In This Issue

From The Editor's Desk

(Petrus Langenhoven, plangenh@purdue.edu, (765) 496-7955)

Welcome to the Vegetable Crops Hotline (VCH), Purdue Extension's exclusive newsletter for people in the business of growing vegetables.

This issue features two Spotlight articles: the Weed Spotlight on Deadnettle and the Insect Spotlight on the Two-Spotted Lady Beetle. It also includes a featured article that discusses soil fertility management in high tunnels, ethylene damage to tomato crops grown in heated greenhouses, online disease management resources, and a Clearspring Produce Auction price update.

Timeless Article

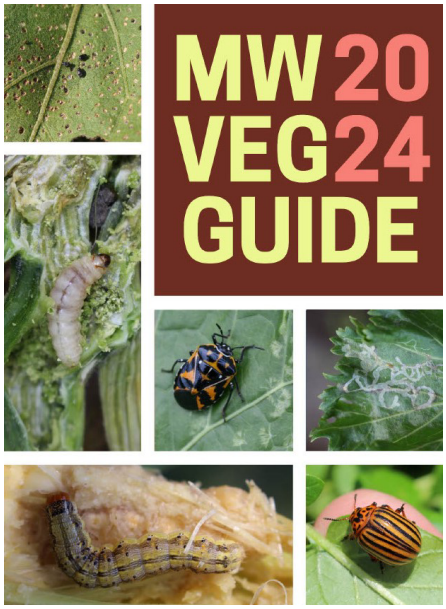
Setting Your Transplants Up for Success. Issue 717.
https://vegcropshotline.org/article/setting-your-transplants-up-for-success/

Website Links

Frequently, we include links to websites or publications available online. If you can't access these resources, don't hesitate to contact your local Extension office or us to request a hard copy of the information.

Midwest Vegetable Production Guide

The Midwest Vegetable Production guide is now available for growers to visit online at **mwveguide.org**. You can also download a free copy of the guide from your computer at **mwveguide.org/guide**. You may also purchase a hard copy for $12 from Stephen Meyers, slmeyers@purdue.edu.



Do not hesitate to contact me at plangenh@purdue.edu if you have any questions or suggestions for improving the newsletter. Let me know if there are specific topics you would like to see more of in the newsletter. Also, let us know if things are not working for you. We want to improve the newsletter, and your input is valuable.

We hope you enjoy the newsletter. Happy reading! And be safe while enjoying the solar eclipse event on April 8th.

Insect Spotlight: Two-Spotted Lady Beetle

(Isabela Arias, iarias@purdue.edu), (Samantha Willden, swillden@purdue.edu) & (Laura Ingwell, lingwell@purdue.edu, (765) 494-6167)

The Two-spotted lady beetle, *Adalia bipunctata,* is a common insect predator, meaning it feeds on other, smaller bugs. Native to North America and Europe, the Two-spotted lady beetle is distinguished from other lady beetles by its oblong shape and two large black spots on either of its back, as well as its large white spots near its head (Figure 1). Beetles go through complete metamorphosis, transitioning from tiny orange eggs (1mm in diameter) to larvae (up to 6 mm; Figures. 2-3), pupa (Figure 3) and then adults (3-4mm). *A.bipunctata* will lay eggs in clusters (Figure 4), often on the underside of leaves, of numerous plant

species, as long as food is nearby. Larvae are scaled and spikey, black and brown in color, often referred to as alligator-looking (Figure 2). They mature into adults in less than a month. The adults live for approximately 1 to 2 years. *A. bipunctata* are commonly found in wooded habitats in temperate regions, where they overwinter as adults. In the warmer months, they can be found near most kinds of vegetation. Common locations to find lady beetles include meadows, forests, gardens, and fields.

Figure 1: *Adalia bipunctata* on spinach (Photo by Samantha Willden).

Figure 2: Larva under a microscope, lying on empty eggs (Photo by Isabela Arias).

Figure 3: Asian lady beetle larvae and pupae on leaf (Photo by John Obermeyer).

Figure 4: Asian lady beetle eggs (Photo by John Obermeyer).

The Two-spotted lady beetle is an intrinsically important insect within an ecosystem: one of their key characteristics is their carnivorous nature at both the larval and adult stages. When compared to other common insects used for pest management, like a parasitoid wasp, which is only capable of predating on pests as an adult, *A. bipunctata* consumes pests for its entire life cycle. These insects consume a wide range of small, soft-bodied pests such as aphids, psyllids, scale insects, or mealybugs. For this reason, lady beetles, in general, are used widely as biological control agents for pest management in specialty crop systems.

When it comes to picking which predator (or lady beetle in particular) to deploy for biological control, the Two-spotted lady beetle is not only an effective option but is Native to Indiana and, therefore, fits perfectly into the existing ecosystem. Compare this to the Asian lady beetle, *Harmonia axyridis* (Figure 3), which was introduced to do the same task as the Two-spotted lady beetle. However, due to its non-native nature, the Asian lady beetle has quickly overrun many native populations, including the Two-spotted.

To tip the scales back in favor of native species, the use of *A. bipunctata* is recommended over other species, such as the Asian lady beetle. When purchasing these insects, it is important that

they are sustainably sourced, meaning they are reared in a controlled environment for IPM use rather than harvested from the wild population. The best way to recognize this is to note if adults are being sold or if the insects are being sold as larvae or eggs. If it is the latter, then it is likely the beetles are sustainably sourced.

Weed Spotlight: Purple Deadnettle

(Carlos Lopez, clopezma@purdue.edu), (Stephen Meyers, slmeyers@purdue.edu, (765) 496-6540) & (Jeanine Arana, jcordone@purdue.edu, (765) 588-7787)

Common Names

Purple deadnettle, red deadnettle.

Latin name

Lamium purpureum.

- "*Lamium*" is derived from the Latin for "throat," referencing the flower tube's elongated shape.
- "*purpureum*", also derived from the Latin, means "purple".

Family

Lamiaceae – "the mint family".

Life cycle

In Indiana, purple deadnettle is a winter annual. Plants emerge as small seedlings in the fall and overwinter. In late winter and early spring, plants mature (Figure 1) and flower, producing seeds by late spring. After setting seeds, the plants die.

Figure 1. A purple deadnettle plant grows at the end of a plasticulture strawberry row in Vincennes, IN (Photo by Carlos Lopez).

Identification

Seedling

Purple deadnettles have two hairless seed leaves ("cotyledons"). Each cotyledon has two lobes at the base, and its tips are flat or slightly indented. The young leaves have soft hairs and appear in pairs across the stem from each other, known as an "opposite" leaf arrangement (as opposed to an "alternate" leaf arrangement).

Mature Plants

Mature plants form low-growing clumps, with the growing points extending upward as the plant matures. Purple deadnettle stems are square and hollow (Figures 2 and 3). Purple deadnettle can be distinguished from henbit by its more triangular-shaped leaves (Figure 4). Additionally, all purple deadnettle leaves attach to the stem with a petiole (Figure 5); upper leaves do not wrap around the stem like those of henbit. Flowers appear in whorls around the upper portion of the plant. The flowers, which are typically light purple in color, have fused petals and appear "hidden" between rows of leaves.

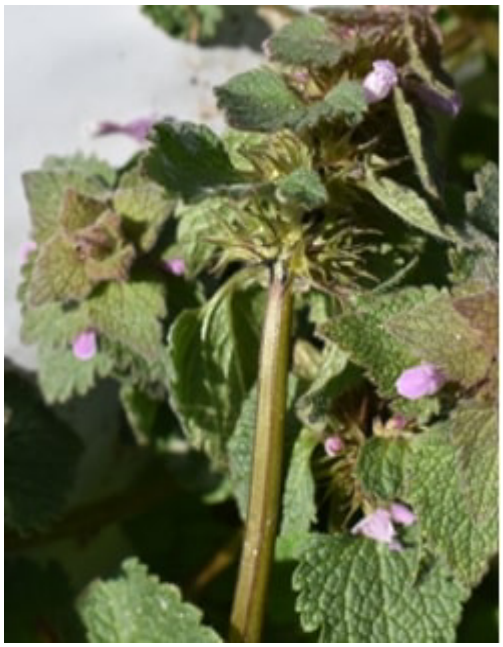


Figure 2. Purple deadnettle has square stems (Photo by Carlos Lopez).

Figure 3. Purple deadnettle stems appear hollow (Photo by Carlos Lopez).

Figure 4. Purple deadnettle (above) leaves are more triangular in shape than the leaves of its close relative, henbit (below) (Photo by Stephen Meyers).

Figure 5. Purple deadnettle leaves at the top of the plant attach to the stem with a short petiole (Photo by Stephen Meyers).

Integrated weed management strategy

Cultural and mechanical practices

- Scouting: Conduct monitoring in the fall after tilling (if applicable) or spring to identify purple deadnettle patches and plan control strategies accordingly.
- Cover crops: Utilize cover crops to outcompete purple deadnettle for resources and provide a physical barrier to its growth. Integrating fall-planted cover crops can disrupt purple deadnettle's life cycle.
- Plastic mulch: Acting as a physical barrier, plastic mulch hinders germinating purple deadnettle seedlings from reaching the soil surface. Ensure that planting holes are sized to fit only your transplant. Excessively large planting holes can allow weeds to emerge next to the crop.
- Silage tarps: Silage tarps prevent germinating weeds from receiving sunlight. Tarps placed in the fall and removed in the spring will effectively control purple deadnettle. Alternatively, tarps can be placed in the spring prior to purple deadnettle seed set and allowed to remain in place for at least three weeks.
- Hand-weeding, hoeing, and cultivation: Eliminate seedlings before seed production to prevent an increase in the weed seed bank. Tillage can be used in the fall after purple deadnettle and other winter annuals have emerged. However, if the soil is left bare, it can be susceptible to erosion from wind and water.
- Flame weeding: Use flame weeding to control purple deadnettle in its early stages of growth.

Chemical control

- Pre-emergence (PRE) herbicides: Because purple deadnettle emerges in the fall, the use of PRE herbicides in annual vegetable crops may not be advisable, especially if fall/winter cover crops will be planted.
- Post-emergence (POST) herbicides: Apply POST herbicides to purple deadnettle in the spring before planting/transplanting. Depending on your production system, this can be done instead of, or in addition to, spring tillage.
- Visit the Midwest Vegetable Production Guide (mwveguide.org) to learn which herbicides are labeled for the crops you intend to grow.

For some, no management is also an option. Purple deadnettle can provide living roots during the fall, winter, and early spring when many vegetables are not in the field. They will naturally senesce before many summer vegetable crops are planted. They also provide an early source of pollen for pollinators.

High Tunnel Soil Fertility Management: What You Need to Know

(Petrus Langenhoven, plangenh@purdue.edu, (765) 496-7955)

Are you looking to enhance your knowledge of soil fertility management in high tunnel farming? Look no further! Let's explore the crucial aspects of High Tunnel Soil Fertility Management that can help you grow abundant and healthy crops.

Spring has arrived, and with it comes the excitement of planting cool and warm-season crops. If you plan to grow crops in a high tunnel, submitting soil samples to your nearest laboratory is essential. If you haven't done so already, it's a good idea to do it now. Additionally, you should analyze your irrigation water, as this will provide you with valuable information that could help you manage your high tunnel fertility program.

Growing in a high tunnel is different from growing crops outdoors,

as there is no natural rainfall inside the tunnel. Therefore, it is crucial to understand the water and soil test results as they provide essential information for the fertility program. High tunnels have unique challenges, such as temperature extremes, salt accumulation in the soil, nutrient deficiencies due to faster crop growth, and faster release of nutrients from organic materials.

To address these issues, growers can plan to manage their soil fertility and moisture issues timely. You can add water-soluble fertilizer to your irrigation system throughout the growing season or add compost and other soil amendments before planting and during the growing season. This article will focus on water quality and how to interpret your soil test report.

Importance of Assessing Water Quality

High alkalinity irrigation water in greenhouse bench crop production can cause a rise in soil or media pH over time, leading to zinc, manganese, and iron deficiencies in specific crops. High tunnel growers also experience this problem. To avoid this, it is recommended that the total alkalinity and pH of your irrigation water should be between 0 to 100 ppm $CaCO_3$ and 5.5 to 6.5, respectively. Ideally, it should be about 80 ppm $CaCO_3$ with a pH of 5.8. If the alkalinity levels exceed 150 ppm $CaCO_3$, it can lead to an increased incidence of clogged drippers. It is important to note that water pH and alkalinity are not strictly related, so it is essential to test for both.

There are two options to deal with high alkalinity and pH. One is the acidification of irrigation water while you irrigate, which involves adding an acid like citric, sulfuric, phosphoric, or nitric to reduce the irrigation water's alkalinity. This is perhaps the fastest and most cost-effective method to manage the soil pH in the root zone. Rates can be calculated using the ALKCALC resource. The other more costly option is to perform reverse osmosis, which will remove all minerals and reduce the water's buffer capacity to almost zero. Another option would be to acidify the soil with elemental sulfur (Figure 1), which is a much slower process. Elemental sulfur is inexpensive and has the highest acidification power (0.32 lb needed to neutralize 1.0 lb of $CaCO_3$) of common amendments used to lower the soil pH. Alternatively, ammonium-based fertilizers can be used, but a higher application rate is needed to decrease soil pH. This may require application rates that are higher than the nitrogen needs of the crop, and in sandy soil, nitrogen might be lost due to leaching. The use of ammonium-based fertilizers is therefore only recommended when you need a minor pH reduction (up to 0.3 pH units) (Gatiboni et al. 2020).

Present Soil pH	Desired Soil pH				
	6.5	6.0	5.5	5.0	4.5
	Pounds Elemental Sulfur per 100 Square Feet				
8.0	3.0	4.0	5.5	7.0	8.0
7.5	2.0	3.5	4.5	6.0	7.0
7.0	1.0	2.0	3.5	5.0	6.0
6.5	—	1.0	2.5	4.0	4.5
6.0	—	—	1.0	2.5	3.5

[1]For sandy soils, reduce amount by 1/3; for clay soils, increase amount by 1/2; if aluminum sulfate is used, multiply by 6.

Figure 1. Elemental sulfur application rate (Mikelbart et al. 2012).

Ensuring that iron, manganese, and sulfate levels are within acceptable ranges is also essential. Iron above 5 ppm could be toxic to the plant, causing iron precipitates to form at the emitter and plugging your irrigation system. Similarly, manganese levels above 1.5 ppm and sulfate levels above 240 ppm could cause emitter blockage. Keeping track of the sodium and chloride levels in the water is also essential. High levels (>50 ppm Na and >70 ppm Cl) can increase soil salinity, especially in the top 2-4 inches. They must be managed carefully, mainly because the high tunnel cover prevents natural rainfall from washing or leaching excess soluble salts from the soil. The elevated soil temperatures inside the tunnel increase soil microorganism activity, releasing nutrients from organic materials such as manures and composts into the root zone faster.

Understanding your Soil Test Report

The optimum pH varies by crop, but it is generally accepted that the ideal pH range for organic and mineral soils is 5.3 to 5.8 and 6.0 to 7.0, respectively. Nitrogen, phosphorus, potassium, calcium, magnesium, boron, and molybdenum are most available in mineral soils when the pH is between 6.0 and 7.0. Zinc, manganese, iron, and copper are the most available at a soil pH below 6.5. Therefore, maintaining mineral soil pH between 6.0 and 6.5 is desirable. The available aluminum increases significantly as the mineral soil pH decreases below 5.5. This can further contribute to soil acidification and aluminum toxicity, which inhibits root growth. The target pH range for organic soils is between 5.3 to 5.8. The lower pH range is acceptable because organic soils have very low aluminum levels (Warncke et al., 2004).

The capacity of soil to hold exchangeable cations is measured and reported as the cation exchange capacity (CEC) of the soil. This value is a good indicator of soil fertility. Good soil has a CEC between 5 and 35 meq/100g soil. Generally, sandy soils have a low CEC, and soils with a high CEC are likelier to have a high clay or organic matter content.

Two tests are performed to determine the phosphorus level: P1 (weak Bray) and P2 (strong Bray). The P1 test indicates the phosphorus that is readily available to plants, and 20 to 50 ppm is an adequate level. The P2 test confirms the level of available phosphorus and part of the active reserve in the soil, and 40 to 60 ppm is a desirable level.

Potassium should be between 150 and 300 ppm, calcium should be between 1000 and 2500 ppm, and magnesium should be greater than 50 ppm.

Soluble salt (a measure of soil salinity) results are presented as the soil's electrical conductivity (EC) and measured in mmho/cm (mmho/cm = dS/m = mS/cm). An EC below 1.0 (below 640 ppm salt) is considered good, and an EC above 2.5 (above 1600 ppm salt) is unsuitable for crops.

Percent base (cation) saturation indicates the proportion of the CEC occupied by cations such as Ca^{2+}, Mg^{2+}, and K^{+}. Optimum ranges for Ca^{2+}, Mg^{2+}, and K^{+} are 40-80%, 10-40%, and 1-5%, respectively.

Micronutrient ranges for vegetable crops are between 1 to 3 ppm Zn, 1 to 5 ppm Mn, 11 to 16 ppm Fe, 0.5 to 1.5 ppm Cu, 0.7 to 1.0 ppm B, and 0.11 to 0.20 ppm Mo.

Let's Take a Closer Look at Compost

Applying compost to the soil is common in many farming systems. Composting involves the controlled biological decomposition of organic materials into nutrient-rich soil amendments or mulches. These materials (feedstocks) may be rich in nitrogen, such as manures and legume plant residue, or rich in carbon sources, such as leaves or straw. An ideal carbon-to-nitrogen ratio for composting is 30:1. Lower ratios can result in excess nitrogen loss as ammonia gas and carbon loss. Nitrogen is insufficient for microbial decomposition at higher C:N ratios, which slows the composting process.

Not all composts are created equally

It is essential to know what is in your compost by analyzing it or requesting that information from suppliers. Test results will help guide how much and when to apply compost to build soil health. Organic amendments like compost do not supply plants with readily available nutrients (apart from inorganic N, which is immediately available) because they are released slowly through microbial decomposition. It may take several years to break down and release nutrients for plant uptake. The decomposition rate is affected by environmental conditions such as soil moisture and temperature. It is important to consider differences in compost decomposition rates for soils in high tunnels compared to open fields. To maximize plant nutrient uptake, apply compost in the Spring. As soil temperatures increase, mineralization will release nutrients during the growing season. Summer compost applications can be beneficial for hay and pasture areas. However, fall application typically increases nutrient loss unless soil temperatures are low enough to immobilize soil nutrients until the following Spring.

What happens if I overapply compost?

When significant, affordable quantities are available, it may be tempting to overapply composts in depleted, compacted, or nutrient-deficient soils. However, over-applying compost, especially manure-based compost, can result in nitrate leaching into groundwater, excessive phosphorus soil concentrations, and high soil salinity. Typically, soils have more phosphorus than crops need when composts have been over-applied for several years, but nitrogen may be lacking. The high phosphorus concentration can reduce the crop's micronutrient uptake ability (particularly iron and zinc) and reduce yield. Manure-based composts typically have a pH greater than 7, so monitoring pH in heavily composted soils is essential because elevated pH can reduce crop yields.

Considerations for the Nutrient Management Plan

Nitrogen is crucial for promoting plant growth. However, excessive nitrogen fertilization can lead to overgrowth and deficiencies in warm and high-light conditions, particularly in fruiting vegetable crops. The type of nitrogen used is also significant. Utilizing an ammonium or urea nitrogen source will decrease the soil's pH in the root zone. The transformation of these nitrogen forms into nitrate nitrogen is temperature-dependent, happening faster in higher soil temperatures. Excess ammonium nitrogen can lead to calcium, magnesium, and potassium deficiency. Since ammonium is a smaller molecule, plants can absorb it more quickly. Conversely, nitrate nitrogen absorption can cause a slight increase in pH in the root zone.

Phosphorus is most available to plants at a pH between 6.2 and 7.2. Therefore, it is essential to manage soil pH to ensure maximum phosphorus availability. Apart from soil amendments, you can adjust the pH of your irrigation water and nitrogen form to help regulate soil pH in the root zone. Potassium is vital for plant growth and high-quality crop production. Higher soil moisture content means more potassium is available in the soil solution, enhancing its availability for root uptake. However, be cautious. Excessive soil moisture reduces root respiration, limits root activity, and therefore decreases potassium uptake. The uptake of both potassium and phosphorus increases with an increase in soil temperature. The ideal soil temperature for uptake is between 60 and 80°F.

Conversion Factors

Expressing fertilizer recommendations in pounds per acre of P_2O_5 and K_2O is common because fertilizer grades on the product label are given as percent N-P_2O_5-K_2O. To convert the P value to P_2O_5, multiply it by a factor of 2.3. On the other hand, to convert the P_2O_5 value to P, you need to multiply it by a factor of 0.43478. Similarly, to convert the K value to K_2O, you need to multiply it by a factor of 1.2; to convert the K_2O value to K, you need to multiply it by a factor of 0.83333. If you need to know how much P or K is available in one acre one foot deep, you can multiply the ppm value in the soil test report by a factor of 3.6.

Final Thoughts

Developing a fertility plan

- To develop a nutrient management plan, you need to know what your crop's nutrient needs are.
- Analyze your soil and water and then, looking at your crop needs, determine what nutrients are needed.
- Ask the laboratory to include recommendations in your soil test report or use tools such as the SWCD Nutrient Management Tool to determine application rates.
- Monitor plant nutrient levels timely.
- Check soil fertility levels annually. The best practice is to collect samples at the same time every year. Soil mineral content can then be tracked over time.

What can you do if the soil salinity in your high tunnel is increasing?

- When the crop is not present, consider applying a lot of water. Irrigate 6 inches of water to flush out 50% of salts from the top 12 inches of soil or apply 12 inches to leach about 80% of the salts (Western Fertilizer Handbook, 10th Ed. 2022. Western Plant Health Association).
- When plants are present, irrigating slightly more than

what the plant needs will push the excess salts to the outer limits of the wetting zone of the dripper/root zone.
- Use low salt irrigation water.
- Use fertilizers with a low salt index.
- Limit the use of organic nutrient sources containing animal manure.
- If the soil is poorly drained due to compaction or a hardpan, till the soil to break all restrictive layers. You should consider installing a subsurface (tile) drain in cases where high clay soils or a high water table is present.
- If you are about to replace your high tunnel plastic in the fall, leave the tunnel uncovered. Fall, winter, and early spring precipitation will help leach excess salts.

Too much P in your high tunnel soil?

- Is your soil P (Bray 1) higher than 100 ppm? Then, there is no need to apply additional P_2O_5.
- Hold off on applying additional compost.
- Avoid applying soil amendments that contain P. Draw down on existing P that is available for uptake.

Is your soil pH increasing?

- Avoid applying additional compost
- Do not apply soil amendments containing only nitrate nitrogen. Urea or ammonium nitrogen sources will help to slow down or decrease the soil pH in the root zone.
- Is the water source used for irrigation alkaline or hard? High levels of magnesium and calcium in the water will increase soil magnesium and calcium over time and, therefore, pH. Excess magnesium and calcium compete with potassium uptake and could reduce tomato fruit quality. Amend the irrigation source water with acid, reducing the alkalinity and pH of the water. Monitor the irrigation water alkalinity and mineral content regularly, especially during the summer when water quality can fluctuate depending on the amount of rainwater entering the aquifer or pond you are pulling water from.
- Apply soil amendments such as elemental sulfur to reduce soil pH. This is a long-term management strategy – a reduction in soil pH could be expected 5-6 months after application. Keep on monitoring soil pH.

Applying granular fertilizer?

- Some growers might apply granular fertilizer prior to planting their crops. This is a great option. Exact amounts of N, P, and K are applied according to your soil test results.
- Do not leave the fertilizer on the soil surface. Incorporate it well into the soil.
- Granular fertilizer is only available when it dissolves. Make sure that the band of fertilizer is in the wetting zone of your irrigation system and that the soil moisture is at field capacity.
- Is the applied fertilizer immediately available, or is it released over a period of time? Some fertilizer sources have a release period of up to 12 weeks. Make sure that soil fertility levels are sufficient for the stage of crop development. Crop nutrient status could be monitored with tissue tests. To make up for the lack of specific nutrients, liquid soil fertility amendments can easily be applied through the irrigation system post-planting.

Have you started to grow your spring tomato crop?

- Now is the time to ensure that you have sufficient potassium available for uptake. Potassium is especially important for producing high-quality fruit.
- If the soil test potassium is higher than 200 ppm, there is no need to apply additional potassium. The soil potassium target range is 150 to 300 ppm. However, potassium can leach from sandy soils. If you irrigate until the water is below the root zone, then potassium might have moved past the root zone and will not be available for uptake. Watering time and volume need to be considered. Also, consider irrigating clean water first and then, towards the end of the irrigation cycle, add the nutrients and flush the irrigation lines with fresh water. Always aim to deliver the water and nutrients to the volume of soil that is currently occupied by the plant's roots.
- Do not apply nitrogen in excess of what the crop needs. Excess nitrogen will encourage excessive vegetative growth and delay fruit set.

Use guides such as the Midwest Vegetable Guide, the Indiana High Tunnel Handbook, and the SWCD Nutrient Management Tool to help you plan and manage your fertility program.

Related Articles

Soil and Water Data is Critical for High Tunnel Growers. Issue 716.
https://vegcropshotline.org/article/soil-and-water-data-is-critical-for-high-tunnel-growers/

Are You Thinking of Applying Compost to Your Soils? Issue 715.
https://vegcropshotline.org/article/are-you-thinking-of-applying-compost-to-your-soils/

Water Affects Efficacy of Soil-Incorporated Fertilizers and Amendments. Issue 712.
https://vegcropshotline.org/article/water-affects-efficacy-of-soil-incorporated-fertilizers-and-amendments/

Reducing Blossom End Rot and Yellow Shoulder/Internal White Tissue in Tomato. Issue 688.
https://vegcropshotline.org/article/reducing-blossom-end-rot-and-yellow-shoulder-internal-white-tissue-in-tomato/

Resources

Gatiboni, L. D. Hardy, D. Osmond and J. Havlin. 2020. **Calculating the Rate of Acidifiers to Lower the pH of North Carolina Soils.**
https://content.ces.ncsu.edu/calculating-the-rate-of-acidifiers-to-lower-the-ph-of-north-carolina-soils

Kaiser, D.E. and C.J. Rosen. 2018. Potassium for crop

production. UMN Extension.
https://extension.umn.edu/phosphorus-and-potassium/potassium-crop-production

Mikelbart M.V., S. Hawkins and J. Camberato. 2012. **Commercial Greenhouse and Nursery Production.**
https://www.extension.purdue.edu/extmedia/ho/ho-241-w.pdf

Rosen, C.J. and R. Eliason. 2005. **Nutrient Management for Commercial Fruit and Vegetable Crops in Minnesota.** University of Minnesota Extension Service.
https://conservancy.umn.edu/handle/11299/197955

Sideman, B. 2018. **High Tunnel Soil Management Update.** UMass Extension. Vegetable Notes, Vol. 30 No. 2.
https://ag.umass.edu/sites/ag.umass.edu/files/newsletters/february_15_2018_vegetable_notes.pdf

Sideman, B. 2017. **Growing Vegetables: Managing Blossom End-Rot.** UNH Cooperative Extension.
https://extension.unh.edu/resource/growing-vegetables-managing-blossom-end-rot-fact-sheet-0

Warncke, D., J. Dahl and B. Zandstra. 2004. **Nutrient recommendation for Vegetable Crops in Michigan.** Michigan State University, Extension Bulletin E2934.
https://www.canr.msu.edu/fertrec/uploads/E-2934-MSU-Nutrient-recomdns-veg-crops.pdf

Clearspring Produce Auction Price Update

(Jeff Burbrink, jburbrink@purdue.edu)

The Clearspring Produce Auction is located just 2 miles south of US 20 in Clearspring Township in the Heart of the LaGrange-Elkhart Amish Settlement. It is within easy driving distance of the towns of Shipshewana, Topeka, Emma, and LaGrange.

Produce is sold 3 days a week throughout most of the growing season (Tuesday, Thursday, Friday), with a hay sale on Saturdays. Office hours are Monday and Wednesday, 1 to 4 pm, and Tuesday, Thursday, and Friday, 8 am to 4 pm. An auction report can be heard by calling (260) 463-4131. Besides the produce and hay auctions, Clearspring has an equipment and supply business operating onsite for growers.

Are you curious about vegetable pricing?

In an effort to communicate more market information, we are publishing Clearspring Produce Auction volumes and prices. You will be able to view volumes and pricing below:

March 28, 2024

As the Saying Go…

(Beth Hall, hall556@purdue.edu)

An old saying predicts that March will go out “like a lamb”. Another saying predicts April’s wetness with “April showers bring May flowers”. A lot seems to have happened across Indiana since April began, but March finished the month with below-normal rainfall (except for the northern counties) and above-normal temperatures. Does this describe conditions that are “like a lamb”? I’ll let ‘ewe’ decide!

And then came April. We are less than a week in, and already, some parts of Indiana have received more than 750% of what is normal for early April. That is not a typo! Actual amounts have ranged from just below an inch of water in southwest and far southeast Indiana along the Ohio River to over three inches around the eastern counties of Adams and Jay (Figure 1). Typical rainfall for the entire month of April (averaged from 1991-2020) ranges from just 0.2” to less than 0.75”. Can we really call what we’ve seen in just the first few days April “showers”? Streams are flooding across the state, soil moisture percentages have increased significantly, and many are hoping for just a few dry days for things to calm down a bit. The U.S. Drought Monitor has eliminated abnormally dry conditions across most of the state except for southwestern counties. The far southwestern counties are considered in Moderate Drought (Figure 2). And then there are the temperatures. True, April is part of the transitional season, where one day, the temperature can be in the 70s, and the next is a chilly 30s, with light snow falling. Much of Indiana was already seeing some snow flurry activity on April 3rd after the heavy rainfall events passed through. Will that be the last of our snow events for the season, or can we expect a few more? The Midwestern Regional Climate Center has a Snowfall Climatology Toolbox (https://mrcc.purdue.edu/resources/climateTools/snowfallclimatology) where users can look up the last date of measurable snowfall for a nearby station. According to this product, since 1991, the average last date of snowfall measuring at least 0.1 inches has occurred sometime in March (with a few stations far north indicating April 1st or April 3rd). However, the latest dates have occurred in late April to mid-May. Will 2024 set a new ‘last date of measurable snowfall’ record since 1991?

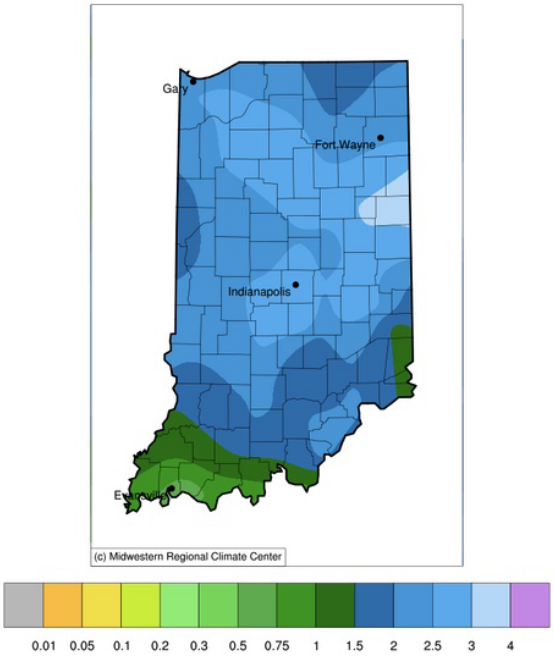


Figure 1. Total precipitation from April 1-4, 2024.

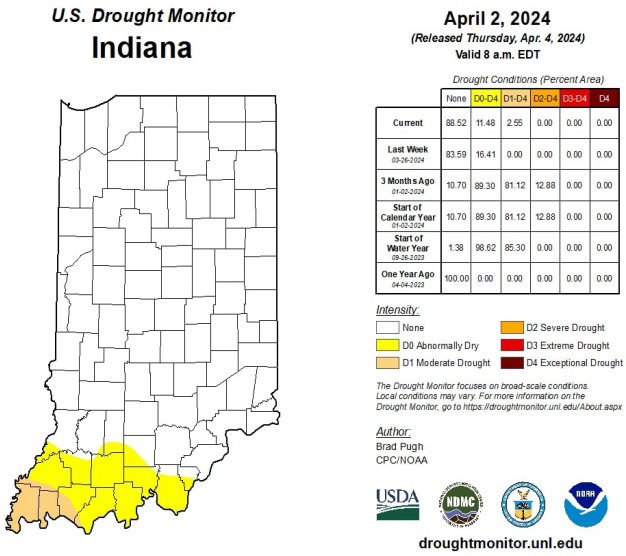


Figure 2. U.S. Drought Monitor reflecting conditions through April 2, 2024.

According to the National Climate Prediction Center, climate outlooks over the next two weeks are favoring above-normal temperatures, with the next 6-10 days favoring above-normal precipitation, while the 8-14-day outlook is favoring near-normal precipitation (Figure 3). Hopefully, this means very little chance of measurable snowfall over the next few weeks. The monthly climate outlook for April continues to support those trends, with the highest probability of above-normal precipitation occurring across central Indiana. Please keep in mind, though, that short-term freeze events can still move through fast enough that climate models are unlikely to predict them. Similar to the MRCC's Snowfall Climatology Toolbox, the MRCC has another tool, the Freeze Date Tool (https://mrcc.purdue.edu/freeze/freezedatetool), where users can select a temperature threshold and statistical value (e.g., earliest, average, latest) for the date when the last spring freeze occurred since 1950. For example, across much of Indiana (except for southwestern counties), the latest date of a 28-degree freeze occurred on May 9th (the "Mother's Day Freeze Event of 2020").

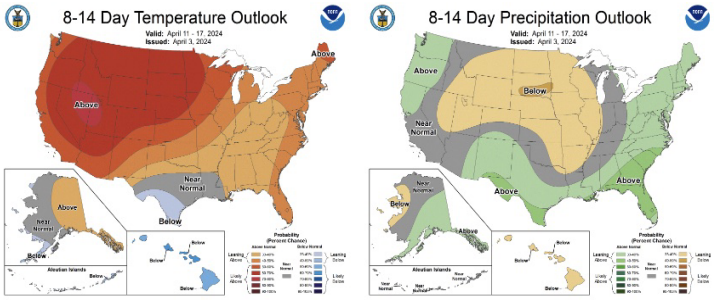


Figure 3. The 8-14 climate outlooks for April 11-17 for temperature (left) and precipitation (right). Note that shading indicates the probability of above-, near-, or below-normal conditions occurring and not necessarily the magnitude of that departure from normal.

Sustainable Agriculture Research and Education (NCR-SARE) News

NCR-SARE Welcomes Liz Brownlee

This article was published by SARE in their news release dated March 21, 2024.

NCR-SARE is pleased to announce Liz Brownlee's appointment as the new Coordinator for the Farmer Rancher Grant Program. Brownlee, who was born and raised in Indiana, brings a wealth of knowledge and expertise to this role.

Brownlee grew up in a farming community but became interested in sustainable agriculture through academics, first through a bachelor's degree in biology from Hanover College in 2009 and then a master's in Botany from the University of Vermont. Alongside her husband, Nate, whom she met at Hanover College, she explored various farming landscapes, gaining hands-on experience working on farms in Pennsylvania, Maine, and Vermont. In 2013, Brownlee and her husband returned to their Indiana roots, establishing Nightfall Farm on family land spanning over five decades. Their dedication to sustainability led them to transform fifty acres of conventional corn and soybean fields into thriving pastures. Today, they practice rotational grazing, ethically raising livestock, and supplying meat and eggs to their customers through their CSA and local restaurants, independent grocers, and farmer's markets.

Building on her interest in sustainable agriculture, Brownlee co-founded the Hoosier Young Farmers Coalition, advocating for beginning farmers and nurturing a supportive community. As Co-Director of Partners IN Food and Farming, she spearheaded farmer-to-farmer program development, outreach initiatives, and network expansion. Her commitment to rural revitalization earned her recognition as a 2021 Hoosier Resilience Hero by Indiana University.

Brownlee succeeds Joan Benjamin, who has served as the Farmer Rancher Grant Program Coordinator for NCR-SARE since 2005 and will retire in spring 2024. With her extensive background and dedication to sustainable agriculture, Brownlee is poised to uphold the program's legacy of fostering innovation and resilience within the farming community.

Ethylene Damage on Tomato Plants

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

Almost every year, I have a greenhouse tomato grower or two call me about tomato plants that are distorted and don't seem to be growing right. The problem often turns out to be ethylene damage. This year, I have already received my first case of heater problem. Please read the article below to avoid or manage this problem.

Tomato plants with ethylene damage often have leaves that are curled down and stems that are twisted (Figure 1). Stems or leaves that are curled downwards are said to have epinasty (in botanical terms). Epinasty is a common symptom of ethylene

damage. Ethylene is a common by-product of incomplete combustion of several different types of fuel. Incomplete combustion is often the result of heaters that are not working efficiently. Tomatoes are very sensitive to ethylene damage; however, other crops may also show ethylene damage.

Figure 1. The tomato seedlings above exhibit downward curled leaves (see plant in upper left corner of photo) which maybe a symptom of ethylene damage and yellow seed leaves with lesions, a possible symptom of sulfur damage (Contributed Photo).

The tomato plants in figure 1 also have yellow seed leaves. Ethylene damage does not include yellowing. Furthermore, there is a spotting on the lower leaves that is not typical ethylene damage. I believe that the symptoms on seed leaves were as a result of a different compound, perhaps sulfur dioxide, a heavier than air compound that would remain relatively close to the heater. In fact, the yellowing leaves were observed close to the heater, while the curling leaves, caused by ethylene gas, were spread throughout the greenhouse. The production of sulfur dioxide may also be as a result of incomplete combustion.

While some greenhouses are heated with a furnace attached to the greenhouse, many greenhouses are heated with a standalone unit inside the structure. In the example in figure 1, the grower stated that the heater was of this latter type-a standalone unvented unit. While this type of heating is not recommended, natural gas, propane and kerosene generally burn clean and do not need to be vented. However, even units that burn clean fuels may cause problems if out of adjustment (see citation below).

I cannot prove that the symptoms in Figure 1 above are caused by ethylene. But a few years ago, we witnessed ethylene-like damage at a greenhouse here at the Southwest Purdue Agriculture Center (See article in the November 2007 Vegetable Crops Hotline, Issue 487). Therefore, we were able to confirm that ethylene was the cause of the symptoms shown in Figure 2. Given the similarities of the two examples and the circumstantial evidence, I believe the example given in Figure 1 was due to a heater malfunction. The grower reports that after the heater was serviced, the plants began to look healthier.

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

Heating specialists should be able to measure ethylene, carbon monoxide and other products of incomplete combustion. The best time to measure incomplete combustion is after a cold night when the heaters have been running. Be sure to make such measurements before venting the greenhouse.

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

To avoid damage from ethylene and other air pollutants:

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

Additional Resources

Bartok, J.W. **Problems with Using Unvented Greenhouse Heaters**

Resources for Vegetable Disease Management

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

Now is a good time to discuss resources that might be used to help solve vegetable disease problems. This article will discuss online resources that may be useful for vegetable disease management.

Let's start with my favorite resource: the Plant and Pest Diagnostic Laboratory. While it isn't necessary to send in a sample to the PPDL each time you see a spot on a leaf, it makes sense to consider sending in a sample when new symptoms that appear to be spreading appear. Be sure to check the information on the PPDL website (https://ag.purdue.edu/department/btny/ppdl/) about how to submit a sample and/or call the number provided. The $11 cost for instate samples is very reasonable. You might also consider sending photos digitally to the PPDL. Some problems can be identified by photos alone, but others may require a physical sample sent as a follow-up. The sample fee covers both the photo sample and any physical follow-up that may be needed at no additional charge. The link to the PPDL submit samples page is https://ag.purdue.edu/department/btny/ppdl/submit-samples/submit-sample.html.

Another option for determining what disease might be present is to study the vegetable disease photos recently posted at https://ag.purdue.edu/department/arge/swpap/veg-disease-photos.html. These photos are of vegetable diseases that one may observe in a typical season in Indiana. Brief descriptions of each crop and disease are included. While viewing photos is not a substitute for sending in a sample to the PPDL, the photos may help you narrow the possible disease problems that might exist in a field.

The PPDL or the photos described above will help in disease diagnosis. Armed with a disease name, you can review the resources below for management options.

Beginning with the *Midwest Vegetable Production Guide*, which is available as a hard copy or as an online guide at https://mwveguide.org/. The first portion of the guide contains a narrative about many aspects of vegetable production. For disease management, most growers will want to visit the second portion of the guide. At the site, you will be asked to follow the prompts to select which crop and disease is of interest. Management options will include cultural and fungicide options (insect and weed pests are also included). Filters can narrow results, such as limiting recommendations to organically certified options or fungicides labeled for greenhouse use. Searches for a particular disease can be downloaded as PDFs. Be sure to check any fungicides listed on the label.

Fungicide schedules for cantaloupe and watermelon have been condensed into a document that can be found here. A pumpkin schedule can be found here. These links and many others can be found by going to the Southwest Purdue Ag Program page at https://ag.purdue.edu/department/arge/swpap/index.html. Visit resources, then click on cucurbit resources. These fungicide schedules should be used together with current recommendations from the Midwest Vegetable Production Guide described above.

The Southwest Purdue Ag Program cucurbit resource page also provides links to extension bulletins that describe anthracnose and gummy stem blight of cucurbits, Fusarium wilt of watermelon, and other subjects. These bulletins describe symptoms, biology, and management options. Other resources, such as for tomatoes and greenhouses, can also be found under resources on the Southwest Purdue Ag Program page. Note that several videos are posted on these pages, such as how to diagnose cucurbit downy mildew or bacterial wilt of cantaloupe. The banner menu on the Southwest Purdue Ag Program also has a link to this newsletter, the *Vegetable Crops Hotline:* https://vegcropshotline.org/.

Finally, when searching elsewhere online for vegetable disease information, websites that end in '.edu' or '.gov' are most likely to provide science-based information unrelated to sales. As you gather information, it's helpful to compare and contrast advice given from multiple sources. Purdue specialists are always available to help sort through problems when management recommendations are unclear.

Vegetable Crops Hotline © Purdue University - vegcropshotline.org
Editor: Petrus Langenhoven | Department of Horticulture and Landscape Architecture, 625 Agriculture Mall Dr., West Lafayette, IN 47907 | (765) 496-7955

Market Report for

Clearspring Produce Auction
2050 S 300 W
LaGrange, IN 46761
* Phone (260) 463-4131
* Fax (260) 463-4362
* Market Report (260) 463-4131

Date of Report:	28-Mar	2024

Description of Product	Unit	Units Sold	Price Average	Price High
Agertum		288	$ 0.20	
Amaryllis		18	$ 4.00	
Annuals, misc		222	$ 0.26	$ 0.30
Bacopia		200	$ 0.05	
Begonia		750	$ 0.65	$ 1.00
Bidens		50	$ 0.25	
Calibrachoa		1000	$ 0.33	$ 0.50
Clematis		4	$ 5.00	
Coleus		1458	$ 0.25	$ 0.65
Fern, Asparagus		6	$ 0.20	
Ferns	10 inch pot	21	$ 7.62	$ 10.00
Fushia		150	$ 0.30	
Geranium	8 inch pots	22	$ 7.00	$ 10.00
Geraniums		86	$ 0.20	$ 0.45
Gerbera Daisy		300	$ 0.45	
Grass, Ornamental		48	$ 0.90	
Gyposphia		200	$ 0.10	
herbs		1114	$ 0.57	$ 1.00
Hibiscus		45	$ 5.67	$ 6.00
Houseplants, misc		23	$ 0.83	$ 8.00

Hypoestes			280	$ 0.25	
Impatiens			550	$ 0.36	$ 0.50
Lantana			50	$ 0.20	
Lillies		pots	2	$ 5.00	
Lisiauthus			244	$ 0.96	$ 1.30
Lysimachia			100	$ 0.40	
Marigold			1388	$ 0.24	$ 0.20
Onions, Green		bunch	54	$ 1.00	
Pansy			200	$ 0.35	
Petunias			8423	$ 0.24	$ 0.90
Roses		potted	6	$ 16.00	
Silver Nickel Vine			100	$ 0.50	
Spikes			300	$ 0.75	$ 0.95
Succulents			1052	$ 0.71	$ 5.00
Sunpatiens			400	$ 0.53	$ 0.75
Sweet Potato Vine			512	$ 0.56	$ 1.40
Vegetables		Flat	13	$ 3.05	$ 22.00
Wandering Jew			150	$ 0.35	