

# VEGETABLE CROPS HOTLINE

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



Issue: 688  
May 6, 2021

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## Reducing Blossom End Rot and Yellow Shoulder/Internal White Tissue in Tomato

(Liz Maynard, [emaynard@purdue.edu](mailto:emaynard@purdue.edu), (219) 548-3674)

As tomatoes bloom and set fruit it is a good time to review practices for avoiding some common fruit problems. Water management is key to avoiding blossom end rot. Adequate potassium is important to reduce yellow shoulder and internal white tissue. This article provides more information on these topics, and includes some information previously published in issues 558 and 599 of this newsletter.

Blossom end rot is a physiological disorder caused by a deficient supply of calcium to the developing fruit. It is a common problem on tomatoes, but can also occur on peppers, eggplants, and melons. Blossom end rot appears first as a small darkened or water soaked area, usually at the blossom end of the fruit (Figure 1). This spot darkens, enlarges and dries out as fruit matures. The area may be invaded by secondary decay causing organisms. Prevention is the best way to avoid losses from blossom end rot. Prevention strategies emphasize ensuring adequate supply and availability of calcium, and managing plant growth environmental conditions to promote movement of calcium to the developing fruit.



Figure 1. Blossom end rot of tomato. Tomatoes with this disorder ripen early.

If I could offer just one suggestion for avoiding blossom end rot it would be to maintain a consistent water supply. In many cases I have seen, this is a key factor. Any interruption of water supply to the roots, for example during hot dry weather, can cause a temporary calcium deficiency in the developing fruit that will lead to blossom end rot. A sudden change to hot sunny weather after a period of cloudiness may promote blossom end rot due to the increase in water demand. In protected culture increasing humidity may reduce blossom end rot because the plant demand for water will be reduced.

Nutrient management is also important. Check that soil calcium levels are sufficient, and in cultural systems where most calcium is supplied through fertigation, assure that sufficient amounts are being applied. In many Indiana high tunnels, soil calcium levels are high as a result of irrigation with hard water. Even in outdoor fields, calcium levels are often sufficient and it is getting the calcium to the developing fruit that is the problem. Avoid excess nitrogen. Nitrogen promotes vegetative growth that can compete with the developing fruit for an adequate supply of calcium, leading to blossom end rot. Avoid excess potassium or magnesium because they can interfere with uptake of calcium. High electrical conductivity (EC) in a soilless culture system can also promote blossom end rot.

In addition to managing nutrients and water, providing

conditions for a healthy root system is important. Avoid compaction and provide good drainage.

Varieties differ in susceptibility to blossom end rot. Plum types are often more prone to the disorder; it is virtually unknown in cherry tomatoes.

Blossom end rot can cause significant losses and is a problem that can be avoided with proper management. It may take some investigation to determine what measures will be effective in a particular situation; time well spent if it reduces the loss of marketable fruit.

Yellow shoulder and internal white tissue are disorders that become visible on ripe tomatoes. Yellow shoulder describes yellow hard areas near the stem end of tomato fruit that fail to ripen properly (Figure 2). Even on fruit that doesn't show the distinct yellow on the shoulder, cutting across the top of the fruit will reveal internal white tissue that is also associated with the disorder (Figure 3). A variety of factors make this problem more likely to occur, including genetics, temperature, and potassium nutrition. The article [Tomato Varieties Differ in Susceptibility to Internal White Tissue Disorder](#) published last August in issue 680 of this newsletter provided information on susceptibility of some fresh market varieties to this disorder. Temperatures in high tunnels can be managed to some extent with ventilation and use of shade cloth.



Figure 2. Yellow shoulder disorder on a ripening tomato fruit.



Figure 3. Internal white tissue of tomato fruit.

Potassium nutrition is important to address early in the season. Tomato fruit contain large amounts of potassium, about 0.35 lb. K<sub>2</sub>O per 100 lb. of fruit, and if the potassium is not available in the soil as plants and fruit grow, disorders can develop. Consider taking some time now to review how potassium is managed for the tomato crop.

A common approach is to use a soil test before planting to assess the potassium supply of the soil. Based on the test, a recommendation for the amount of potassium to add is developed that takes into account the soil type and the expected tomato yield. For example, if the soil test reports 115 ppm K for a soil with cation exchange capacity (CEC) of 4, the recommendation would be to add enough potassium to replace what is removed by the harvested crop. For a yield of 30 tons/acre, that would be 210 lb. K<sub>2</sub>O/A. For a yield of 2500 lb./1000 sq. ft. that would be 8.75 lb. K<sub>2</sub>O/1000 sq. ft. The potassium should be in the root zone before the plant needs it, either applied before planting, or in several applications over the season, or routinely through a fertigation system. A rate of 1 to 3 lb. K<sub>2</sub>O /A/day (0.0229 to 0.0687 lb. K<sub>2</sub>O/1000 sq. ft. /day) could be appropriate in a fertigation system, depending on soil K levels and crop need. A video working through calculations for potassium fertilizer application is available at <https://www.youtube.com/watch?v=73s3m8Ke3r4>.

Assuring that soil potassium is available to the tomato crop is also important. In addition to placing nutrients in the root zone, pay attention to supplying adequate water in that zone. Also, remember that excess supply of other positively charged nutrients (e.g. calcium and magnesium) can interfere with potassium uptake by the plant.

It can be difficult or impossible to know, just by looking at a crop, whether nutrient levels in the plant are sufficient. Deficiencies occur before visible symptoms occur. For this reason, plant tissue tests are recommended for new growers, in situations where yellow shoulder or internal white tissue have previously been a problem, and for others

wanting to assess crop nutrition. Samples collected early in the season and then every two or three weeks will alert you to potential problems so that nutrient application can be adjusted if needed. A & L Great Lakes Laboratory, Fort Wayne, IN and Waters Ag Lab, Owensboro, KY are examples of commercial labs that routinely perform plant tissue tests.

## Cantaloupe and Watermelon Transplant Diseases

(Dan Egel, [egel@purdue.edu](mailto:egel@purdue.edu), (812) 886-0198)

Many cantaloupe and watermelon growers are either growing transplants in a greenhouse or are expecting delivery of transplants in the next few weeks. Either way, growers should inspect transplants for disease before planting in the field. Below I will describe several common transplant diseases of cantaloupe and watermelon as well as management options.

Gummy stem blight on transplant seedlings may be recognized by the watersoaked area of the stem near the seed leaves (Figure 1). The watersoaked area may eventually turn brown and woody. A closer look at the woody area may reveal the small, dark fungal structures of the gummy stem blight fungus. Medium brown, irregular lesions may also be observed on true leaves. A watersoaked area near the soil line is more likely to be damping-off (Figure 2).



Figure 1. A common symptom of gummy stem blight of watermelon is a watersoaked area where the seed leaves attach to the stem.



Figure 2. Damping-off lesions, such as for this watermelon seedling, typically begin at soil level.

The fungus that causes gummy stem blight (*Stagonosporopsis* spp.) may survive in crop debris, thus overwintering in the field from year to year. This fungus may also be introduced through seed or transplants. It is also possible for the fungus to survive in greenhouse production facilities.

Anthracnose of watermelon is another disease that may be observed on transplants. The lesions caused by anthracnose (*Colletotrichum orbiculare*) are often jagged or sharp in appearance (Figure 3). Stem lesions are less common, but if they occur they may appear watersoaked, light brown and pitted. Such stem lesions will not necessarily appear at the seed leaves. Anthracnose on cantaloupe transplants is less common.



Figure 3. Anthracnose lesions on watermelon often appear jagged.

As described above for gummy stem blight, the fungus that causes anthracnose may survive in crop debris such as in transplant production facilities. This fungus may also be introduced through seed or transplants.

Watermelon transplants with *Fusarium* wilt often appear wilted or the plant tops may have died back (Figure 4). Symptoms that appear under humid greenhouse conditions may be accompanied by white mycelial growth of the causal fungus, *Fusarium oxysporum* f.sp. *niveum*. Seedlings with

Fusarium wilt symptoms may be clustered in transplant trays.

Fusarium wilt may be introduced through seed or transplants. Unfortunately, the fungus that causes Fusarium wilt has long-lived spores that may survive for years in soil, equipment, or transplant trays.



Figure 4. Fusarium wilt on a watermelon transplant with die-back symptoms.

The symptoms of bacterial fruit blotch (BFB) can be difficult to recognize on foliage. Leaf lesions may have a dark necrosis with watersoaked margins (Figure 5). Leaf symptoms of BFB are easily confused with angular leaf spot, a disease that is not often economically important. A laboratory analysis may be required to distinguish these two diseases.



Figure 5. Lesion of bacterial fruit blotch on a watermelon transplant may appear watersoaked.

The bacteria that cause BFB do not often survive in crop debris; the disease is more often transmitted through seed. Although symptoms are more often observed on watermelon, cantaloupe transplants may also be affected. To guard against these diseases in your field, carefully

inspect transplants regularly during production or upon delivery. If unsure about symptoms, send them to the Plant Pest and Diagnostic Laboratory or a similar laboratory for an official diagnosis. Clean and sanitize transplant production facilities and equipment in-between generations. Purchase transplant trays for each generation of transplants or clean and sanitize trays well. Do not use soilless greenhouse mix that has been opened or come into contact with the ground or unclean equipment.

Purchase vegetable seed that has been tested for the diseases described above. Ask your seed company representative if you are uncertain about what tests have been conducted.

If fungicides are applied during transplant production, growers should choose a product that is allowed for greenhouse use. In addition, a contact fungicide with the FRAC group M is recommended so that future use of systemic products will be easier to schedule. Fungicides with the active ingredient mancozeb (e.g., Dithane®, Manzate®, Roper®, Penncozeb®) should serve most purposes.

Finally, avoid planting transplants grown from seed lots or greenhouses where any of these diseases has been confirmed. Seedlings that appear healthy may in fact have a disease that has spread from a nearby seedling.

In most years, it will be impossible to avoid at least some of the diseases described above. But, as much as possible, do not plant these diseases with your transplants. In particular, avoid using transplants with Fusarium wilt. Since the Fusarium wilt fungus survives many years in the absence of a host, an introduced fungus may last indefinitely. Plus, watermelon transplants with Fusarium wilt may add a new race or strain of the fungus to your field.

Managing these diseases in the field is a different discussion and will be addressed in many articles throughout the year.

This article was updated from an article published in May 6, 2020 in issue 673.

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## Strawberry Update

(Wenjing Guan, [guan40@purdue.edu](mailto:guan40@purdue.edu), (812) 886-0198)

Strawberry harvest is right around the corner. We visited a few fields last week, things are generally looking good at the farm visited. Damage from the freeze event about two weeks ago seems minimal. With last year's lesson, growers are prepared and applied frost protection to the early cultivars. Under the protection, the blooms survived the freeze event without significant damage. Some blooms were killed in fields without protection, but in general, those plants have not reached the full blooming stage and the

temperature in the area did not drop to the point to kill popcorn stage flowers and tight buds.

The past fall was relatively warm, and winter was mild, which might have created great strawberry growth and flower initiation conditions. In southern Indiana, we saw Chandler plants growing on black plastic mulch with 3-5 crowns will likely lead to a good yield this year (Figure 1). We even saw some fruit has started to turn red. In central Indiana, bare-root plants that were planted in June last year on white plastic mulch are also developing very well, with a similar number of crowns. Early cultivars were starting to bloom. In the matted row systems, we also found many cultivars are entering the blooming stage (Figure 2). Farmers commented that the crop is looking good, and the plants are in a good spacing.

High tunnel strawberry is in peak harvest in our trials in southern Indiana. Harvest started around middle April, a little later than previous years. This might be related to a severe aphid outbreak in the winter. But yield seems not to be affected.

Little disease and pest issues were observed in our scouting of growers' fields, except two-spotted spider mites that were observed in a plasticulture field.

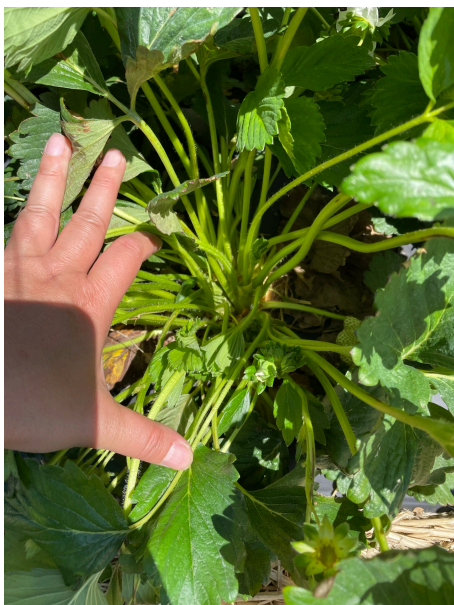


Figure 1. Strawberry growing on black plastic mulch in southern Indiana.



Figure 2. Strawberry in a matted row system.

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## 10 Useful Rules for Fungicide Applications

(Dan Egel, [egel@purdue.edu](mailto:egel@purdue.edu), (812) 886-0198)

This is the time of year when vegetable growers may start to apply fungicides. Below I list 10 rules that will help vegetable growers apply fungicides effectively and safely.

1. Apply fungicides prior to the development of disease. Although many fungicides have systemic ("kick back") action they will not completely eradicate diseases after they have started. And by the time a single disease lesion is observed in the field, many more lesions too small to observe are already working at your crop. Most systemic fungicides move less than an inch toward the tip of the plant or may just move from the upper to the lower side of the leaf.
2. Use shorter spray intervals during weather conducive to plant disease. Each plant disease has its own "personality" and thus prefers different weather. However, most foliar plant diseases require leaf wetness. Therefore, during periods of rain and heavy dews, more frequent fungicide applications are a good idea. The normal range of spray applications is every 7 to 14 days. Cantaloupe and watermelon growers have the guesswork taken out of this process with a Purdue University program known as **MELCAST**. Ask the author for more details by calling (812) 886-0198 or go to [melcast.info](http://melcast.info).
3. Apply fungicides before a rain if possible. Water is necessary for most fungal spores to infect a plant and for the splash dispersal of many spores. Therefore, apply fungicides before a rain if it appears that the

fungicide will have a chance to dry before the rain. It is not necessary to apply fungicides again after every rain. Most fungicides have a good sticker and will persist through rains pretty well. The **MELCAST** program takes into account the effect weather has on fungicides. More information can be found about rainfastness of fungicides in issue 685.

4. Know when to alternate fungicides. Systemic fungicides, those with a single mode of action, if applied again and again in sequence, may cause disease causing fungi to mutate into a form resistant to the fungicide. It is always a good idea to alternate fungicide applications from one FRAC code (MOA code) number to another. Read the label carefully to find language about fungicide alternation. Contact fungicides with a FRAC code of M like chlorothalonil and mancozeb are very unlikely to cause such mutations and therefore may be applied in sequence. Although some fungicides may have designations such as M01 or M02, any fungicides with an M does not need to be alternated. Table 32 in the *Midwest Vegetable Production Guide* <http://mwveguide.org/> will help growers alternate fungicides.
5. Timing of fungicide applications is more important than nozzle type and spray pressure. Studies here in southern Indiana as well as by researchers in other areas of the country have found that nozzle type and spray pressure don't make as much difference as we once thought. In general, the more water one uses per acre, up to about 50 gallons, results in better coverage.
6. Some diseases cannot be managed by foliar sprays. Problems caused by soil borne fungi or nematodes cannot be controlled with foliar fungicides. Examples of these types of problems would be Fusarium wilt of watermelon or root-knot nematodes. Also, be certain that the problem you observe is really a disease. No amount of fungicide will improve a problem caused by soil fertility. Send a sample to the Purdue Plant and Pest Diagnostic Laboratory to find out the official diagnosis <http://www.ppd.l.purdue.edu/ppdl/index.html>.
7. Use copper products for bacterial diseases. For the most part, copper products are more effective against bacterial diseases than they are against fungal diseases. However, some bacterial diseases are caused by pathogens resistant to copper products.
8. Some diseases require specialized fungicides. Diseases, such as downy mildew and Phytophthora blight, may require specialized fungicides. It may be

wasteful to apply specialized fungicides all season long for diseases that are not a threat. For example, downy mildew of cucurbits usually does not arrive in Indiana until late in the season.

9. Double-check the label for details. Rates may vary widely based on label changes and different formulations. While you are checking the rate, also make sure that the crop and disease are on the label. (Can this fungicide be applied in the greenhouse?) Did you get the rate from the *Midwest Vegetable Production Guide for Commercial Growers?* <http://mwveguide.org/> Check the label anyway.
10. Play it safe. Always adhere to the Post-Harvest Intervals, Re-Entry Intervals and Worker Protection Standards listed in the label. No one wants an accident or lawsuit. Besides, the label is the law.

This article was updated from an article published in June 22, 2017 in issue 630.

## More Observers Needed to Monitor Precipitation Across Indiana

(Beth Hall, [hall556@purdue.edu](mailto:hall556@purdue.edu))

It seems the weather pattern may have shifted toward wetter conditions. Over the past week, Indiana has received over an inch of rain and the 7-day forecast is predicting at least another inch (Figure 1) in the central and southern parts of the state. The northern counties of Indiana, that have been in the *Abnormally Dry* status (or worse) on the US Drought Monitor, seems to continually miss the bulk or precipitation. The latest monthly outlook for May was released on April 30<sup>th</sup> and it is favoring above-normal precipitation for the month (Figure 2). Certainly, the first few weeks of May look wet; will the remainder of the month continue in that pattern? With respect to temperature, the outlooks are slightly favoring below-normal conditions which may help keep whatever rain falls from evaporating too quickly!

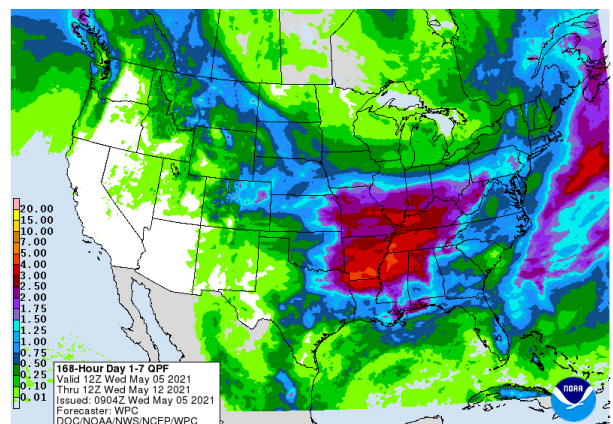


Figure 1. Forecasted precipitation amounts for May 5-12, 2021.

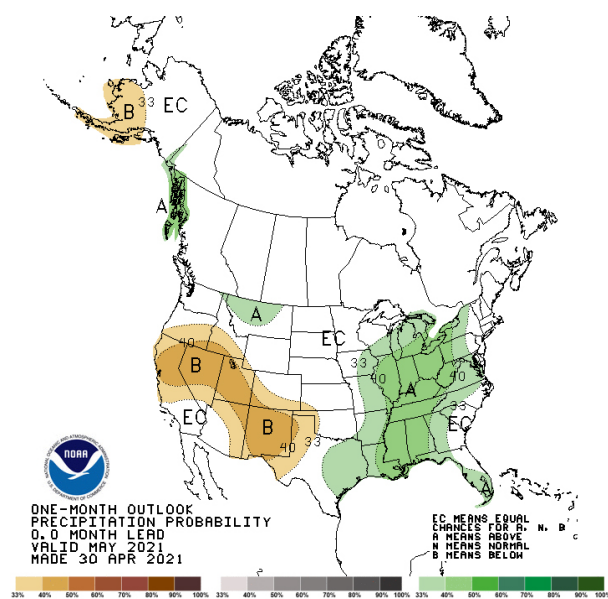


Figure 2. Probabilistic precipitation outlook for May 2021. Predictions are favoring above-normal precipitation for the Indiana region. Source: Climate Prediction Center.

Over the past several months, it seems northern Indiana has not received as much precipitation as central and southern Indiana. When we examine maps that average precipitation over longer periods of times, data tends to smooth the more detailed story of individual rainfall events. However, for individual storm events, it is helpful for weather and climate experts and enthusiasts to know more specifically where higher and lower amounts of precipitation fell, even over short distances. While the federal government manages a variety of rain gauge networks, getting rainfall information every few kilometers has been challenging. In 1998, an isolated rainstorm event occurred in the mountains of Colorado that resulted in serious, unpredicted flooding. Because of the lack of observations, the National Weather Service was unable to know how much was falling and where, let alone better calibrate their radar and forecast models due to the lack of data. Thus, formed CoCoRaHS – the Community Collaborative Rain, Hail & Snow Network ([www.cocorahs.org](http://www.cocorahs.org)). This is a citizen science program that invites volunteers such as yourself to join, provide a standard, manual rain gauge, and take daily observations of rainfall in your area. The impact of this additional data can be striking. For example, Figure 3 illustrates a rainfall total map from an event in early January 2020 that compares data from federal observation sites compared to one that includes data from CoCoRaHS volunteers. Note the increased level of detail that the CoCoRaHS observations provide! If you're interested in learning more about CoCoRaHS and perhaps signing up to be a volunteer, please go to [www.cocorahs.org](http://www.cocorahs.org) or email me at [bethhall@purdue.edu](mailto:bethhall@purdue.edu).

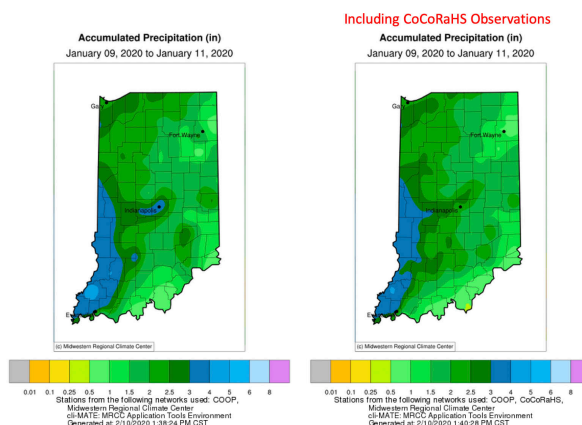


Figure 3. Comparison of maps showing interpolated precipitation observations when considering data from only the National Weather Service's Cooperative Network (COOP; left map) to the one that includes both COOP and CoCoRaHS data (right).

## Communicating For the Farm Webinar Series

(Cora Carter, [cora@purdue.edu](mailto:cora@purdue.edu))

Montana State University Extension Pondera County and Purdue Extension – Bartholomew County are teaming up to bring you a webinar series dedicated to helping you improve your agriculture communication skills. Adriane Good, from MSU Extension, and Cora Carter, from Purdue Extension, noticed that many agricultural producers want to engage with the public and share their story but have difficulties doing so. This webinar series aims to help producers with that, giving them the skills to communicate effectively and present themselves professionally online when engaging with a non-agricultural based public.

The series will start off with two scientific communication professors from Purdue, Drs' Beth Forbes and Linda Pfeiffer leading two sessions on effective communication. The first, on May 13, will focus on media literacy and critical thinking. This session will help participants figure out where to find credible sources and how to verify the information you're getting. The second session, on May 20, will discuss how to effectively communicate your points and engage with the people you're speaking to. Beth and Linda are both part of the leadership team of College of Agriculture course at Purdue that helps students learn how to engage with the public on controversial issues.

On May 27, participants will get a chance to practice these skills. Participants will be broken out into smaller groups and asked to practice by discussing common controversial practices in agriculture, while remaining civil and professional.

Our fourth session, on June 3, will feature Carrie Mess (@dairycarrie), a Wisconsin dairy farmer with a large social

media following. Carrie has been using social media to connect with consumers for over 10 years and will help you learn how to craft your own story for social media.

On June 10, Sara Hollenbeck of High Five Meats, Montana, will discuss presenting yourself professionally online. It can be difficult trying to decide what you should share on social media to retain a sense of professionalism while still being authentic. Sara will help you figure that out, drawing from her experience using social media to promote her local meat company.

The final session, on June 17, will be allowing you to put it all together! Once again, participants will be broken out into smaller groups and given a chance to practice using all your new skills. Other MSU and Purdue Extension educators have volunteered to participate in discussion with class participants, to give everyone a chance to communicate with all sorts of different people.

Each week's class will begin at 7 PM EST and last until 8 PM. The webinar series will be hosted via Microsoft Teams, which will allow class participants to interact with each other between sessions. If you are unfamiliar with teams, a video will be distributed to familiarize you with the software. The webinar series is free of charge. Registration can be accessed at [puext.in/comm4farm](https://puext.in/comm4farm), please answer all the questions in the registration as these will help us tailor the program to the group that attends. For more information about the webinar series, contact Cora Carter at [cora@purdue.edu](mailto:cora@purdue.edu) or 812-379-1665.

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Communicating for the farm

## Northwest Indiana Produce Update Video Series

Purdue Extension Educators will be updating growing conditions at different produce farms throughout Northwest Indiana this Spring and Summer. Videos will highlight growing methods and talk about things to be on the lookout for. See the first video from Kajer's Greens in Starke County and find future updates at <https://sites.google.com/view/nwinproduceupdate/home>.

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