

VEGETABLE CROPS HOTLINE

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



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Dicamba Herbicide Updates and New Resources

(Stephen Meyers, slmeyers@purdue.edu, (765) 496-6540) & (Bill Johnson, wj@purdue.edu, (765) 494-4656)

Dicamba has been in the headlines the last two weeks. In case you've missed it, here are the highlights:

On June 3 the United States Court of Appeals for the Ninth Circuit ruled against the Environmental Protection Agency and its 2018 registration of over-the-top dicamba products Xtend, Engenia, and FeXapan and vacated their registrations. The suit did not include a fourth over-the-top dicamba herbicide, Tavium. The ruling can be viewed here: <https://cdn.ca9.uscourts.gov/datastore/opinions/2020/06/03/19-70115.pdf>

Between June 3 and June 8, state regulators across the middle part of the country were forced to interpret the ruling, with some choosing to ban the products and others continuing to allow them. Extension row crop weed scientists across the country pulled together recommendations for managing broadleaf weeds without dicamba, including Purdue (<https://extension.entm.purdue.edu/newsletters/pestandcrop/article/well-now-what-do-i-do-if-i-cant-spray-a-dicamba-product-in-xtend-soybean/>).

On June 8 the EPA issued a cancellation order for the three dicamba products, but allowed applicators to use products in their possession. The product had to be purchased on or before June 3 and must be used by July 31. The full order can be found here: https://www.epa.gov/sites/production/files/2020-06/documents/final_cancellation_order_for_three_dicamba_products.pdf

What does all of this mean for the future of over-the-top auxinic herbicides and off-target risk to sensitive crops?

The Indiana cut-off date for over-the-top dicamba application was June 20. This date has not changed. Many other states have similar cut-off dates well before the EPA deadline of July 31.

The three dicamba herbicides affected by the court's ruling and the EPA cancellation order were only registered for two years with their registrations ending in 2020. It is expected that there will be new formulations of dicamba for over-the-top use in 2021.

Time will tell what effect these events will have on off-target movement to sensitive crops. For this reason it is important for applicators to practice good herbicide stewardship and for producers of sensitive crops to remain vigilant.

New fact sheet series about dicamba and 2,4-D drift now available online.

Scientists with Purdue University, Ohio State University, along with the North Central Integrated Pest Management Center and a nation-wide working group of weed scientists have developed a series of fact sheets to help specialty crop producers navigate issues related to dicamba and 2,4-D drift. Although the emphasis is on auxinic herbicides, the principles laid out in the fact sheets can be more broadly applied to other types of herbicide drift. Printed versions of the fact sheets will be available this fall.

Overview of Dicamba and 2,4-D Drift Issues:

<https://ipm-drift.cfaes.ohio-state.edu/dicamba-and-24-d-fact-sheet-series/overview-dicamba-and-24-d-drift-issues>

Frequently Asked Questions:

<https://ipm-drift.cfaes.ohio-state.edu/dicamba-and-24-d-fact-sheet-series/frequently-asked-questions>

Preparing for Drift Damage:

<https://ipm-drift.cfaes.ohio-state.edu/dicamba-and-24-d-fact-sheet-series/preparing-drift-damage>

Responding to Drift Damage:

<https://ipm-drift.cfaes.ohio-state.edu/dicamba-and-24-d-fact-sheet-series/responding-drift-damage>

More Resources:

<https://ipm-drift.cfaes.ohio-state.edu/dicamba-and-24-d-fact-sheet-series/more-resources>

Warm, Dry Weather Causing Abnormally Dry Conditions Across Indiana

(Beth Hall, hall556@purdue.edu)

Indiana has been very dry the last several weeks (Figure 1) and

conditions are starting to show in lawns and fields. This dryness has been exacerbated by low humidity and warmer temperatures (Figure 2). After a nice respite this past weekend, temperatures will start rising again into the weekend, but may not seem too uncomfortable with humidity remaining low at the front end of that warming period. The short-term forecast is calling for a slight chance of precipitation over the next seven days, but expect it to be light and spotty. The good news is the climate outlooks for the rest of June is showing increased probabilities of above-normal precipitation (Figure 3), ... but will it be enough to compensate for the deficit we have been facing these past few weeks? It is too early to know for sure, but there are no major storm systems on the horizon, nor jet stream patterns that indicate a lot of precipitation is on its way.

Accumulated Precipitation (in): Percent of 1981-2010 Normals
May 19, 2020 to June 17, 2020

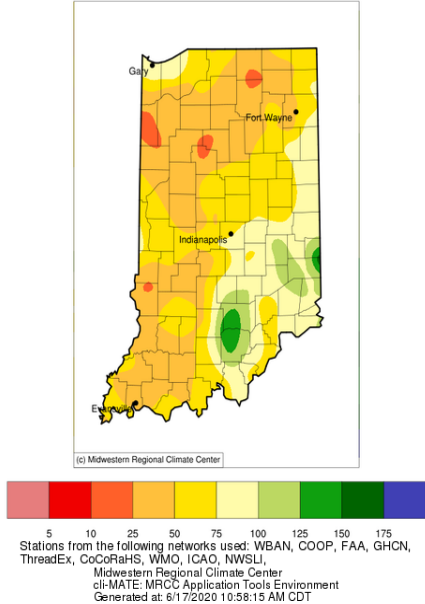


Figure 1. Accumulated precipitation from May 19 through June 17, 2020 presented as the percent of the 1981-2010 climate normal period.

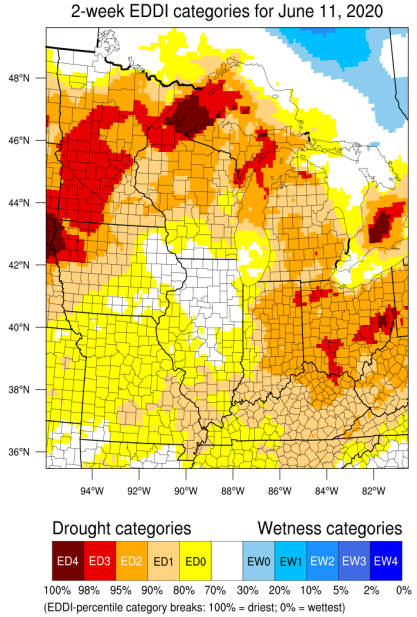


Figure 2. The Evaporative Drought Demand Index (EDDI) representing the level of modeled dryness based on recent precipitation, temperature, humidity, and other evapotranspiration factors. Period covers May 28 through June 11, 2020.

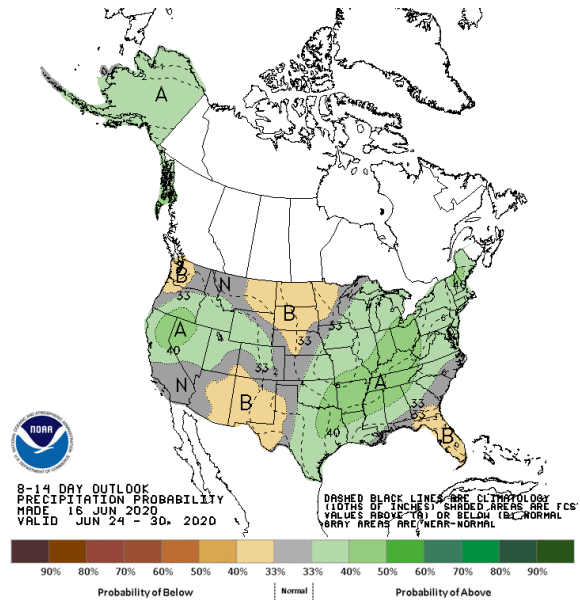


Figure 3. The 8-14-day climate outlook for precipitation representing June 24-30, 2020 where shading indicates the probability of above- or below-normal precipitation occurring during that time period.

Cucumber Beetle Updates and Spray Considerations

(Jacob Pecenka, jpecenka@purdue.edu) & (Laura Ingwell, lingwell@purdue.edu, (765) 494-6167)

While in your fields in the last week you may have noticed fewer striped cucumber beetles on the leaves and stems of the growing cucurbit plants (Figure 1). This is because there are two generations of this pest in Indiana; the 1st generation adults that overwintered in the field have mated and left behind their eggs in the soil around the crop roots. When these eggs hatch the cucumber beetle larvae will feed on plant roots until they pupate into adults and emerge as the second generation typically in early July. Fields in northern Indiana will likely be 1-2 weeks behind on the second-generation emergence compared to southern regions of the state.



Figure 1: Striped cucumber beetle feeding on newly transplanted watermelon. The first-generation beetles can occur in high enough numbers to stunt plant growth or kill the seedling outright.

This means that while you still may see adult striped cucumber beetles in your vegetable fields, they are likely not going to be found at high enough populations to cause economic damage (1 beetle per plant in cucumbers and cantaloupes and 5 beetles/plant in other cucurbits) and insecticide sprays will not likely prevent any yield loss. In fact, as the early planted cucurbits begin to produce flowers the application of insecticides may be repellent or harmful to pollinators and reduce early fruit set. Weekly scouting during the time between generations can

inform pest management decisions. Looking for pests on 8-12 plants across of few rows in your field (Figure 2) should give an accurate picture of average pest populations to determine if action is needed.



Figure 2: The author of the article is scouting watermelon plants for striped cucumber beetles and other pests. This can be a cost-effective way to avoid unnecessary sprays that could harm beneficial insects.

If sprays are necessary to respond to high cucumber beetle numbers, apply as late as possible in the evening to avoid times of pollinator activity. For smaller growers, research has shown that applying entomopathogenic nematodes (EPNs) to the base of the plant can reduce the population. EPNs are microscopic organisms that live in the soil and feed on a variety of soil-borne insects. *Steinernema carpocapsae* and *Heterohabditis bacteriophora* have been shown to be effective when applied in summer. Both can be purchased from a variety of biological suppliers, see article [Considerations and Suppliers for Biological Control](#) published in *Issue 616* of *Vegetable Crops Hotline Newsletter* for some options. Monitoring pest populations in vegetable fields and applying pesticides in a conservative manner is an effective way to reduce harmful exposure to pollinators and other beneficial insects.

Consult the 2020 *Midwest Vegetable Production Guide for Commercial Growers* at www.mwveguide.org for management options. When applying foliar spray during bloom be sure to apply in the evening when flowers are closed and fewer pollinators are active in the field to avoid exposure to beneficial insects.

Tomato Leaf Curling

(Wenjing Guan, guan40@purdue.edu, (812) 886-0198) & (Liz Maynard, emaynard@purdue.edu, (219) 548-3674)

We received calls recently reporting observations of leaf curling on tomatoes. This article discusses factors that may cause tomato leaf curling.

In a similar way as other vegetables, hot and dry conditions may cause leaf curling on tomatoes. In late spring and early summer, plants that are actively growing and developing fruit have a high demand for water. Under hot and dry conditions, plants respond by rolling the leaves to reduce the surface area exposed to high radiation. Lower leaves on a tomato plant are often affected first, they may recover if environmental stresses are reduced. Leaf curling itself due to the environmental stresses is not a significant concern, but if the stress condition continues, it may eventually lead to blossom end rot fruit and decreased yield. There is a great variation among tomato varieties in terms of whether the observation of leaf curling suggests the plant is suffering water stress that may eventually affect yield and quality. But as leaf curling is relatively easy to notice, it would be a good idea to check developing fruit for potential blossom end rot if severe leaf curling is detected.

Tomato leaf curling can be a response to heavy pruning (Figure 1). In this study, all branches below the first flower cluster were removed (0 branches); or 1, 2, 3, 4, branches below flower cluster were left. Unpruned plants were the control. Leaf curling was noticed on the most heavily pruned plants. It is believed that when a large amount of photosynthate is produced and there are not enough sinks to use it all (e.g. because branches have been removed), starch builds up in the leaves and causes them to curl. Note the difference between cultivar Mt. Spring (above) and Florida 91 (below), with Mt. Spring had heavier leaf curling.



Figure 1. Tomato leaf curling responded to pruning.

Except for the margins of the leaves which are rolled up, the leaves generally appear normal for the above-mentioned leaf curling situations. However, if the curling leaves are severely deformed or twisted, herbicide damage may be a concern. In Figure 2., leaf curling is likely caused by hormone-type herbicide damage (such as 2,4-D and dicamba). The symptom was more pronounced on top of the plants, where new growth occurs. Tomato plants are extremely sensitive to herbicide damage. Depending on the level of the injury, some plants may not be able to recover. In less severe cases, about half a dozen leaves that were developing at the time of exposure show symptoms, along with flowers or fruit near those leaves, but later growth appears normal. There are no remedies for herbicide damage. More information about the herbicide damage can be found in the new [Dicamba and 2,4-D Fact Sheet Series](#).

Insect or disease damage may also cause tomato leaf rolling. Other symptoms such as mosaic, chlorosis or the signs of the insect itself may accompany with the leaf curling symptom. If you suspect the leaf curling was caused by these biotic factors. Samples should be sent to the Plant and Pest Diagnostic Laboratory for pest identification before taking action.

Stay Ahead of Caterpillars in Your Crucifers!

(Elizabeth Long, eylong@purdue.edu, (765) 796-1918)

I really thought I was staying ahead of the insects in my crucifer greens pretty well, but as you can see from my ravaged arugula plant (Figure 1), I was wrong!



Figure 1. Early stage cabbage looper caterpillars (I think!). Photo by E. Y. Long

It's *that* time of year again when holes may be appearing in your favorite crucifer crops, including cabbage, broccoli, cauliflower, kale, arugula, Brussel sprouts...and the list goes on! *Although there are several insect culprits that may be causing damage, caterpillars are key pests to be vigilant for.*

Whether you have fields or a small garden of delicious cruciferous greens, caterpillars are the primary pests to manage; if you don't stay ahead of them, they can devastate your crop. **In Indiana, the three most common caterpillars you'll find eating your crucifers are the imported cabbageworm, cabbage looper, and the diamondback moth.** All three caterpillars feed on the leaves and heads of developing crucifer plants, reducing plant growth and leaving behind large holes (Figure 2) and crop-fouling frass (insect excrement) that make crops unmarketable.



Figure 2. Cabbage looper caterpillars. Photo by John Obermeyer

Of these three very hungry caterpillars, the cabbage looper eats the most foliage during its development. Cabbage looper caterpillars are light green with a white stripe on each side of the body and reach a maximum size of ~1.5 inches (Figure 2). The imported cabbageworm is a green, slightly fuzzy caterpillar with a yellow stripe down the back and reaches ~1 inch in length when mature (Figure 3). Diamondback moth caterpillars are a pale greenish-yellow color and the smallest of the three species, reaching a size of just a third of an inch when mature (Figure 4). These small caterpillars are notorious for dropping off the plant and dangling from a silken thread when disturbed.



Figure 3. Imported cabbageworm caterpillar on cabbage head. Photo by E. Y. Long



Figure 4. Mature diamondback moth caterpillar. Photo: John Obermeyer

While most crucifers can withstand significant amounts of feeding with no impact on crop yield, it's important to be mindful of where the feeding damage occurs and whether that is the marketable part of the crop. For example, cauliflower and broccoli can tolerate caterpillar feeding on the leaves, but any feeding on the heads can render these crops unmarketable. Conversely, in turnips grown for the greens (rather than the root), collards, and mustard greens, the leaves are the marketable parts that must be protected.

Scout your plants regularly so you catch infestations before they become damaging. See the "Caterpillars" section of "[Managing Insect Pests of Commercially Grown Crucifers](#)" and the *Midwest Vegetable Production Guide for Commercial Growers* (<https://mwvegguide.org/results/pest/3279/crops/566,567,569,571,574,573>) for more detailed information about action thresholds for each caterpillar species, as well as organic and conventional insecticide products that target these pests. And always remember there are good insects in your crops too, like damsel bugs (Figure 5) that may be feeding on the eggs and caterpillar stages of these crucifer pests!



Figure 5. A beneficial insect, commonly known as a damsel bug, searching for caterpillar prey. Photo by E. Y. Long.



Figure 2. Leaf crisping and wilting as a result of squash bug feeding damage. Photo by Dan Egel.

Now is the Time to Treat Squash Bugs

(Laura Ingwell, lingwell@purdue.edu, (765) 494-6167)

Squash bugs are a pest of cucurbit crops and can sometimes go unnoticed until late in the season when the local populations have built up and you see them in high numbers (Figure 1) attacking the fruits of your crop. Squash bugs are similar in appearance to stink bugs but smell much more pleasant (in my opinion) when you squish them. They feed on all parts of the plant (leaves, stems, fruits) with piercing-sucking mouthparts and inject toxins in their saliva that can lead to localized wilting and crisping of leaves (Figure 2). Squash bugs are particularly problematic in pumpkin and squash (Figure 3) but can also be quite damaging in cucumber.



Figure 3. Squash bug nymphs feeding on zucchini and pumpkin fruits. Photos by Dan Egel.



Figure 1. Squash bug nymphs of various age on pumpkins, late in the season, in a home garden. Photo by Laura Ingwell.

The adults (Figure 4) are more difficult to control with insecticides, therefore best management practices should target the young nymphs, soon after hatching. The eggs are easy to identify. They are copper-colored and laid on the underside of leaves or the stem of plants. They are laid in clusters of straight lines. When the nymphs first hatch, they are black/light green (Figure 5) and quickly turn pale gray/white. As of June 5, I have been seeing egg clusters on some vegetation at farms near Lafayette, IN. Now is the time that you should be inspecting your

crops, looking at the underside of the leaves, and making insecticide applications when the eggs hatch. This can occur over a span of weeks, so multiple applications may be necessary to treat them all. However, early intervention can prevent the build-up that we get frustrated with later in the season.



Figure 4. Squash bug adult. Photo by Dan Egel.



Figure 5. Squash bug nymphs hatching from the distinct egg clusters on the underside of the leaf. Photo by Dan Egel.

When egg clusters exceed an average of one cluster per plant, application should be made at the onset of hatching. Refer to the 2020 *Midwest Vegetable Production Guide for Commercial Growers* at www.mwveguide.org for spray recommendations. For organic considerations, Grandevo® and Azera®, applied at 2 lbs per acre, has shown good control.

Cercospora Leaf Spot of Beet

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

This disease was observed in a home garden recently on table beet (Figure 1). I was surprised considering how dry it has been. *Cercospora* leaf spot also affects swiss chard. Symptoms include circular leaf spots that may have a reddish margin. The center of the lesions may start off a light brown and turn to gray after the fungus (*Cercospora beticola*) begins to sporulate. Under conditions conducive to disease, the lesions can coalesce and result in loss of foliage. Yield and quality of the crop can be reduced.



Figure 1. *Cercospora* leaf spot of beet.

Cercospora leaf spot is favored by rainy weather or overhead irrigation and temperatures from 77 to 95°F. The spores are readily dispersed in rainy, windy weather. One reference I found said that *Cercospora* leaf spot can start with 90% relative humidity—that is, leaf wetness may not be necessary. That might be why this disease is present in this dry spell.

Cercospora may survive crop residue over winter. The fungus may also be seed borne.

Resistant cultivars are available. Fall tillage and crop rotations of 2 to 3 years should help to lessen disease severity.

Several fungicides are listed in the 2020 *Midwest Vegetable Production Guide for Commercial Growers* including copper compounds, some of which may be allowed in organic certifications.

Synthetic fungicides include: Products with the active ingredient chlorothalonil (e.g., Bravo®, Equus®, Initiate®); Cabrio EG®; Flint®; Fontelis 1.67 SC®; Merivon®; tebuconazole products such as Monsoon® and Onset®; Quadris® and Satori®; The *Midwest Vegetable Production Guide* has more information. Always consult the label before every pesticide application.

What Factors Affect Strawberry Flavor?

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

Strawberries have a rich flavor; sugar, acid, phenolic content, and aroma all together make the wonderful fruit. Many factors are assumed to affect strawberry flavor. Some are supported by scientific evidence, some may be simply people's impressions. In this article, we discuss some of the factors that are more likely to affect strawberry flavor.

Locally grown strawberries often taste better than strawberries purchased from grocery stores. Part of the reason is that strawberries shipped long distances are harvested a few days before they are fully ripe. The fruit has longer shelf-life but the flavor is sacrificed.

We are testing ten strawberry varieties in a high tunnel and in an open-field in southern Indiana this spring. Regardless of cultivars, we consistently noticed better fruit quality (higher sugar content, softer, and much cleaner) for strawberries grown inside of the high tunnel than grown in the open-field (Figure 1). I do not think it is fair to say the high tunnel itself makes the berry taste better. The conclusion would be too

blank. Let's look further to see the potential reasons.



Figure 1. Strawberries are growing in a high tunnel.

One big difference is the management system. We used a more intensive fertility management system inside the high tunnel than in the field. In the high tunnel, plants were fertigated during all the irrigation events starting in February (from once a day to three times a day). Plants grown in the open field depended on preplant fertilizers applied in the fall until April and then fertigated once a week. Another difference is temperature. In general, the high tunnel has a greater day/night temperature difference until more recently, this is another factor known to favor sugar accumulation. Strawberries grown in the open-field have been exposed to strong wind several times at the fruit forming stage. Many immature fruit are injured by sand (Figure 2). The injured fruit tend to change color earlier, but with lower sugar content, less flavor and firmer flesh.



Figure 2. Sand injury on immature strawberry fruit.

The variety is a well-known contributor to strawberry flavor. When growing the ten varieties together, sometimes we can immediately tell what the variety of the berry is by looking at the appearance of the berry or smelling it. Some varieties are associated with very favorable aroma. Strawberry lovers can surely tell them apart. Unfortunately, fruit aroma is not easily measured by instruments. We focused on measuring sugar content and fruit softness. We noticed that the varietal difference was more pronounced for field-grown strawberries than high tunnel strawberries. In general, high tunnel strawberries all taste good. A noticeable difference existed for field-grown strawberries.

Another interesting thing I want to share happened when I grew strawberries in North Carolina, where day-neutral strawberries were harvested for several months. At the beginning and the end of the season, when the yield was low, the fruit tasted great. Sugar content reduced when large amounts of berries were maturing at the same

time. This happened in an organic system, lack of fertility during the peak season likely contributed to the reduced strawberry flavor. Surely, there are more environmental factors unique to a year or to a farm that may affect fruit flavor, such as the amount of sunlight, or rainfall before harvest. I also heard comments that the late frost this past season may also play a role in affecting strawberry quality depending on the stage of the plant growth when the frost happened. We probably can not do much in front of the environmental factors. But healthy plants with well-balanced fertility and well-controlled disease and insect pests will surely bring outstanding strawberry fruit.

Organic Aphid Control Update

(Laura Ingwell, lingwell@purdue.edu, (765) 494-6167)

Aphids have been a particularly challenging pest to get under control in our high tunnel strawberries this year. They quickly colonized the strawberries we had growing all winter and took off as the weather warmed (Figure 1). In my first attempt to knock them back I introduced 2,000 lacewing larvae (22-Apr), too little too late.



Figure 1. An example of the level of aphid infestations experienced in the high tunnel strawberries prior to treatment applications.

I decided to take the 'opportunity' at hand to evaluate four OMRI approved insecticide options. Applications began when populations were much higher than what growers should tolerate, so I would anticipate you would see even better results if you intervene at the first signs of infestation. Table 1 shows the products, active ingredient (A.I.), application rate and dates of applications. The change in aphid populations over the course of this trial are shown in Figure 2. In entomological tradition, I surveyed the aphid population prior to treatment (1-May) to get a baseline. As you can see in the figure, populations were higher in the Grandevo® and BotaniGard® treated rows, prior to the start of applications.

Table 1: Pesticide products and application details.

Product	Active Ingredient (A.I.)	Application Rate	Application Dates
Azera®	Azadirachtin 1.20 % Pyrethrins 1.40%	2 fl. Oz. / gal.	5-May, 8-May, 15-May, 26-May, 5-Jun
BotaniGard®	Beauveria bassiana Strain GHA	3 lbs. / 100 gal.	5-May, 8-May, 15-May, 26-May, 5-Jun

Grandevo®	<i>Chromobacterium subtsugae</i> strain PRAA4-1	3 lbs. / 100 gal.	5-May, 8-May, 15-May, 26-May, 5-Jun
Pyganic®	Pyrethrins	1.4 fl. Oz. / gal.	5-May, 8-May, 15-May, 26-May, 5-Jun

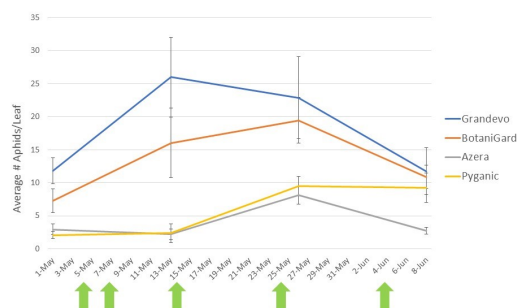


Figure 2. Changes in aphid populations across time for the four insecticide treatments. Means are calculated based on number of plants sampled within each treatment on each sampling date + standard errors. Arrows along the x-axis indicate pesticide application timing.

Two of the tested products are biological pathogens, which we can expect to take some time to negatively impact the population. BotaniGard® typically takes 7-10 days to see control, according to the label. The Grandevo® product label recommends a knockdown is applied prior to or in a tank mix application at high populations, which was the case here. The label also suggests application of the high rate with increased volume to ensure coverage and short intervals between applications. In this study we applied the high rate for all products and used an electro-static sprayer to optimize coverage of the product. The results shown here indicate good control being achieved with the Azera® and Pyganic® products, when applied at levels of high population infestations. Over time, Azera® maintains the highest level of control. However, BotaniGard®, Grandevo® and Pyganic® provide the same level of control at the most recent survey (8-Jun). Some unique symptomology observed in the row treated with Grandevo® are shown in Figure 3. There were desiccated aphid bodies that appeared white in color with dark black spots on the back side. This was not observed on aphids in any of the other treated rows.



Figure 3. Aphid carcasses observed on Grandevo®-treated strawberry plants and observed under a microscope.

Observations of Other Pests and Natural Enemies

In addition to monitoring the changes in aphid populations during our insect surveys, we take note of other pests and beneficial insects encountered. In terms of pests in our strawberry plot, we occasionally encounter whiteflies, green planthoppers and some caterpillars but none of these pests have reached economically damaging levels. In terms of natural enemies, we have seen a wide variety including lacewings (eggs and larvae), lady beetles (larvae and adults), syrphid fly larvae, orius nymphs, parasitized aphids and nabid bugs, shown in Figure 4. These natural enemies occur more frequently in the area treated with Grandevo® and to a lesser extent BotaniGard®. This is likely a combination of more prey items available in these treatments and less impact from the pesticide applications. Azadirachtin (neem) and Pyrethrins are toxic to the pests and beneficial insects. **Food for thought when designing your pest management program.**



Figure 4. Ladybeetle (A), Orius nymph (B), lacewing larva (C), syrphid fly larva (D), and nabid bug (E) predators of aphids found in strawberry plot. Photos by John Obermeyer and Laura Ingwell.

Hoophouse Nutrient Management — Notes from Great Lakes Vegetable Producer's Network Weekly Roundtable Discussion

(Wenjing Guan, guan40@purdue.edu, (812) 886-0198) & (Liz Maynard, emaynard@purdue.edu, (219) 548-3674)

A few weeks ago, Great Lakes Vegetable Producer's Network discussed hoophouse nutrient management. Judson Reid from Cornell University and David Van Eeckhout from The Good Acre, St. Paul, MN are the invited speakers. They shared their insights in hoophouse nutrient management. I find them very helpful, thus want to pass my notes to Indiana hoophouse growers.

Judson pointed two things from greenhouse perspective that may greatly benefit hoophouse growers, one is ventilation, another is pollination. Ventilation is important for managing relative humidity and maintaining carbon dioxide level. But ventilation may be sacrificed in hoophouse for the reason of maintaining temperatures during periods of cool weather. For hoophouse growers, anything that can increase ventilation (end wall vents, peak vent) could greatly benefit vegetable production in the early season. Hoophouse tomato growers can also greatly benefit from bumblebees for pollination. If the structure is usually closed and there is little wind movement of the plants, plants or flowers must be manually vibrated or visited by insects for pollination.

In terms of fertility management, Judson noted that a big change between fertility management inside hoop house and in the open field is Calcium. Vegetables grown in open field may need additions of Calcium fertilizer, but soils inside a hoophouse tend to build up Calcium when hard water with high levels of calcium carbonate is used for irrigation. Phosphorus also tends to build up in soils of hoophouses. This often occurs when composts and other fertilizers or soil amendments are applied as sources of nitrogen without attention to the amount of phosphorus that is being applied, which can be well above the amount needed or removed by the crop. A related issue is pH creep due to irrigation water high in alkalinity. Speakers gave practical ways to avoid pH creep: 1. Measure soil pH, find what pH is, one measurement in the spring, one measurement in the fall; 2. Apply sulfur on an annual basis, and include this as a standard practice if irrigation water is known to increase soil pH; 3. Acidify irrigation water if needed. Be cautious when adding acid. Test irrigation water for alkalinity and consult charts that provide guidance for the amounts of various kinds of acid to add based on the alkalinity of the water. Mixing high alkaline well water with rain water can be another approach to reducing alkalinity; 4. Remove plastic every 3-4 years and leave soil uncovered during a period with substantial precipitation. Plastic should be replaced periodically anyway because the light transmittance declines. By leaving plastic off, precipitation moves through the root zone and leaches salts and calcium; reducing salinity and pH. David pointed out that organic fertilizers are expensive, and without knowing soil pH, it is like throwing money away.

About using foliar fertilizers, speakers agree that it is a corrective action, not the main way to apply fertilizers. Foliar fertilizers may solve some immediate problems, for example, Mn (manganese) deficiency; Mn probably is enough in the soil but deficiency can occur when soil pH is too high. Foliar applied Mg (magnesium) may also have some effects, but if irrigation water is hard (alkaline) it probably contains magnesium carbonates and so magnesium is already being regularly supplied to the soil. As a corrective action, use foliar fertilizers only when a specific nutrient deficiency is known and the plant cannot obtain the nutrient from the soil.

Great Lakes Vegetable Producer's Network is scheduled at 12:30 ET

every Wednesday from the May to Sep. covering a lot of topics in vegetable production. Check the website <https://www.glveg.net/listen> for previous (recorded) and upcoming sessions.

Question of the Week (6-18-2020)

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



What is causing the spots on the watermelon leaf?

- A) anthracnose
- B) early blight
- C) a contact herbicide

Answer to Question from Last Issue (6-3-2020)

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Question: Why are the water droplets arranged so evenly around the edge of this cucurbit leaf?

Answer:

The water droplets came out of pores that are at the edge of the leaf where a vein ends. The pores are called hydathodes. The droplets form through the process of guttation. Guttation is when the water pressure in the plant is high enough to force water out of the hydathodes. This occurs when soil moisture and humidity are high, typically at night during rainy humid weather.

The hydathodes may also serve as a means for bacterial pathogens to enter leaves. The water droplets can be drawn back into the plant as the sun comes out, relative humidity drops, and the leaf begins to lose water through transpiration. When bacterial diseases are present, these water droplets can be a major means of disease spread if people, animals, equipment, wind, or rain move water droplets containing bacteria from one plant to another.

For instance, see how the angular leaf spot on this cantaloupe leaf starts at the leaf margin and moves down the vein.



Black rot of cabbage and other crucifers also can enter through hydathodes and spread down the veins.



Updated Resources to Check Out!

(Laura Ingwell, lingwell@purdue.edu, (765) 494-6167)

The Purdue Extension Entomology Vegetable Team has a new website available for you to stay in touch and access resources for pest management in your vegetables, wherever and however you grow them! It is also the place to stay updated with the CEW trapping for 2020 by following the page to this [location](#).

Check it out! <https://extension.entm.purdue.edu/veg/>

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