

PENNSYLVANIA
VEGETABLE GROWERS

NEWS

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for the commercial vegetable, potato and berry grower



PVGA Twilight Meeting at Shenot Farms

On August 2, about 20 growers and industry people from western Pennsylvania gathered at Shenot's Farm and Market in Wexford for PVGA's first twilight of the season. Shenots grow over 60 different hybrid varieties of vegetable crops and sweet corn. Their orchards produce 25 varieties of apples, 15 varieties of peaches and nectarines with a few plums and pears.



The family started farming in the Wexford area in 1854. At that time the farm was like many of its era, mainly for sustenance, serving its own family. Through the years the farm evolved from a diverse operation, including a dairy, to a focused culture of fruits and vegetables. The farm is now being farmed by the 5th and 6th generation Shenots - Ed and his son Rob. They focus on the production of nearly 80 acres of sweet corn and assorted vegetables, 20 acres of orchard and their award-winning apple cider!

Rob's wife, Leah, oversees the production of over 50 flavors of their signature fudge plus caramel and fudge dipped apples as well as kettle corn. Leah also oversees the day-to-day market responsibilities and focuses on the marketing of the business.

Shenot's modern market facility is tastefully arranged and decorated to highlight the various fruits and vegetables produced on the farm. In addition, there is a whole wall of jarred preserves and canned fruit and vegetable products either private labelled for Shenot's Farm or with the producer's label. The market also offers meats, dairy and baked goods from other local farms and businesses to offer their customers a more complete line of food items.

Shenot's have their own pick-your-own cut flower patch and offer flower arranging events regularly that draws dozen's of customers to the farm after market hours. The market regularly offers cut flower bouquets from another local vendor as well.



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NEWS



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*An association of
commercial vegetable,
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PVGA Twilight Meeting at Shenot Farms

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The tour of the farm's production fields began at a new planting of zucchini just below an older planting. Rob explained that they plan on several successive plantings to have a constant supply of zucchini for their market with about an acre of zucchini total. He noted that has gone to incorporating the recommended amount of dry fertilizer into his raised beds as they are forming the beds and laying the plastic mulch rather than relying on using fertigation to supply nutrients.

Shenot's make extensive use of drip irrigation using it on essentially all their crops except sweet corn where they use a travelling gun. While they have several ponds on the farm, they

have access to a municipal water supply that they use for their irrigation purposes eliminating the need for pumps and filters. Of course, municipal water does come with a cost but is still very convenient.

For soil conservation purposes, Rob and his family have long used contour strips with rye/sod strips between the strips used for the vegetable crops. Rob noted that after the rye is taken off a strip in the summer, there is reserve of clover seed in the ground from years of hay production in his grandfather's days that clover takes over the rye strips providing cover.

Shenots grow about eight acres of pump-



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The **Pennsylvania Vegetable Growers News** is the official monthly publication of the

Pennsylvania Vegetable Growers Association, Inc.,

908 North Second Street, Harrisburg, PA 17102

Phone and fax: 717-973-5915 • Email: pvga@pvga.org • Website: www.pvga.org

Our Mission:

The Pennsylvania Vegetable Growers Association serves Pennsylvania's commercial vegetable, potato and berry growers through education, research, advocacy and promotion.

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NEWS

Meet PVGA's New Management



After 40 years of dedication to PVGA, our current Executive Director William Troxell will retire on December 15, 2023. Tammy K. Linn, an account executive and project manager at Wanner Associates, assumed the role of deputy executive director and will become the executive director upon Mr. Troxell's retirement.

Wanner Associates has been in business since 1985. The firm provides management services to 19 other associations, including the Pennsylvania Landscape and Nursery Association and the Pennsylvania/Delaware Chapter of the American Society of Landscape Architects. In addition, Wanner offers lobbying and government affairs advocacy services. Wanner currently has a staff of 13 professionals serving their clients.

Ms. Linn joined Wanner in February of 2021. She offers over 39 years of increasingly responsible, multidisciplinary experience in association management for various-sized organizations. She is well-versed in association protocols and has worked closely with executive leadership, board and committee members, associate members, and the general membership.

Tammy enjoys reading, crocheting, sewing, baking, gardening, and spending time with her granddaughter.

PVGA Twilight Meeting at Shenot Farms *continued from page 2*



NEWS

PVGA Twilight Meeting at Shenot Farms *continued from page 4*

kins. Hayrides to the pumpkin patch for pick-your-own pumpkins is a major part of their fall agritourism business after their pick-your-own apples are finished. They create two mazes for their fall season using a sorghum/sudan grass mix rather than corn. These mazes are a distance from the market and are accessed from the hayride.

Rob grows about 35 acres of sweet corn in contour strips to supply the market throughout the season. Providence is their main season variety. Although most of their corn is bi-color, they do offer white corn varieties as well. Like many farm markets, sweet corn is a major draw for customers, but Shenot's also grow a good variety of other crops such as tomatoes, peppers, cole crops, and as noted before, zucchini and pumpkins and gourds. They have several greenhouses to produce their own transplants for their field production. Rob noted that in recent years they have moved to buying cantaloupes and watermelons from other local growers although they do grow some melons themselves. Apples are also a major draw for the market along with peaches and nectarines. Shenots are one of the few growers in western Pennsylvania to grow their own peaches and it is not usual for them to lose their peach and nectarine crops due to a spring frost. They also grow blueberries and raspberries.

Besides local high school labor, Rob also depends on several H-2A workers to plant and harvest their crops.

The farm is located in Allegheny County and therefore has a large customer base nearby – although they share it with several other well-established farm markets. The suburban nature of the area also allows the local deer population to flourish as well with limited hunting pressure possible. Shenots have addressed that issue by fencing their farm to prevent excessive deer crop damage. Fortunately the layout of the farm property made fencing economically feasible.

As noted above, agritainment has become an important part of their market business in recent years. During the pandemic Shenots pivoted to online ordering from their website so customers could pick-up their orders with minimal person-to-person contact. They continue to use their website extensively to communicate with their customers and announce upcoming event schedules as well as hours of operation. The website contains a whole section to outlining the farm's commitment to sustainability. Like other successful farms, the family has transitioned their operation from a diverse self-sustaining farm operation with livestock and dairy to one specializing in fruits and vegetables that are marketed direct to consumers on the farm. Likewise, the farm market has evolved its techniques to meet the changing demands of consumers.

PVGA very much appreciates the willingness of the Shenots to host this twilight meeting that was a welcome opportunity for local growers to informally get together with each other and with Penn State Extension educator Glen Bupp.

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NEWS

Richard Roush to Step Down as Dean of the College of Agricultural Sciences



Richard Roush Photo: Michael Houtz / Penn State. Creative Commons

After nine years leading the Penn State College of Agricultural Sciences, on September 17 Richard Roush stepped down as dean of the college and will serve as a special adviser to the interim dean through the end of 2023.

László Kulcsár, head of the college's Department of Agricultural Economics, Sociology and Education, and professor of rural sociology and demography, has been appointed interim dean until a permanent replacement is named, with Roush serving as a special adviser before retiring in December. A national search for Roush's permanent

successor will begin soon.

"We appreciate all that Rick has done in leading the College of Agricultural Sciences over the past nine years to support and grow the college's vital teaching, research and outreach efforts," said Justin Schwartz, executive vice president and provost. "The college's work is not only an important part of Penn State's land-grant mission, but also has been instrumental in tackling many of the broader issues facing the world today."

Roush was named dean of the University's College of Agricultural Sciences in 2014. Prior to coming to Penn State, he was the dean and a professor at the University of Melbourne's Melbourne School of Land and Environment in Australia.

Under Roush, the college's research enterprise continued to flourish, with annual research expenditures hitting a new record of \$114.3 million for 2021-22, placing it among the top-performing academic colleges over the past decade. Its Institute for Sustainable Agricultural, Food and Environmental Science, formed in 2020, has earned more than \$49.5 million in grants and now involves 150 faculty across eight academic colleges and four Commonwealth Campuses.

Penn State's College of Agricultural Sciences continues to be recognized by the state and federal government as a research leader, including Penn State Extension's work to promote and support water quality in Pennsylvania's streams and rivers. In addition, Extension has been recognized by peers as a national leader in digital education, and has dramatically increased its reach across the commonwealth and the world.

The college's state appropriations grew with Roush as dean, increasing by more than 25%, from approximately \$46.2 million in 2014-15 to approximately \$57.5 million in 2022-23.

Undergraduate enrollment remained at high levels and the college's graduate enrollment expanded to a high of approximately 550 students. Its graduate students have received more USDA predoctoral fellowships than any other institution over the past five years.

Since Roush took over as dean, the percentage of tenured or tenure-track female faculty members in Agricultural Sciences has increased from 18.5% in 2015 to 35% today.

In 2015, Roush engaged the college to play a major role in the commonwealth's efforts to limit the spread and impact of the spotted lanternfly, including leading awareness and education programs, providing prevention and mitigation advice through Penn

State Extension, and conducting extensive research on the invasive insect.

The College of Agricultural Sciences has made major capital investments over the past nine years, including completing a major renovation of the historic Agricultural Engineering Building in 2018 and opening the new Animal, Veterinary and Biomedical Sciences Building in 2021, and plans to expand and update its greenhouse facilities and the Animal Diagnostic Laboratory.

During the recently concluded "A Greater Penn State for 21st Century Excellence" fundraising campaign, the college raised more than \$113.5 million — exceeding the college's target of \$100 million — and received a number of major gifts, including a landmark gift from campaign vice chair Peter Tombros and his wife Ann to create the Peter and Ann Tombros Dean's Chair in Penn State's College of Agricultural Sciences, as well as the Harbaugh Entrepreneur and Innovation Faculty Scholar, the John and Patty Warehime Entrepreneur in Residence, the Samuel Pancoast Simon Professorship in Entomology, the Masser Family Faculty Chair in Potato Research and the Publius Vergilius Maro Professor of Entomology.

Prior to his time at the University of Melbourne, Roush served as a faculty member at the University of California, Mississippi State University, Cornell University, Texas A&M University and the University of Adelaide in Australia. Roush was CEO of Australia's Cooperative Research Centre for Weed Management, and director of the University of California's Statewide Integrated Pest Management Program.

He is a fellow and member of the Entomological Society of America, and a founding member of the Australian Council of Deans of Agriculture.

Roush has consulted for corporations such as Eli Lilly, Dupont, Monsanto and Dow on the management and prevention of resistance to conventional and biological pesticides, and genetically transformed plants.

He holds a bachelor of science degree in entomology from the University of California, Davis, and his doctorate in entomology from the University of California, Berkeley.



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NEWS

H-2A Labor Updates

Sara Gligora

In recent weeks there has been quite a bit of activity around the H-2A program including 2 proposed rule changes and a new funding opportunity. The proposed rule change includes a 60 day period for public comment allowing industry an opportunity to present their concerns or questions regarding the proposed changes.

The new funding opportunity will provide up to \$2 million dollars to H-2A employers to support their H-2A workforce.

More information on the proposed rule and funding opportunity can be found below. If you have any questions or concerns please let us know. PDA can provide guidance and technical assistance as needed.

DOL Proposed Rule- Improving Protections for Workers in Temporary Agriculture Employment in the United States

On September 12, 2023, the U.S. Department of Labor (DOL) Employment and Training Administration (ETA) published in the Federal Register a proposed rule (88 FR 63750) (see <https://www.federalregister.gov/documents/2023/09/15/2023-19852/improving-protections-for-workers-in-temporary-agricultural-employment-in-the-united-states>) titled "Improving Protections for Workers in Temporary Agricultural Employment in the United States," amending several H-2A program regulations. The agency states that the proposed rule, among other things, will

- "Clarify workers' rights to invite and accept guests—including labor organizations—to employer-provided housing";
- "Clarify that an employer only terminates a worker 'for cause' when the worker either fails to meet pre-specified productivity standards or fails to comply with employer policies after the employer applies a system of progressive discipline";
- "Require employers to provide a copy of all agreements with any agent or recruiter the employer engages in recruiting prospective H-2A workers to the department, regardless of whether the agent is in the U.S. or abroad";
- "Require employers to identify and disclose the name and location of anyone soliciting H-2A workers on their behalf";
- "Prohibit the use of any employer-provided vehicle to transport H-2A workers unless each occupant is wearing a seat belt before the vehicle is operated"; and
- "Mak[e] new wage rates applicable immediately upon their publication in the Federal Register rather than weeks later."

Comments on the proposed rule may be submitted until November 14, 2023.

DHS Proposed Rule- Modernizing H-2 Program Requirements, Oversight, and Worker Protections

On September 20, 2023, the U.S. Department of Homeland Security (DHS) published in the Federal Register a proposed rule (88 FR 65040) (<https://www.federalregister.gov/documents/2023/09/20/2023-20123/modernizing-h-2-program-requirements-oversight-and-worker-protections>) titled "Modernizing H-2 Program Requirements, Oversight, and Worker Protections." Also announced by DHS, the proposed rule would "provide H-2A and H-2B workers [who report their employers for program violations] with 'whistleblower protection' comparable to . . . that . . . currently offered to H-1B workers" and "extend grace periods for [workers] seeking new employment, preparing for departure from the United States, or seeking a change of immigration status." The proposed rule would also establish permanent H-2 portability, "which would allow employers who are facing worker shortages to hire H-2 workers who are already lawfully in the United States while the employer's H-2 petition for the worker is pending."

Comments on the proposed rule may be submitted until November 20, 2023.

Funding Opportunity- Farm Labor Stabilization and Protection Pilot Program (FLSP Program)

The USDA Farm Labor Stabilization and Protection Pilot

Program (FLSP) will award up to \$65 million in American Rescue Plan Act funding to provide support for agricultural employers in implementing robust labor standards to promote a safe, healthy work environment for both U.S. workers and workers hired from northern Central American countries under the seasonal H-2A visa program. The program is funded by the Farm Service Agency and will be administered by the Agricultural Marketing Service and the Farm Production and Conservation Business Center.

The FLSP Notice of Funding Opportunity (NFO) can be found at https://www.ams.usda.gov/sites/default/files/media/FLSP_NFO.pdf. Based on your employer type, applicants can apply for FLSP funding as a Fixed-site Employer; Farm Labor Contractor; or Joint Employer. See https://www.ams.usda.gov/sites/default/files/media/FLSP_Flowchart.pdf.

The purpose of the FLSP program is to improve food and agricultural supply chain resiliency by addressing challenges agricultural employers face with labor shortages and instability. The FLSP Program seeks to advance the following Administration priorities:

- Goal 1: Drive U.S. economic recovery and safeguard domestic food supply by addressing current labor shortages in agriculture;
- Goal 2: Reduce irregular migration from Northern Central America through the expansion of regular pathways; and
- Goal 3: Improve working conditions for all farmworkers.

The 2023 FLSP grant application period closes November 28, 2023.

Ms. Gligora is the Special Assistant for Workforce Development at the PA Department of Agriculture and can be contacted at 717-798-5048 or sgligora@pa.gov

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NEWS

Free Legal Services from the Penn State Law Rural Economic Development Clinic

The Penn State Law Rural Economic Development Clinic provides law students with practical legal experience in the food and agricultural sectors. Working under the close supervision of law faculty and staff attorneys who are licensed Pennsylvania attorneys, student attorneys can assist farmers and agricultural businesses in a variety of legal matters.

The Rural Economic Development Clinic is now accepting applications for its Fall 2023 semester and is looking to assist farmers and agricultural businesses who are engaged in agri-tourism operations or the direct sale of agricultural products. To take advantage of this opportunity, interested individuals and organizations should send an email to Ross Pifer at rhp102@psu.edu providing a detailed explanation of the specific legal services desired along with appropriate background information. Priority will be given to those applications received by October 10, 2023. The Clinic may not be able to provide services to all who request, but we will do our best to serve the greatest number of clients possible - consistent with our resources and the legal expertise of the student attorneys.

U.S. Specialty Crop Coalition Endorses Legislation Addressing Research, Nutrition and Trade

The Specialty Crop Farm Bill Alliance (SCFBA), a national coalition of more than 200 specialty crop organizations representing growers of fruits, vegetables, dried fruit, tree nuts, nursery plants and other products, this week endorsed legislation that would address major priorities tied to research, nutrition and trade laid out in the group's 2023 Farm Bill recommendations:

Specialty Crop Research Act of 2023, introduced by Rep. Elissa Slotkin (MI-07), would increase mandatory funding for the Specialty Crop Research Initiative and IR-4.

GusNIP Expansion Act of 2023, introduced by Reps. Rick Crawford (AR-01) and Dan Kildee (MI-08), would enhance and expand the Gus Schumacher Nutrition Incentive Program (GusNIP), providing low-income Americans with greater access to fresh fruits and vegetables.

Expanding Agricultural Exports Act, introduced by Senators Angus King (ME), Joni Ernst (IA), Tina Smith (MN), Susan Collins (ME), and Chuck Grassley (IA) and Reps. Dan Newhouse (WA-04), Jim Costa (CA-21), Tracey Mann (KS-01), Kim Schrier (WA-08), Ashley Hinson (IA-02), Jimmy Panetta (CA-19), Bradley Finstad (MN-01), and Chellie Pingree (ME-01), would double the funding for the Market Access Program to \$400 million.

"The Specialty Crop Farm Bill Alliance has long advocated for investments in the competitiveness and sustainability of the U.S. specialty crop industry to produce a strong return for both farmers and all Americans – it's foundational to everything we do," the SCFBA Co-Chairs said in a joint statement. "That's why we are grateful for those in the U.S. Senate and House who continue to champion policy ideas that will improve access to fruits and vegetables in federal nutrition programs and enhance the long-term competitiveness of the industry."

The SCFBA was established to advocate for the unique needs of specialty crop growers in the Farm Bill and enhance their overall competitiveness in the face of increasing global competition and regulatory and buyer demands. It is led by Co-Chairs Mike Joyner, President of the Florida Fruit & Vegetable Association; Dave Puglia, President and CEO of Western Growers; and Kam Quarles, CEO of the National Potato Council, with Robert Guenther, Chief Public Policy Officer for International Fresh Produce Association, who serves as secretariat for the Alliance.

Specialty crop production, including fruits, vegetables, tree nuts, nursery and greenhouse commodities, contributes significantly to the U.S. economy, accounting for \$64.7 billion in farm gate value and 30 percent of farm cash receipts for crops.

DEP Agriculture Energy Efficiency Rebate Program Now Re-Open

The Pennsylvania Department of Environmental Protection (DEP) Energy Programs Office has announced that funding is available for its Agriculture Energy Efficiency Rebate Program for Pennsylvania farmers and ag producers.

Rebates are being offered for the following technology categories:

- Energy efficient lighting systems: LED lighting (both interior and exterior), including fixtures and controls.
- Energy efficient ventilation equipment: Ventilation fans including both circulation and exhaust fans, motors, and controls (all fans must be third party tested to verify efficiency).
- Variable speed drives for multiple end uses.

The program guidelines detail applicant and equipment eligibility and can be found at www.dep.pa.gov/agricultureenergy.

Rebates will pay up to 50 percent of equipment purchase costs, up to \$7,500. Applicants may apply under any or all technology categories, but the maximum rebate is \$7,500 per applicant (increased from \$5,000 last fiscal year). Up to \$2,000 in installation costs may be included in the total project costs for each technology category, to be reimbursed at up to 50 percent (up to \$1,000).

The program is open on a first-come first-served basis as funding remains available or through Dec. 31, 2023. Approximately \$100,000 is available for the rebate program this fiscal year. Those interested must submit an application to obtain a rebate voucher prior to installing equipment. All applications must be submitted online through eGrants/Electronic Single Application.

More information can be found on the DEP website, including the program guidelines, a link to step-by-step application instructions and a link to the online application. Questions on the program may be directed to Michelle Ferguson at 570-327-3783 or by email RA-EPAgEnergyProgram@pa.gov.

From **Farm Bureau Express**, Penna. Farm Bureau, September 29, 2023



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MARKETING

Utilizing Bundling Strategies to Increase Sales Revenue

Nate Bruce

Direct-to-consumer marketing often involves selling various products that have both high profit margins and low profit margins. A useful pricing strategy to promote sales of both high profit margin items and low profit margin items is to use bundling strategies. Bundling is a useful pricing strategy for complimentary, overstock, or older products. Bundling can result in increased total sales revenue and enable items in inventory that remained unsold to be purchased.

Bundling enables both revenue maximization and quantity maximization by providing extra value to the product the customer really wants, increasing the amount they are willing to spend. Bundling can reduce profit margins because overstocked or older inventory items being sold in the bundle will be at a reduced-price rate to trigger sales of the high demand product it is being bundled with. However, bundling can easily make up for it by increasing total sales and reducing marketing expenses such as labeling and packaging. On the other end of the spectrum, customers may not want the other item being offered in the bundle but will be content with the purchase option that was offered to them. Bundling can promote customer retention.

Bundling can help simplify marketing, especially if you are producing multiple different products. Bundling enables you to sell multiple products in one single package, reducing potential marketing expenses. Some examples of this are CSA boxes, value-added product pairings, meal kits, multiple meat cut packages, etc.). By using bundling strategies such as those listed, you can sell items in inventory that have sold at slower rates. A partial cost recovery occurs when you can sell products that would have gone unsold that you have already invested the expenses in to produce. Although the items are being sold at a discount, bun-

dling them allows for you to recover a fraction of the production expenses that were needed for their production.

If implementing bundling within your marketing strategy, ensure the items being offered are complimentary. Consider what your customer base would purchase together. For example, if your customer base is looking to purchase pumpkins for fall decorations, mums may be a good bundling option. At the same time, offer the items in the bundle individually as well so the customer can see the bundle is a great purchase.

If bundling both high and low margin items, consider the price of the bundle itself represents the average of all its components. If bundling low margin items decreases the overall average price of the bundle, the customer may pass on the bundle as there is a perception of decreased value. Always consider the bundle price as an average price of all the components within.



Ensure the bundle is attractive and simple. You can bundle as many items together as you want, however it is easiest for customers to see value in smaller item bundles.

Bundling is a fantastic marketing strategy to increase sales revenue. Make sure to use multiple marketing channels to ensure your customer base is aware of the bundle.

Mr. Bruce is the Farm Business Management Specialist at the Univ. of Delaware. From the **Weekly Crop Updates**, Univ. of Delaware Extension, Vol. 31, Issue 21, August 18, 2023.

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VEGETABLE PRODUCTION

Plectosporium Blight Found in Pumpkin Fields

Gerald Brust

By this time of the season (mid-August) I usually see pumpkin fields infected with powdery mildew commonly throughout the mid-Atlantic. And while powdery is present in many pumpkin fields it does not seem as bad as in previous years. The one disease I am seeing is plectosporium blight. This fungal disease of pumpkin, zucchini and squash can cause yield loss if left uncontrolled. Plectosporium blight prefers warm, humid, or rainy weather conditions. It overwinters on crop residue and can persist in the soil for several years. Plectosporium blight can be recognized from the small white to light tan spots on leaves (Figure 1) and elongated lesions on stems and leaf petioles (Figure 2). On green fruit the lesions are very small white to tan flecks (Figure 3) on more mature fruit the lesions are round to irregular shaped pimples on the surface of the pumpkin that often makes them unmarketable (Figure 3). These fruit lesions also allow soft rot pathogens to penetrate the pumpkin, that will cause the fruit to 'melt-down' into a deflated mess. When stem and foliar lesions occur in large numbers, they can give a light gray or white appearance to the foliage. As the lesions increase in numbers and merge, they turn the vines and leaf petioles white (Figure 2). Severely infected pumpkin stems or petioles will become brittle and can split or shatter if disturbed (Figure 2).

When Plectosporium blight occurs, rotate away from summer squash and pumpkins for 2 years. Scout for disease and apply fungicides when disease first occurs. Thorough coverage of foliage, vines, and fruit is necessary for good control. Most of the time a protective spray of chlorothalonil or mancozeb will give you good protection from this disease, however in years like this one the disease control needs a kick with the addition to the protective sprays of using something in rotation such as Cabrio or Flint Extra or Pristine. These 'extra sprays' should not be rotated with each other.

*Dr. Brust is the IPM Vegetable Specialist at the Univ. of Maryland. From the **Weekly Crop Update**, Univ. of Delaware Extension, Vol. 31, Issue 22, August 25, 2023.*



Figure 1. Plectosporium yellow-tan spots (lesions) on pumpkin leaf



Figure 2. Plectosporium on pumpkin leaf petioles-the petiole to right has split.

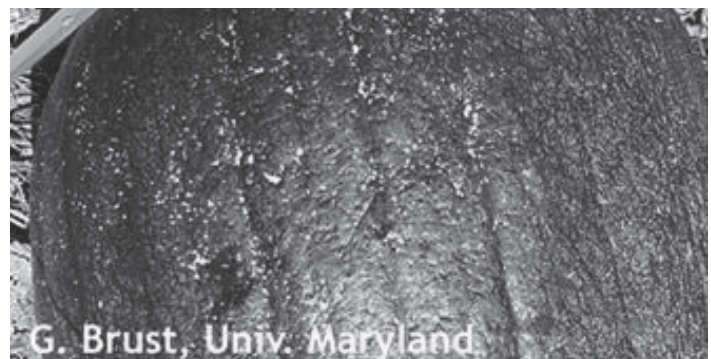


Figure 3. Plectosporium lesions on small green fruit and on more mature orange fruit



VEGETABLE PRODUCTION

Cover Cropping is a Necessary Tool for Vegetable Growers

Gordon Johnson

With cover crop season coming up, vegetable growers will have decisions to make on what cover crops to plant and how best to grow and use them.

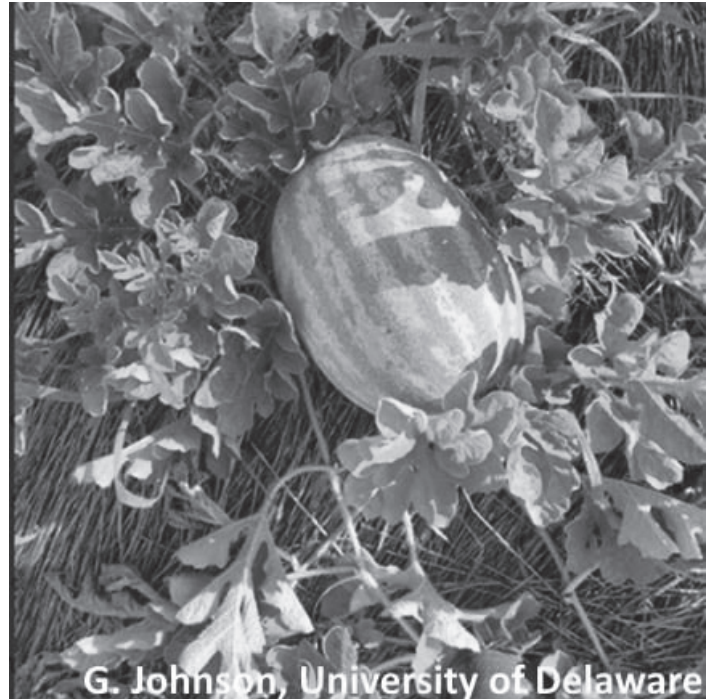
Cover crop acreage has been growing in the region, largely due to nutrient management efforts, cost share programs and recent programs encouraging farmers to grow cover crops for soil health benefits and soil improvement. Cover crops are also an important tool in Climate Smart Agriculture programs to store carbon.

First, consider your goals for cover cropping in vegetable rotations. Nutrient management goals and soil health goals are not necessarily the same. In nutrient management-based cover crop programs, the goals are to have crops that can take up residual nitrogen and provide cover to reduce soil erosion losses. Non-legumes predominate, with most of the acres planted in small grains such as rye and some recent use of radishes. Limited or no fertilizer can be used with cover crops in these programs. In this case the answer to the question above is that a cover is being grown. While there will be soil health benefits, they are not maximized.

In contrast, for most vegetable growers, soil improvement is the primary goal. In this case the cover crops are grown as crops. You are growing plants to maximize the benefits they provide. To increase organic matter and improve soil health the main goal is to produce maximum biomass above ground and below ground. A second important goal is to provide different types of organic matter (such as with cover crop mixtures) to support a diverse soil microbial environment.

Cover crops can also be important to break soil borne pest cycles. Certain cover crops such as some rye varieties can reduce root knot nematode levels because they are non-hosts. Other cover crops such as hairy vetch can reduce Fusarium levels in watermelon rotations. Biofumigant mustards can be used to reduce Phytophthora. Cover crops also can be an important part of weed

continued on page 12



Watermelon growing in a no-till system on a heavy rye cover. In this case a heavy biomass cover crop was grown.

G. Johnson, University of Delaware

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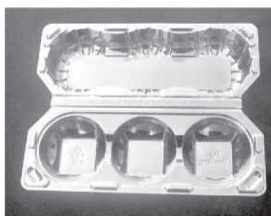
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VEGETABLE PRODUCTION

Cover Cropping is a Necessary Tool for Vegetable Growers

continued from page 11

management programs through the production of allelopathic chemicals that inhibit weed seed germination.

In other cases, the goals will be different. With leguminous cover crops a goal may be to maximize the amount of nitrogen fixed. With soil compaction reducing crops such as radishes, the goal is to maximize the amount of “biodrilling” (the amount of tap roots being produced). With biofumigant crops, the goal is to maximize the production of fumigant-like chemicals by the crops. With mulch-based systems, the goal is to maximize above-ground biomass.

What these soil improvements and specific use goals have in common is the need to treat the cover crop as a crop to optimize plant growth. This includes seeding at the proper rate to achieve optimal stands, planting at the right time, using best seeding methods to get maximum seed germination and plant survival, having sufficient fertility to support good plant growth, providing water during dry periods, managing pests (insects, diseases, weeds), and inoculating legumes. If cover crop mixtures are being used, the ratios of seeds being planted must be considered to have the

best balance of plants in the final stand.

The best cover crop stands are obtained with a drill or seeder that places the seed at the proper depth, at the proper seeding rate, with good soil to seed contact. Fertilization and liming programs should be used to support season-long growth – fertilizers and other soil amendments will be necessary in most cases. Nitrogen will need to be added for non-legumes.

When the crop is terminated is also key. The cover crops should be allowed to grow to the stage that maximizes the benefits they have to offer before killing the crops. Planting green (planting into a living cover crop before termination) is now being practiced by some vegetable growers. Allowing a winter cover to grow for an extra week in the spring can make a large difference in the amount of biomass but may cause water deficits in dry years.

*Dr. Johnson is the Retired Extension Vegetable and Fruit Specialist from the Univ. of Delaware. From the **Weekly Crop Update**, Univ. of Delaware Extension, Vol. 31, Issue 19, August 4, 2023.*

Factors Affecting Bell Pepper Fruit Size and Shape

Emmalea Ernest

Bell pepper fruit must reach adequate size, have a symmetrical shape, and have an acceptable height to diameter ratio in order to be marketable. Bell pepper fruit characteristics are influenced by variety, but also by environmental factors that occur during flower formation and early fruit development. Horticultural researchers have attempted to identify specific environmental factors that affect pepper size and shape, but some mysteries remain.

High and low nighttime temperatures are known to impact pepper fruit set, size, and shape. Both high and low nighttime temperatures result in poor pollination which can cause small and lopsided pepper fruit (Figure 1). Night temperatures that are below 64 °F reduce pollination and increase the incidence of parthenocarpic (seedless) fruit. Parthenocarpic fruit tend to be smaller and are likely to be unmarketable. Low night temperatures also cause ovary enlargement during flower development that results in short fruit that do not elongate properly (Figure 2). These short, flattened peppers are also likely to be unmarketable. Longer pepper fruit develop from flowers that form during warm nighttime (68-75°F) conditions. Excessively high nighttime temperatures (90°F) applied to peppers in experimental situations cause fruit set to cease because of damage to pollen; high temperatures do not induce parthenocarpic fruit. The nighttime high temperature threshold for damage to pepper pollen has not been established but is probably higher than the typical night temperatures experienced in Delaware.



Figure 1. Small and misshapen peppers (left) have inadequate or uneven pollination compared to marketable fruit (right).

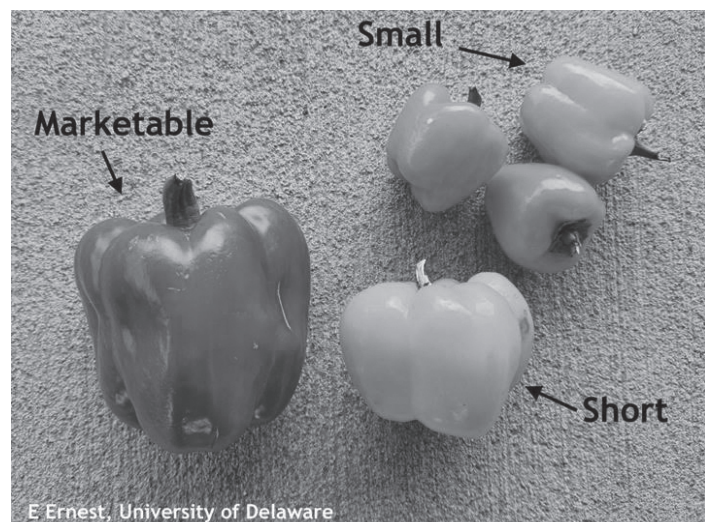


Figure 2. Conditions during flower development affect pepper size and length. Low night temperatures can cause short, unmarketable pepper fruit.

Pepper fruit size is also influenced by photosynthate availability during fruit development. The photosynthate availability will depend on plant size and leaf area and fruit load. Plants that do not reach adequate size before flowering begins will not produce marketable size fruit (Figure 3). Plants that set many peppers at the same time will also tend to produce small fruit because of competition between fruit. To avoid small fruit size, provide adequate nutrients and irrigation early in the season to promote leaf and stem growth in pepper plants. Use of shade cloth in peppers can help to promote early season vegetative growth. Later in the season, damaged, undersize, and misshapen fruit should be removed from the plant as early as possible so that they do not compete for resources with fruit that have potential to be marketable (Figure 4). Bell pepper plants tend not to abort fruit that has survived 14 days post pollination, even after significant damage. Pepper fruit that have a short, flattened appearance early in development will not develop a marketable shape later and should be removed. Pepper fruit that have begun to ripen will not grow larger so undersize peppers that begin to change color should also be removed.

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VEGETABLE PRODUCTION

Factors Affecting Bell Pepper Fruit Size and Shape *continued from page 12*



E Ernest, University of Delaware

Figure 3. Small pepper plants tend to make small pepper fruit.



E Ernest, University of Delaware

Figure 4. Small fruit with sunscald or other types of damage should be removed to reduce competition with potentially marketable fruit. Pepper plants will not naturally abort such fruit.

Dr. Ernest is the Extension Fruit and Vegetable Specialist at the Univ. of Delaware. From the **Weekly Crop Update**, Univ. of Delaware Extension, Vol. 31, Issue 22, August 25, 2023.

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VEGETABLE PRODUCTION

Fertilizer Recommendations for Broccoli, Cabbage and Cauliflower

Emmalea Ernest

Fall cole crops are being transplanted into the field and within this group, broccoli, cabbage, and cauliflower have high nutrient requirements. Following recommended fertility practices can help to avoid some physiological disorders, such as hollow stem and buttoning. The Mid-Atlantic Commercial Vegetable Recommendations include our regional nutrient recommendations for broccoli, cabbage and cauliflower. However, some of those recommendations are in footnotes in very small print, so I am reviewing them here:

Broccoli

Nitrogen 150-200 lb/acre split between three applications (planting, 2-3 week sidedress, 4-6 week sidedress).

Phosphorus should be applied at planting based on soil test results. Rates are as follows in lb/acre of P₂O₅: Low – 200, Medium – 100, High/Optimal – 50, Very High – 0.

Potassium should be applied at planting based on soil test results. Rates are as follows in lb/acre of K₂O: Low – 200, Medium – 100, High/Optimal – 50, Very High – 0.

Boron should be applied at planting at rate of 1.5-3 lb/acre.

Sulfur should be applied as a part of the fertilizer program at a rate of 20-45 lb/acre.

Cabbage and Cauliflower

Nitrogen 100-150 lb/acre split between two applications (planting, 2-3 week sidedress).

Phosphorus should be applied at planting based on soil test results. Rates are as follows in lb/acre of P₂O₅: Low – 200, Medium – 100, High/Optimal – 50, Very High – 0.

Potassium should be applied at planting based on soil test results. Rates are as follows in lb/acre of K₂O: Low – 200, Medium – 100, High/Optimal – 50, Very High – 0.

Boron should be applied at planting, 1.5-3 lb/acre.

Molybdenum should be applied at planting with broadcast fertilizer. Rate is 0.5 lb/acre of sodium molybdate.

Sulfur should be applied as a part of the fertilizer program at a rate of 20-45 lb/acre.

*Dr. Ernest is the Extension Fruit and Vegetable Specialist at the Univ. of Delaware. From the **Weekly Crop Updates**, Univ. of Delaware Extension, Vol. 31, Issue 20, August 11, 2023.*

End of Season Practices to Reduce Vegetable Diseases Next Year

Emmalea Ernest

Harvest in some of this season's vegetable fields is done and others will finish up very soon. End of season sanitation in these fields can help prevent next year's disease problems. When harvest is complete, it is best to mow and incorporate (disc, plow, till) crop residue as soon as possible.

One way that this helps control plant diseases is that disease organisms will continue to increase on the abandoned crop – especially after disease management sprays stop. With more of the disease present in the field there is a greater chance that some of it will overwinter and survive until next year. When you terminate the host crop, the disease organism can't keep buying raffle tickets (figuratively, of course) to win a trip to your next growing season.

The second way that sanitation will help to manage vegetable diseases is that many disease organisms survive best on intact plant residue. Decomposition of crop residue reduces the survival of many diseases that affect vegetable fruit, leaves and stems. It may seem like exposing residue to winter conditions above soil would be most detrimental to survival, but actually the breakdown of crop residue by soil microbes is more effective at reducing disease. Incorporation of plant residue is especially recommended for managing certain diseases including gummy stem blight of watermelon, anthracnose of pepper/tomato/eggplant and *Alternaria* leafspot of brassicas.

*Dr. Ernest is the Extension Fruit & Vegetable Specialist at the Univ. of Delaware. From the **Weekly Crop Update**, Univ. of Delaware Extension, Vol. 31, Issue 24, September 8, 2023.*

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POTATO PRODUCTION

Identifying Potato Tuber Diseases

Potato harvest season is happening now! Some fields have been harvested already, other fields have just been burned down, and some later plantings are still sizing up, albeit with some yellowed and diseased foliage after this wet year. There are many diseases that affect potato tubers, so as you begin to sort through your potato harvest this year, take a moment to check for disease symptoms. Proper identification will help you decide which tubers will store well and which should be sold as tablestock, and will give you a better idea of which soil-borne diseases are present in your fields, improving your future crop rotations. To be sure of a diagnosis, samples can be submitted to the Penn State Plant Disease Clinic (PlantClinic@psu.edu or 814-865-2204). Most of these diseases (except for scabs, scurfs, and potato virus Y) get started on foliage and, if controlled there, can be prevented on tubers. See the [Mid-Atlantic Commercial Vegetable Recommendations] potato disease section for fungicide recommendations.

Common scab (Bacterial: *Streptomyces spp.*) produces tan to dark brown, circular or irregular lesions, which are rough in texture. Scab may be superficial (russet scab), slightly raised (erumpent scab), or sunken (pitted scab). The type of lesion is dependent on potato cultivar, tuber maturity at infection, organic matter content of soil, strain of the pathogen, and the environment. Common scab is controlled or greatly suppressed at soil pH levels of 5.2 or lower, though a closely related but less common species of *Streptomyces* known as acid scab can survive down to 4.0.

Maintaining moist soil conditions, especially during tuber initiation, can be an effective way to prevent scab infections, though is usually tricky to implement on the scale most potatoes are grown. However, in a wet year like this one, perhaps scab is one disease we might see less of!

Some varieties are more susceptible than others, with red

skinned varieties being generally most sensitive and russets being most resistant. From Christopher Clark, USDA-ARS Vegetable Breeder, "Some recently released cultivars that are at least partially common scab resistant are Lamoka, Upstate Abundance, and Caribou, though none of these are highly scab resistant. In our very limited trials, Blazer, Canela, and Gold Rush Russet potatoes performed better for common scab resistance than some of the more commonly grown russets when challenged with the species of the pathogen that appears to be the most prevalent in New England. For red potatoes, Dark Red Norland performed the best for scab resistance in some of our limited trials among red potatoes, though it is still quite susceptible. Superior is a white potato that performs reasonably well for scab resistance."

For conventional growers, the fungicide quintozene (Blocker) seems to work quite well.



Early blight.
Photo: S. Jenson, Cornell Univ., Bugwood.org

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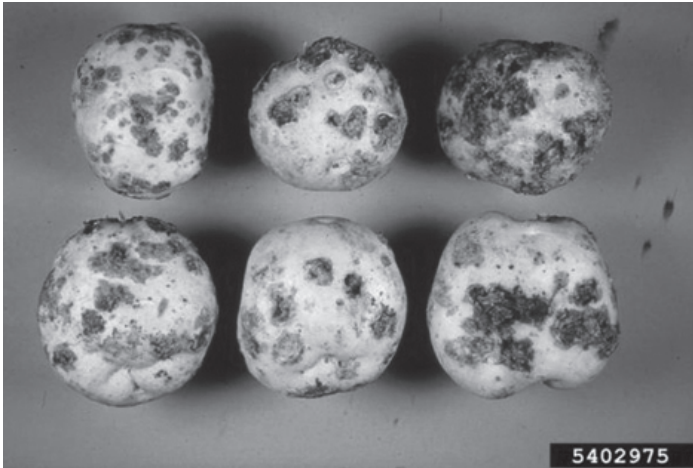
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POTATO PRODUCTION

Identifying Potato Tuber Diseases continued from page 15

Early blight (Fungal: *Alternaria solani*) usually affects potato foliage but tuber infections can also occur. Tuber lesions are dark, sunken, and circular, and are often bordered by raised, purple to gray tissue. The underlying flesh is dry, leathery, and brown. Lesions can increase in size during storage, causing tubers to become shriveled.

Fusarium dry rot (Fungal: *Fusarium spp.*) causes internal, light to dark brown or black dry rot of the potato tuber. The rot may develop at an injury site, such as a bruise or cut. The pathogen penetrates the tuber, often rotting out the center. Extensive rotting causes the tissue to shrink and collapse, usually leaving a dark sunken area on the outside of the tuber and internal cavities.



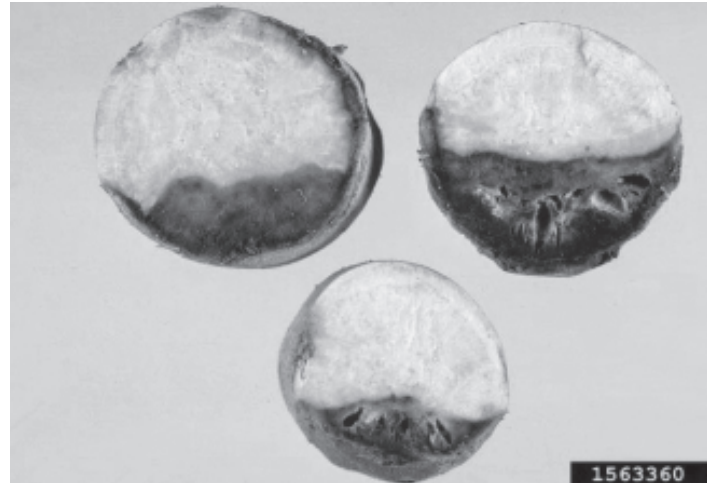
Common scab. Photo: R. W. Samson, Purdue Univ., Bugwood.org



Silver scurf. Photo: UMaine Extension

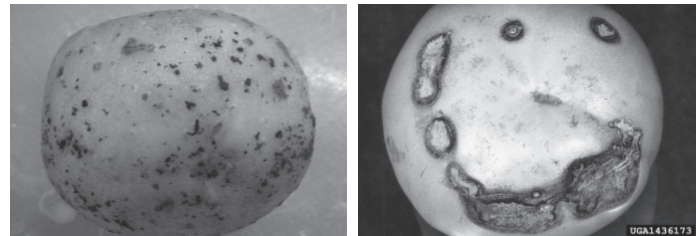
Silver scurf (Fungal: *Helminthosporium solani*) affects only tuber periderm (skin). Lesions start at the stolon end of the tuber as small, pale brown spots which may be difficult to detect at harvest but will continue to develop in storage. In storage, lesions may darken and the skin may slough off. Many

small circular lesions may coalesce to form large affected areas. Tubers may also dry out and become wrinkled due to excessive moisture loss in storage.



Dry rot caused by *Fusarium spp.* Photo: C. Averre, Bugwood.org

Black dot (Fungal: *Colletotrichum coccodes*): On potato foliage, symptoms of black dot are nearly indistinguishable from early blight. On tubers, it produces large discolored areas that can easily be mistaken for silver scurf. Under a 10X lens, tiny black sclerotia are visible on the surface of the affected tissue.



Black scurf (left, photo: UMass Vegetable Program) and *Rhizoctonia canker* (right, photo: Clemson University, Bugwood.org), both caused by *Rhizoctonia solani*.

Black scurf and Rhizoctonia canker (Fungal: *Rhizoctonia solani*): Black scurf is purely cosmetic and does not reduce yield, even in storage. Irregular, hard, black masses that develop on tuber surfaces are overwintering structures (sclerotia) of the fungus. Development of these sclerotia may be minimized by harvesting tubers soon after vine-kill and skin set. While the sclerotia themselves do not cause damage, they allow the pathogen to survive in the soil and serve as evidence of its presence. In cool, wet soils, *R. solani* can cause dark, sunken lesions on underground sprouts and stolons. These lesions can cut off the supply of nutrients and kill tubers, or can reduce the transfer of starches to the tubers, reducing their size. Cankers can also form on the tubers themselves, usually at the stolon or in lenticels. Tuber cankers vary greatly in size, from small and superficial to large, sunken, and necrotic.

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POTATO PRODUCTION

Identifying Potato Tuber Diseases *continued from page 16*



Pink rot caused by Phytophthora erythroseptica. Photo: Univ. of Minnesota

Pink rot (Oomycete: *Phytophthora erythroseptica*): Pink rot infections start at the stolon end of tubers and result in rotten and discolored periderm with a clear delineation between healthy and diseased tissue. When exposed to air, tuber flesh turns pink and then brown-black.

washed down into the soil and usually begins in wounds, eyes, or lenticels. Lesions are copper brown, red or purplish and white sporulation may occur on tuber surfaces in storage or cull piles. Infected tubers are susceptible to infection by soft rot bacteria, which can turn entire bins of potatoes in storage into a smelly, rotten mass. (Late blight has not been seen in MA since 2017; there are currently 3 reports of late blight in central NY.)



Necrotic ringspots on Yukon Gold potatoes caused by PVY. Photo: potatovirus.org

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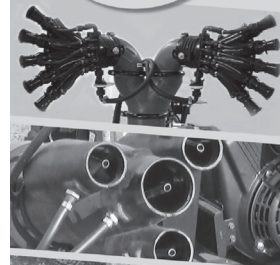
Pythium leak. Photo: S. B. Johnson

Pythium leak (Oomycete: *Pythium* spp.): The *Pythium* species that cause leak infections invade tubers through harvest wounds and continue to develop in transit and storage. Infections result in

internal watery, gray or brown rot with well-defined red-brown lines delineating healthy and diseased tissue.

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Late blight causing water-soaked spots on tubers. Photo: R.W. Samson, Purdue Univ., Bugwood.org.

Late blight (Oomycete: *Phytophthora infestans*) affects potato foliage and tubers. Foliar symptoms start with brown to black, water-soaked lesions on leaves and stems, which produce visible white sporulation at the lesion margins under humid conditions. Whole plants and fields may collapse rapidly. Tuber infection is initiated by sporangia from foliage being

POTATO PRODUCTION

BERRY PRODUCTION

Identifying Potato Tuber Diseases

continued from page 17

Potato virus Y can cause necrotic ringspots on tubers, depending on which strain of the virus is present, which potato variety is grown, and the time of infection. Affected tubers have roughened rings of darker brown or reddened skin. Necrosis beneath the rings may extend into the tuber flesh. Necrotic symptoms in tubers often increase after storage. Potato varieties vary in their susceptibility to PVY and the symptoms they exhibit on foliage and on tubers; Yukon Gold is particularly susceptible to tuber necrosis. Management of this disease starts with sourcing certified disease-free seed tubers, then preventing spread by aphids by planting buffers around the potato crop.

Physiological Disorders



Hollow heart. Photo: B. Phillips, Michigan State Univ., Bugwood.org

Black heart is caused by lack of oxygen during storage, which causes the tissue to die from the inside out and turn black. The condition is not reversible, but if you notice it quickly and correct your storage conditions you can prevent the whole crop from being affected.

Brown center and **hollow heart** are internal physiological disorders of potato that often occur together. Brown center is an area of dead pith cells that turn brown, while hollow heart is a star- or lens-shaped hollow area in the center of the tuber. These disorders make fresh-market tubers unattractive and can reduce repeat sales. Severe hollow heart negatively impacts the quality of chip-processing potatoes and can result in shipments not making grade. Both disorders are related to stress, and occur at a higher incidence when growing conditions abruptly change during the season. Brown center and hollow heart likely form during tuber initiation but could also form during tuber bulking. If the disorder occurs during the early part of the season, it most often begins as brown center that forms in the stem-end of the tuber, while late-forming hollow heart usually occurs near the bud-end with no brown center symptoms. Conditions such as soil temperatures below 56°F for 5-8 days, or available soil moisture above 80% initiate brown center formation. Incidence of brown center and hollow heart also increases with periods of stress caused by high or low soil moisture, especially if heavy rains occur suddenly after a dry spell. Large tubers are more prone to develop the disorder, so using closer spacing and avoiding skips in the row can reduce incidence of brown center and hollow heart. There are also differences in the susceptibility of potato varieties to both of these disorders.

*Ms. Scheufele is with the Univ. of Massachusetts Extension Vegetable Program. From **Vegetable Notes**, Univ. of Mass. Extension, Vol. 35, No. 20, August 31, 2023.*

Strawberry Plug Planting Issues to Avoid

Gordon Johnson

Plasticulture strawberry planting season will start in 2-3 weeks and most growers will use plug plants for planting. Plug plants are produced from rooting strawberry tips in plug trays filled with growing media, most commonly in 50 cell trays. Plant losses often arise from issues with plug plants and how they are planted.

One common issue is when strawberry tips are not fully rooted. When pulled during transplanting the strawberry roots are then damaged and plants often die or are stunted. Check all trays for rooting before transplanting and if plants have not fully rooted, put them in a greenhouse, tunnel, or nursery area to continue to root until they can be pulled without damage.

In contrast, another problem occurs when plugs are root bound. Root bound plants often cannot be watered adequately as plugs cannot absorb water well. They often are too dry at transplanting and desiccate before they can establish new roots. In addition, root bound plugs are often slow to root into the soil because roots are old and growing in a circle. Once roots circle in the plug they do not grow out properly.

During transplanting, particularly with water wheel transplanters and transplanting crews, there is a tendency to plant plugs too deep. If soil covers the crown of the strawberry plant the plant will often rot and die. In contrast, if plugs are planted so that part of the plug is out of the ground, the plug will often dry out and die before rooting in. Plugs should be planted at soil level with a small amount of soil covering the plug without covering the crown of the plant. It may be necessary to have workers follow the transplanter to properly set plant depth.

All plug trays should be inspected for signs of disease both in the foliage and in the roots and suspect trays should not be planted. Unfortunately, many diseases may be asymptomatic and appear later when strawberries are growing.

The following are recommendations from a past article by Kathy Demchak, Penn State Extension and Dr. Mengjun Hu, University of Maryland: Disease management recommendations for fall-planted strawberry plug plants <https://sites.udel.edu/weekly-cropupdate/?p=19318> "Remove any leaves with symptoms and all runners while the plants are still in their trays, starting with the cleanest-appearing trays. Watch for brown blotches on leaves and



Strawberry plug plant fully rooted but not yet root bound.

Photo from <https://www.archiexpo.com/prod/jiffy/product-139036-2060133.html>.

brown sunken lesions on petioles in particular. Collect and dispose of this material. If you cannot complete this operation before you plant, do so right afterwards, and remove this foliage from the field. Diseases sporulate on plant tissue even after it is removed, so dropping plant tissue in the row middles does not eliminate the problems – though this is an improvement over doing nothing. Wash hands and tools frequently, or use hand sanitizer, as diseases can be moved from plant to plant on hands, clothing, and tools. Do not plant any plug plants that are wilted and fail to recover quickly once watered."

*Dr. Johnson is a retired Extension Vegetable and Fruit Specialist from the Univ. of Delaware. From the **Weekly Crop Updates**, Univ. of Delaware Extension, Vol. 31, Issue 21, August 18, 2023.*



BERRY PRODUCTION

Reduced Fruit Size in Strawberries

Gordon Johnson

Often, strawberry growers will have some plantings with reduced fruit size. The following are some possible causes:

In plasticulture strawberries, one critical factor with varieties such as Chandler is the number of branch crowns that develop in the fall. Early planting or extended warm weather in the fall may cause plants to produce excess crowns leading to too many buds, flowers, and fruits per plant in the spring and, consequently, small berries. This is also a common problem with carry-over plasticulture strawberries where crown thinning was not done or was inadequate.



G. Johnson, University of Delaware

Carry over 'Camarosa' strawberries with too many branch crowns producing many small fruit.

Another cause of smaller sized strawberries is related to pollination. Strawberries are aggregate fruits. That is, they have multiple ovules per receptacle where the fruit is formed. The strawberry receptacle may have up to 500 ovules per berry. You will see these as "seeds" on the outside of the strawberry fruit which are called achenes. To have the largest berry possible, you need as many of these ovules to be successfully pollinated as possible. With pollination the receptacle tissue around

the achenes will develop to form the strawberry fruit.

Strawberries have both male and female flower parts on the same flower and can self-pollinate. Wind and rain can move pollen within the flower. However, this usually does not allow for full pollination of all the ovules. Bees such as honeybees or bumblebees are usually necessary to allow for complete pollination. Some flowers actually produce bigger berries with cross pollination with pollen from other flowers. Incomplete pollination will often result in smaller or misshapen berries.

Strawberry flowers are not heavy nectar producers. However, bees do visit the flowers and studies have shown that where native bees are limited, adding hives of honeybees or bumble bees increased productivity. It is recommended that each flower receive 16-25 bee visits. This is particularly true of the king berries, which form from the first flower to open on a fruiting truss.

This additional pollination by insects is limited when row covers are placed over fields for extended periods during flowering, by poor weather for honeybee flights (rainy, windy, cold), or by other actions affecting pollinator performance.

Dr. Johnson is the retired Extension Vegetable & Fruit Specialist at the Univ. of Delaware. From the Weekly Crop Update, Univ. of Delaware Extension, Vol. 31, Issue 9, May 27, 2023.

Strawberry Diseases to Watch for in the Fall and Spring

Gordon Johnson

The following are strawberry diseases to watch for starting in the fall that can cause plant collapse. This information was adapted from Disease Management Recommendations for Fall-Planted Strawberry Plug Plants by Kathy Demchak, Penn State Extension and Dr. Mengjun Hu, University of Maryland.

Phytophthora Crown Rot

This disease has caused severe losses in some varieties.

Symptoms consist of complete plant collapse in the fall and/or spring. Collapsing plants show a reddish-brown discoloration to the crown that is sharply delineated from healthy tissue, though eventually the entire crown may be affected.



Plant collapse and bluish-green leaf color of 'Flavorfest' plants affected by Phytophthora crown rot.



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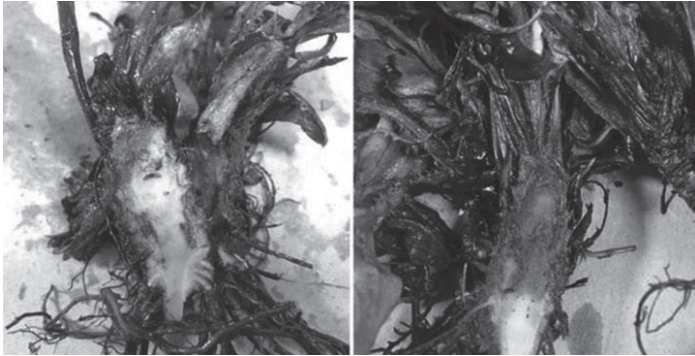
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BERRY PRODUCTION

Strawberry Diseases to Watch for in the Fall and Spring

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Historically, this disease has been caused by specific "pathotypes" of *Phytophthora cactorum* which differ from the ones causing leather rot and red stele (*Phytophthora* root rot)



Darkened tissue is usually at the top of the crown but may appear in other areas or be more limited in scope, depending on the entry point of the fungus and length of time since initial infection.

Some varieties such as Camarosa have good resistance. With varieties susceptible to *Phytophthora cactorum* such as "Flavorfest", use fields that have never been used for growing strawberries if possible. At planting, use a plant dip of fosetyl-Al (Aliette WDG) or a phosphite product (ProPhyt, Phostrol, etc.). Make foliar applications through mid-Fall at intervals allowed on the label. The fungus is thought to become inactive later in the fall when temperatures cool. Watch for symptoms next spring and continue to treat.

Anthracnose Crown Rot

With this disease, plants fail to grow as expected, and may eventually die. Upon close examination, you may find that the main crown has died, but branch crowns have started to grow. No cultivars are completely, but some such as Chandler are very susceptible. Affected crowns appear firm and reddish brown when they are sliced open. Crown tissue may be uniformly discolored brown, and symptoms sometimes can be confused with those from other crown rot issues.

Switch and Abound plant dips have been found to help with anthracnose crown rot control. Refer to the label for instructions. Two or three applications of captan or thiram may be made after planting during the fall season at 10- to 14-day intervals. Other products are also labeled for this use including Tilt, Inspire Super, Quadris Top, Quilt Xcel, Luna Sensation, Merivon Xemium, Pristine, Miravis Prime, Switch, Abound, Cabrio and Aftershock.

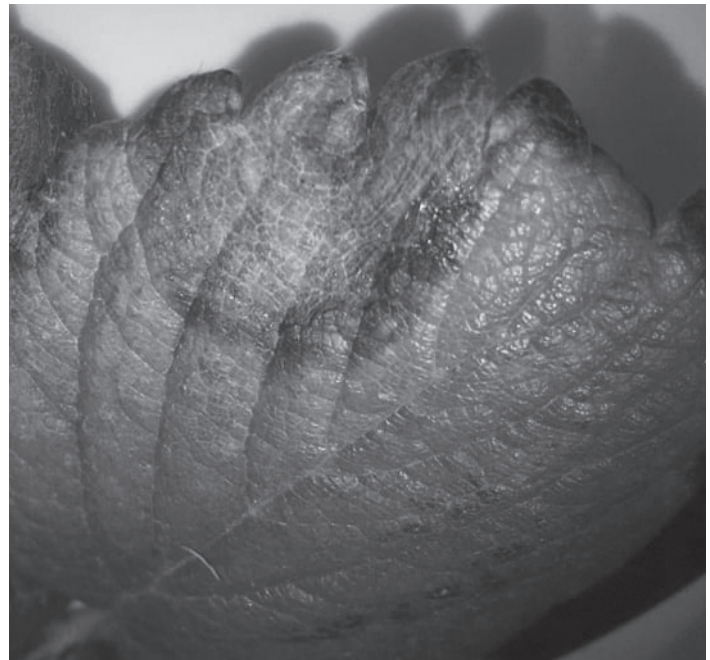
Neopestalotiopsis Crown and Fruit Rot

This relatively new disease can also cause plant losses.

There are various strains or species of *Neopestalotiopsis* that cause different symptoms ranging from slowly progressing foliar symptoms to rapid plant decline and death. Early symptoms appear on leaves and consist of tan to brown roughly V-shaped lesions that are wider at the edge of the leaf. If the more virulent strain is present, large areas of the leaf are invaded in a matter of a few days with pycnidia (tiny black raised dots) appearing in the lesions shortly thereafter. The disease can also invade the crown and kill plants and causes a fruit rot similar to anthracnose fruit rot.

Many cultivars seem to be susceptible. At planting and throughout the fall, remove any leaves showing disease symptoms. Sprays of Thiram, Switch, or Miravis Prime, 7 to 10 days

apart can reduce the disease. Other materials showed little efficacy against this disease. There may be a correlation between spider mites and high severity of *Neopestalotiopsis*. A miticide spray may therefore be important to managing this disease.



Neopestalotiopsis on 'Galletta' showing V-shaped lesion which has consumed most of the leaf within a few days.

Angular Leaf Spot

This is a bacterial disease that is usually noticed in the spring because it causes caps to turn brown but is mentioned here because if the infection is severe enough, the bacteria can invade the plants' vascular systems causing them to collapse, and thus could be confused with other causes of plant collapse. The bacteria are splashed around by water and unlike most other diseases, this one thrives under cold temperatures. In years where long periods of overhead irrigation for frost protection are needed, it can become very widespread, resulting in tissue death that could be mistaken for fungal diseases.



The most obvious symptom of angular leaf spot is blackened berry caps.

The bacteria also cause clearing of leaf tissue, at first delineated by the leaf veins. Injured tissue eventually coalesces and may die.

Some newer cultivars grown in plasticulture appear to be

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HIGH TUNNEL PRODUCTION

Improving Germination and Stand in Winter High Tunnel Spinach

Genevieve Higgins

One of the most common difficulties that winter spinach growers in the Northeast have is achieving good germination and stand in high tunnels. Germination is often patchy, and pre- and post-emergence damping off, caused by several fungal and fungal-like pathogens, is hard to avoid. These diseases are caused by fungi in the genera *Rhizoctonia* and *Fusarium* and fungal-like organisms in the genus *Pythium*, which are weak pathogens that only attack young, weakened, or slow-growing plants. They build up in the soil when crops are grown continuously, with no fallow period for the soil and its microbial community to recover. Incorporating fresh organic matter, especially in the form of cover crop residue is one well-documented way to support growth of healthy microbes in soil and reduce incidence of damping off.

In the fall of 2021, we investigated a few different strategies to improve spinach stands in winter tunnels by reducing damping off and/or improving spinach germination. We tested three factors:

1. Incorporating cover crop residues into the soil pre-plant. Soil microbes, including both beneficial and pathogenic fungi and fungal-like organisms, feed on organic matter in the soil. Soil microbes compete for resources and space, and pathogenic soil fungi are relatively poor competitors. By adding fresh organic matter to the soil, we hoped to provide more resources for the whole soil microbial community and give a boost to beneficial soil fungi that could out-compete pathogenic fungi. We chose buckwheat as our cover crop because it could potentially be grown quickly between summer and fall high tunnel crops and has been shown to reduce damping off when incorporated 3-weeks before planting.
2. Priming the seed to speed up germination. Priming is a process of soaking seed before planting in order to jumpstart the germination process, resulting in faster germination after seeding. Damping off pathogens only infect young or weakened seedlings, so we hypothesized that the faster seeds germinate in the soil, the less time damping off pathogens have to infect the germinating seeds, resulting in lower incidence of damping off and better stands. Solutions used for priming seed vary from just water, to water + hydrogen peroxide, to solutions with chemicals added to control the osmotic potential in order to limit how much liquid the seeds take up. We did not find a common, scientifically-verified procedure for priming spinach seed, so we spoke to an expert on seed science, Dr. Alan Taylor of Cornell University, and developed the method described below. We wanted to test a protocol that would be simple for farmers to replicate on farms using materials they could easily source.
3. Spinach varieties vary widely in their germination speed and uniformity, and the effects of seed priming are known to vary by variety, so we also included two varieties in our trial. For this trial, we compared the effects of cover cropping and seed priming on Kolibri, which is commonly grown in Northeast tunnels, and Crosstrek, a newer variety that has performed well in our recent variety trials.

Trial Setup Cover Crop

To evaluate the effects of incorporating cover crops on spinach germination, the high tunnel was split in half. Over the summer prior to planting the spinach trial, one half was planted

into cucumbers for an unrelated trial, and one half was planted into a cover crop in preparation for the spinach trial.

For the cover crop treatment, buckwheat was broadcast-seeded into half of the tunnel on July 23 at a rate of 1.39 lbs/1000 ft² (60.5 lbs/A). Due to poor germination, the buckwheat was reseeded at a rate of 2.08 lbs/ft² (90.75 lbs/A) on July 30. The seeding on July 30 was raked by hand to incorporate and then irrigated for 4 hours. The buckwheat was irrigated regularly throughout July and August, then mowed on September 9 and rototilled to incorporate on September 10, three weeks before planting spinach.

The non-cover cropped half of the tunnel was planted with cucumbers grown on white plastic beds over the summer of 2021. This side of the tunnel was amended with 50 lbs/A of nitrogen in the form of 5-4-8 chicken manure prior to the cucumbers being planted. The cucumbers and the plastic mulch were removed in late-September.

Priming

The spinach seed was primed overnight the day before seeding. The seeds were soaked in a 0.3% hydrogen peroxide solution for 3 hours, then were drained and put into a container where they remained damp for 16 hours at 65°F, allowing the seeds to slowly imbibe water overnight. The next morning, the container lids were removed and the seeds were spread out to dry at room temperature before planting.

Spinach was seeded into the tunnel on September 31, at a rate of 3 million seeds/A (70 seeds/ft²). Plots were 2 ft x 6 ft, with 1 ft between plots in-bed. Within each cover crop treatment, plots were arranged in a randomized complete block design with each factor replicated 4 times within the cover cropped side and the non-cover cropped side. The tunnel was overhead irrigated as needed throughout the winter. From September 31 to November 2, the tunnel sides, end wall doors, and end wall vents were open. On November 2, the end wall doors were closed and the sides were programmed to close at 40°F and open at 50°F; end wall vents remained open. There were no exhaust or circulating fans running throughout the course of the trial.

Over the course of the trial, air temperature ranged from 28.9 to 77.7°F, and soil temperature 3 inches below the soil surface ranged from 40.0 to 72.1°F. Both air and soil temperatures were highest at the beginning of the trial, in mid-October, and both were coldest in early to mid-November, just before the end of the trial.

Germination was rated by counting the number of plants in 2 row feet 1 week after seeding. Post-emergence damping off was rated on October 12, 15, and 19 by counting the number of wilting or dead plants in 2 row feet. Plot vigor, rated as a percentage, was also rated on all of those dates and twice a week from October 22 through November 16. All plots were harvested on November 18 and yield data was collected.

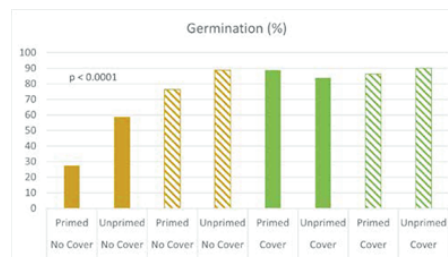


Figure 1. Percent germination. In all cases, the primed seed had worse germination than unprimed seed, so priming was eliminated as a factor for the rest of the data analysis.

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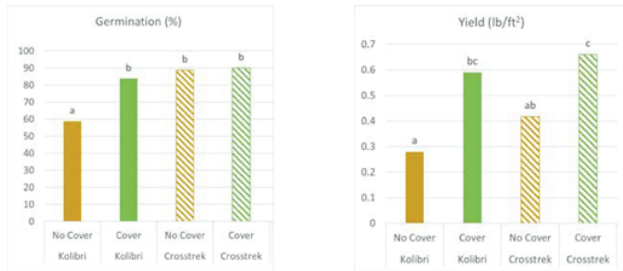
HIGH TUNNEL PRODUCTION

Improving Germination and Stand in Winter High Tunnel Spinach

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Results

Statistical analysis was conducted using a general linear mixed model including all main effects and interactions. While priming was significant ($p = 0.0477$), using the priming protocol we developed had no positive effect on germination speed—plots with primed seed actually had lower germination rates than plots with unprimed seed. Thus, we used the unprimed data for the rest of the analysis, leaving cover crop and variety as our two main effects. The incorporation of cover crop residual had the largest effect ($p = 0.0001$) on germination, vigor, and yield, though variety was also significant ($p = 0.0392$), with Crosstrek outperforming Kolibri in all measures. All treatments reached their maximum vigor (all above 80%) and yields (all 0.58 lbs/ft²) in the cover crop plots (see Figures 1 and 2). The interaction of variety and cover crop was not significant ($p=0.4550$), meaning the effect of cover cropping was the same across the two varieties—cover crop residues led to increased germination, vigor, and yield no matter the variety.



Figures 2-3. Germination rates and yield, excluding the priming factor. In all three metrics, Crosstrek outperformed Kolibri in both cover cropped and bare ground plots. Both varieties performed better in plots that had been cover cropped compared to in bare ground plots.

Discussion

While we had hypothesized that turning in fresh cover crop residues would stimulate activity of beneficial soil microbes and reduce damping off, we were surprised by the scale of the difference we saw in germination and growth on the two sides of the tunnel by mid-October. So, we tried to determine what else might have contributed to these differences in growth.

The bare ground half of the tunnel had been planted to cucumbers the previous summer, while the cover-cropped half was in buckwheat all summer. No fertilizer was added to either side before the spinach trial was planted. On October 29, pre-sidress nitrate tests showed that the soil nitrate in the cover-cropped beds was double that of the bare ground beds—32 compared to 15 ppm. Since we did not control for soil nitrate content between the cover-cropped side of the tunnel and the bare ground side, the effects we saw from cover crop incorporation may have simply been the effect of higher soil nitrate.

We hope to conduct further experiments to tease apart these two variables in the future.

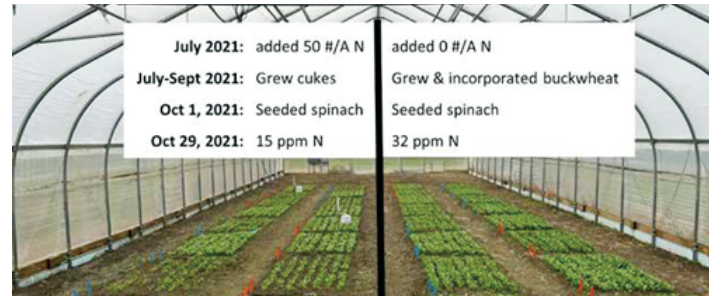


Figure 4. Timeline of nitrogen contributions to both sides of the high tunnel. The left side received fertilizer prior to growing cucumbers that were trellised and harvested all summer, and had nitrate content of 15 ppm in October 2021. The right side had no fertilizer applied before buckwheat was planted and grown all summer, and had nitrate content of 32 ppm in October 2021, more than double that of the cucumber side.

Conclusions

The significant trends that we saw from this study were:

1. Incorporation of a buckwheat cover crop three weeks before seeding (and/or higher available nitrate at seeding) resulted in maximized germination, vigor, and yield of winter high tunnel spinach. This difference could also be attributed to nitrogen fertility in the plots, further study is needed to tease this apart.
2. The variety Crosstrek consistently out-performed Kolibri.
3. Priming seed using the protocol we developed reduced germination and yield of both varieties.

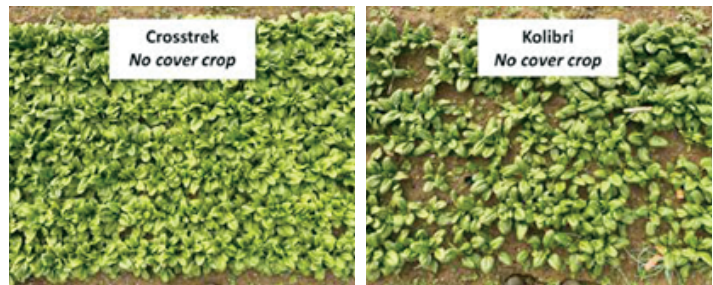


Figure 5. Comparing effects of spinach variety. Crosstrek (left) and Kolibri (right), both unprimed, both with no incorporated cover crop on November 18, the day of harvest. Crosstrek had much better germination and vigorous growth than Kolibri

Taking a step back, it's clear that variety selection can have a big impact on germination, and therefore on yields. It can be difficult to access the newest spinach varieties through New England distributors, as most spinach is marketed to large-scale, West Coast producers. Distributors are often able to special order unlisted varieties, especially if the order meets a minimum size, so work with neighboring farms to meet minimum orders! One of the most important recommendations for managing spinach downy mildew, an important disease of winter spinach, is to grow several varieties with varying gaps in DM resistance. If you follow this recommendation and grow several varieties, pay attention to differences in germination, and adjust your variety choices based on your observations.

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Figure 6. Comparing effects of cover crop incorporation. Un-primed Kolibri, in plots with incorporated cover crop (left) and no cover crop (right), on November 18, the day of harvest. The plots with incorporated cover crop had much higher germination and more vigorous growth than those with no cover crop.

The effects of cover crop incorporation in this trial were clear – plots with buckwheat incorporated significantly outperformed those with no buckwheat – but the mechanism behind those effects are unknown. More research is needed to investigate whether the benefits we saw from buckwheat incorporation were from the addition of fresh organic matter to the soil, or whether they were from the higher residual nitrate, or both.

Lastly, while priming as we did it clearly had a negative effect on germination, there are many other priming procedures—different priming solutions and treatment times—that might have different effects. More research in this area could also be useful.

Ms. Higgins is with the Univ. of Massachusetts Extension Vegetable Program. From the Univ. of Mass. Vegetable Notes, Vol. 35, No. 21, September 14, 2023.

Strawberry Diseases to Watch for in the Fall and Spring

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quite susceptible. Since this disease is caused by a bacterium and not a fungus, copper-based materials are needed instead of standard fungicides (which have no effect) and should be applied in the spring to protect healthy foliage and berry caps from disease spread. Make these applications only if the disease is known to be present, as phytotoxicity can occur with multiple applications and when drying conditions are prolonged. It is unlikely that any spray applications will be needed for this disease in the fall. In addition, Actigard, which induces the plants' systemic activated resistance, provided some control efficacy based on trials. Note that Actigard should be applied at the lowest label rate. Higher rates were found to reduce yields.

Dr. Johnson is the retired Extension Vegetable & Fruit Specialist at the Univ. of Delaware. From the Weekly Crop Update, Univ. of Delaware Extension, Vol. 31, Issue 24, September 8, 2023.

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