VEGETABLE CROPS HOTLINE

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

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In This Issue

Control Root-knot Nematode in High Tunnels

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

In a recent grower visit in southwest Indiana, we saw a severe root-knot nematode infestation on high tunnel tomatoes. Soil fumigation is by far the most effective approach to control nematodes, but many soil fumigants are not labeled for greenhouse (high tunnel) use. In addition, the types of equipment that used for soil fumigation are often hard to fit into high tunnels. Considering the constraints, this article focuses on cultural practices to control root-knot nematodes that can be easily adopted by small-scale, high tunnel growers.

Root-knot nematodes are small, colorless roundworms that dwell in the soil. They penetrate into plant root in the juvenile stage. Once they find a favorable location in plant tissues, they stop moving. Infested root cells start swelling and form galls that are the characteristic symptom of root-knot nematode infestation (Figure 1.). Infested roots fail to absorb water and nutrient resulting in stunted growth, yellowing and wilt of above ground plants. Going through their life cycles, mature females lay eggs on root surfaces.

Figure 1. Galling of tomato roots infested by root-knot nematode.

Root-knot nematode thrives best in well aerated, moderately dry soils; it is a problem in regions where winter is not harsh enough to kill root-knot nematode eggs. It causes damage on melons in southern Indiana but generally is not a major pest for vegetable production in other parts of the state. High tunnels can extend the crop production season. However, high tunnels also creates a more favorable environmental condition for pests like root-knot nematode. As a result, root-knot nematode can potentially cause damage to high tunnel grown vegetables everywhere in Indiana. Movement of root-knot nematode in soils is extremely slow, it is unlikely that root-knot nematodes move into the high tunnels by themselves. But contaminated tools and plant materials, feet of human and other animals are more likely to bring root-knot nematode into high tunnels. Once soils are contaminated, root-knot nematode populations increase quickly with the presence of host plants, and favorable soil conditions, i.e. warmth, moisture, and oxygen.

Good cultural practices can effectively prevent or reduce damage caused by root-knot nematode. The first step is to prevent soil contamination. Carefully clean and sanitize any tools used in high tunnels after being used in the open-field, including trackers, shovels etc. Use ground covers to cover exposed soils in high tunnels. Do not allow plants to stand in the high tunnel for a long period after the final harvest; destroy plants immediately. The preferred approach is to remove plants completely and expose the roots to the drying action of wind and sun. Keep high tunnels free of weeds as many species are also hosts of root-knot nematode.

Soil solarization can help clean the soil. It should be routinely practiced in the summer when it is possible. In vivo studies found

root-knot nematode eggs and juvenile can be killed in 14 hours at temperatures of 108 ºF and above. This exposure time can generally be obtained within a six-week period of solarization during summer in a high tunnel. However, soil solarization is less likely to completely eliminate root-knot nematode population in the soil. Root-knot nematode may be recovered at the end of the following cropping season if susceptible crops are planted. This is because roots of the host plant attract nematode that survive in the lower soil profile at where temperatures during soil solarization did not reach the lethal level. However, crop damage normally is much lower in soils with low nematode population than that of high population.

Dry fallowing and cultivation to bring as much soil as possible to the surface are effective in killing root-knot nematode through starvation and desiccation. It is very important to keep the field or high tunnel weed-free during fallowing. Dry fallowing and tillage, however, are destructive to soil fertility. Composts and other organic materials should be added to the soil following fallowing to restore soil fertility.

Using crop rotation to control root-knot nematode is difficult in high tunnels because of the limited and valuable spacing. Vegetables commonly grown in high tunnels (tomato, cucumber, pepper, lettuce, spinach, carrot etc.) are hosts of root-knot nematode. It might be possible to plant a non-host winter cover crop to help managing root-knot nematodes, examples include rye and wheat. Be cautious that some of the cool season legume cover crops such as hairy vetch and crimson clover are also hosts of root-knot nematode; they may encourage populations of root-knot nematode under high soil temperatures. Various *Brassica* species that can release toxic compounds after breakdown have nematicidal effects. However, results of growing cover crops as biofumigant to control root-knot nematode is mixed because these crops may be hosts of root-knot nematode, resulting in a population increase during cover crop cultivation when conditions are favorable.

Tomato varieties with resistance to root-knot nematode are available. The resistant tomato varieties contain a single dominant resistant gene. Nematode fails to develop and reproduce normally within root tissues of a resistant variety. However, under high root-knot nematode populations, crop yield loss may still occur even though resistant plants develop less galling. Studies conducted in Florida indicated that the resistant gene is sensitive to high temperatures, it may lose resistance when temperatures are above 78 °F. Another concern of using resistant variety is that they may not have required market characteristics such as flavor, yield, fruit type etc. In this scenario, grafting market-acceptable but nematode susceptible varieties onto nematode-resistant rootstocks has shown great promising in controlling root-knot nematode on tomatoes. Moreover, most commercial tomato rootstocks have vigorous root systems that may improve crop yield even without the presence of root-knot nematode pressure.

A new nonfumigant nematicide Nimitz® (active ingredient Fluensulfone) has shown promise in controlling root-knot nematode. The product has a unique but unknown mode of action. It is a soluble compound and moves through the soil water. Studies have shown that drip application of Fluensulfone reduced the number of root-knot nematodes and galls on tomatoes. However, this product has limited residue activity, only works when nematodes are active. Its label is silent on greenhouse use.

It is not likely that any of the approaches can completely eliminate root-knot nematode population in the soil. Whenever it is possible, using a combination of the practices to reduce root-knot nematode population in the soil, and reduce crop damage to the greatest extent.

Powdery Mildew of Cucurbits

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

Powdery mildew is a common disease of cantaloupe and pumpkin in Indiana. Occasionally, I observe this disease on watermelon as well. Recently, I have noticed more powdery mildew than usual on watermelon. If left uncontrolled, this disease can cause loss of foliage, loss of yield and lower quality fruit. This article will discuss the biology and management of powdery mildew of cucurbits with an emphasis on watermelon.

Powdery mildew is relatively easy to recognize; talc-like lesions occur on both sides of the leaf (Figure 1). (This article https://vegcropshotline.org/powdery-mildew-symptoms-vs-variegated-leaves/ has additional information about powdery mildew symptoms.) The fungus that causes powdery mildew, *Podosphaera xanthii*, does not require leaf wetness for infection of leaves, only high humidity. The optimum temperature for disease development is 68 to 81°F. *P. xanthii* may survive for a period in crop residue as a resilient fungal structure, but the disease is so easily windborne, that crop rotation is not always a practical control measure. The powdery mildew fungus does not require leaf wetness to cause infection-only high humidity.

Figure 1. Powdery mildew causes talc-like lesions on pumpkin leaves.

The fungus that causes powdery mildew of cucurbits does not cause powdery mildew on other plant families. In the same way, powdery mildew of other plant families does not affect cucurbits.

Fortunately, commercial varieties of pumpkin and cantaloupe exist with partial resistance to powdery mildew. Most growers,

however, find it necessary to apply systemic fungicides to manage powdery mildew, even when using partially resistant varieties. As far as I know, there are no differences in the susceptibilities of watermelon varieties to powdery mildew.

Traditionally, powdery mildew symptoms have not been common on watermelon in the Midwest. When I have occasionally observed symptoms of powdery mildew on watermelon, the symptoms have been relatively unimportant (Figure 2). Recently, however, I have observed more powdery mildew symptoms than usual on watermelon in southwestern Indiana (Figure 3, 4). I am not certain that the severity of the powdery mildew symptoms on watermelon I have observed recently will cause a yield or fruit quality loss, but growers should be aware of management options.

Figure 2. Powdery mildew has caused round chlorotic lesions on this watermelon leaf and a small necrotic area.

Figure 3: Occasionally, powdery mildew can be severe on watermelon.

Although unusual in Indiana, powdery mildew can cause infections on watermelon fruit as seen here.

To avoid additional sprays, watermelon growers who are worried about powdery mildew and wish to apply fungicides may want to choose products that are effective on more diseases than just powdery mildew. For example, Luna Experience® should be effective on powdery mildew and gummy stem blight. Merivon® should be effective on anthracnose and powdery mildew. Aprovia Top® has proven effective on powdery mildew of cucurbits plus it is labeled on anthracnose and gummy stem blight. However, I don't have any information about how effective Aprovia Top® is on the latter two diseases.

Inspire Super®, may not be as effective as the products listed above on powdery mildew, however it should be effective against both anthracnose and gummy stem blight. Similarly, fungicides with the active ingredient tebuconazole (e.g., Monsoon®, Onset®, Toledo®, Vibe®) should have good efficacy against gummy stem blight and moderate efficacy against powdery mildew.

More information about powdery mildew management can be found in the Midwest Vegetable Production Guide 2017 mwveguide.org. A proposed fungicide schedule can be found at https://ag.purdue.edu/arp/swpap/Pages/SWPAPPresentationFiles.aspx. More information about powdery mildew can be found at https://vegcropshotline.org/article/powdery-mildew-of-cucurbits/. Finally, always read the label!

Tools to Help Midwest Specialty Crop Producers Better Adapt to Changing Climate

The Midwestern Regional Climate Center, the USDA Midwest Climate Hub, and National Drought Mitigation Center (NDMC) are partnering to determine data needs and develop additional tools, educational resources and other information for producers to better adapt to a variable and changing climate. Changing climatic conditions are having a wide ranging impact on agriculture in the Midwest including changes in crop yields, season length, and soil health.

To meet these changes, we will host several workshops with specialty crop producers and extension staff to determine specific data and tool needs as well as climate change education needs

this coming winter. To decipher what specialty crop producers are currently using, and to facilitate the adaption and creation of new tools, the following survey (https://ssp.qualtrics.com/jfe/form/SV_0vtKm5WhOdoKawZ) has been created to help gather information. From the results of this survey, we will be inviting producers to workshops in December, 2017. Please visit our website for more information and printable PDFs of our goals and objectives and the survey.

If you have questions or require more information, please contact:
Beth Hall – Director, Midwest Regional Climate Center, bethhall@illinois.edu
Charlene Felkley – Coordinator, USDA Midwest Climate Hub, Charlene.felkley@ars.usda.gov or at 515-294-0136

What You Need to Know about Selling in Farmers Market — Farmers Markets and Its Benefits

(Allan Pinto, pinto7@purdue.edu) & *(Ariana Torres, torres2@purdue.edu)*

Farmers markets continue to grow in number and locations. According to the United States Department of Agriculture-Agricultural Marketing Service (USDA-AMS), there are currently 8,702 farmers markets in the United States, an increase of almost 400 percent since 1994 (USDA-AMS, 2017). The USDA-AMS directory of farmers markets reported 191 farmers markets in Indiana by August 2017: 129 summer and 62 winter markets. Indiana farmers markets vastly differ in size: markets may occupy a few stalls to several city blocks. For example, the Broad Ripple Farmers Market is an 80-vendor market in Indianapolis and is considered one of the biggest farmers market in Indiana.

Depending on the location, summer market season is anytime between mid-March until mid-November, while the winter season tends to be between November and March. Winter and summer markets offer vastly different produce choices. Winter markets usually offer less produce and the majority of the sales are spinach, kale, microgreens, potatoes and sweet potatoes, mushrooms, and squash. On the other hand, summer markets tend to offer a wide variety of greens, vegetables, fruits, and other specialty crops. Data collected by the Horticulture Business pricing reports website shows that Indiana farmers markets can sell anything from 13 fruits and vegetables (Warrick County Farmers Markets) to over 40 crops (Bloomington Community Center Farmers Market). The wide variety of fruits and vegetables of these locally sourced outlets highlight the local economy and gastronomy.

Farmers markets benefits

Farmers markets are much more than just a place to sell produce; they offer important benefits to farmers, buyers, and communities across the United States. Farmers markets provide a venue for communities to socialize, revitalize downtown districts, and help educate people to make healthier food choices.

Farmers markets are attractive outlets for locally grown flowers, ornamentals, and edible crops. These markets tend to serve as the primary outlet for smaller and part-time operations or as a complementary outlet for medium- and large-size growers who want to expand their sales (Feenstra et al., 2003). According to a study by Brown et al. (2007), there are two common groups of farmers market vendors: part-time and retired farmers. Part-time farmers tend to report lower sales value (which also represents a lower share of their household income) compared to full-time farmers. Feenstra et al. (2003) found almost 80 percent of vendors reported that farmers markets provided the greatest opportunity to develop their business as compared with other market outlets. By selling directly to consumers, farmers are able to gain a higher share of the consumer's dollar, improve their cash flow, and travel shorter distances (which reduces costs in transportation, handling, refrigeration, and storage). Farmers indicate that these markets help them improve skills in customer relations, merchandising, and pricing; they also increase their business self-confidence (Brown, 2002).

For consumers, quality and value are among the most important attributes when purchasing produce at farmers markets. Consumers prefer these markets because they are able to buy fresh, locally grown, sold-by-grower, and seasonal produce (Egan, 2002). Andreatta and Wickliffe (2002) surveyed farmers markets costumers. They found that respondents prefer farmers markets due to the availability fresh produce (88 percent) and local products (64 percent). The same study found that main disadvantages of farmers markets are distance to markets (23 percent), seasonal variation (14 percent), and hours of operation (12 percent). Kezis et al. (1998) found similar customer characteristics in surveys they conducted similar in Maine, Virginia, and Delaware.

The growth and popularity of farmers markets offer important opportunities for fruit and vegetable farmers in Indiana. Farmers markets help to connect farmers and consumers and provide important economic benefits to growers (Torres and Marshall, 2016). Although Indiana farmers can take advantage of the economic opportunities of selling directly to consumers, farmers face a dearth of marketing information to help them choose how to price and market their products.

This article is the first of a series of articles providing information to farmers selling at farmers markets or other local outlets. This publication illustrates the main characteristics of farmers markets and the benefits of selling produce direct to consumers. Farmers can find more information about pricing strategies and more on the Purdue Extension Horticulture Business website.

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USDA’s Fruit & Vegetable Industry Advisory Committee is Looking for Nominations

The U.S. Department of Agriculture is currently accepting nominations from qualified fruit and vegetable industry members to fill 10 seats on the Fruit and Vegetable Industry Advisory Committee. This Committee is composed of 25 members from every commercial capacity within the fruit and vegetable industry including growers, distributors, processors, farmers market managers, food hubs etc. The committee provides advice and recommendations to the Secretary of Agriculture on issues related to the programs and services that USDA provides to the produce industry. Nomination is end on Sep 1, 2017. More information about nomination and serving on the committee can be found at https://content.govdelivery.com/accounts/USDAAMS/bulletins/1b13cdd

The 2018 North Central Region – Sustainable Agriculture Research & Education Grant Opportunities

Farmer Rancher Program

Farmers and ranchers are invited to submit grant proposals to explore sustainable agriculture solutions to problems on the farm or ranch. There are three types of competitive grants: individual grants ($7,500 maximum), team of two grants for two farmers/ranchers from separate operations who are working together ($15,000 maximum), and group grants for three or more farmers/ranchers from separate operations who are working together ($22,500 maximum). Projects may last up to 24 months. Interested applicants can find the call for proposals online as well as useful information for completing a proposal at http://www.northcentralsare.org/Grants/Types-of-Grants/Farmer-Rancher-Grant-Program. Proposals are due on December 7, 2017 at 4 p.m. CST.

Partnership Program

The Partnership Grant program is intended to foster cooperation between agriculture professionals and three or more farmers or ranchers to catalyze on-farm research, demonstration, and education activities related to sustainable agriculture. Partnership Grants are funded for up to 24 months. Up to $30,000 total funding request per application is allowed. The deadline for Partnership Program proposals is October 26, 2017 at 4pm CDT. Interested applicants can find the call for proposals online http://mailchi.mp/93dc8d5886f3/ncr-sare-announces-2018-call-for-partnership-grant-proposals?e=69d6522a77

If you have questions about the programs, please contact Roy Ballard, Purdue Extension Educator, ANR Hancock County and Indiana SARE Coordinator- by calling (317) 462-1113 or by e-mail at **rballard@purdue.edu**. Please contact Roy if you need a hard copy or an email version of the call for proposals. Revisions are made to calls for proposals each year, which means it is crucial to use the most recent call for proposals and application.

Upcoming Events

Organic Vegetable Seed Production & Varietal Selection Workshop

Date: August 22, 2017, 9:00 am – 3:00 pm.

Location: Daniel Turf Center, 1340 Cherry Ln, West Lafayette, IN, 47907.

Registration: http://tinyurl.com/y7da7dsh

Topics include Seed biology fundamentals; Harvesting, processing, and storing seed; Population size and isolation requirements; Managing pathogens during seed production and after harvest; On-farm variety trialing and participatory breeding techniques. Registration fee is $15 including workshop and lunch.

ORGANIC VEGETABLE SEED PRODUCTION & VARIETAL SELECTION WORKSHOP

AUGUST 22ND, 2017
9:00 A.M. - 3:00 P.M.
WEST LAFAYETTE, INDIANA

Join partners from the Carrot Improvement for Organic Agriculture (CIOA) and Tomato Organic Management and Improvement (TOMI) projects for a one-day classroom and field based workshop on organic varietal development and seed production. Nationally renowned researchers from Purdue University, University of Wisconsin, and Organic Seed Alliance will lead this course and instruction will include:

Seed biology fundamentals
Harvesting, processing, and storing seed
Population size and isolation requirements
Managing pathogens during seed production and after harvest
On-farm variety trialing and participatory breeding techniques

We'll also connect with chefs to develop and identify varieties that shine in the kitchen. The morning classroom portion will be held at the Daniel Turf Center. We'll head to the field at The Student Farm in the afternoon to tour and taste test advanced carrot and tomato breeding populations.

SPEAKERS
MICAELA COLLEY, Organic Seed Alliance, Program Director
JULIE DAWSON, University of Wisconsin-Madison, Assistant Professor
LORI HOAGLAND, Purdue University, Associate Professor
LAURIE MCKENZIE, Organic Seed Alliance, Research & Education Associate
KAREN MITCHELL, Purdue Extension, Agriculture & Natural Resource Educator
LOCAL CHEF AND FARMER PANEL, TBA

Daniel Turf Center, 1340 Cherry Lane, West Lafayette, Indiana 47907 (morning) and The Student Farm, 1491 Cherry Lane, West Lafayette, Indiana 47907 (afternoon)

$15 registration includes workshop and lunch by The Juniper Spoon

Questions? Lori Jolly-Brown at 765-494-1296 or ljollybr@purdue.edu

Register today http://tinyurl.com/y7da7dsh

PURDUE UNIVERSITY HORTICULTURE
TOMI Tomato Organic Management and Improvement Project
Carrot Improvement for Organic Agriculture

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Hydroponics Workshop II

Date: Sep 8, 2017, 7:30 am – noon.

Location: WSLR 116, Horticulture & Landscape Architecture 170 S. University St. Purdue University West Lafayette, IN 47907

Registration: http://tinyurl.com/yb4dnwrh For further questions contact Lori Jolly-Brown, ljollybr@purdue.edu, 765-494-1296

In this workshop, you will learn about:

- LED lighting for winter produce in greenhouses
- Things to know about successful production in 'vertical or indoor farms'
- Biological control of insects
- Fertilizer recipes and injectors
- Ongoing research in our greenhouses

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Hydroponics Workshop II

Friday, September 8th
7:30am-noon

WSLR 116
Horticulture & Landscape Architecture
170 S. University St.
Purdue University
West Lafayette, IN 47907

In this workshop, you will learn about:
- LED lighting for winter produce in greenhouses
- Things to know about successful production in 'vertical or indoor farms'
- Biological control of insects
- Fertilizer recipes and injectors
- Ongoing research in our greenhouses

FREE Registration!
Register at http://tinyurl.com/yb4dnwrh
For further questions contact Lori Jolly-Brown, ljollybr@purdue.edu, 765-494-1296

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Midwest Mechanical Weed Control Field Day

Date: Sep 26, 2017, 10:00 am – 5:00 pm.

Location: Michigan State University Horticulture Teaching and Research Center – 3291 College Rd, Holt, MI 48842

Registration: The fee for the field day and lunch is $15. Register before September 15th. More information and Registration of the field day is available at http://msue.anr.msu.edu/events/midwest_mechanical_weed_control_field_day

Beginning Farmer Tours and Workshops

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

September 11. 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

PURDUE EXTENSION

Beginning Farmer
Tours and Workshops

Join Purdue's Beginning Farmer team for farm tours in 2017!

August 26. Goat Milk Stuff is a dairy goat farm located near Scottsburg, IN that produced soaps, candies, and cheeses. The tour will include information on agricultural tourism and value-added products.

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.

October 14. Blue Yonder Organic Farm is a Veteran owned and operated farm near North Salem producing pastured poultry, sheep, and other products. Learn about poultry production and organic certification.

October 28. Freedom Valley Farm is an organically managed farm located near Freedom, IN. The tour will include information on winter markets and developing business plans.

Registration Now Open!

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