# VEGETABLE CROPS HOTLINE

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



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In This Issue

- Root-knot Nematode may be a Hidden Problem in High Tunnels
- Black rot of Brassica Crops
- Tips for Harvest and Postharvest of Pumpkin and Winter Squash
- What Happened to the Winter Squash?
- The Final Fungicide Application
- Water Affects Efficacy of Soil-Incorporated Fertilizers and Amendments
- Protect Your Livelihood with Crop Insurance
- Warm, Dry Conditions Ahead
- Webinar from Midwest Climate Hub About Fall Freeze
- Strawberry Chat Update
- 2023 Indiana Horticulture Conference Save the Date
- New Questionnaire to Identify Grower Interest in Novel Weed Management Technology

# Root-knot Nematode may be a Hidden Problem in High Tunnels

(Wenjing Guan, guan40@purdue.edu, (812) 886-0198) & (Dan Egel, egel@purdue.edu, (812) 886-0198)

We announced in a previous newsletter article that we are doing a survey to understand the extent of root-knot nematode (RKN) damage on vegetable crops in Indiana. Among the 18 soil samples from high tunnels of 14 farms, RKNs (juvenile or adult) were found in 13 samples at 9 farms. Only 3 farmers knew RKN was an existing problem at their farms before our survey.

This lack of awareness is not surprising because above-ground symptoms caused by RKN are similar to plant nutrient deficiency. One needs to carefully scout roots for galling to identify RKN problems. The observation of galling also depends on how many roots were recovered from the soil, and the health level of the plants. If the roots have started to decay, one may not notice the galling and can easily overlook the problem. Farmers who grow root vegetables such as carrots may be more likely to notice the problem because roots are the harvested portion (Figure 1).



Figure 1. Root-know nematode damage on a carrot.

Why might root-knot nematodes be a hidden problem in high tunnels? This is because high tunnels used for year-round crop production largely increase soil temperatures inside of the structure throughout the year. Increased temperatures, constant soil moisture, and the fact that excellent RKN hosts are growing year-round make high tunnels an ideal environment for RKN population buildup.

Why is it important to be aware of the potential RKN problem? Compared with other disease or insect problems spread of RKN is limited except for spread by human activities. We will have other articles to discuss how RKN may spread to high tunnels, but being aware of the pathogen is the first step to tackling the problem.

We are continually doing this field survey. If you want to find out if root-knot nematode is a problem at your high tunnel, please contact Wenjing Guan (guan40@purdue.edu) or Dan Egel (egel@purdue.edu). We will arrange a soil nematode test for you.

The project is funded by United States Department of Agriculture National Institute of Food and Agriculture grant no. 2021-51181-35904.

## Black rot of Brassica Crops

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

I have observed the disease black rot of cabbage and broccoli this year. I have discussed the basics of this disease in April (Issue

701). Here, I would like to share some photos and observations. For a brief background, black rot is a bacterial disease that becomes systemic-that is, moves within the plant. The disease may overwinter in crop residue or may be brought in on seed/transplants.

The first set of photos is of an outbreak that occurred on first crop cabbage in early July. Figure 1 shows typical early symptoms on cabbage. If such symptoms occur when the heads are well formed, it is unlikely that any yield loss will result. Figure 2, on the other hand, shows severe symptoms on a plant that may render the head unmarketable.



Figure 1. Initial symptoms of black rot on cabbage often include V-shaped necrotic and chlorotic lesions on the leaf margin. Such lesions will probably not be important to marketability if the heads are close to maturity.



Figure 2. Severe symptoms of black rot on cabbage threaten to affect maturity and marketability of cabbage.

The next set of photos show symptoms of black rot on broccoli on a second crop of broccoli in September. The symptoms range from minor to severe. While I have not observed black rot to affect the heads of broccoli directly, it is possible for severe symptoms to affect yield and marketability of broccoli. Initial symptoms are similar to those on cabbage-lesions including necrotic and chlorotic V-shaped lesions (Figure 3). More severe lesions may include the entire leaf (Figure 4). Affected lower leaves such as in Figure 4 may not be important, however the bacterium is systemic and may move to other parts of the plant.



Figure 3. Initial symptoms of black rot of broccoli are similar to those of cabbage and include marginal V-shaped lesions.



Figure 4. The older broccoli leaf in the photo has severe symptoms of black rot.

# Tips for Harvest and Postharvest of Pumpkin and Winter Squash

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Pumpkin and winter squash should be harvested fully mature to reach their optimal quality and fulfill their potential shelf live. Characters indicating fruit maturity include loss of rind surface gloss, ground spot yellowing, and hardening of the skin to the level that it is resistant to puncture with a thumbnail. Except for some striped varieties, mature fruit should have solid external color. If mature fruit are left attached to the vines, it increases the chance of disease infection and insect damage on stems and fruit. For example, Plectosporium blight causes cosmetic damage on handles, and bacterial spot reduces quality and longevity of fruit. In addition, if diseases such as powdery mildew and downy mildew cause significant loss of foliage, fruit left in the fields are likely to suffer sunscald (Figure 1) and low-quality handles as explained in this article

https://vegcropshotline.org/article/powdery-mildew-of-cucurbits/.



Figure 1. A pumpkin fruit with sunscald due to lack of vine canopy (photo: Dan Egel)

In some situations like pick-your-own where mature fruit have to be held in the field, scout carefully to manage diseases and insects to maintain healthy vines and protect fruit. Recommended fungicides and insecticides can be found at the *Midwest Vegetable Production Guide for Commercial Growers*. If fruit has to be harvested pre-mature because of plant decline, these fruits won't store as well as mature fruit. The best practice is to harvest the fruit as soon as they are fully mature and then store under proper conditions.

After harvest, pumpkins may benefit from curing, especially when fruit show non-hardened skin and surface damage. Curing is conducted under temperatures between 80 to 85°F in a shaded area for about 10 days. Studies have shown that curing heals wounds, hardens the rind, enhances fruit color and increases sugar content. It should be noted that curing is detrimental to acorn squash; it accelerates skin color change, deteriorates fruit texture and taste, and stimulates fruit decay.

Pumpkins and winter squash are best stored at temperatures between 50 to 55°F and relative humidity between 50 to 75%. With higher storage temperatures, excessive loss of weight, color and eating qualities might be experienced. When temperatures are above 55°F, the surface of acorn squash becomes yellow and flesh becomes stringy. Under the optimal storage conditions, acorn squash can be stored for 5 to 8 weeks, pumpkins and butternut squash for 2 to 3 months, and hubbard squash for 5 to 6 months. Both pumpkins and winter squash are sensitive to ethylene. They should not be stored near apples, ripening tomatoes or cantaloupes. When temperature is below 50°F, fruit might develop chilling injury (Figure 2). Pumpkins, butternut and acorn squash may survive one or two cold nights in the field, however, a frost might lead to fruit rot. If fruit is displayed in the field or a farm stand, they should be protected if frost is anticipated.



Figure 2. Chilling injury on butternut squash.

#### What Happened to the Winter Squash?

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

For a few years, I participated in the Squash Hunger Trial led by Dr. Annette Wszelaki, where we grew a wide range of winter squashes at multiple states. One year, I failed to manage insects, leading to a squash bug and cucumber beetle outbreak. The insects defoliated leaves (Figure 1) and caused cosmetic damage to the fruit. We managed to harvest some good-looking fruit and hoped to store them for up to 6 months as indicated on the seed package. Surprisingly, we started to see oozing from several of these fruits in a few weeks (Figure 2). I could not figure it out until I saw a related discussion among several vegetable specialists at the Great Lakes Vegetable Working Group.



Figure 1. Squash bug damage on winter squash leaves.



Figure 2. Oozing on a winter squash fruit at storage.

This phenomenon is not unique to one region. According to Ben Phillips, the vegetable crops educator at Michigan State University, the correlation between squash bugs and the postharvest froth appears strong. Ben explained that the foam indicates pathogenic respiration taking advantage of the pin-prick wound caused by insects. Poor storage conditions, such as a facility without good air exchange, bins filled too deeply, or high humidity may support the proliferation of the pathogen. Brian Hudelson, plant disease diagnostician from the University of Wisconsin-Madison, further explained that an opportunistic yeast Getotrichum might be associated with the symptoms. It is possible the yeast gains entry into the fruit through insect wounding. While it digests tissues, it produces a fair amount of carbon dioxide, creating symptoms like oozing from the fruit. I learned from other specialists the symptoms are commonly observed on acorn squash, spaghetti squash, even summer squash, and it could happen in the field or in storage.

To help the problem, Ben suggested to reduce squash bug population (I assume other insect causing similar damage as well); keep vines healthy to make squash bugs interested in more things than just the fruit; pick without delay to limit squash bug feeding; and sell immediately to limit the effects of poor storage conditions.

# The Final Fungicide Application

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

Vegetable growers may be wondering when to apply the final fungicide application. It is important to leave the crop protected until the last harvest. Yet, it is important not to waste fungicides.

In most cases, the last fungicide application should occur 10 to 14 days from the final harvest. Most fungicides that are designed to protect the foliage will last on or in the plant for 10 to 14 days. In addition, foliar diseases that affect primarily leaves and stems such as downy mildew, early blight, gummy stem blight/black rot, powdery mildew, and Septoria leaf spot that do not affect fruit directly are not necessary a few days from harvest. A fungicide application a few days before harvest is expensive and ineffective. Plus, it is necessary to keep in mind the Pre-Harvest Interval (PHI). Note—downy mildew has not been reported in

Indiana in 2022.

Some diseases affect the fruit directly. However, even for these diseases, most final fungicide applications should occur no sooner than 7 days before harvest. Lesions of diseases that occur directly on the fruit usually result from splash from the foliage. Therefore, season-long protection of the foliage is important for protecting the fruit.

Diseases that may affect fruit directly include:

Cucurbits-anthracnose (cantaloupe/watermelon), bacterial spot (pumpkin) Plectosporium blight (pumpkins), Phytophthora blight. Both anthracnose and Phytophthora blight usually cause lesions on the bottom of the fruit. Such lesions result from spores that splash from leaves. It is difficult if not impossible to coat the bottom of the fruit with fungicide. Instead, the idea is to protect the foliage so fewer spores splash from foliage to fruit. Plectosporium blight and bacterial spot are unlikely to develop on fruit in the last few weeks before harvest.

Tomato/pepper-bacterial spot, bacterial speck and bacterial canker are the diseases most likely to affect the fruit (bacterial speck and canker are mostly tomato diseases). Bacterial canker is a systemic disease—the bacteria moves within the plant—thus, it is unlikely that an application of a bactericide within days of harvest will make any difference in control. Bacterial speck is mainly an early season disease and is not as common as bacterial spot. Applications to control bacterial spot will probably not be effective within 7-10 days of the final harvest. Remember, that bacterial spot and speck are very unlikely to occur in a greenhouse situation.

Broccoli/cabbage-Alternaria leaf spot may directly affect broccoli heads. Therefore, applications within 7-10 days of the final harvest are probably warranted if the disease has been observed. Alternaria leaf spot and black rot may affect cabbage heads directly. However, late season black rot or Alternaria leaf spot on outer cabbage leaves will probably not affect marketability.

#### Water Affects Efficacy of Soil-Incorporated Fertilizers and Amendments

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We discussed wetting patterns in drip irrigation in a previous article. The take home message is drip irrigation applies water to only a portion of the soil. Uneven water distribution in the soil profile is not a problem as long as enough water is applied to the crop. However, the water wetting pattern might influence the effectiveness of soil-incorporated amendments and drip-applied pesticides. In this article, we will expand on the first aspect, and discuss how water affects the efficacy of soil-incorporated fertilizers and other soil amendments in vegetable production in two production systems, i.e. high tunnel and open-field.

Drip irrigation is the primary irrigation method for growing

tomatoes, cucumbers, and peppers in high tunnels. Since high tunnels block natural precipitation, irrigation is often the only water source in the high tunnel. Many high tunnel growers use compost or other amendments incorporated into the soil to maintain soil fertility or adjust soil pH. Organic matter decomposition and sulfur-facilitated soil acidification are microbial activities that require constant soil moisture. If only a portion of the soil is maintained moist, it is likely only soil amendments placed where the soils are moist contribute to crop production. Because wetting the entire area is critical in ensuring soil amendment efficacy, farmers should consider overhead irrigation after applying the soil amendments inside high tunnels. In addition, high tunnel growers should consider using drip tapes with closer emitter spacing and/or multiple drip tapes on each bed during the production season. Figure 1 shows how different drip irrigation setups affect wetting patterns on the beds.



Figure 1. Irrigation dye demonstration to compare wetting pattern of one single drip tape vs. two drip tapes on a bed at Pinney Purdue Vegetable Field Day (Credit: Irrigation educator Lyndon Kelley). The drip tape in the demonstration was 12" emitter spacing and 0.4 gpm/100 ft flow rate at 8 PSI and ran for an hour at 10 PSI.

Farmers will likely use synthetic fertilizers, such as urea, in openfield vegetable production. Similar to organic amendments, synthetic fertilizers require water to fulfill their function. Urea turns to ammonium after being in contact with water through a chemical process (urea hydrolysis); it then turns to nitrate through a biological process (nitrification) which requires moisture, oxygen, and suitable temperature. Unlike high tunnel production, crops receive natural rainfall in the open field. Depending on the timing and amount of the rain, it could significantly impact the nutrient availability of preplant-applied fertilizers. Figure 2 shows a case study (conducted in the 2021 watermelon season) of how soil inorganic nitrogen content in the plastic mulch-covered beds changed throughout the season. We found the nitrogen content was at the highest level in week 6 after transplanting, which corresponded to a few rainfalls that happened around middle June in 2021 after an extended dry period. The rains wetted the beds and made most nutrients available for the crops.



Figure 2. Soil inorganic nitrogen content in the plastic mulch-covered beds during the 2021 watermelon season. 150 lb N/acre as urea was broadcast before building the beds and laying plastic mulch.

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## Protect Your Livelihood with Crop Insurance

(Dakota Moore, dakota@kyhortcouncil.org)

This article was originally published in the August 2022 Center for Crop Diversification Newsletter. Dakota Moore is the Grower Outreach Coordinator of Kentucky Horticulture Council. You can reach Dakota at dakota@kyhortcouncil.org

"That'll never happen to us." "It's always been this hot and dry." "This storm won't be that bad." If the last year has taught Kentuckians anything, it's that statements like these can easily be proven false.

To make an assumption when it comes to safety, health, and livelihood is to make a mistake. So, we build storm shelters. We use medicine and diet to keep us healthy. We even take out insurance policies on our homes and businesses. Yet very few Kentuckian specialty crop producers take the necessary steps to insure their crops, their livelihoods. The December 2021 tornado outbreak hurt some specialty crop operations, but not in the middle of production or harvest. However, the recent flooding in Eastern Kentucky has put a spotlight on just how devastating a midseason disaster can be. If your farm is your sole source of income, it needs to be protected.

Crop insurance is the best way to prevent a loss in revenue due to natural disasters like tornados, floods, and droughts. The crop insurance process can be tedious, and it's not as easy for specialty crops as it is for row crops, but there are several options for vegetable growers, and this year things got a little easier for some.

Whole Farm Revenue Protection combines all farming operations under one policy. That means it combines vegetables, fruit, and livestock under one policy. This also includes value-added products and some post-production activities like washing and packaging. With WFRP you are insuring the revenue, not yield. If revenue dropped below the insured point, you could receive an indemnity, or payment. WFRP pulls the insured revenue from your Schedule F tax documents and requires a separate revenue for each commodity and overall expenses. That can be frustrating for larger growers. But this year, the USDA Risk Management Agency, the organization that creates crop insurance policies, launched a new Micro Farm Policy to help cut down on the amount of records required.

The new Micro Farm Policy is a type of Whole Farm Revenue Protection made specifically for direct marketing farms with revenue under \$350,000 starting in 2023 season. The maximum revenue was \$100,000 for the 2022 growing season. This policy combines all commodities into a single commodity code and removes the need for individual crop records and expense records. Micro Farm is meant to serve as a steppingstone for growers into the world of crop insurance.

For those wishing to insure one commodity or just insure a few of their crops, the Noninsured Crop Disaster Assistance Program, or NAP, may work better. NAP is a Farm Service Agency program covering a single commodity that can help protect against financial loss from disaster and return between 27.5% and 65% of your crop value to you. NAP also lets you use organic or direct market prices. NAP, like WFRP and Micro Farm, has some benefits for beginning, limited resource, socially disadvantaged, and veteran farmers. NAP offers a waiver of the service fee and a 50% premium reduction. WFRP and Micro Farm may have administration fees waived and some may even see premium reductions in some cases.

If you want to learn more about your crop insurance options and the next steps, check out our webpage containing videos and resources or contact dakota@kyhortcouncil.org.

# Warm, Dry Conditions Ahead

(Beth Hall, hall556@purdue.edu)

After another wet weekend and cooler temperatures to start this week, it may be surprising to hear that conditions will be changing back to warm and dry for the next several weeks. Climate models are strongly favoring above-normal temperature throughout the rest of September with a slight favoring of belownormal precipitation. Abnormally dry conditions continue to persist in counties across northern Indiana, but the spatial extent is gradually shrinking (Figure 1). It is too soon to tell if the upcoming warm and dry outlooks will be strong enough to expand and intensify those drier areas or if a few periodic rain events will be enough to keep conditions relatively stable. Monthly (October) and seasonal (September-October-November) outlooks were released on 15 September 2022. For both of these time frames, the outlooks are favoring above-normal temperatures to continue with below-normal precipitation across Indiana (Figure 2).



Figure 1. U.S. Drought Monitor for data through August 30, 2022.



Figure 2. Climate outlook for the 3-month period of September-October-November from the national Climate Prediction Center. Levels of shading indicate levels of confidence for above- or below-normal conditions to occur. Temperature outlook is on the left; Precipitation outlook is on the right.

With each day that passes, we get closer to the first fall freeze event - whether that is defined at 32°F, 28°F, or some other temperature threshold. Over the past several decades, with increasing temperatures, the story has been an expanding growing season defined as the consecutive number of days between the last spring freeze and first fall freeze. Is this expanded season highly variable from year to year or relatively stable? If the growing season, on average, is expanding, is it due more to earlier last spring freeze dates or later first fall freeze dates? The Midwestern Regional Climate Center (mrcc.purdue.edu) has developed a new tool that allows users to peruse the historical data and find answers to these questions and more. This tool will be formally launched later this fall, but a webinar is being offered this next Wednesday, September 21, 2022 at 11am EDT (https://www.zoomgov.com/j/1605071265) for anyone wanting sneak peek and learn more about what the findings say. This is a project that was supported by the USDA Midwest Climate Hub with a focus on agricultural impacts and awareness regarding climate trends and extremes.

Finally, as temperatures gradually cool, the accumulation rate of modified growing degree days (MGDD) slows down. Figures 3 and 4 show the latest accumulation totals and departure from climatological average, respectively. MGDDs now range from slightly over 3400 units in southern Indiana to around 2000 units in the northern counties. These accumulations are around 150-200 units above normal across central and southern parts of the state and near normal in the northern third counties.



Figure 3. Modified growing degree day (50°F / 86°F) accumulation from April 15-September 13, 2022.





# Webinar from Midwest Climate Hub About Fall Freeze

Webinar from Midwestern Regional Climate Center on Sept. 21, 11 am EDT. Registration is not needed. Participating zoom link https://www.zoomgov.com/j/1605071265



# Strawberry Chat Update

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

Strawberry Chat in Sept. is about substrate production. You will learn the basics of substrate production and hear about two substrate strawberry production systems. Dr. Chieri Kubota and Mark Kroggel from The Ohio State University talk about root zone management in substrate production and introduce the greenhouse system. Richard Barnes is the owner of Tanglewood Berry Farm in Fort Wayne, IN. Richard discusses how Tanglewood Berry Farm grows strawberries in an elevated system with a lower level of environmental controls.

Strawberry Chat in Aug. is about plasticulture production. We discussed many topics in plasticulture strawberry production, including site selection, beds, plastic mulch, fertility management, crop rotation, winter protection, cultivar selection, and more. If you grow vegetables on plastics and are interested in learning more about plasticulture strawberry production, you may find this episode helpful.

You can hear all the episodes of Strawberry Chat on this site https://anchor.fm/strawberrychat



# 2023 Indiana Horticulture Conference Save the Date

(Stephen Meyers, slmeyers@purdue.edu, (765) 496-6540)

Purdue University will host the 2023 Indiana Horticulture Conference at the Beck Agricultural Center, West Lafayette, IN on Jan.23 and 24. This two-day conference will feature educational sessions for commercial fruit and vegetable producers. CCA credits will be available. We look forward to seeing you there. More information will be available soon.

If you have questions about this conference, please contact Stephen Meyers (slmeyers@purdue.edu) or Lori Jolly-Brown (ljollybr@purdue.edu).

# New Questionnaire to Identify Grower Interest in Novel Weed Management Technology

This questionnaire is part of a USDA Specialty Crop Research Initiative (SCRI)-funded proposal (DEVELOPING A NATIONAL TEAM TO OPTIMIZE NON-HERBICIDE WEED MANAGEMENT TECHNIOUES IN COLE AND LEAFY GREEN CROPS) to identify grower interest in novel technology for weed management. Novel technology includes vision-guided sprayers/thinners, steam weeding, and precision mechanical, laser, and electric weeders. It may also include drone-based activities such as imaging, mapping, and pesticide application. Specifically, our team would like to know what tools and services are/would be valuable to you and what barriers are in place that would prevent you from adopting specific technologies. The questionnaire is available at https://clemson.ca1.qualtrics.com/jfe/form/SV 1lfwcgkAXC9i6h0. More information about the project can be found at https://cris.nifa.usda.gov/cgi-bin/starfinder/0?path=fastlink1.txt&i d=anon&pass=&search=R=94323&format=WEBLINK.



Figure 1. A Carbon Robotics weeder demonstration at a field day in Salinas, CA. Photo by Matthew Cutulle



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