PENNSYLVANIA
VEGETABLE GROWERS

NEWS

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for the commercial vegetable, potato and berry grower

Chris Torres

Art King held a steady job at a local lumber business in his hometown of Valencia, Pa., when his father died in 1992.

His parents had built a solid farm business since moving to the North Hills outside Pittsburgh many decades earlier, but Art didn't follow them into farming. When his father's will was read, something was left to Art that he didn't expect: his father's tractor.

"I took that as a sign from the grave, and I made the difficult decision to quit my comfortable job and go into business with my brother, Larry, farming," he says. "I also wanted to spend time with my kids and work alongside them on the farm."

Turns out, he was pretty good at farming. Since joining the operation, Art has overseen most of the farm's improvements and innovations, and has become passionate about sharing his knowledge with other vegetable growers.

Art is equal partners in Harvest Valley Farms with his brother, Larry, who's been on the farm since the 1970s, and son, David. Art is administrator of the operation that includes 160 acres, and more than 163 varieties of fruits and vegetables.

It's changed a lot since his parents started the operation and ran a 5,000-layer poultry operation, plus vegetables, pigs and other things — although Art still has a small herd of pastured pigs and some chickens.

In an area where consumers have lots of options to get their produce, Art focuses on raising the best-quality fruits and vegetables to keep his customers coming back.

"I think the essence of Harvest Valley Farms has a lot to do with the quality of product that we put out. We know what quality looks like, and so we're able to present quality all the time," he says.

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Chris Torres

Have Your Farm Picture Featured in a Future PVG News

We try to feature a prominent picture each month of the front page of the Pennsylvania Vegetable Growers News. In the past we have used photos from a PVGA member that we found on their Facebook page or photos a member submitted at our request. We would like to offer the opportunity for any member to submit a photo from their farm or market that they think would be appropriate for the PVG News front page. It could be a scenic view from your farm, a picture of produce displayed at your market, a photo of something unique to your farm or operation or a photo you have used on your Facebook or other social media page.

In addition, we will offer the opportunity to also include a paragraph or so about your farm or family, or an account of something unique that you are doing on your farm. We hope this will add an extra human-interest aspect to the newsletter.

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All In on Greenhouses

Greenhouses and high tunnels are an integral part of the farm today. There were none when Art came back to the farm in 1992.

"The thinking in building the first one was, we wanted to grow our own vegetable plants; we wanted to extend the season. And then Penn State started getting into high tunnel research," Art says.

The first high tunnel, a 16-foot-by-96-foot structure, was constructed in 1995. It was so successful that a second one was constructed in 1996, and then larger ones were built later.

There are now 11 greenhouses and high tunnels on the farm, which helps extend the season for dozens of vegetable and fruit plants. Some of the high tunnels are heated by giant wood burners on the outside with interior heat exchangers that keep the temperature inside above freezing in February or March, or later in the season.

"The main thing is we want to have something fresh, green, that we just picked that day at our farm market in November and December, and March and April, and we wouldn't be able to do that without the high tunnels," Art says.

Innovating to Grow

Millions of people live around the Pittsburgh area, which provides a good market to sell to. But growing crops in the North Hills is not easy.

"It is not conducive for vegetable farming, or any farming for that matter," Art says. "Almost all the fields are sloped, and that is challenging."

It's forced Art and his partners to come up with innovative solutions to make growing easier. For example, he uses a bale shredder that takes round bales, chops them up and then spreads the mulch onto the fields. This helps to reduce soil erosion and runoff from rain, holds soil moisture in the plants and provides some organic matter.

Potatoes, which need a lot of moisture, can be challenging to grow in his fields, especially if it gets dry. One thing he's done is grow spuds in degradable black plastic in raised beds and drip irrigation.

"When we did them, it's easy to cut a trough with the potato digger. And it worked out good," Art says. "With plastic, the potatoes grew faster and bigger because it conserved moisture."

Cucumbers also need lots of water to grow bigger and to taste better. Art likes growing cucumbers in bags that are attached to lines in the greenhouse, allowing the cucumber vines to grow longer throughout the season.

Two fertilizer mixes are added to a 100-gallon tank, along with some acid to lower the water pH. A submergible pump feeds the drip irrigation system and allows the cucumbers to get plenty of water and food.

"We're always willing to try something new and different," Art says.

All Retail

Growing produce is only part of the farm's key to success. All produce is sold within 25 miles of the farm — at two farmers markets in Pittsburgh, through the farm's 530-member CSA (community supported agriculture) and at the farm's own market located a few miles away.

"It gives us a lot of flexibility," Art says. "Say we have a lot of cucumbers to sell. Well, we can include it in the CSA that week, or move a lot of product somewhere else or offer it to the food bank. But there's lots of different ways we can juggle things."

One outlet he's proud of is the farm's own market located a few miles away from the farm. The market started as a small operation run out of his mother's garage, but in 2009, a new market was built. Subsequent improvements have added a bakery, which he says was suggested to him by experts in the farm retail space.

"We try to focus on local," Art says. "We have about 25 vendors who sell local products in addition to our fruits and vegetables."

Supporting the Next Generation

Art's son, David, graduated from Penn State in the mid-2000s and then joined the business. He is an equal partner and will take over the farm once Art and his brother retire.

"We've already done a succession plan with a lawyer from Ohio," Art says. "Everything is set. We got a vitality grant from the Pennsylvania Department of Agriculture to help. It's essentially a book that covers every base of the plan."

But educating the next generation of farmers is just as important to Art as knowing his farm will be in the family once he steps away.

"Getting educated and sharing my ideas with others, it's very important to me," he says. "I think what knowledge I have should be shared, especially with beginning farmers. That's why I'm always very much involved with the Pennsylvania Vegetable Growers Association. I've been on the board of directors for many years, and always help put together the Mid-Atlantic Fruit and Vegetable Convention."

Art has volunteered his time on several community boards, through his church and was even a Boy Scouts Webelos leader.

"It's important to be involved in the community," he says. "I have done talks at schools for no charge. I do a lot of talks for garden clubs, rotaries and I continue to do that all the time. That's just a very important thing to do for the community."

Art King at a Glance

Operation: Harvest Valley Farms; 137 acres, 163 varieties of fruits and vegetables

Family: Wife, Kathleen, and three children, David, Jenifer and Stephanie

Ag and community involvement: Board member or active member of Pennsylvania Vegetable Growers Association, PASA Sustainable Farming, Pennsylvania Farm Bureau, Royal Grange #1972, Holy Sepulcher Church Council, volunteer with the Youth Core Committee, Pennsylvania Simply Sweet Onion committee, Knights of Columbus, Boy Scouts Webelos leader, 2019 Penn State Extension Honorary County Agent, 2022 PASA Pasabilities Award winner

*Mr. Torres is with the American Agriculturalist. From the **American Agriculturalist**, https://www.farmprogress.com/master-farmers/high-quality-produce-drives-art-kings-success-story, June 3, 2022.*

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Directors Meet, Hear Update on New Executive Director

The PVGA Board of Directors held their summer meeting virtually on Tuesday, July 19, at 8:00 p.m. There were no major issues to be decided at this regular meeting although the Executive Secretary Search Committee reported that they would be scheduling an in-person meeting for the Committee and the Executive Committees of the Association and the Pennsylvania Vegetable Marketing and Research Program with a candidate for the position on July 26.

PVGA received over 100 resumes for the Executive Director position although only 20 applicants submitted a full application packet. The Committee reviewed these 20 applications and selected six to interview. Two of these six applicants found other positions prior to the interview, so only four were actually interviewed. These interviews were all virtual. The Committee is in the process of narrowing down their choices now. When a final candidate is selected for recommendation to the Board, a special meeting of the full Board will be scheduled to vote on the recommended candidate. The goal is to have the candidate begin this fall as a deputy Executive Director for a year or so of transition until William Troxell retires at the end of 2023.

Besides the Search Committee report, the Directors received reports from the officers and other committees. The financial report showed sufficient resources in the treasury although the cancellation of the Farm Show and Mid-Atlantic Convention in 2021 have significantly depleted the reserves that the Association previously had on hand. Membership has rebounded to 859 from last year's dip to 784 at this point in the year. However, it is over 100 below what membership was in the summer of 2020.

The Board reviewed the preliminary program plans for the 2023 Mid-Atlantic Fruit and Vegetable Convention. One of the sessions being planned is a session on urban agriculture. Since this will be targeted at an audience that usually does not attend the Convention, the team planning the session is working on a special outreach to those involved in urban agriculture – hopefully bringing them to the Mid-Atlantic Convention for the first time and enabling them to see the benefit of returning in future years. The Board approved sponsoring a special luncheon for this group at the 2023 Convention.

One the of current issues the Government Affairs Committee is working on is eliminating the requirement for H-2A employers and workers to pay into the state unemployment fund. H-2A workers cannot collect unemployment benefits but Pennsylvania law currently requires that employers and employees still pay into the fund. Representative Torren C. Ecker introduced HB 390 in 2021 to end this requirement but it has not been reported out of the Labor and Industry Committee yet. It was agreed that the Association should urge members, especially those who employ H-2A workers, to contact their state representatives and members of the Labor and Industry Committee to urge them to move this bill to the House floor. The Board also briefly discussed the issue of stormwater management plans for high tunnels and the newly released proposal for delay compliance dates for the FSMA Water Rule.

The Penn State Liaison Committee reported that the urban ag position in Philadelphia County is open again and that Andrew Muza has retired from the Erie County extension position. Applicants for both positions are being recruited. The vegetable entomology research/extension position is high on the list to be filled – hopefully being moved to list of positions to definitely be filled in the near future. The Vegetable and Small Fruit Extension Team is adding information kiosks at three additional produce auctions/locations bringing the total number of kiosks to 13. They are also producing a biweekly newsletter called PA Produce News especially designed for the plain community. Another new project is a new series of podcasts entitled Produce Pointers being developed by three extension educators.

In response to requests from some members, the Board voted to authorize the Executive Director to establish special funds in memory of individuals. This will allow families to request memorial donations to be directed to the Association in memory of a loved one with the funds being designated for a specific purpose. One drawback is that because PVGA is not 501(c)3 organization, the contributions would be not tax-deductible to the donor.

The Board also reviewed a request from a member that the Association consider an effort to help recruit permanent farm workers for management level positions. Another need identified was the need for assistance for small growers to obtain third-party Good Agricultural Practices certification. These concepts will be further studied and developed for the December meeting. The Board voted to hear a presentation at their December meeting on the proposed Ag Discovery Center being developed by the Pennsylvania Dairymen's Association and the Center for Diary Excellence.

The next regular meeting of the Directors will be on December 6 in State College although, as noted above, the Board is expected to be holding a special meeting to approve the candidate for Executive Director prior to December.

Agriculture Fares Well in 2022-23 State Budget

Pennsylvania Farm Bureau is pleased that the 2022-23 state budget will institute a program for conservation funding on farms, with $220 million in funding to create the Agriculture Conservation Assistance Program (ACAP) to the clean streams fund, aimed at reducing nutrient and sediment runoff, which comes as a huge victory for farmers as PFB's biggest legislative ask of the year.

While information regarding how the funds will be administered to county conservation districts is not yet available, a burden will be lifted off a lot of farmers that can now implement their best land management practices on their properties to keep the environmental impacts to a minimum.

As a whole, conservation districts will receive an increase of $6.8 million, with $5 million coming from the Department of Environmental Protection and the other $1.8 million coming through the Department of Agriculture.

The 2022-23 state budget also notably includes $32 million to help combat avian influenza, with $25 million of the funding coming in the form of indemnity payments to the impacted farmers. An additional $6 million is available to increase laboratory surveillance activities while another $1 million was allocated for additional staffing for the Department of Agriculture.

An increase of funds to the Animal Health and Diagnostic Commission was also a part of the 2022-23 budget, which is a win for Pennsylvania farmers. When the original budget proposal was rolled out the program was essentially going to be cut, but the final iteration of the budget saw the commission reinstituted with an increase in funding.

The budget also reinstates a $5 million general fund appropriation for the Farm Show, reducing the reliance on Race Horse Development Fund dollars. The budget increases funding for the

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Produce Pointers: A Podcast for the Produce Industry

The podcast focuses on delivering timely growing information to the vegetable and small fruit industry with guest interviews from experts in research, extension, and farming.

The emphasis is on growing conditions in Pennsylvania and surrounding states. The Produce Pointers podcast is hosted by Penn State Extension Horticulture Educators Glen Bupp, Leah Fronk, and Karly Regan.

Every two weeks from early spring to late autumn, Penn State's vegetable and small fruit extension educators meet to update one another on the progression of insects and diseases throughout Pennsylvania. We also problem solve horticultural issues and look for novel pests. The information shared during these bi-monthly meetings is distilled down and shared with produce growers via Produce Pointers. This offers growers another resource for keeping up-to-date on the movement of pests and helps inform integrated pest management decisions.

Interviews with guests focus on emerging topics in the research of growing produce, in-field observations, and practical experience that can be applied by growers on their farms. Episodes for the 2022 season include interviews with university researchers, extension educators, and current farmers.

You can access the podcast and download episodes from the Produce Pointers webpage (see https://extension.psu.edu/produce-pointers) or anywhere you listen to podcasts. We encourage questions and suggestions for podcast topics and can be reached at producepointers@psu.edu.

From Penn State Extension.

Educator's Ag Institute

The PA Friends of Ag Foundation Educator's Ag Institute provides a unique learning experience for PreK-12th grade formal educators, pre-service teachers and informal community educators. The Institute provides educational tours at Penn State University as well as local family-run farms where teachers learn valuable information from those involved in agriculture including farmers, university professors and agricultural leaders. The learning experience also includes hands-on classroom sessions that cover topics such as plant and animal production, agricultural research, PA state education standards, ag history, and current/future farming trends in the agricultural industry.

Educator's Ag Institute provides teachers with:

- An **increased knowledge** of agriculture
- **First-hand experiences** with agriculture on field trips to local farms and agricultural industries
- **Lesson plan ideas and activities** that are applicable to many subject areas you are teaching on a daily basis in Oyour classroom
- **Resources** and a network of people to assist you in bringing agriculture to your classroom
- **25–27 Act 48 credits** (will need a valid PA PPID)

Educator's Ag Institute prepares teachers to **bring agriculture to life in their classrooms** and across their curriculum. It is a **standards-based program** that makes real connections. Teachers use the information they've received to integrate agriculture and information about the earth's natural resources into their curriculum. Many educators form lasting bonds with other educators, which extends the idea sharing as they go forth to bring ag into their classrooms!

PVGA annually supports the Educator's Ag Institute with $500 contribution along with another $500 for the Ag Mobile Classrooms provided by the Friends of PA Agriculture Foundation.

Agriculture Fares Well in 2022-23 State Budget

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State Food Purchase Program by $2 million as well, to provide emergency food assistance and purchase surplus agricultural products.

Overall, the Department of Agriculture will see just shy of a 30 percent increase this year in funding.

Pennsylvania Farm Bureau President Rick Ebert shared the following thoughts on the 2022-23 state budget:

"I'm really happy with the passage of the state budget this year with agriculture being the number one industry. We had our priorities of the extension service and the diagnostics lab supported. It really shows legislative support for the ag industry.

In addition, the added funding for conservation will help us reach our 2025 water quality goals for the Chesapeake Bay. We have a lot more funding resources to go back to the conservation districts to work toward that goal so farmers can implement practices to reach those goals."

The Penn State non-preferred appropriation bill remains at the current 2021/22 level of $242 million for the education and general funding line that supports undergraduate education at the University.

Richard Roush, Dean of the College of Ag Sciences had this to say about the new budget: "We are thrilled to relay that the college Land Scrip Fund, that supports the college's agricultural research and extension programs, received a 5% increase to $57.7 million. Our Animal Diagnostic Lab received a $2 million increase. Also included in the budget are funds to provide the college reimbursement for select costs related to our emergency response efforts to the highly pathogenic avian influenza outbreak. We are grateful to the Pennsylvania Legislature and Governor for this support."

Several college funding lines received flat funding, including the Ag Resource Centers and RULE.

Also worth noting, the budget contains $220 million from the federal American Rescue Plan Act for the Clean Streams Fund. Included in that funding is $154 million for a new Ag Conservation Assistance Program to provide cost-share and technical assistance to farmers. The program will be administered through the local county conservation districts. The college has been collaborating with agricultural associations and conservation groups in the development of the program and will likely play a role in the implementation.

The College of Ag Sciences is extremely thankful to their college advocates for the strong showing of support and budget advocacy in Harrisburg! They also appreciate the support we received from university leadership and the Office of Government and Community Relations, as well as their College Relations and Communications staff.

From Pennsylvania Farm Bureau and Penn State College of Agricultural Sciences.

FOOD SAFETY

USDA Announces Assistance for On-Farm Food Safety Expenses for Specialty Crop Growers

Wesley Kline

Program Details

The Food Safety Certification for Specialty Crops Program (FSCSC) will assist specialty crop operations that incurred eligible on-farm food safety certification and related expenses related to obtaining or renewing a food safety certification in calendar years 2022 and 2023. For each year, FSCSC covers a percentage of the specialty crop operation's cost of obtaining or renewing their certification, as well as a portion of their related expenses.

To be eligible for FSCSC, the applicant must be a specialty crop operation; meet the definition of a small business or very small business; and have paid eligible expenses related to the 2022 (issued on or after June 21, 2022) or 2023 certification.

Specialty crop operations may receive assistance for the following costs:

- Developing a food safety plan for first-time food safety certification.
- Maintaining or updating an existing food safety plan.
- Food safety certification.
- Certification upload fees.
- Microbiological testing for products, soil amendments and water.
- Training

FSCSC payments are calculated separately for each category of eligible costs. A higher payment rate has been set for socially disadvantaged, limited resource, beginning and veteran farmers and ranchers. Details about the payment rates and limitations can be found at https://www.farmers.gov/pandemic-assistance/food-safety.

Very small ($250,000) and small farms (less than 500,000) average monetary value of specialty crops sold during the 3-year period preceding the program are eligible.

Applying for Assistance

The FSCSC application period for 2022 is June 27, 2022, through January 31, 2023, and the application period for 2023 will be announced at a later date. FSA will issue payments at the time of application approval for 2022 and after the application period ends for 2023. If calculated payments exceed the amount of available funding, payments will be prorated.

Interested specialty crop producers can apply by completing the FSA-888, Food Safety Certification for Specialty Crops Program (FSCSC) application. The application, along with other required documents, can be submitted to the FSA office at any USDA Service Center nationwide by mail, fax, hand delivery or via electronic means. Producers can visit f http://www.farmers.gov/service-locator to find their local FSA office. Specialty crop producers can also call 877-508-8364 to speak directly with a USDA employee ready to assist.

Producers can visit https://www.farmers.gov/pandemic-assistance/food-safety for additional program details, eligibility information and forms needed to apply.

Dr. Kline is with Rutgers Coop. Extension in Cumberland Co.

*From the **Plant and Pest Advisory**, Rutgers Coop. Extension, https://plant-pest-advisory.rutgers.edu/usda-announces-assistance-for-on-farm-food-safety-expenses-for-specialty-crop-growers/, June 21, 2022.*

Payment Amount of Eligible Costs		
Category of Eligible Expenses	**Historically Underserved Farmer or Rancher**	**All Other Applicants**
Development of a food safety plan for first-time certification	75 percent (no maximum)	50 percent (no maximum)
Maintaining or updating a food safety plan	75 percent, up to a maximum of $375	50 percent, up to a maximum of $250
Food safety certification	75 percent, up to a maximum of $2,000	50 percent, up to a maximum of $2,000
Certification upload fees	75 percent, up to a maximum of $375	50 percent, up to a maximum of $250
Microbiological testing – products	75 percent, up to 5 tests	50 percent, up to 5 tests
Microbiological testing – soil amendments	75 percent, up to 5 tests	50 percent, up to 5 tests
Microbiological testing – water	75 percent, up to 5 tests	50 percent, up to 5 tests
Microbiological testing – water	75 percent, up to 5 tests	50 percent, up to 5 tests
Training	100 percent, up to a maximum of $300	100 percent, up to a maximum of $200

FOOD SAFETY

FDA Proposes Compliance Date Extension for Pre-Harvest Agricultural Water Requirements

Lisa McKeag

Key Points:

- We'll keep you posted about the finalized pre-harvest water rule and compliance timeline.
- If you're covered by FSMA, plan to comply with post-harvest water requirements (including water testing, in some cases) by January 2023 for the largest businesses (see timeline below).

This week, FDA issued a supplemental notice of proposed rulemaking that would extend the compliance dates for the FSMA Produce Safety Rule pre-harvest agricultural water provisions.

Last December, FDA issued a new proposed rule regarding agricultural water that would replace some of the provisions finalized in 2015. The original rule stated that farms required to comply with the FSMA Produce Safety Rule must create a microbial water quality profile (MWQP) for each agricultural water source used for any pre-harvest activities. The MWQP would consist of results from 20 water samples over 2-4 years for each surface water source, with 5 additional samples taken annually thereafter, and 4 samples in the first year for each ground water source, with one additional sample annually thereafter. The original rule also included requirements for all water used in harvest and post-harvest activities. Water used post-harvest (e.g., for vegetable washing, cooling, or cleaning of food contact surfaces) must be free of generic E. coli and any untreated ground water used for these activities must be sampled 4 times in the first year and once annually thereafter to ensure this quality criterion is met.

Changes apply to pre-harvest water requirements

The rule proposed in December, if finalized, would eliminate the testing requirement for pre-harvest water and replace it with a requirement to conduct a pre-harvest agricultural water assessment for each water source at least once annually. Growers would be required to consider certain factors in their assessment including the degree to which the system is protected from contamination and the type of application method used. The proposed rule keeps the testing requirement for post-harvest water. The public comment period for the proposed rule closed this past April and we're waiting for FDA to consider those comments and issue a final rule.

New compliance dates proposed

The proposed rule issued this week provides a timeline for implementation of the pre-harvest provisions of the rule, according to the size of farm businesses by annual sales. (If you're unsure if you have to comply or what size your business is, use our tool "Do I Need to Comply with the FSMA Produce Rule?" at Do I Need to Comply with the FSMA Produce Rule? | Center for Agriculture, Food, and the Environment at UMass Amherst)

- Large businesses will have 9 months after the final rule becomes effective to comply
- Small businesses: 1 year and 9 months after the effective date of a final rule
- Very small businesses: 2 years and 9 months after the effective date of a final rule

FDA is not proposing new effective dates for the post-harvest provisions, but it has stated that it will continue enforcement discretion (meaning it is choosing not to enforce these parts of the rule) until the following dates:

- January 26, 2023, for large businesses
- January 26, 2024, for small businesses; and
- January 26, 2025, for very small businesses

FDA is accepting public comments ONLY with respect to the compliance dates for the proposed pre-harvest agricultural water provisions. Comments can be viewed and submitted at Regulations.gov/document/FDA-2021-N-0471-0272.

*Ms. McKeag, is with the Univ. of Massachusetts Extension Vegetable Program. From the V**egetable Notes for Vegetable Farmers in Massachusetts**, Univ. of Mass. Extension, Vol. 34, No. 14, July 21, 2022.*

VEGETABLE PRODUCTION

Expect Heat Damage to Vegetable and Fruit Crops

Gordon Johnson

The current heat wave is causing losses in vegetables and fruits. The following are some effects of high temperatures on vegetable and fruit crops.

The plant temperature at which tissue dies is around 115°F. Normally, plant temperature is just above air temperature. However, plant temperature can rise to a critical level under certain conditions. Plants have 3 major ways in which they dissipate excess heat: 1) long-wave radiation, 2) heat convection into the air and 3) transpiration.

A critical factor is transpiration. If transpiration is interrupted by stomatal closure due to water stress, inadequate water uptake, injury, vascular system plugging or other factors, a major cooling mechanism is lost. Without transpiration, the only way that plants can lose heat is by heat radiation back into the air or wind cooling. Under high temperatures, radiated heat builds up in the atmosphere around leaves, limiting further heat dissipation.

Dry soil conditions start a process that can also lead to excess heating in plants. In dry soils, roots produce Abscisic Acid (ABA). This is transported to leaves and signals to stomate guard cells to close. As stomates close, transpiration is reduced. Without water available for transpiration, plants cannot dissipate much of the heat in their tissues. This will cause internal leaf temperatures to rise.

Vegetables can dissipate a large amount of heat if they are functioning normally. However, in extreme temperatures (high 90s or 100s) there is a large increase the water vapor pressure deficient (dryness of the air). Rapid water loss from the plant in these conditions causes leaf stomates to close, again limiting cooling, and spiking leaf temperatures, potentially to critical levels causing damage or tissue death.

Very hot, dry winds are a major factor in heat buildup in plants. Such conditions cause rapid water loss because leaves will be losing water more quickly than roots can take up water, leading to heat injury. Therefore, heat damage is most prevalent in hot, sunny, windy days from 11 a.m. to 4 p.m. when transpiration has been reduced. As the plants close stomates to reduce water loss, leaf temperatures will rise even more. In addition, wind can decrease leaf boundary layer resistance to water movement and cause quick dehydration. Wind can also carry large amounts of advected heat.

Photosynthesis rapidly decreases above 94°F, so high temperatures will limit yields in many vegetables and fruits. While daytime temperatures can cause major heat related problems in plants, high night temperatures can have great effects on vegetables, especially fruiting vegetables. Hot night temperatures (nights above 75) will lead to greater cell respiration. This limits the amount of sugars and other storage products that can go into fruits and developing seeds.

High temperatures also can cause increased developmental disorders in fruiting vegetables. A good example is with pollen production in beans. As night temperatures increase, pollen production decreases leading to reduced fruit set, reduced seed set, smaller pods, and split sets. Most fruiting vegetables will abort flowers and fruits under high temperatures.

Heat injury in plants includes scalding and scorching of leaves and stems, sunburn on fruits and stems, leaf drop, rapid leaf death, reduction in growth, and lower yields. Wilting is the major sign of water loss which can lead to heat damage. Plants often will drop leaves or, in severe cases, will “dry in place” where death is so rapid, abscission layers have not had time to form. See https://sites.udel.edu/weeklycropupdate/?p=13716 for more information on controlling sunburn.

On black plastic mulch, surface temperatures can exceed 150°F. This heat can be radiated and reflected onto vegetables causing tremendous heat loading. This is particularly a problem in young plants that have limited shading of the plastic. This can cause heat lesions just above the plastic. Heat lesions are usually first seen on the south or south-west side of stems. High bed temperatures under plastic mulch can also lead to reduced root function limiting nutrient uptake. This can lead to increased fruit disorders such as white tissue, yellow shoulders, and blotchy ripening in tomato fruits.

High heat and associated water uptake issues will cause heat stress problems. As heat stress becomes more severe a series of event occurs in plants starting with a decrease in photosynthesis and increase in respiration. As stress increases, photosynthesis shuts down due to the closure of stomates which slows or stops CO2 capture and increases photorespiration. This will cause growth inhibition. There will be a major slow-down in transpiration leading to reduced plant cooling and internal temperature increase. At the cellular level, as stress becomes more severe there will be membrane integrity loss, cell membrane leakage and protein breakdown. Toxins generated through cell membrane releases will cause damage to cellular processes. Finally, if stress is severe enough there can be plant starvation through rapid use of food reserves, inefficient food use, and inability to call on reserves when and where needed.

Another negative side effect of reduced plant photosynthate production and lower plant food reserves during heat stress is a reduction in the production of defensive chemicals in the plant leading to increased disease and insect vulnerability.

The major method to reduce heat stress is by meeting evapotranspiration demand with irrigation. Use of overhead watering, sprinkling, and misting can reduce of tissue temperature and lessen water vapor pressure deficit. Certain mulches can also help greatly. You can increase reflection and dissipation of radiative heat using reflective mulches or use low density, organic mulches such as straw to reduce surface radiation and conserve moisture. In very hot areas of the world, shade cloth is used for partial shading to total incoming radiation and heat. Research at UD has shown that use of shade cloth can have significant benefits in heat sensitive crops if applied at the right time. Current research is underway investigating timing of shade cloth application. See https://sites.udel.edu/weeklycropupdate/?p=20476 and https://sites.udel.edu/weeklycropupdate/?p=19864 for more information on use of shade cloth.

Dr. Johnson is the Extension Vegetable and Fruit Specialist at the Univ. of Delaware. From the ***Weekly Crop Update****, Univ. of Delaware Extension, Vol. 30, Issue 18, July 22, 2022.*

https://extension.psu.edu/produce-pointers

Phytophthora Blight Control in Pepper in 2022

Phytophthora blight typically develops in low-lying areas after a heavy rain and can spread quickly throughout the entire field. Fortunately, this spring in New Jersey has been really dry – too dry thus far, but that does not need you don't need to prepare for potential phytophthora issues down the road. This is particularly important if are in fields with a known history of Phytophthora blight. Although the extended period of dry weather works against Phytophthora development, it can lead to Rhizoctonia root rot issues in newly transplanted plugs.

Cultural Recommendations

In general, planting on a ridge or raised, dome-shaped bed will help provide better soil drainage. In fields with known low-lying or wet areas, avoid transplanting in those areas all together. In fields with a known history of Phytophthora blight, plant ONLY resistant cultivars to help reduce plant losses. If mefenoxam-insensitivity is known to exist in a field/farm, plant only tolerant cultivars. Do not apply mefenoxam or metalaxyl in fields where insensitivity is known to exist.

Chemical Recommendations

Code	Product Name	Product Rate	Active Ingredient(s) (*=Restricted Use)	PHI (d)	REI (h)	Bee TR
For control of the CROWN ROT phase of Phytophthora blight, apply one of the following at transplanting and 30 days later.						
4	MetaStar 2E AG	4.0 to 8.0 pt/A[1]	metalaxyl	7	12	N
4	Ridomil Gold 4SL	1.0 pt/A[1]	mefenoxam	—	—	N
4	Ultra Flourish 2E	1.0 qt/A[1]	mefenoxam	—	—	N
21	Ranman 400SC	2.75 fl oz/A[2,3]	cyazofamid	0	12	L
43	Presidio 4SC	3.0 to 4.0 fl oz/A[3]	fluopicolide	2	12	L
49 + 4	Orondis Gold 1.67SC	See labels[1,2,4]	oxathiapiprolin + mefenoxam	0	4	—

Recommendations for Organic Practices

Organic bell pepper growers with a history of the Phytophthora blight should only plant cultivars that have resistance or tolerance to the disease. Long non-host crop rotations are critically important for organic production. Regular applications of Double Nickel (Bacillus amyloliquefaciens) or Regalia (Extract of Reynoutria sachalinensis) as drenches or via the drip system prior to the onset of disease may help suppress Phytophthora blight development.

*Dr. Wyenandt is vegetable pathologist with Rutgers Coop. Extension. From the **Plant and Pest Advisory**, Rutgers Coop. Ext., https://plant-pest-advisory.rutgers.edu/early-season-control-of-the-crown-rot-phase-of-phytophthora-blight-in-pepper-2-3/, June 23, 2022.*

VEGETABLE PRODUCTION

Corn Disease Identification

Alyssa Koehler

As corn is beginning to tassel, it is a good time to scout fields to decide if a fungicide will be applied. While you are out scouting, here are some tips for sorting out pathogens.

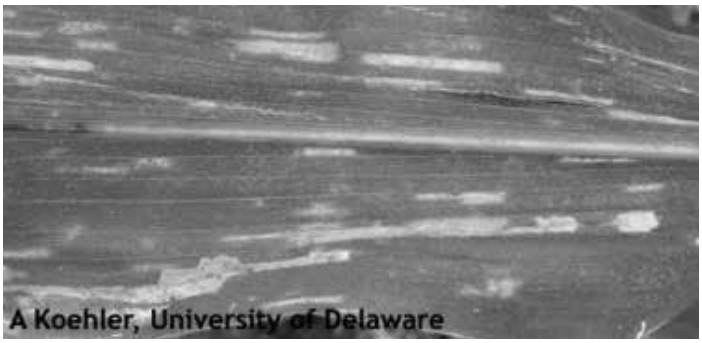

Figure 1. Rectangular lesions of Grey Leaf Spot on Corn

Grey Leaf Spot

Grey leaf spot (GLS) is our most common foliar disease of corn. Symptoms usually begin on lower leaves as small, tan, rectangular lesions with a yellow halo. When lesions are young, they can be difficult to distinguish from other common corn foliar diseases. As lesions mature, they become more diagnostic. At maturity, lesions are grey to tan in color, with a long rectangular shape (Figure 1); partially resistant hybrids can have more jagged margins than lesions on susceptible cultivars. Lesions often join to form large necrotic areas under favorable environmental conditions. Yield reductions are typically observed when lesions are present on the two leaves below the ear leaf or higher, so these are the leaves to pay close attention to when scouting. If over 50% of plants have lesions on 5% or more of this leaf surface (flag leaf or 2 below), you may want to consider a fungicide application. If applying a fungicide, VT/R1 timing has shown the greatest chance of economic return for GLS. The 2022 Fungicide Efficacy for Control of Corn Diseases, (see https://cropprotectionnetwork.org/publications/fungicide-efficacy-for-control-of-corn-diseases) provides ratings of product performance across multiple diseases based on trials conducted by Extension specialists across the country.

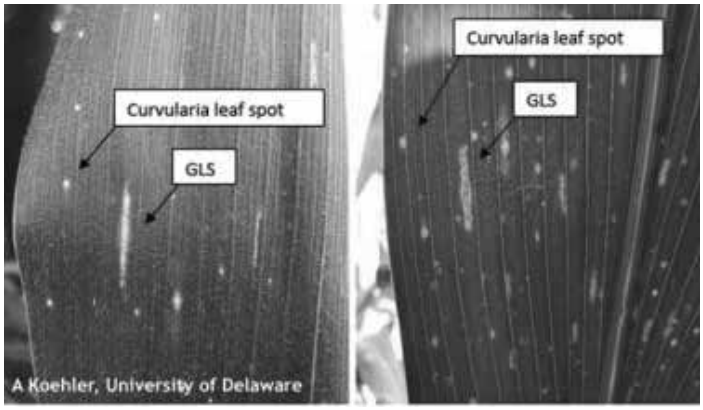

Figure 2. Curvularia leaf spot v. GLS on the upper (left) and lower (right) corn leaf

Curvularia Leaf Spot

Curvularia leaf spot is a new disease that was first observed in the region at the end of 2020. Lesions will have a brown border with a yellow halo that can look very similar to the start of a GLS lesion. However, these lesions will usually stay small and round, while GLS lesions will continue to expand to a rectangular shape (Figure 2). Lesions can be scattered or in dense groups. At present, this disease is not associated with notable yield loss and foliar fungicides are not labeled for management of Curvularia leaf spot.

Northern Corn Leaf Blight

Northern Corn Leaf Blight (NCLB) is present in the regions at low levels, often showing up later in the season. Like many of the foliar pathogens, it is favored by prolonged wet weather and canopy moisture. These lesions will be oblong to cigar shape Figure 3).

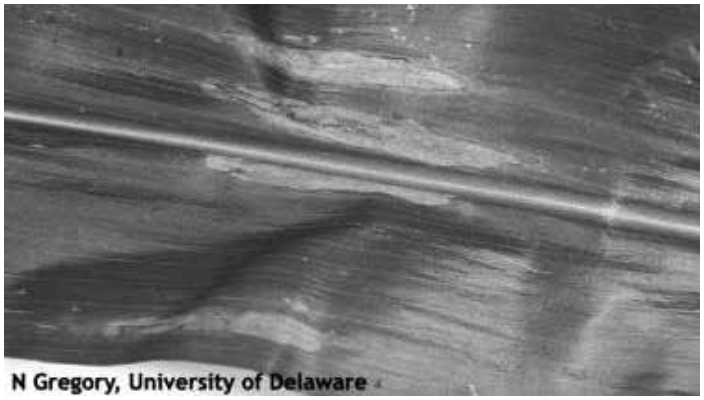

Figure 3. Northern Corn Leaf Blight lesions

Diplodia Leaf Streak

Diplodia leaf streak can be observed occasionally in the region, most often in fields with corn on corn rotation. These lesions can look similar to NCLB, but inside of the lesions you will see black dots called pycnidia that contain spores of this fungus (Figure 4).

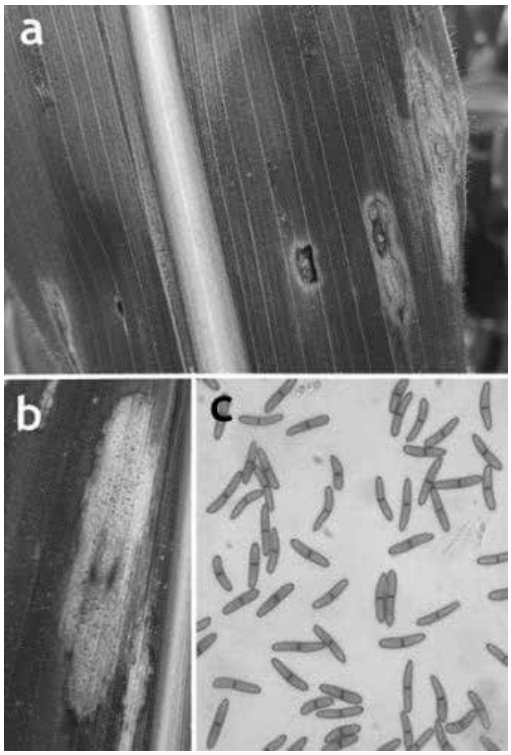

Figure 4. Symptoms of Diplodia leaf streak (a), close up of a lesion with black pycnidia (b), pill-shaped spores of Stenocarpella maydis (c)

Tar Spot

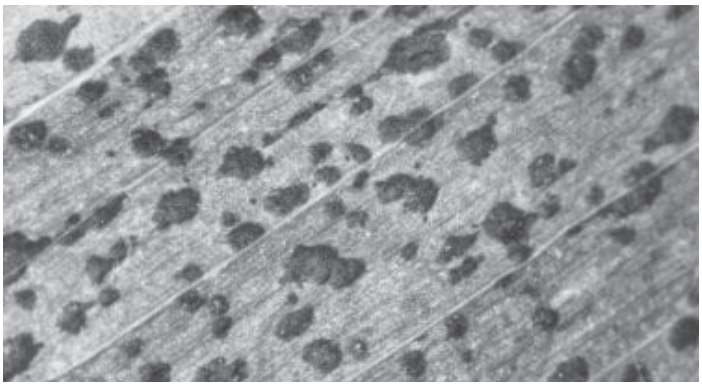

Figure 5. Slightly raised, black stroma of Phyllachora maydis (https://cropprotectionnetwork.org/publications/an-overview-of-tar-spot)

As you are out scouting this year, you will also want to keep an eye out for Tar Spot, a foliar disease caused by the fungus *Phyllachora maydis*. It first showed up in northern Illinois and Indiana in 2015 and was found in Lancaster County at the end of the 2020 season and continued to spread to surrounding PA counties in 2021. To date, this disease has not been reported in DE or MD. The fungus produces small, raised, black bumpy lesions that look like specks of tar, giving it the common name of tar spot (Figure 5). These structures known as stroma can be on the upper or lower leaf surface and do not wipe off the corn leaf. In severe cases, lesions may also be observed on the leaf sheaths, husks, and tassels. Tar spot is most often observed after silking, but can appear earlier, particularly in areas where it is established. If you suspect you have Tar Spot, please contact your county Extension agent or submit a sample to the UD plant diagnostic lab for confirmation.

Dr. Koehler is the Extension Field Crops Pathologist at the Univ. of Delaware. From the ***Weekly Crop Update****, Univ. of Delaware Extension, Vol. 30, No. 16, July 8, 2022.*

Cover Crops Provide Important Services for Vegetable Growers

Gordon Johnson

Vegetable growers should take time to revisit their rotations and plans for the next growing season. Decisions on fall rotational crops or cover crops will need to be made soon. The following is a reprint of a 2019 article on decision making with cover crops.

Services that cover crops provide:

- *Returning organic matter to the soil to maintain soil health.* Vegetable rotations are tillage intensive and organic matter is oxidized at a high rate. Cover crops help to maintain organic matter levels in the soil, a critical component of soil health and productivity. Brassicas and winter legumes provide the most biomass followed by ryegrasses and then rye.
- *Providing winter cover.* By having a crop (including roots) growing on a field in the winter you recycle plant nutrients (especially nitrogen), reduce leaching losses of nitrogen, reduce erosion by wind and water, and reduce surface compaction and the effects of heavy rainfall on bare soils. Cover crops also compete with winter annual weeds and can help reduce weed pressure in the spring.
- *Providing fall and early winter cover and then winter killing.* The use of winter killed cover crops are very useful when early spring (March or April) plantings of vegetable crops such as potatoes, peas, cole crops, early sweet corn, or early snap bean crops are being planned. By winter killing, cover crop residue is more manageable and spring tillage and planting can proceed more quickly.
- *Reducing certain diseases and other pests.* Cover crops help to maintain soil organic matter. Residue from cover crops can help increase the diversity of soil organisms and reduce soilborne disease pressure. Some cover crops may also help to suppress certain soil borne pests, such as nematodes, by releasing compounds that affect these pests upon decomposition. One system would be planting mustards in August or early September, tilling them into the soil to provide some biofumigation in October, and then planting a small grain crop for winter cover. Spring planted mustards can also work ahead of later spring planted vegetables.
- *Providing nitrogen for the following crop.* Leguminous cover crops, such as hairy vetch or crimson clover, can provide significant amounts of nitrogen, especially for late spring planted vegetables. Hairy vetch is particularly well suited for no-till systems and can provide full nitrogen requirements for crops such as pumpkins and partial requirements for crops such as sweet corn, tomatoes, or peppers.
- *Improving soil physical properties.* Cover crops help to maintain or improve soil physical properties and reduce compaction. Roots of cover crops and incorporated cover crop

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VEGETABLE PRODUCTION

Cover Crops Provide Important Services *continued from page 11*

residue will help improve drainage, water holding capacity, aeration, and tilth. The use of large tap rooted cover crops such as forage radish or oilseed radish are particularly well adapted to these uses.

- *Setting up windbreaks in the fall for spring planted vegetables.* Small grain crops will overwinter and grow tall enough in to provide wind protection for spring planted vegetables. Rye has been the preferred windbreak because tall types are still available, and it elongates early in the spring. While barley is also early, tall varieties are not generally available. Wheat and triticale are intermediate and later.
- *Developing no-till, bio-strip-till, and bio-bed preparation systems.* There is much opportunity to increase the use of no-till and bio-tillage systems. The key will be selecting the right cover crop for the desired system. Rye, crimson clover, subclover, tillage radish, spring oats, and other cover crops have been used successfully for no-till vegetables. One innovative system that uses a combination of winter killed covers and standard covers is bio-strip-till. In this system, a high biomass cover crop such as rye or vetch is planted with strips of forage or oilseed radish in rows where spring planting will occur. Another system uses rye strips with forage radish planted where the beds will be next year.

Cover crop planting windows vary with crop and timely planting is essential to achieve the desired results. There are many cover crop options for late summer or fall planting including:

Small Grains

Rye is often used as a winter cover as it is very cold hardy and deep rooted. It has the added advantage of being tall and strips can be left the following spring to provide windbreaks in crops such as watermelons. Rye makes very good surface mulch for roll-kill or plant through no-till systems for crops such as pumpkins. It also can be planted later (up to early November) and still provide adequate winter cover. Wheat, barley, and triticale are also planted as winter cover crops by vegetable producers.

Spring oats may also be used as a cover crop and can produce significant growth if planted in late August or early September. It has the advantage of winter killing in most years, thus making it easier to manage for early spring crops such as peas or cabbage. All the small grain cover crops will make more cover with some nitrogen application or the use of manure.

To get full advantage of small grain cover crops, use full seeding rates and plant early enough to get some fall tillering. Drilling is preferred to broadcast or aerial seeding.

Ryegrasses

Both perennial and annual ryegrasses also make good winter cover crops. They are quick growing in the fall and can be planted from late August through October. If allowed to grow in the spring, ryegrasses can add significant organic matter to the soil when turned under, but avoid letting them go to seed.

Winter Annual Legumes

Hairy vetch, crimson clover, field peas, subterranean clover, and other clovers are excellent cover crops and can provide significant nitrogen for vegetable crops that follow. Hairy vetch works very well in no-till vegetable systems where it is allowed to go up to flowering and then is killed by herbicides or with a roller-crimper. It is a common system for planting pumpkins in the region but also works well for late plantings of other vine crops, tomatoes and peppers. Hairy vetch, crimson clover and subterranean clover can provide from 80 to well over 100 pounds of nitrogen equivalent. Remember to inoculate the seeds of these crops with the proper Rhizobial inoculants for that particular legume. All of these legume species should be planted as early as possible – from the last week in August through the end of September to get adequate fall growth. These crops need to be established at least 4 weeks before a killing frost.

Brassica Species

There has been an increase in interest in the use of certain Brassica species as cover crops for vegetable rotations.

Rapeseed has been used as a winter cover and has shown some promise in reducing the levels of certain nematode in the soil. To take advantage of the biofumigation properties of rapeseed you plant the crop in late summer, allow the plant to develop until early next spring and then till it under before it goes to seed. It is the leaves that break down to release the fumigant-like chemical. Mow rapeseed using a flail mower and plow down the residue immediately. Never mow down more area than can be plowed under within two hours. Note: Mowing injures the plants and initiates a process releasing nematicidal chemicals into the soil. Failure to incorporate mowed plant material into the soil quickly, allows much of these available toxicants to escape by volatilization.

Turnips and mustards can be used for fall cover but not all varieties and species will winter over into the spring. Several mustard species have biofumigation potential and a succession rotation of an August planting of biofumigant mustards that are tilled under in October followed by small grain can significantly reduce diseases for spring planted vegetables that follow.

More recent research in the region has been with forage radish. It produces a giant tap root that acts like a bio-drill, opening up channels in the soil and reducing compaction. When planted in late summer, it will produce a large amount of growth and will smother any winter annual weeds. It will then winter kill leaving a very mellow, weed-free seedbed. It is an ideal cover crop for systems with early spring planted vegetables such as peas. Oilseed radish is similar to forage radish but has a less significant root. It also winter kills. Brassicas must be planted early to mid-August through mid-September for best effect.

Mixtures to Provide the Best Range of Services

It is important to choose cover crops that provide the maximum service benefits. Research in the regions has shown that generally mixtures of 3 cover crops providing different services maximizes benefits and creates conditions that favor soil microbial diversity.

Mixtures of rye with winter legume cover crops (such as hairy vetch) have been successful and offer the advantage, in no-till systems, of having a more rapidly decomposing material with the longer residual rye as a mulch. Other winter legume-small grain, winter legume-Brassicas, small grain-Brassica, and small grain-winter legume-Brassica combinations have been successful.

Dr. Johnson is the Extension Vegetable and Fruit Specialist for the Univ. of Delaware. From the ***Weekly Crop Update****, Univ. of Delaware Extension, Vol. 30, No. 19, July 29, 2022.*

Tarping in the Northeast – State Seedbedding with Tillage and Tarps

Natalie Lounsbury, Sonja Birthisel, Jason, and Ryan Maher

Introduction

Reusable tarps, including black plastic (silage tarps), clear plastic, and landscape fabric, are multi-functional, accessible tools that are increasingly popular on small farms. The use of opaque materials that block light is frequently called "oc¬cultation" while the use of clear tarps is called "solarization." We treat "tarping" as a general term to include both. Regardless of the material used, tarps are applied to the soil surface between crops and then removed prior to planting.

In cool climates like that of the Northeastern US, tarping has emerged as an important way to manage weeds, crop residue, soil moisture, and nutrients. Tarps can be versatile tools left in place for days to months at a time depending on context. They are commonly seen as 'placeholders,' covering soils to keep them weed-free and to retain moisture and nutrients until planting time. Many farmers use tarps to reduce the intensity of tillage or the number of tillage passes, while other farmers have moved to rotational no-till or even continuous no-till with tarps. Tarps have also been deployed as a way to transition new fields into production.

Farms using tarps are generally small (<5 acres) and employ organic practices, however, the reasons farmers use tarps are diverse. A recent survey of farmers in the Northeast (Rangarajan 2019 – see full Guide for list of works cited at https://extension.umaine.edu/publications/1075e/) showed that there are many different goals with tarping.

Despite the advantages of using tarps, there are tradeoffs to this practice and many unknowns. Farmers cite the logistics associated with handling tarps, including moving, securing, and storing them, as especially challenging. Because of these challenges, tarping is currently scale-limited. Tarping is a powerful weed management tool, but some weed species can become problematic when tarping is deployed without additional or alternative weed management techniques. Occupying valuable field space during the growing season with a tarp on land that would otherwise be planted to cash or cover crops represents an opportunity cost, and the benefits of tarping must outweigh the time required to implement the practice effectively. While tarps are reusable, they are made of plastic; manufacturing, disposal, and plastic contamination during their use are concerns.

[The full guide includes sections on types of tarps, logistics and management, specific tarping practices, concerns about plastic, and farmer case studies. The individual practice sections and farmer case studies serve as standalone resources. The section below on stale seedbedding is one of the tarping practice sections and is timely for growers considering tarping to create stale seedbeds this spring.]

"STALE SEEDBEDDING" WITH TILLAGE AND TARPS

Introduction

Stale seedbedding is a practice that encourages the germination of weed seeds, then kills emerged weeds before crop

Continued on page 14

Tarping in the Northeast *continued from page 13*

planting in order to minimize weed competition with the crop. The practice reduces in-season weed competition and can also deplete the weed seed bank, leading to reduced weed pressure in subsequent seasons (Gallandt, 2006). Tarps can be used for enhanced stale seedbedding.

Typically, stale seedbedding is done over a period of several weeks in the spring or early summer. Fields are prepared for planting with primary and secondary tillage, and raised beds may be made before applying this practice. These early-sea¬son soil disturbances help stimulate a "flush" of weed seeds to germinate. In traditional stale seedbedding, emerged white thread or cotyledon-stage weeds are killed with flaming, cultivation, or herbicide. When tarps are used for stale seedbed¬ding, they are applied soon after field preparation, and kept in place for two or more weeks to allow time for weed seeds to germinate and be killed (Marenco and Lustosa, 2000).

Both occultation and solarization can enhance the flush of weeds by altering the soil's thermal and temperature regime. Emerged weeds are killed either from the absence of light (occultation) or extreme heat (solarization). Because it targets the seed bank, stale seedbedding is typically more effective for annual weeds than perennials. After tarp removal, crops should be seeded or transplanted into the prepared field with little additional soil disturbance – and certainly without fur¬ther deep tillage or heavy cultivation – since disturbing soil can bring more deeply buried weed seeds to the soil surface, reducing the in-season benefit of the practice.

Farmers and researchers in the Northeast have had success with occultation and solarization for stale seedbedding in both fields and hoophouses (Birthisel et al., 2019; Fortier and Bilodeau, 2014). A key benefit to this practice is reducing the number of hand weeding, cultivation, or flaming passes needed by at least one. This results in less field traffic and fuel use. Under good conditions, solarizing can also create a better (less weedy) stale seedbed than is possible with other stale seedbedding techniques, potentially saving time and money on cultivation and hand weeding throughout the growing season while retaining valuable nitrate in the soil (Birthisel and Gallandt, 2019).

Logistics

Stale seedbedding with tarps can occur anytime during the growing season, especially in hoophouses. When applied in open fields, it is most commonly done in the springtime. For solarization, effectiveness is greatest near the summer sol¬stice when solar energy gain is at a maximum.

Two weeks is a minimum time frame needed to establish a stale seedbed with tarping. This is based on the time required for many weed seeds to germinate and subsequently be killed. Farmer experience suggests that shorter treatment times may be effective in some circumstances. Research conducted in Maine found that four-six weeks does not typically lead to greater weed suppression than two (Birthisel and Gallandt, 2019).

Amendments that need to be incorporated into soils should be applied before tarping, so that field operations that could unearth buried weed seeds are not needed after tarp removal. Incorporating organic amendments before tarping may also improve the effectiveness of this practice by increasing microbial activity and microbial seed decay.

There are key tradeoffs when considering occultation vs. solarization for stale seedbedding. Solarization is a higher-risk, higher-reward scenario. Under ideal conditions and when correctly applied (i.e. when plastic is applied over moist soils with edges tightly secured) and the weather is hot and sunny, solarization results in higher soil temperatures, more weed seed bank depletion, and better subsequent weed control than occultation (Birthisel et al., 2018). However, because light can penetrate clear plastic tarps, solarization is more likely to 'fail' if conditions are not ideal, call¬ing for subsequent occultation, tillage, or other practice to control weeds. Occultation is by comparison a lower-risk, lower-reward strategy: it is unlikely to fail in ways that cause a 'mess' that must be cleaned up through subsequent flaming or cultivation, but maxi¬mum effectiveness for depleting the seed bank is lower.

Research and experience in the Northeast have shown that solarization is a higher risk, higher reward method for stale seedbedding, while occultation is slightly less ef¬fective but also less likely to fail and cause a weedy mess that must be cleaned up through subsequent flaming or cultivation. Photo: L. Kenefic

Effects and outcomes from stale seedbedding with tarps

Stale seedbedding with tarps has proven effective at reducing weed density across a range of summer annual weeds including hairy galinsoga (*Galinsoga quadriradiata* Cav.), redroot pigweed (*Amaranthus retroflexus* L.), lambsquarters (*Chenopodium album* L.), and crabgrass species (*Digitaria* spp.). Solarization decreased subsequent weed density by 78% in Maine in comparison to a stale seedbed created with flaming, demonstrating that this application can be very effective when correctly applied.

Data from experiments in Maine suggest that solarization may indeed thermally kill some weed seeds at shallow soil depths. However, not all species are susceptible – neither solarization nor occultation have proven reliably effective against purslane in our region. This application of tarping also has minimal utility for controlling perennial weeds.

The substantial weed control achieved through stale seedbedding with tarps can contribute to improved yields. For exam¬ple, a study in Brazil found that a stale seedbed created with 3 weeks of solarization decreased weed pressure and doubled carrot yield as compared with untreated controls (Marenco and Lustosa, 2000). Yield impacts are likely also a result of increased nutrient availability. As with other tarping applications, available nitrogen accumulates in the soil during stale seedbed periods and can be significantly higher under tarps compared to bare soil controls (Birthisel et al., 2019). Tarps may improve yields for direct seeded crops, especially in dry periods, by leaving a firm, moist seedbed that can lead to more favorable germination; on the other hand, added compaction can be a challenge for root crop development, depend¬ing on soil conditions.

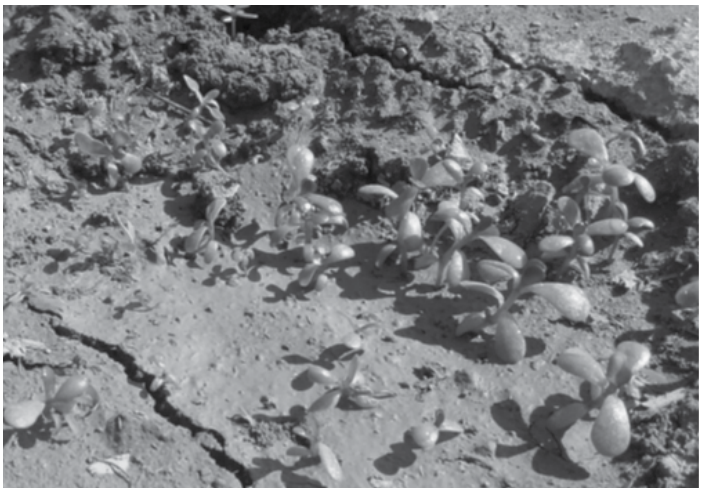
Soil biological activity and abundance of beneficial soil microbes can be somewhat reduced during and for a period of days to weeks after tarping for stale seedbed establishment, with greater impacts seen for solarization than occultation. It is likely that reduced weed pressure contributes to this, as beneficial rhizosphere-associated bacteria may be less abundant where there

are fewer plant (weed) roots with which to associate. Dead inverte¬brates including carabid beetles under tarps at the end of a stale seedbed period have been observed, and more research to evaluate the impact of tarping on these organisms would be beneficial.

Drawbacks

Key considerations when stale seedbedding with tarps include the time, or opportunity cost, and labor required. When creating a stale seedbed using flaming, it is common practice to plant slow-germinating direct-seeded crops like carrots during the waiting period, and flame directly before crop emergence; with tarps, this is not possible. Another drawback is the time and effort required for tarp application – particularly for solariza¬tion, which requires tighter edge securement than occultation. Because stale seedbed preparation using tarps can be both time and labor-intensive, reserving this practice for high-value crops, particularly those that are slow-growing, highly susceptible to weed competition, or for which weeds are likely to interfere with harvest and cleaning (e.g., salad mix) is advisable.

Several drawbacks to the use of solarizing are worth reiterating. If tem¬peratures under the tarp are sub-lethal, it can actually create a 'green¬house' that encourages weed growth. This is likely to occur if plastic edges are not tightly secured, and when the practice is applied too late in the season and there is insufficient sunlight to achieve killing tem¬peratures. Solarizing can also fail in low-lying portions of fields where water pools, creating a cool microclimate. Finally, not all species are susceptible to stale seedbedding with tarps; purslane germination even appeared to be stimulated by solarization (Birthisel and Gallandt, 2019). By contrast, black tarps may fail to result in substantial seed bank deple¬tion if applied under suboptimal conditions, but are unlikely to fail so abjectly.



A cautionary tale - purslane seedlings successfully established after stale seedbedding with clear plastic during the summer in Maine. Photo: S. Birthisel

Dr. Lounsbury is with the Univ. of New Hampshire, Dr. Birthisel is with the Univ. of Maine, Mr. Lilley is with the Univ. of Maine Coop. Extension), and Mr. Maher is with Cornell Univ. The above article is an excerpt by the Vegetable Program at the Univ. of Massachusetts Extension from Tarping in the Northeast: A Guide for Small Farms, published this year by the Univ. of Maine Cooperative Extension by the authors listed above. Access the full Guide here: https://extension.umaine.edu/publications/wp-content/uploads/sites/52/2022/03/1075-Tarping-Guide.pdf. See the full Guide for the list of works cited below. This excerpt is reprinted from the Vegetable Notes for Vegetable Farmers in Mass., Univ. of Mass. Extension, Vol. 34, No. 4, April 14, 2022.

Using Copper Fungicides

Copper products play an important role in disease management in both conventional and organic systems. They are the most effective controls for most bacterial diseases. In organic production, copper products are the main protectant fungicide used in the control of diseases caused by destructive oomycete pathogens, such as those that cause late blight and downy mildews, as well as fungal and bacterial diseases. As more copper products become available, it is helpful to understand the differences and benefits of different active ingredients and formulations. Solubility, phytoxicity, human health risks, impact on soil ecology, labeled crops and diseases, and efficacy are important considerations in using particular copper products.

How copper works. When copper (Cu) is mixed with water, copper ions (Cu2+) are released into solution. Modern copper products typically use insoluble or "fixed" forms of copper, creating a suspension of copper molecules in the spray solution. These un-dissolved copper particles persist on plant surfaces after the spray dries and copper ions are released from these deposits each time the plant surface becomes wet. The gradual release of copper ions from the copper deposits provides residual protection against plant pathogens present on the leaf surface. Copper ions kill pathogens primarily by destroying cell membranes and proteins and by disrupting protein synthesis. Since the mode of action of copper targets such fundamental components of living tissues, it affects a wide range of plant pathogens including bacteria, fungi, and oomycetes, but can also damage plant cells and be toxic to humans and other non-target organisms. Achieving the best control without injuring plant foliage and fruit depends on the concentration and rate of release of copper ions on the leaf surface, which is determined largely by the solubility of the copper formulation.

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VEGETABLE PRODUCTION

Using Copper Fungicides *continued from page 15*

Solubility.

Less soluble (fixed) formulations release copper ions more slowly. This slow-release lowers the risk of phytotoxicity and provides longer residual activity. The following are low-solubility active ingredients: copper oxide (e.g., Nordox), copper hydroxide (e.g., Kocide, Champ), copper oxychloride (e.g., COCS and BadgeX2), and copper octanoate, which is copper ions linked to fatty acids to form a soap, (e.g., TennCop, Cueva).

More soluble formulations act rapidly but have higher risk of phytotoxicity and shorter residual activity. Basic copper sulfate and copper sulfate pentahydrate are highly soluble.

Metallic Copper Equivalent (MCE).

Product labels list percent active ingredient (eg., 23.8% copper oxychloride or 98% basic copper sulfate), but this doesn't tell you the actual metallic copper by weight, as the formulation also impacts the total copper present. Look for the "metallic copper equivalent" listed below the active ingredients to determine the amount of actual copper by weight. A product with 40% metallic copper has 0.4 lbs metallic copper per lb of product. The range in MCE among products is vast, ranging from under 1.8% to over 50% copper by weight, so it is important to consider the MCE because the effectiveness of a copper spray is highly correlated to the amount of copper applied.

Phytotoxicity.

Several crops are sensitive to copper, notably brassicas, lettuce and strawberry. Injury occurs when ionic copper moves into plant tissue and reaches a level the plant species cannot tolerate. Amount of copper uptake into the leaf tissue depends partly on availability of copper on treated leaf tissue. Several factors affect this including pH, Spray Additives, and Weather. We see damage most often when a spreader sticker is used, since this can be a matter of habit when spraying waxy brassicas, but should not be done when spraying copper on brassicas.

- Under acidic conditions, copper solubility and the potential for phytotoxicity increases. Spray solutions should be kept above pH 6-7, depending on the formulation, to prevent excessive amounts of copper ions from being released and possibly damaging fruit and foliage.
- Adding maneb or mancozeb to copper products as a tank mix increases the release of copper ions in solution, which increases the risk of phytotoxicity. There are pre-mixed products available (e.g., ManKocide), or growers can make 7 their own mixtures. This may be especially helpful for controlling bacterial diseases such as bacterial speck, spot and canker of tomato.
- Using an approved adjuvant or 'sticker' may help the product to be more rainfast. However, when stickers are used with highly soluble copper sulfate formulations, they can cause phytotoxicity, especially on sensitive crops.
- Finely ground compounds will be more active than coarser ground materials because the smaller particles result in better coverage of the leaf and are less likely to be removed from the leaf by wind and rain.
- Copper can accumulate on plant tissue when sprayed repeatedly to cover new growth and there is no rain. In this situation, after a rain event, a large amount of copper ions will be released and may cause phytotoxicity.
- The risk of plant injury increases when the spray solution dries slowly due to cool wet weather, as the duration of active release of copper ions on the leaf is increased.
- For each product, application rates vary with crop and disease. The recommended rate for a given crop may have a 2-fold difference between the high and low rates. Higher rates are recommended when disease pressure is high or conditions are especially favorable but may increase phytotoxicity. Most products are labeled for a wide range of vegetable crops.
- Always read the label instructions. When mixing, follow the tank mix partner instructions.

From the Univ. of Massachusetts Extension Vegetable Program. From ***Vegetable Notes for Vegetable Farmers in Massachusetts****, Vol. 34, No. 15, July 28, 2022.*

Tips for Managing Too Little Water

Elizabeth Buck

As of [late July, parts of northern Pennsylvania and the upper Susquehanna Valley were listed as "abnormally dry", which is the first stage of drought while Potter, Tioga and most of Union Counties were listed as under "moderate drought" conditions.] It's not hard to spot the corn rolling as you drive, particularly in the later plantings, and the ground cracks developing. Streams are running low and ponds are getting drawn down. The depletion of those surface water resources is quickly demanding a question be answered: How do I make the most impactful use of the water I do have?

1 Watering Efficiency

Look for and fix leaks. Trickle tape is highly efficient. For overhead systems, watering at night reduces losses to heat and sun driven evaporation. Trade off: watering at night can increase disease risk. Rather windy conditions drive droplets off course and increase evaporation. If your crop can wait until night when the wind often drops, you'll increase your watering efficiency. But when it is that windy and dry, the crop often can't wait, especially big leafy crops like pumpkins and winter squashes on plastic.

2 Know Your Soils

Do you have high or low organic matter? What's your field's innate ability to hold water? Higher OM fields will provide more water storage and improve the infiltration of any irrigation or rain.

Where are the high patches in a field, or the sandier, gravelly areas? The heavier ground? Can the irrigation be adjusted to deliver variable amounts of water to these zones? With a reel this will take manual monitoring and adjustment of the reel speed and could be a strategy if you have big soil differences along the length of a pass.

For trickle, do you have a single header watering several kinds of crops? Say you have a couple cuke rows and some cabbages or kale. The cole crops don't need as much water as the cukes and tolerate drought much better, so consider shutting off their header valves every other watering or part way through an irrigation.

Compaction, amount of ground cracking, and prior root development will play a role, too. Compacted ground keeps roots shallow and more dependent on supplemental water. Soils prone to cracking can drop a lot of the water you give below the bulk of the root zone. Plants that were in wet spots earlier and crops that have always been regularly irrigated to soils saturation or sufficiency tend to have shallower root systems. Crops with

Continued on page 17

Tips for Managing Too Little Water

continued from page 16

shallow feet are much more dependent on regular irrigation and show more stress when you shift to maintaining the soil water in a somewhat-of-a-deficit condition.

3 Know Your Prioritization

What are you most economically important crops? Which crops are in their most important stage for receiving water? Which crops are unlikely to be economic performers and could be sacrificed? If you're choosing between a bean field about/in flower, and a bean field with poor stand and past root rot, it is a better economic move to water the plants in the critical flowering stage to ensure that you realize your yield potential.

4 Know When it is Time to Quit Watering a Crop

Have a zucchini crop filled with powdery and a second planting coming into production? Or a cuke crop blasted with downy? Fresh market beans that you've already been through 2 or 3 times? Quit watering them and if they're diseased mow them off. On the upside, you'll save time and money by no longer needing to manage the diseases and pests and realize labor savings by forgoing an inefficient (small amount, lots of hunting) harvest.

Yes, it can be a gut-punch to sacrifice a planting or give up on something while there's still a bit of fruit coming. But think longer-term and think economically, not emotionally. Save your water for areas with better economic performers.

5 Don't Get Too Far Behind

There are some soils and crops that are very difficult to catch up on water status. Fields that are cracked, crusted, or that have a heavy dust mulch can become difficult to move water into the root zone. Some crops can tolerate living in the somewhat stressful, slight water deficit conditions. Other crops have a very hard time recovering to full water status once they become overly dry.

6 Use Monitoring Tools

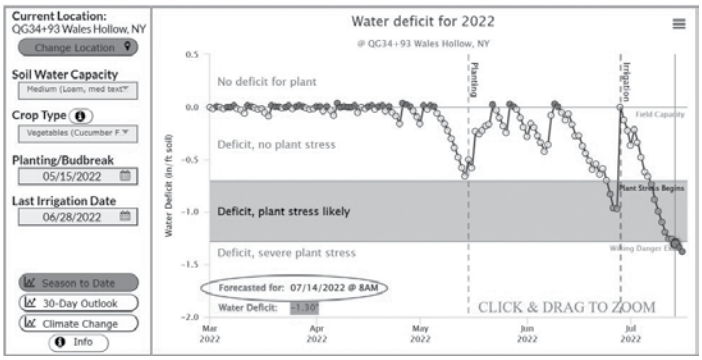
I like the Cornell Climate Smart Farming Water Deficit Calculator (see http://climatesmartfarming.org/tools/csf-water-deficit-calculator/) for a monitoring tool. It's user-friendly, it only takes 3-5 minutes to set up a field, you can save many fields in the tool, and you can enter your irrigation events. Each setting has a little info button to help you quickly make the right choices. Very helpful for the crop groupings.

The CSF Water Deficit Calculator uses your soil texture, crop category, and high-resolution weather data as the base of the model. Importantly, it takes evapotranspiration into account, meaning it models more water loss from the soil on those hot, windy days. The tool then forecasts the amount of water stress your plant will experience and groups the water depletion into categories that I'll paraphrase as "green – full water", "yellow – sufficient", "orange – I'm stressed, but I'll live", and "red – water me yesterday" categories.

The goal is to water when you enter the orange zone and never let the crop get into the red zone. The orange zone may be insufficient for some crops at some stages. The orange zone would be too dry for corn during pollination, beans during flowering, or fruiting tomatoes that aren't used to infrequent or variable water availability.

If you know your most water-sensitive stages and crops, you can use the CSF Water Deficit Calculator to help you decide which field has to get water today and which one has some room to go before it gets into a troublesome zone. Of course, nothing is better than going out and sticking your hand in the soil, but this tool can provide a good starting point.

Every time it rains the tool calculates if the rainfall was enough to bring the soil completely or only partially back to full water status. If you enter an irrigation date, a dashed vertical blue line will appear. Right now, the tool assumes you're irrigating back to field capacity. This is a flaw that you'll have to take into consideration. There are plans to add a new feature with the next update that will allow growers to input the amount of their last irrigation to further increase the accuracy of the tool. Case studies have shown that the current version of the CSF Water Deficit Calculator is still a useful irrigation management tool.



The current CSF Water deficit calculator readout for a loamy field of cucumbers located in East Aurora (Wales), NY planted on May 15, 2022. The dashed vertical gray planting date line and vertical dashed blue line for date of last irrigation, which was well timed in the mid-orange zone. The solid gray line is the forecasted water deficit. Today, July 13, the crop is at the very bottom of the stressful, pre-wilt orange zone. Tomorrow severe stress is forecast to begin (red zone). The crop should be irrigated today, July 13, and as fully as possible. From the Cornell Climate Smart Farming Water Deficit Calculator

Ms. Buck is with the Cornell Cooperative Extension – Cornell Vegetable Program. From VegEdge, Cornell Cooperative Extension, Vol 18, Issue 14, July 13, 2022.

VEGETABLE PRODUCTION

Pollination-Related Problems in Vegetables

Gordon Johnson and Emmalea Ernest

We are seeing quality problems in many fruiting vegetables. Often this is due to poor pollination.

Cucurbits

Misshapen fruit is a sign of incomplete pollination in cucurbits. This includes bottlenecked fruit; fruit with a pinched end; crooked or lopsided fruit; fruit small in size or nub-like; and fruits with prominent lobes or that are triangular in shape. Causes of incomplete pollination may be inadequate pollen transfer by pollinating insects; inadequate pollen sources (pollinizers); or hot, dry weather that reduces pollen viability or that desiccates flower parts during pollination. Research has shown that a minimum of 1,000 grains of pollen are required to be distributed over the three lobes of the stigma of the female flower of a watermelon to produce a uniformly shaped fruit.

Hollow cavities in fruit and vacant seed cavities are related to lack of seed formation, again traced back to poor pollination. Fruit tissue separation, such as hollow heart in watermelon, has also been linked to inadequate pollination and may be worsened by rapid fluctuation in environmental conditions affecting fruit development.

Each year we see pumpkin fields with poor fruit set or fruit carry. Remember that in larger pumpkin sizes, each plant will only carry 1-2 fruits. The large vining plants also need considerable space – 25 to 50 square feet per plant. While planting Jack-o-lantern types at higher densities might at first seem to be a way to achieve higher yields, interplant competition will increase, and you can decrease fruit carry because of this competition.

A major reason for poor fruit set in some years is high temperatures during flowering in July. Day temperatures in the 90s or night temperatures in the high 70s will cause flower and small fruit abortion. For pumpkin growers that do wholesale and start shipping right after Labor Day, this will limit early pumpkin availability. Varieties vary considerably in their ability to tolerate heat and to set under hot conditions. Inadequate irrigation and excessive water stress can also reduce fruit set, increase abortions, and reduce fruit carry. High temperatures and water stress reduce photosynthesis and the ability of the plant to carry fruits. Drought can also cause a higher-than-normal male/female flower ratio, thus affecting the number of fruits per plant.

Sweet Corn

Sweet corn growers often see quality problems related to poor pollination as a result of high temperatures. This problem is more severe in less stress tolerant varieties and where irrigation is inadequate.

In corn, silk elongation begins 7 to 10 days prior to silk emergence from the husk. Every potential kernel (ovule) on an ear develops its own silk that must be pollinated for the ovary to be fertilized and develop into a kernel. The silks from near the base of the ear emerge first and those from the tip appear last. Under good conditions, all silks for an ear will emerge and be ready for pollination within a span of 3 to 5 days and this usually provides adequate time for all silks to be pollinated before pollen shed ceases.

Pollen grains are borne in anthers, each of which contains a large number of pollen grains. The anthers open and the pollen grains pour out after dew has dried off the tassels. Pollen is light and can be carried considerable distances (up to 600 feet) by the wind. However, most of it settles within 20 to 50 feet. Pollen shed is not a continuous process. It stops when the tassel is too wet or too dry and begins again when temperature conditions are favorable.

Under favorable conditions, a pollen grain upon landing on a receptive silk will develop a pollen tube containing the male genetic material, develop and grow inside the silk, and fertilize the female ovary within 24 hours. The amount of pollen is rarely a cause of poor kernel set. Each tassel contains from 2 to 5 million pollen grains, which translates to 2,000 to 5,000 pollen grains produced for each silk of the ear shoot.

Poor seed set is often associated with poor timing of pollen shed with silk emergence (silks emerging after pollen shed). Shortages of pollen are usually only a problem under conditions of extreme heat and drought. Extreme heat and desiccating winds can affect pollen germination on silks or pollen tube development leading to poor seed set. Insects that clip silks during pollination can cause similar problems.

Tomatoes

In tomatoes, day temperatures over 95°F and/or night temperatures in excess of 80°F can cause pollination problems due to reduced pollen production, reduced pollen viability, or reduced pollen germination or pollen tube production. This can lead to flower drop, smaller fruit, misshapen fruit, or reduced gel formation inside the fruit producing hollow areas. To manage these pollination related problems in tomatoes, use “hot-set” type tomatoes bred for better production under heat conditions. Use hot-set varieties for plantings where high temperatures are expected during pollination.

Beans

In snap beans and lima beans, plantings that flower and set pods during summer conditions when night temperatures are high (> 68°F) will be susceptible to reduced sets and yields, split sets, small pods, and misshapen pods. Most of our currently grown lima bean varieties and many commercial snap bean varieties are susceptible to heat stress related yield losses due to reduced pollen production when nighttime temperatures are high before and during flowering. This is why bean crops are planted in certain periods to avoid pollination related losses (snap beans planted for spring and fall crops but avoiding summer crops, lima beans planted in June and early July for fall harvest). Some heat tolerant snap bean varieties are available, including PV 857, Bridger and Usambara. Small seeded lima beans are more heat tolerant than the large seeded Fordhook and pole types (i.e. Dr. Martin).

Dr. Johnson and Dr. Ernest are with the Extension Vegetable and Fruit Program at the Univ. of Delaware. *From the Weekly Crop Update, Univ. of Delaware Extension, Vol. 30, Issue 16, July 8, 2022*

Tomato Spotted Wilt Vitus in Tomatoes

Jerry Brust, IPM Vegetable Specialist, University of Maryland; jbrust@umd.edu

A few high tunnels and even a couple of tomato fields have been found with tomato spotted wilt virus (TSWV) in Maryland. The high tunnel finds were not too suprising but the fields were, as we usually do not see field infections until much later into the season. TSWV has also been found in greenhouse and field production of cut flowers. So it appears this virus is more common this year than it usually is, most probably due to greater thrips populations being present in our greenhouse production areas.

Tomato spotted wilt virus (TSWV) is an obligate parasite, i.e., it must have a living host and must be moved from one plant to another by thrips or through cuttings or possibly seed. This disease can affect tomato and other Solanaceae crops as well as lettuce, beans and cucumber. TSWV may occur in the field but tends to affect greenhouse and high tunnel crops more severely. TSWV is transmitted most efficiently by Western flower thrips (WFT) (*Frankliniella occidentalis*), and less so by Onion thrips (*Thrips tabaci*), Tobacco thrips (*Frankliniella fusca*) and several other thrips species. It is not transmitted by Eastern flower thrips (*Frankliniella tritici*).

Western flower thrips completes its life cycle in about 10-18 days. Eggs are laid in the leaf or tomato fruit. When WFT oviposit into tomato fruit they often cause a deeper dimple than other thrips species and very often the dimple is surrounded by a white halo of tomato tissue. Larvae hatch in about three days and immediately begin to feed and in so doing pick up the virus. After four days, they pupate in the soil, and in a little over three days, the pupae become adults. Only immature thrips can acquire the virus, which they can acquire within 15 minutes of feeding, but adults are just about the only stage able to transmit the virus. Adults can transmit the virus for weeks. It may take 2 – 4 weeks from when the adult thrips first feeds on a plant until initial symptoms are observed. Because of this TSWV appears to worsen in plantings over time.

TSWV infected leaves can show small, dark-brown spots or streaks (Fig. 1) on stems and leaf petioles. Growing tips are usually affected with systemic necrosis and potentially stunted growth. Tomato fruit will have mottled, light green or yellow spots or rings usually with raised centers (Fig 2).

The host range for TSWV is one of the largest of any plant virus – hundreds of plant species, including vegetables, ornamentals and weed species, are susceptible. Weed hosts act as important virus reservoirs for TSWV and can survive in and around greenhouses, high tunnels or fields. Some of these weeds include prickly lettuce, chickweed, spiny amaranth, lambsquarters, black nightshade, shepherd's purse, galinsoga and burdock. These weeds as well as adult thrips need to be controlled in the greenhouse where vegetable transplants are being produced. Because thrips are commonly found in bedding plants or other flower production areas vegetable transplants should never be grown in the same GH as these ornamentals.

Figure 1. Tomato leaves with TSWV symptoms

Figure 2. Tomato fruit with TSWV symptoms

Dr. Brust is the IPM Vegetable Specialist at the Univ. of Maryland. From the ***Weekly Crop Update****, Univ. of Delaware Extension, Vol. 30, Issue 14, June 24, 2022.*

VEGETABLE PRODUCTION

Controlling Cercospora Leaf Spot in Beet in 2022

Andrew Wyenandt

Cercospora leaf spot (CLS), caused by *Cercospora beticola*, is an important and emerging disease in beet and swiss chard production in New Jersey. Efforts to control this disease has become more difficult in the past few years in some areas of southern New Jersey. The soil-borne fungal pathogen, once established in fields, can survive in the soil for up to 2 years on infected debris and on weed hosts such as Chenopodium, goosefoot, and pigweed. The pathogen may also be seed-borne. Symptoms of infection include numerous, small tan leaf spots with distinct dark purple margins that are easily diagnosed (Fig. 1). Overhead irrigation and rainfall help spread the pathogen throughout the field. *Cercospora beticola* is most damaging in warm weather (day temperature of 77 to 90° F and night temperature above 60° F).

Controlling Cercospora leaf spot with preventative fungicide applications has become challenging for some growers in New Jersey. The pathogen is known to have developed resistance to important fungicide classes in recent years, such as the QoIs (FRAC code 11) and the DMIs (FRAC code 3) in different regions of the country, based on fungicide use. This is not surprising since resistance development can occur when fungicides in these groups are used extensively over many years. In New Jersey, azoxystrobin has been used extensively for years to manage this disease.

Cultural practices to help mitigate losses to Cercospora leaf spot

There are a number of cultural practices growers can do to help reduce losses to CLS.

- Start with certified, disease-free seed, or treat seed using hot water seed treatment method.
- Avoid fields with a known history of CLS.
- Rotate to non-host crops (outside of the Chenopodium family) for 2-3 years.
- Bury infected crop residues and destroy volunteer plants and weed hosts.
- Burn down fields after harvesting.
- Avoid planting succession crops close together (at least 100 meters apart).
- Avoid overhead irrigation if it will result in prolonged leaf wetness periods (e.g., late evening or at night); irrigate early to mid-day when leaves will dry fully or use drip irrigation for small plantings.
- Using the proper fungicides, rates, and fungicide rotations.

Fungicides for controlling Cercospora leaf spot

In recent years a number of new fungicides have been labeled for CLS control. Many of these fungicides contain two different active ingredients with more than one mode of action. Growers who have relied on managing CLS with azoxystrobin (FRAC code 11) for years and suspect a loss in efficacy should consider removing it from their fungicide program. There is a good chance fungicide resistance has developed. In 2019, a field study was done at RAREC to examine the efficacy of different fungicides for CLS control (Table 1). The fungicide efficacy trial was established in field with a history of CLS; where the field was inoculated with infected debris collected from a farm in southern New Jersey. Fungicides were applied weekly for 5 weeks with overhead irrigation to help promote disease development.

Cercospora leaf spot development was extremely high during the course of the study. Area Under Disease Progress Curves (AUDPC) were calculated to determine the amount of disease development under each fungicide program (Table 1). CLS development was highest in the untreated control (UTC), with no significant differences between the UTC and weekly copper applications suggesting that weekly copper applications did not help reduce CLS in this study (Table 1). Weekly applications of Quadris, Fontelis, Miravis Prime were not significantly different, but significantly lower than the UTC (Table 1). Control of CLS was best with weekly applications of Tilt and Merivon, but these were not significantly different from weekly applications of Miravis Prime or Fontelis (Table 1). Results of this study suggest that growers with resistance concerns who have relied heavily on copper and azoxystrobin for CLS control should consider using other fungicides in their weekly preventative fungicide programs. Control programs should focus on applying fungicides with more than one mode of action and focus on rotating fungicides with different modes of action. For example: (please see 2020/2021 Commercial Vegetable Production Guide), Apply Tilt (FRAC code 3) followed by Miravis Prime (7 + 12), then tebuconazole (3), then Merivon (7+ 11), then Tilt (FRAC code 3), then Luna Tranquilty (7 + 9). Remember, resistance development to FRAC code 11 fungicides (QoIs) is qualitative and controlled by single point mutations, once resistance develops the fungus is completely resistance (to all fungicides in the group). Resistance development in FRAC code 3 fungicides (DMIs) is quantitative which often characterized as a gradual loss of resistance over time. As a note, FRAC code 3 fungicides should always be applied at the highest rate, using lower rates may increase selection pressure.

Organic Control Options

Controlling CLS in organic production systems starts by following and executing good cultural practices listed above. Always purchase certified seed. Use the hot water seed treatment method to help disinfested seed. Avoiding fields with a history of the disease. Producing beet on mulch and drip irrigation in small operations should be considered. This will help reduce weed pressure (as well as potential hosts) and reduce the need for overhead irrigation. Organic copper applications may not be effective in some operations where disease pressure is extremely high. Unfortunately, control of CLS with organic and biopesticides has been difficult, therefore good cultural practices must be followed accordingly.

For more information please see the 2022-2023 Mid-Atlantic Commercial Vegetable Production Recommendations Guide.

*Dr. Wyenandt is the Vegetable Pathologist at Rutgers Coop. Extension. From the **Plant and Pest Advisory**, Rutgers Coop. Extension, https://plant-pest-advisory.rutgers.edu/controlling-cercospora-leaf-spot-in-beet-2-2/, June 21, 2022.*

Fungicide program (application timing)	FRAC code	active ingredient(s)	Rate per acre	Labeled for beet	AUDPC value
Untreated control	n/a	n/a	n/a	n/a	617 a
Kocide 3000 (1-5)	M01	copper hydroxide	1.0 lb	Yes	564 ab
Quadris 2.08F (1-5)	11	azoxystrobin	15.5 fl oz	Yes	538 bc
Fontelis 1.67SC (1-5)	7	penthiopyrad	30.0 fl oz	Yes	510 bcd
Miravis Prime 3.34SC (1-5)	7 + 12	pydiflumetofen + fludioxonil	13.4 fl oz	Yes	497 bcd
Merivon 2.09SC (1-5)	7 + 11	fluxapyroxad + pyraclostrobin	5.5 fl oz	Yes	471 cd
Tilt 3.6EC (1-5)	3	propiconazole	4.0 fl oz	Yes	445 d

Blueberry Cane Diseases and Their Management

Kathleen Demchak and Thomas Ford

Symptoms of cane diseases are frequently present in blueberries, and calls about them seem to be coming in more frequently these days. Whether this is due to plants being grown on less-than-ideal sites where they grow few new canes and diseases accumulate, or weather conditions that are conducive to development of diseases, or some other factor is unclear. In all cases, it is important to make sure that the basic conditions of having an acidic soil pH (4.5 to 5.), applying sufficient water and mulch, and fertilizing in correct amounts and timings are being met, so that the plants produce enough new growth to replace the old.

Blueberry canes of various ages are a mixture of colors and textures, and it can be difficult to tell what is healthy from what is not. One approach to help sort this out is to closely compare canes on plants that are growing well with canes of the same age on plants that are not. If they look the same, what you are seeing is probably normal.

Young canes (grown this year and into spring of next year) should be smooth and the surface should be even, though lengthwise cracks will form as bark replaces the younger surface. Cut crosswise, young canes should be light green all the way through while older ones may tend towards being cream-colored (but not tan or brown). Color should be the same across the cane, except for slight variation from growth rings. Variation in surface color may be present, and as long as the discoloration doesn't extend into the cane tissue, growth is likely normal.

If disease is present, fairly drastic color changes occur on random canes. If you run your fingers along the new canes you may feel sunken areas. Often colors change within the infected area. Disease symptoms may progress from fungal entry points which can be buds, leaf scars, lenticels (raised pores on stems), pruning cuts (especially if wet conditions follow soon after cuts were made), and physical injury or burndown herbicide damage. Brown or tan discoloration in the cane indicates disease or possibly winter injury.

Symptoms to Watch For: Summer

During the summer, you can prune out infected tissue to prevent disease progression, so this is a good time to nip problems in the proverbial bud. If you find areas on the canes that appear to be diseased, cut progressively lower and far enough below the infected tissue to ensure that only healthy tissue remains. Here are some common diseases and their symptoms.

Phomopsis cane blight. The cane tip in Figure 1 was infected by Phomopsis; with this disease, infected tissue often "bleaches" as it ages. Note the "water-soaked" appearance at the invasion zone, which in this case is a very narrow area delineating healthy and infected tissue.

Fig. 1. Phomopsis invading a new cane tip. Photo: K. Demchak.

Cankers in Figures 2 and 3 show other symptoms to watch for - various shade of brown within the affected tissue, sunken or flattened areas, and reddening of tissue in the invasion zone. Botryosphaeria stem blight was isolated from the cane in Figure 2, and anthracnose from the one in Figure 3. Infections appear to have occurred through a bud or leaf scar.

Fig. 2. Botryosphaeria stem blight on a one-year-old blueberry cane. Photo: K. Demchak.

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BERRY PRODUCTION

Blueberry Cane Diseases and Their Management

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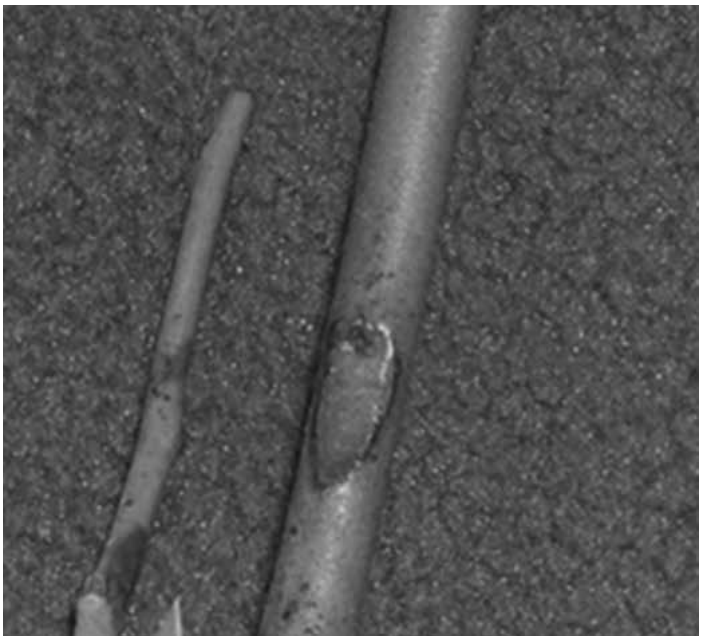

Fig. 3. Anthracnose on blueberry cane. Lesion tissue is flattened. Photo: K. Demchak

The plant in Figure 4 was severely infected by Botryosphaeria stem blight. Lesions are visible on young canes where color changes from green to yellow to chocolate brown. Botryosphaeria stem blight is more deadly to young plants. The variety Duke is very susceptible.

Figure 4. Plant from which Botryosphaeria stem blight was isolated. Note chocolate brown lesions on young canes and dying young cane to the left. Photo: K. Demchak

If infections from any of these diseases are not caught quickly, they can result in rapid cane death in summer during heat or drought stress. Leaves die and remain attached, referred to as "flagging", as no abscission zone is formed that would allow the leaves to fall off (as would normally happen in the fall). These canes should be removed and closely examined, as should other canes on the plant. It is difficult to find lesions on dead canes, as the entire cane may be darker than usual, so the lesion blends in.

Symptoms to Watch for: Dormant Pruning and Summer

Dormant pruning in late winter is a good time to watch for symptoms of diseases in the canes that you remove in addition to during the summer, as you may also see these symptoms anytime you cut through dying canes.

Botryosphaeria stem blight causes characteristic wedges of tan or taupe-colored wood in the cut stems.

The cane on the left in Figure 5 shows a young cane that is only a little over a year old and that was recently infected with Botryosphaeria stem blight. Uninfected canes would be light green all the way through. In the cane on the right, the cane has been infected for longer and is nearly dead or completely killed.

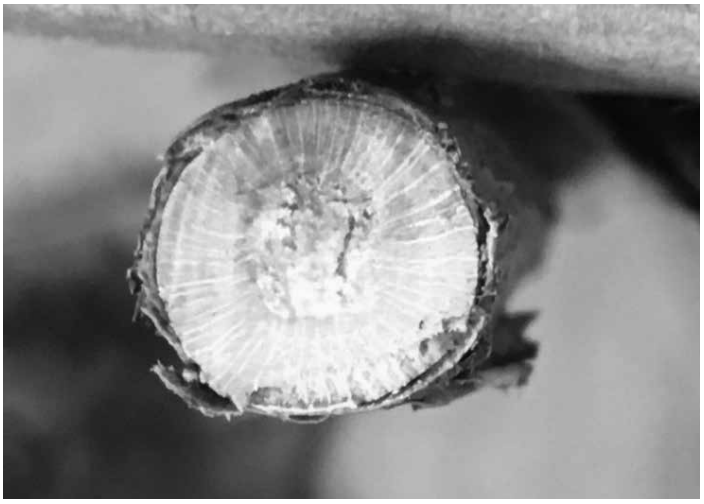

Figure 5. Wedges of tissue affected by Botryosphaeria stem blight to varying degrees. Photos: K. Demchak.

BERRY PRODUCTION

Phomopsis cane blight and other diseases as well can cause a browning of the pith (Figure 6), often progressing far below the location of other cane symptoms such as those occurring at the tip. Be careful not to mistake this symptom for a borer, which will tunnel downward through the cane center and leave frass behind.

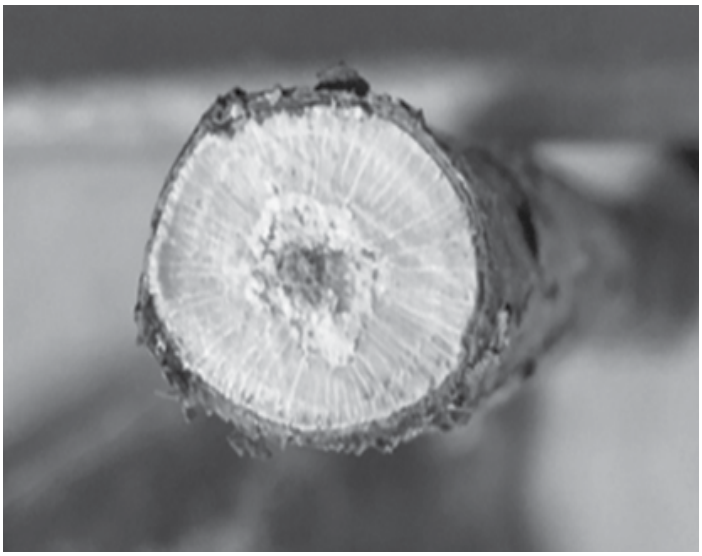

Figure 6. Phomopsis canker symptoms in stem. Photo: K. Demchak

What Can Be Mistaken for Cane Diseases

Winter injury – Tips may die and are desiccated. Cut through buds in the spring to check for browning.

Herbicide injury – Cane surfaces may be injured and discolored by burndown herbicides. This injury provides entry points for fungi, so can increase disease incidence.

Road salt injury – Plantings near roads may experience salt burn from salt spray drifting onto canes. Salt injury is more obvious in the areas that are closest to the road. Elevated salt levels may not be detectable in the soil by the time injury is observed in the spring due to salts being flushed out by melting snow or spring rains.

Pruning and General Management

When pruning out infected canes, keep cutting until you reach healthy tissue with no discoloration, and then go a few inches further to make sure you are removing all of the diseased tissue. The entire cane may need to be removed in some situations. If diseases reach the crown area, the entire plant may be killed. Lime sulfur in Spring and possibly Fall (for Phomopsis) helps decrease disease incidence. Other fungicides may need to be applied to protect new growth, but it helps to have an accurate diagnosis first to know which diseases are present, as treatment and timing of pesticide application will vary.

Ms. Demchak is with the Penn State Dept. of Plant Science and Mr. Ford is with Penn State Extension in Cambria Co. From Penn State Extension.

CLASSIFIEDS

Equipment

FOR SALE - Checchi & Magli Semi-Automatic WOLF Transplanter – 3 Row, asking $10,000
2004 Vibrating Green Bean Sorting Table - asking $1,500
6" Caprari Irrigation Pump System – 4 cyl. Turbo diesel, Trailer and 150 gal fuel tank, Ford engine with Murphy switch, asking $9,000
All are in very good working condition. Call Ken at 814-442-1706

FOR SALE - Harvest Wagon with two conveyors 30' long rear wheel steer $12,000.
2 Row No-Till Mechanical Transplanter with driptape $3,500.
Shuknect Onion Finish Topper $2,000.
Rainflo Waterwheel Transplanter with 4 seats $1,500.
Adams County PA 717-353-9241

Supplies

FOR SALE - New 1/2-Bushel Waxed Produce Boxes – 10,000 available, 480 to a bundle - $500.00 per bundle. Call 717-615-8986

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