

# VEGETABLE CROPS HOTLINE

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

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[vegcropshotline.org](http://vegcropshotline.org)

No. 595  
April 16, 2015

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**UPDATES TO THE MIDWEST VEGETABLE PRODUCTION GUIDE, 2015** - (Dan Egel, [egel@purdue.edu](mailto:egel@purdue.edu) 812-886-0198) - While the hard copy of the *Midwest Vegetable Production Guide for Commercial Growers 2015* (ID-56) has been available since early January, the online version is updated as needed. Below I outline the latest changes.

Page 40, Table 16. Several insecticide products were added to the "Insecticide Labeling for Greenhouse Use" table.

Page 100, Cucurbit chapter. Luna Privilege® was removed from the lists of suggested products for Alternaria leaf blight control and gummy stem blight/black rot control. While Luna Privilege® is labeled for these uses, it is not available yet.

Page 100, Cucurbit chapter. The rates for Presidio® for downy mildew and Phytophthora blight control were modified by the manufacturer.

Page 109, Product/Disease Rating for All Cucurbits. Several products were deleted, added, or modified in the Product/Disease Ratings for All Cucurbits table. These include Luna Experience®, Actigard®, Revus® and Presidio®.

Page 125, Fruiting Vegetable chapter. Ridomil Gold SL® was added to the list of recommended products for buckeye rot and Phytophthora blight control in tomato.

Page 125, Fruiting Vegetable chapter. Gavel 75DF® was added to the list of recommended products for leaf mold control in tomato.

Page 130, Product/Disease Ratings for All Fruiting Vegetables. Several products were deleted, added, or modified in the Product/Disease Ratings for All Fruiting Vegetables table. These include Bravo®, Dithane®,

Priaxor®, Quadris Top®, Fontelis® and Inspire Super®.

Note that the index page <http://mwvegguide.org/> for the online version of the ID-56 details the change history. If you have questions or comments about any of these changes or want a hard copy of the changes, contact me at [egel@purdue.edu](mailto:egel@purdue.edu) or 812-886-0198.



**ETHYLENE DAMAGE ON TOMATO** - (Dan Egel, [egel@purdue.edu](mailto:egel@purdue.edu) 812-886-0198) - This is the time of year when growers often call to complain about tomato transplants that do not look right. One possibility is that the seedlings suffer from heater problems. In particular, tomato plants are very susceptible to damage from the gas ethylene. In Figure 1, some of the seedlings have leaves that are curled down and stems that are twisted (epinasty in botanical terms). Epinasty is a common symptom of ethylene damage. Ethylene is a common by-product of incomplete combustion of several different types of fuel. Incomplete combustion is often the result of heaters that are not working efficiently. Tomatoes are very sensitive to ethylene damage.



Figure 1. The tomato seedlings above exhibit downward curled leaves (red arrows) which maybe a symptom of ethylene damage and yellow seed leaves with lesions (red circles), a possible symptom of sulfur dioxide damage (Contributed Photo).

A second clue is to take a closer look at the yellow seed leaves (see Figure 1). Ethylene damage does not include yellowing. Furthermore, there is a spotting on the lower leaves that is not typical ethylene damage. I believe that the symptoms on seed leaves were as a result of a different compound, perhaps sulfur dioxide, a heavier than air compound that would remain relatively close to the heater. The grower confirmed that the yellowing leaves were close to the heater, while the curling leaves, caused by ethylene gas, were spread throughout the greenhouse.

While some greenhouses are heated with a furnace attached to the greenhouse, many greenhouses are heated with a standalone unit inside the structure. In the example above, the grower stated that the heater was of this latter type—a standalone unvented unit. While this type of heating is not recommended, natural gas, propane and kerosene generally burn clean and do not need to be vented. However, even units that burn clean fuels may cause problems if out of adjustment (see citation below).

I cannot prove that the symptoms in Figure 1 above are caused by ethylene. But a few years ago, we witnessed ethylene-like damage at a greenhouse here at the Southwest Purdue Agricultural Center (See article in the *November 2007 Vegetable Crops Hotline*). Therefore, we were able to confirm that ethylene was the cause of the symptoms shown in Figure 2. Given the similarities of the two examples and the circumstantial evidence, I believe the example given in Figure 1 was due to a heater malfunction. The grower reports that after the heater was serviced, the plants began to look healthier.

Poorly adjusted heaters can also add water to the greenhouse air—as much as 22 gallons of water a night! This unwanted moisture can lead to disease problems.

To avoid damage from ethylene and other air pollutants:

1. Have unit heaters checked by a professional and follow maintenance recommendations.
2. Assure adequate air supply for complete combustion. For each 2500 BTU's of heater output, 1 sq. in. of vent cross section is needed.
3. Prevent back drafts. Make sure the chimney extends 2 ft. above the ridge of the greenhouse, or 2 ft. above a 10-ft. line to any part of the structure.
4. Install an inexpensive carbon monoxide detector. If carbon monoxide levels rise it's likely ethylene and other pollutants are present also. And if carbon monoxide levels are high it is a significant human health hazard.
5. Scout for possible growth effects of ethylene and investigate right away if you see anything.

Additional Resources: Bartok, J.W. Problems with Using Unvented Greenhouse Heaters <http://extension.umass.edu/floriculture/fact-sheets/problems-using-unvented-greenhouse-heaters>

This article was originally published on the [veg-giediseaseblog.org](http://veg-giediseaseblog.org), at <https://ag.umass.edu/fact-sheets/problems-with-using-unvented-greenhouse-heaters>



Figure 2. These tomato plants are exhibiting epinasty or a downward growth of the leaves in response to ethylene produced from a malfunctioning heater in a greenhouse. The topmost leaves are growing normally because the plants were removed to a separate greenhouse after exposure to ethylene. (Photo by Dan Egel)



**MANAGING COVER CROPS IN SPRING** – (Liz Maynard, [emaynard@purdue.edu](mailto:emaynard@purdue.edu), 219-531-4200 and Rick Foster, [fosterre@purdue.edu](mailto:fosterre@purdue.edu), 765-494-9572) - Cover crops should be killed at least a couple of weeks before planting vegetables. That will give the cover time to partially decompose, and time for any cutworm larvae that may be in the crop to die or pupate. If wet weather delays killing or incorporation of cover crops, the time between incorporation and planting may be shorter than normal, or the cover crop may be larger than normal. There are implications for pest, nutrient, and cover crop management.

Black cutworm moths prefer to lay eggs in vegetated areas, including fields with cover crops or weeds. They typically show up in early May. To track black cutworm moth catches in pheromone traps throughout the state, refer to the Purdue Pest & Crop Newsletter at <http://extension.entm.purdue.edu/pestcrop/2015/index.html>. If larvae are present in the cover crop and they survive until the cash crop is planted or emerges, they may cause serious stand loss. If you plow down a cover crop that is infested with cutworms, you should wait at least 7 days before you plant. If you plant sooner, you may want to use an appropriate pyrethroid insecticide shortly after you plant to protect your crop.

Seed corn maggot adults prefer to lay eggs in soils with high levels of fresh organic matter, such as newly-incorporated cover crops. The longer you can wait after incorporation before planting, the less damage you are



likely to experience. Waiting 2-3 weeks will usually suffice. Even more importantly, waiting until soil temperatures reach at least 70° F will greatly reduce the amount of damage. Similarly, waiting to plant will reduce the amount of damage from cabbage maggots on crucifers and onion maggots on onions.

Nitrogen tie-up and release by the decomposing cover crop depend on the ratio of carbon to nitrogen (C:N ratio) in the plant tissue. If the ratio is higher than about 30:1, some soil nitrogen will probably be temporarily tied up as the cover crop begins to decompose, possibly limiting early season crop growth. For grain crops like winter rye, the C:N ratio increases as the crop matures, and by flowering the C:N ratio is higher than 30:1. If your cover crop grows to the point where N tie-up is likely, the problem can be overcome by supplying a small amount of fertilizer with readily available N (20 - 25 lb./A N) close to planting time.

Annual legumes like hairy vetch have a lower C:N ratio throughout the life cycle, and no matter when they are killed are not likely to tie up soil N. However, the longer they grow in the spring before they are killed, the more N they fix. If an annual legume cover crop is allowed to grow longer than usual, the additional N it supplies should be taken into consideration. As a rough estimate, each 1 inch of growth taller than a height of 6 inches will contribute about 2.6 lb./A of N for this season's crop if the cover crop is incorporated (SAN 2007, pp. 22-23). For example, if you normally work up a crop of hairy vetch when it is 6 inches tall, but this year you don't get to it until it is 16 inches, about 26 lb./A additional N will be supplied by the vetch, beyond the normal amount from a 6-inch height.

If the cover crop has grown too large to be incorporated using standard equipment, it may be possible to mow it, allow it to dry down a little, and then incorporate. Or, if crop plans allow for no-till or strip-tillage, a killed cover crop need not be entirely incorporated. I wouldn't recommend adopting either no-till or strip till on a wide scale without careful planning and trials, but this may be a good opportunity to experiment with a small area of reduced tillage.

For reduced tillage systems, cover crops may be killed with herbicide, or winter annuals like winter rye and hairy vetch may be killed by mowing or rolling at the appropriate stage. Winter rye can be mowed after it has bloomed, and may be rolled at the milky dough stage. Hairy vetch can be mowed or rolled at 75% bloom or later, when immature seed pods are visible from the earliest flowers. If not mowed or rolled at the appropriate time, the cover crop will not die and can be very difficult to control once the crop is planted.

References: SAN, 2007. Managing Cover Crops Profitably, 3rd ed. SAN, Beltsville, MD. Available from <http://aws.sare.thinkcreativeinternal.net/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition>



**HONEY BEES AND OTHER POLLINATORS** - (Rick Foster, [fosterre@purdue.edu](mailto:fosterre@purdue.edu), 765-494-9572) - As you all know, many of our vegetable crops are dependent upon pollinators to move pollen from flower to flower. The cucurbits, muskmelons, cucumbers, watermelons, pumpkins, and squash, are completely dependent on insect pollination. Eggplant, okra, lima beans, and peppers will set fruit without pollinators but can have increased yield if pollinators are present. Honey bees are likely the most important pollinators for most of these crops, but other pollinators such as a number of species of native bees and other insects can also provide useful pollination services. In recent years, there has been a lot of attention given to larger than normal die off of honey bee colonies, commonly referred to as colony collapse disorder. There has been a great deal of discussion in the scientific community and in the public about the cause or causes of these colony deaths. Some of the suspected causes include new disease organisms, Varroa mites feeding in the hives, and a relatively new class of insecticides, the neonicotinoids.

Many factors can determine the survival of honey bee colonies, particularly over the winter. According to our apiculturist, Greg Hunt, the average overwintering hive losses in Indiana have averaged about 30% over the last 10 years. After the severe winter of 2013-14, losses were about 65% statewide. This year, after a more normal winter, losses were about 29%. In addition to weather, Varroa mites and whether beekeepers treat for them can be important to hive survival. The impact of neonicotinoid use on bee health and hive survival is less clear.

The neonicotinoids have been on the market for about 20 years and have become one of the most popular groups of insecticides in the world. Their success has been the result of their low toxicity to humans and vertebrate wildlife, their effectiveness against both chewing and sucking insects, and their systemic activity, meaning they move through the plant and can kill insects at location throughout the plant. The neonicotinoid insecticides labelled for use on vegetable crops include Platinum®, Actara® and FarMore® seed treatment (thiamethoxam), Admire Pro® (imidacloprid), Assail® (acetamiprid), Belay® (clothianidin), Venom® and Scorpion® (dinotefuran) and Transform® (sulfoxaflor). There are also a number of pre-mixes that contain neonicotinoids. All of these are very toxic to honey bees, except for Assail®, which is only slightly toxic.

Recent work conducted by Christian Krupke and Greg Hunt in our department has shown that the dust created during planting of agronomic crops with seed treated with neonicotinoid insecticides has the potential for killing bees. Around planting time, they found lots of dead bees in hives near corn fields (which would be pretty much anywhere in Indiana) and found lethal concentrations of neonicotinoid insecticides in those bees and found it to be persistent in the soil. My group completed a study last year (funded partially by the In-

diana Vegetable Growers Association) that showed that neonicotinoid seed treatments, soil drenches, and foliar treatments on muskmelons resulted in levels of those insecticides in the pollen that could be lethal to bees, similar to recent research done elsewhere on pumpkins and squash.

Because of these concerns, the US EPA has charged each state with developing a pollinator protection plan, with a particular emphasis on potential pesticide effects. In Indiana, that responsibility has fallen to the Indiana Pesticide Review Board, on which I serve. Recently, we held an open forum that brought together beekeepers, farmers, pesticide applicators, Purdue scientists and educators, environmental groups, and others to establish a dialogue that will eventually result in a protection plan, with best management practices for all parties so that we can all achieve the common goal of continuing to produce our crops without harming honey bees and other pollinators.

As a vegetable grower, what can you do to protect bees? First, try to avoid spraying when crops are in bloom. This is obviously not always possible. For the cucurbit crops, flowers are only open for a single day, so if you spray insecticides in the evening after bees have gone back to the hive and flowers have closed up, you will reduce the impact on the pollinators. Second, when you have a choice, use the pesticide with the least effect on pollinators. See the *Midwest Vegetable Production Guide (ID56)* for recommendations. Relative toxicity levels to bees are shown in Table 10 on page 29. Finally, always use Integrated Pest Management (IPM), spraying insecticides only when necessary. Our research has consistently shown that spraying insecticides for striped cucumber beetle control based on the threshold of 1 beetle per plant (2-3 sprays) instead of weekly applications (8-10 sprays) not only resulted in fewer insecticide applications, but also led to significantly higher yields.



**STATE OF THE INDIANA HOPS INDUSTRY** - (Clayton Nevins, [cnevins@purdue.edu](mailto:cnevins@purdue.edu), 765-592-6270) - Rapid growth in the craft beer industry is stimulating Indiana's economy and creating an opportunity for Indiana farmers to start growing hops. In 2012, the Indiana craft brewing industry contributed over 600 million dollars to the state's economy. The industry continues to grow, increasing from 63 breweries in 2013<sup>1</sup> to nearly 100 in 2015, and housing over 6,000 full-time employees<sup>2</sup>. Hop production has increased over 10% since 2013, with the hops industry in Indiana being no exception<sup>3</sup>. Hop production currently occurs predominantly in the Pacific Northwest, with Washington state leading production at 74% of the total acreage, followed by Oregon (14%), Idaho (10%), and the rest of the country (2%). However, many hop yards have now taken root in Indiana, with many additional yards currently under

construction (see Figure 3)

### Hops (*Humulus lupulus*)

Hops are a perennial crop essential for beer production - imparting bitterness and aroma. The plants produce bines that climb over 20 feet during the course of the growing season. The female cones (flowers) (see Figure 4) are harvested in late summer or early fall, and are dried or sent directly to the brewery to begin the process of producing beer. Healthy hop plants have a life span of over 10 years.

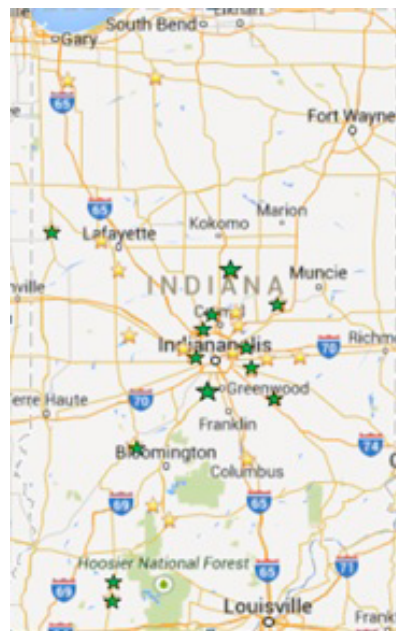


Figure 3. 2015 Hop yards in Indiana. Established yards are represented with gold stars and planned hop yards in green.

### Purdue's Interaction with the Industry

With a rapidly growing industry comes a need for professional assistance through university research and extension. The Specialty Crop Production Systems Research Lab at Purdue is providing that assistance. Entering its second year, the Boiler Hop Yard is home to variety trials that aim to identify best adapted varieties, and key insect pests and diseases affecting hops in Indiana. This summer, the lab will travel to established and aspiring Indiana hop yards to collect soil, pest and cone samples to help farm owners optimize their production systems.

Training the next generation of hop growers, researchers and extension educators is another aim of the Purdue Boiler Hop Program, and this summer Clayton Nevins, a senior in Purdue's Department of Agronomy, was hired as an intern to help manage the hop yard and assist with disease scouting and soil analysis throughout the state. In the fall, Clayton will collect cone samples and quantify the essential oils and alpha and beta acid levels present in the hops in collaboration with scien-



tists in the Department of Food Science. The acids and oils impart bitterness, flavor and aroma in beer. Finally, Clayton will assist with development of extension bulletins aimed at helping aspiring hop growers get started.

### Purdue's Hop Yard

The Boiler Hop Yard, located at the Meigs Horticulture Research Farm south of Lafayette, IN serves as a research and demonstration plot. Two trellis systems were erected last spring: the more common 18-ft trellis and a shorter 10-ft "dwarf" trellis. Dwarf trellis systems offer a potential advantage to smaller-scale hop growers because of lower management and input costs. Although costly (roughly \$10,000 an acre) and labor intensive, a well-constructed trellis system can last for over 10 years.

The Boiler Hop Yard is home to several varieties of hops including Cascade, Centennial, Nugget, Chinook, Galena, and Zeus. These varieties were chosen for several reasons. First, they are publicly available - meaning that they are available for any aspiring hop farmer to plant. Second, these varieties are popular among the industry, and already had a presence in Indiana hop yards prior to establishment of the Boiler Hop Yard in 2014. Lastly, these varieties are expected to be the most adaptable to Indiana's climate, and some are likely to perform well in dwarf trellis systems.

### Purdue's Outreach Activities

Purdue is hosting several events to help Indiana's established and aspiring hop growers get started and optimize production. This included a workshop at the recent Indiana Small Farms Conference. Representatives from different departments in the College of Agriculture, as well as visiting scholars from the University of Vermont and the University of Minnesota were on hand to give presentations and answer questions about the crop and the industry. Topics covered included trellis construction, practical pesticide use, food safety awareness issues, insurance for specialty crops, insect suspects in Indiana's hop production, as well as information about how important it is to secure legitimacy in a new and expanding market. Over 100 people were in attendance. Copies of the presentations can be found on Purdue's hop website along with links to webinars and other resources for hop growers. <https://ag.purdue.edu/hla/Extension/Pages/Hops.aspx>. The next outreach activity will be held at the Boiler Hops Yard sometime in late July or early August when the hops are getting close to harvest. Details will be made available on Purdue's hop website.

### Getting Connected

In addition to Purdue's hop website, the Grow-INHops active mailing list is also an excellent way to connect with the Indiana hop industry. To sign up for the mailing list go to: <https://lists.purdue.edu/mailman/listinfo/growinhops>. Additional information or questions regarding Purdue's Boiler Hop Program can be directed to Dr. Lori Hoagland ([lhoaglan@purdue.edu](mailto:lhoaglan@purdue.edu)) or Dr. Bruce Bordelon ([bordelon@purdue.edu](mailto:bordelon@purdue.edu)).

<sup>1</sup> Indiana Craft Beer Sales Statistic, 2013: <http://www.brewersassociation.org/statistics/by-state/?state=IN>

<sup>2</sup> Brewers of Indiana Guild About: <http://drinkin.beer/about/>

<sup>3</sup>Hops Growers of America 2014 Statistical Report: [http://www.usahops.org/userfiles/image/1421356603\\_2014%20Stat%20Pack.pdf](http://www.usahops.org/userfiles/image/1421356603_2014%20Stat%20Pack.pdf)



Figure 4. Female hop cones at the Boiler Hop Yard.



**PLAN TO DISPOSE OF UNWANTED PESTICIDES** - (info provided by Office of the Indiana State Chemist, 765-494-1492, [www.isco.purdue.edu](http://www.isco.purdue.edu)) - The Indiana Pesticide Clean Sweep Project designed to collect and dispose of suspended, canceled, banned, unusable, opened, unopened or just unwanted pesticides (weed killers, insecticides, rodenticides, fungicides, miticides, etc.) is being sponsored by the Office of Indiana State Chemist (OISC). This disposal service is free of charge up to 250 pounds per participant. Over 250 pounds there will be a \$2.00 per pound charge. This is a great opportunity for you to legally dispose of unwanted products at little or no cost.

All public and private schools, golf courses, nurseries, farmers, ag dealers, cities, towns, municipalities and county units of government or others receiving this notice are eligible to participate.

Pesticides will be accepted from 9:00 a.m. to 3:00 p.m. Local Time at the following dates and locations in August, 2015:

August 18: Miami County Fairgrounds, Peru, IN  
 August 19: Elkhart County Fairgrounds, Goshen, IN  
 August 20: Randolph County Fairgrounds, Winchester, IN  
 August 26: Decatur County Fairgrounds, Greensburg, IN  
 August 27: Hendricks County Fairgrounds, Danville, IN

To dispose of pesticides, first, complete the Pesticide Clean Sweep Planning Form to the best of your ability

(download from [http://www.oisc.purdue.edu/pesticide/clean\\_sweep.html](http://www.oisc.purdue.edu/pesticide/clean_sweep.html)). Mail, fax or e-mail the completed form to Kevin Neal at OISC, 175 S. University, W. Lafayette, IN 47907-2063, 765-494-4331, or [nealk@purdue.edu](mailto:nealk@purdue.edu) no later than Monday, July 30, 2015. Then bring your labeled, leak free and safe to transport containers to the collection site. DO NOT mix materials. In case of an emergency, you should bring with you a list of products you are carrying and a contact phone number.

OISC reserves the right to cancel this Pesticide Clean Sweep Project if there is not adequate demand. Participants submitting the planning form by August 3, 2015 will be contacted immediately if cancellation is necessary.



**TOMATO GRAFTING WORKSHOP.** Sunday, April 26, 9-11 a.m. Purdue Extension - Marion County on the Indiana State Fairgrounds. Cost: \$25 (if registered by April 17). Register here: <http://goo.gl/vZOPWD> Contact: Emily Toner, Urban Agriculture Educator, 317-275-9269.

### Tomato Grafting Workshop

**Grafting** is the process of fusing a young shoot onto a different rootstock

**AT THE WORKSHOP YOU WILL**

- Learn grafting costs and benefits
- Watch a demonstration by an experienced grafter, Nate Parks of Silverthorn Farm
- Practice grafting tomatoes
- You will leave with grafted tomato plants in your hand!

**WHEN**  
Sunday, April 26, 9-11 a.m.

**WHERE**  
Purdue Extension - Marion County

**COST**  
\$25, if registered by April 17  
\$30, after April 17

**REGISTER AT**  
<http://goo.gl/vZOPWD>  
REGISTRATION DEADLINE IS APRIL 24

&



**INDIANA FOOD HUB EMAIL LIST** - (Liz Maynard, [emaynard@purdue.edu](mailto:emaynard@purdue.edu), 219-531-4200) - Purdue Extension is starting the Indiana Food Hub Network this year. So what's a food hub? The USDA working definition is a centrally located facility with a business management structure facilitating the aggregation, storage, processing, distribution, and/or marketing of locally/regionally produced food products. Extension educator Roy Ballard, who is working with Local Food Coordinator Jodee Ellett to develop Indiana's network, says, "Food hubs come in all shapes and sizes, and are finding great success nationwide. They can enable small- to mid-sized growers to enter a larger, wholesale-style local food marketplace with other growers by co-marketing

products and services such as communication and distribution. But hubs are scale-neutral; they are providing a means for all sizes of farms and food entrepreneurs to expand their local food markets." If you want to learn more, or might be interested in forming a food hub, consider joining the new email list Indiana Food Hubs <https://lists.purdue.edu/mailman/listinfo/foodhubin>.



#### ARE YOUR FIELDS LISTED AT DRIFTWATCH.ORG?

- (Liz Maynard, [emaynard@purdue.edu](mailto:emaynard@purdue.edu), 219-531-4200) - Vegetable, fruit, and organic farmers can register their production areas on [Driftwatch.org](http://Driftwatch.org) to let commercial pesticide applicators know where the fields are. Beekeepers can also register sites where beehives are located. Once sites are registered and approved they appear on the Driftwatch registry map (see Figure 5) and partnering applicators are notified. This helps applicators reduce drift or accidental application to vegetable crops.

Registration is free and easy. Why not do it today? Visit [Fieldwatch.com](http://Fieldwatch.com) to find the user guide with instructions.

If you registered fields last year you will need to renew the sites in order for them to show up in the registry this year. When renewing, it isn't necessary to reenter all the information, just what has changed for 2015. Instructions for renewal are also online.

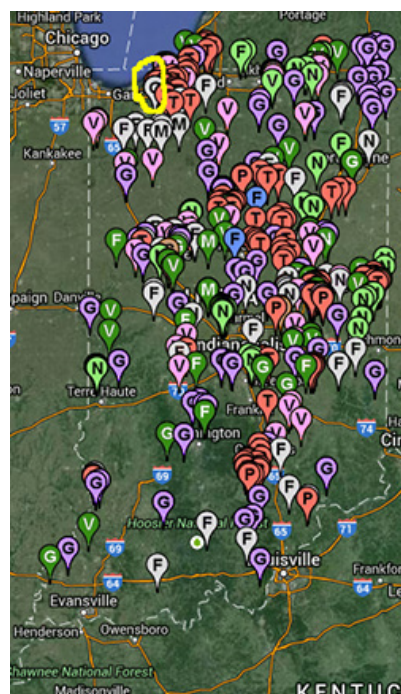


Figure 5. Driftwatch registry map. The pin marking high tunnels at Pinney-Purdue Ag Center is circled in yellow.