling, the first step of a successful crop. Fertility management of especially vining crops (e.g. tomato, cucumber, peppers) are critical to achieving a good yield. It does not matter if you grow your crop in soil or in a soilless production system. Steering your crop to have the optimum balance between vegetative and reproductive growth will result in good yields over a longer period.

It is important for growers to know what is in their water and soil. Therefore, soil analysis of a representative sample of the area that will be planted, and water analysis of a water sample from the source that will be used is important. The water quality of water sources such as ponds and wells can change throughout the season. The grower might consider sampling two to three times during the growing season. This will help to manage your plant nutrient program better.

One of the big issues with well water in Indiana is that in some instances it is very alkaline. Alkalinity (as $CaCO_3$) measures the combined amount of carbonate, bicarbonate and hydroxide ions in the water, and it describes the ability of water to neutralize acids. In other words, it buffers water against pH changes. A water that helps to buffer against pH changes is great, but a too high alkalinity will lead to an increased incidence of dripper clogging. The pH of container-grown plants tend to increase over time. Usually the optimum alkalinity range for plants is between 30 to 60 ppm ($mg \cdot L^{-1}$). Some laboratories report alkalinity in milli-equivalents ($meq \cdot L^{-1}$). Alkalinity of 50 ppm $CaCO_3$ is equal to 1 $meq \cdot L^{-1}$. Most growers aim to have a water alkalinity of between 1.5 and 2 $meq \cdot L^{-1}$. Alkalinity can be adjusted with acid. Acid injection or the use of an acidic fertilizer can help to remedy the situation. Although, usually fertilizers with a high potential acidity do contain a high percentage of ammonical nitrogen and urea. This approach works well for container-grown plants, but be aware of ammonium toxicity under cool conditions (below 60°F). There are a few sources of acid available on the market of which sulfuric acid is very affordable and nitric acid is very caustic and has harmful fumes. Always exercise caution when working with acids, and remember **always add acid to water** and never water to acid. Also, take into account that the source of acid used can provide specific nutrients. Citric acid is the only source that does not supply any additional nutrients. A very useful tool to calculate how much acid is needed can be found at https://extension.unh.edu/Agric/AGGHFL/alk_calc.cfm. All you need to complete the form is the pH and alkalinity content of the water and what is your target alkalinity level.

This is the first article in a 7 part series that will look at soil fertility and nutrient solution management for high tunnels. The series will address (1) Alkalinity, (2) Water Hardness and the Removal of Unwanted Ions, (3) Water Soluble Fertilizer Calculations, (4) Fertilizer and Nutrient Solution Mixing Tips, (5) Fertilizer Injection, (6) Soil fertility, and (7) Monitoring and Diagnostic Tools.

Upcoming Events

(Wenjing Guan, guan40@purdue.edu, (812) 886-0198)

Southwest Purdue Ag Center Field Day

Southwest Purdue Ag Center Field Day will be held on June 29, 2017 at Southwest Purdue Agricultural Center, Vincennes, IN.

The field day provides two choices of tours: Horticultural Crop Production and Agronomic Crop Production. The Horticultural Crop Production tour will feature Organic Tomato Production, High Tunnel Vegetable Production, Grape Research, Protecting Pollinators while Managing Insect Pests in Watermelon Production, and Produce Food Safety. A meal will accompany the tour with PARP classes available after lunch. Please contact Barb Joyner (joynerb@purdue.edu, 812-886-0198) for registration, or register online at https://purdue.qualtrics.com/jfe/form/SV_0rICQrMVJmiMnqZ. More information about the tour can be found here.

Beginning Farmer Tours and Workshops

Join Purdue's beginning farmer team for farm tours in 2017.

June 15. Clay Bottom Farm near Goshen, IN uses intensive growing methods to support a CSA program on less than an acre of land. Learn about their 'lean farm" approach to support a CSA, supply restaurants, and sell at farmers' markets.

June 24. Silverthorn Farm near Rossville, IN uses organic practices to produce a wide variety of fruits and vegetables. The tour will include a session on working with restaurants.

September 11. Two tours for the price of one! Tour Little Prairie Farms, a small acreage vegetable farm near Brookston, IN, and the Purdue Student Farm near West Lafayette to learn about farming practices and tools for small acreage farms.

September 27. Full Hand Farm is a diverse vegetable farm located near Noblesville, IN. The tour will include information on the use of high tunnels in vegetable production.

October 2. Aficionado Farms produces organically grown produce, herbs, and flowers near Elberfeld, IN. Learn about their farm and Farm to School programs.

More information about these tours are available at http://www.cvent.com/events/beginning-farmer-tours-and-workshops/event-summary-0f7526f0380a432788708b2f2edcf1e7.aspx

Vegetable Crops Hotline © Purdue University - vegcropshotline.org
Editor: Wenjing Guan | Department of Horticulture and Landscape Architecture, 625 Agriculture Mall Dr., West Lafayette, IN 47907 | (812) 886-0198