



**RUTGERS UNIVERSITY**  
**New Jersey Agricultural**  
**Experiment Station**



# **Proceedings** of the **2025 New Jersey Annual** **Vegetable Meeting**

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**New Jersey Vegetable  
Growers Association**



**Mid-Atlantic Commercial  
Vegetable Guide**



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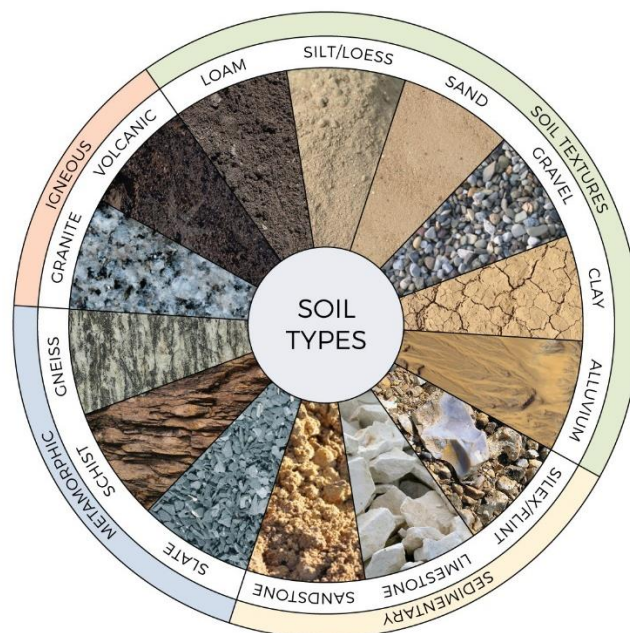
# **Vineyard Soil Health**

## SOIL TESTING METHODS FOR VINEYARDS

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At last year's New Jersey Annual Vegetable Meeting, Dr. Gary Pavlis had a presentation titled: SHOULD YOU BE GROWING GRAPES? PROS, CONS, AND SITE SELECTION. In answer to this, Dr. Pavlis asked – after several other considerations were favorably dispensed with - “Where are the grapes and the winery to be?....Soil is not the top priority for site selection. First of all, I want to know how cold it gets on their land in the winter. If it gets to -10 degrees Fahrenheit routinely the grapes are going to die. It won't matter that the soil was great.”

But still let's talk about the soil; after all, wine quality is usually associated with its terroir, which comprises many factors, soil included. Although research has not gotten a good handle on this, the flavor of a grape crop or wine is often credited on the soil type.



**Figure 1. Categories of soil parent material or texture that theoretically affect soil flavor. credit: WinePair.com**

Assuming that the site and climate are suitable, what are favorable characteristics of a soil for vineyard culture?

We define soil quality as the ability of the soil to function according to its intended use. Physical, biological, and chemical characteristics are all important to consider.

Physical: Soil texture is frequently mentioned as a factor in wine quality; this is usually related to its relative ability to drain and/or store water. Contrary to what might seem apparent, limited soil water availability is often associated with wine quality. Sandy or

even gravelly soils are beneficial in their ability to allow drainage – assuming no excessive compaction or a shallow water table, and with adequate organic matter content can still retain a reasonable supply of water for the short term. The increasing unpredictability of precipitation makes drip irrigation a wise choice, but remember that too much water can be unfavorable, just as too little will be.

Soil texture is a measurement that can be done in the laboratory by sedimentation. Detailed analysis of sand size distribution can also be done. A combination of soil texture and sieve analysis can provide an estimate of soil permeability. Experienced soil scientists and agronomists can estimate soil texture in the field by its “feel” and cohesiveness when moist.

Being a perennial crop, soil compaction is somewhat less of a concern than in annual crops. As long as the soil is not compacted when planted, the minimal subsequent soil disturbance and the establishment of extensive root systems is beneficial in building and/or maintaining good physical conditions. However, using heavy equipment in vineyards when soil is wet always threatens compaction and subsequent problems with infiltration/permeability, aeration, and root growth. Compaction testing is usually performed in the field, for example with a penetrometer. Alternatively, a sample carefully extracted from a defined soil volume can be taken, dried, and weighed for a measure of its bulk density. A soil’s bulk density is inversely related to its porosity.

Biological: The organisms living in the soil are very important; we must think of the soil as its own microbiome, but a microbiome strongly influenced by the vegetation or crop being grown. “The microbiome of a vineyard may play a critical role in fruit development, and consequently, may impact quality properties of grape and wine.” Chou, MY., et al., (2018). A detailed analysis of the soil microbiome is not yet a routine soil test for most producers, but researchers are doing these types of analyses to learn what we can about microbial populations under various crop and management practices and how best to interpret and make recommendations based on these data. Meanwhile, a measure of overall respiration, such as the Solvita® CO<sub>2</sub>-burst test offered by Rutgers Soil Testing Laboratory, gives a good assessment of the relative suitability of the soil for soil organisms and even provides an estimate of nitrogen mineralization (plant-available nitrogen released by organic matter decomposition).

Chemical: This includes soil pH and nutrient levels. Interestingly, general guidance is that vineyard soils should not be too fertile. Just as with water availability, a limited degree of stress induces plant compounds to form which add to the flavor and complexity of wine flavor. It is well established that there is no flavor compound transferred directly from soil to grape; but it’s the ability and stimulation of plants to produce the flavor compounds that matter. Having adequate nutrients and favorable soil pH is necessary to assure that the vines/roots have access to the necessary elements to construct the flavor compounds internally. Remember that too much can upset the balance; try to maintain nutrient levels near the critical value for best balance.

Chemical analysis is usually done in the laboratory. Rutgers Soil Testing Laboratory’s fertility test includes soil pH, buffer pH (lime requirement index), and 10 essential plant nutrients. Keep in mind that nitrogen is not part of the basic fertility test (but can be analyzed as an extra test) because application timing and rates of nitrogen are determined by vegetative, seasonal, and weather factors rather than a plant-available

nitrogen value at a single point in time. Rutgers Cooperative Extension provides the recommendations – usually through Dr. Pavlis.

Other chemical tests are also available through laboratory testing. A complete listing of all tests available through Rutgers/NJAES is available on the soil testing webpages.

Chou, MY., Vanden Heuvel, J., Bell, T.H. *et al.* 2018. Vineyard under-vine floor management alters soil microbial composition, while the fruit microbiome shows no corresponding shifts. *Sci Rep* **8**, 11039 Chou, MY.,. <https://doi.org/10.1038/s41598-018-29346-1>



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**Terroir** is a term often associated with wine and vineyards, and one compelling definition is that it encompasses “authentic fertility”—principally the reliance on what the deep soil profile within a landscape offers (Seguin, 1986; Smart & Gladstone, 1999). Recent microbiological research examining microbial consortia in agricultural soils has revealed a strong association with soil type, reinforcing the view that terroir may be thought of a geologic-historic phenomenon.

An additional aspect bridging tradition with modern ecological practices, is site-specific quality, endowed by soil type. This can be enhanced through the recycling of a vineyard’s own residues and nutrients, supplemented as needed. Achieving this effectively requires quantifying the nutrient cycle and aligning it with plant needs.

In another session at this event, I will address the challenge of measuring key aspects of soil biology and its relation to nutrients, which support soil health. The vineyard’s relationship to terroir in this context lies in our ability to quantify the local nutrient cycle—what the soil *at rooting depth* provides, what if any must be supplemented, and how to maximize the recycling of organic matter and nutrients within the vineyard.

My involvement in vineyard nutrient management began during my post-graduate years in Europe, where I was exposed to efforts in France and Germany to recycle local green waste through composting for vineyard application. This work coincided with a shift in vineyard management practices to reduce the use of bare soil cultivation and integrating cover crops. Our efforts focused on characterizing the cleanliness of local composts, addressing plant nutrient needs, and investigating what the vineyard itself could supply—such as marc (press cake) and shredded prunings, and stopping the practice of burning.

This research evolved beyond nutrients to include vineyard hygiene and disease issues. For instance, grape powdery mildew (*Uncinula necator*), which is ubiquitous in vineyards across Europe and the eastern and western U.S. (Gadoury and Pearson, 1988), became a focal point. Working with a vineyard team at the University of Bonn, we found that surface litter management had a measurable impact on reducing airborne spores of pathogens, including those causing downy mildew.



Figure 1 McNab Vineyard in the Russian River Valley, CA, where the author designed a composting mix of grape pomace waste with local cattle manure for later soil use. PHOTO: W. Brinton

During the 1990s, I expanded my work with vineyards in Pennsylvania, Long Island, and California as a partner in Woods End West alongside the late Alan York, a renowned organic viticulturist who collaborated with Bonterra, Fetzer, and Benziger vineyards. Our joint papers in *Practical Winery & Vineyard* detailed our experiences in balancing nutrient ratios for sustainable vineyard management in California (Brinton & York, 2003).

Recently, in 2024, I toured vineyards in Tuscany to evaluate challenges in transition to regenerative practices. I am currently working with particular new vineyard near Montalcino to develop a comprehensive, but minimalistic nutrient program. This includes landscape stratification testing in a hilly vineyard intended to produce the highly regulated Rosso di Montalcino and Brunello wines. A key focus of this program is creating a cover crop mix and nutrient support tailored to the vineyard's significant seasonal shifts in soil temperature and precipitation.

Table I. Laboratory composition of pomace by-product								
SAMPLE	Water	pH	C:N Ratio	Density g/cc	Salt, mmhos	Organic Matter	Total-N	Potash
POMACE (merlot mix)	14.7%	6.4	19.5	0.36	1.9	%dm 91.6%	%dm 2.53%	%dm 1.8%
Pomace (Range of Values)	12–85%	3.5–6.5	18–27	0.3–0.5	1.0–2.5	90–94%	1.8–2.6%	1.5–3.0%
Per ton of wet waste (avg)	1000 lbs	–	–	25 lbs/ft <sup>3</sup>	–	910 lbs	25 lbs	20 lbs

As shown in Table 1 (Brinton, California data), each ton of pomace contains approximately 20 pounds of potash and 25 pounds of nitrogen, highlighting its appreciable value as a

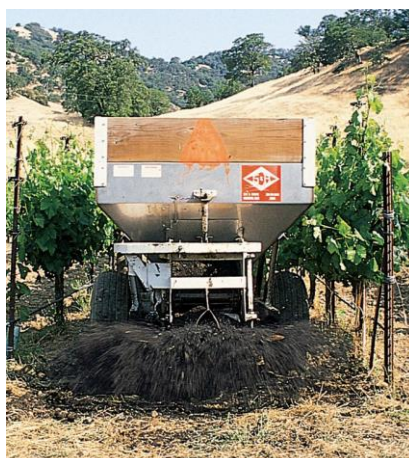


Figure 2 Spreading compost in a California Vineyard. Applications of less than 3 tons/acre were found to meet the nutrient requirements. Photo: W. Brinton

natural amendment. The final compost analysis, after a period of about 4 months, is shown in Table II.

Table II. Laboratory composition of finished pomace/manure compost									
SAMPLE	Water	pH	C:N Ratio	Density g/cc	Salt, mmhos	Organic Matter	Total-N	K	Ca
Finished pomace/ manure compost	40.0%	8.3	11.0	0.8	12.0%	42.0%	2.20%	2.6%	2.4%

Figure 2 shows a mini-spreader that has been calibrated for light topdressings – sometimes less than 1 ton/acre. The rates must be controlled to avoid pushing plant vigor, resulting in the need for heavier pruning or lowered grape quality. Each vineyard must strike a balance between ease and efficiency of residue recovery, hygiene and disease aspects, and the desire to create a locally-oriented nutrient and organic matter cycle that reflects Terroir.

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# **Nursery and Ornamentals I**

## IPM ESSENTIALS FOR ORNAMENTALS

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Ornamental crops, including nursery, greenhouse, and Christmas tree production represent the largest economic sector of New Jersey's agriculture, generating \$950 million in economic impact and supporting over ten thousand jobs. Within this commodity group there are many different species of ornamental annual and perennial plants being grown in a multitude of different production systems (i.e. field-grown, potted plants, greenhouse production). Each species and each production system require unique and optimized best management practices to promote plant health and reduce losses due to pest and disease issues. Nursery growers in New Jersey also demonstrate considerable variability in their size and scope of operation, ranging from wholesale, field-grown operations that may encompass several thousand acres to retail nurseries on 1 to 5 acres.

**Integrated pest management (IPM)** is an approach that uses knowledge about pests and their life cycles, cultural practices, nonchemical methods, and pesticides to manage pest problems.

Aphids, scale insects, borers, mites, and thrips are just a few examples of the major insect problems that affect ornamental crop producers. To maintain aesthetic quality, insecticides, including systemic neonicotinoid materials are often used as controls. Proper scouting and monitoring, along with the use of biocontrols as part of an IPM program can help to reduce the use of insecticides in these operations, however additional knowledge is required for successful implementation. Additionally, climate change is creating increased variability in weather patterns, which makes traditional calendar-based pest forecasting models less accurate and further underscores the importance of site-specific IPM programs. Developing site-specific IPM programs can also help to make operations more prepared to manage the ever-growing list of invasive pests.

Due to the uniqueness of each operation, site-specific IPM programs for farm owners and workers on IPM strategies for their individual operation provide an effective and targeted method to maintain crop quality, while reducing insecticide use. Additionally, many new and beginning growers may not have any knowledge of IPM or proper pesticide safety, which is essential to ensure that potential human health risks and environmental effects from pests and related management strategies are minimized.

The IPM approach involves a series of practical steps to help provide safe, effective, economical, and sustainable pest control:

- **Step 1. Monitor** and scout insects to determine insect types and population levels
- **Step 2. Identify** pest and host accurately
- **Step 3. Assess** and consider economic or aesthetic injury thresholds

- **Step 4. Implement** a treatment strategy using mechanical, cultural, biological, or chemical controls, or a combination of these strategies
- **Step 5. Evaluate** success of treatments

If there are specific pest-prone plants in an operation, then they may be some of the first ones to develop problems and can act as valuable indicators of when certain pests are present in the area. These plants should be monitored first and watched closely so that preventative controls can be implemented in a timely manner. An understanding of specific key pests that show up every year will also help with preparations for addressing their anticipated arrival. Researching which species of insects they are, the plants they attack, when they come out, how to control them, and how they overwinter will provide important baseline information for developing a comprehensive IPM program.

Growing degree days (GDDs) can be a valuable tool to help monitor the timing of insect growth, life stages, and activities. GDDs are based on temperature and measure thermal units accumulated each day, which correlate to specific stages of an insect's life cycle. This information can be especially useful when targeting the most vulnerable stage of the insect's life cycle to employ effective and efficient control measures. There are several resources included below that can assist in calculating and tracking GDD accumulation for a specific location, including Network for Environmental and Weather Application (NEWA), U.S. Pest, and the Michigan State University GDD Tracker.

Additional resources are available to assist with correlating GDDs to specific insect pests, including the Rutgers University Nursery and Landscape Pest Scouting Guide and the University of Maryland Landscape IPM Report and Pest Predictive Calendar. These resources identify specific times of the year when insect pests will be active and when the best time to control them would be. The Rutgers Plant and Pest Advisory also provides timely updates on pest issues throughout the growing season.

Another valuable tool for developing site-specific IPM programs involves the use of plant phenology indicators. Whereas the life cycle of an insect is directly linked to temperature, so is the development and bloom of plants. Observing plant phenology of a specific location suggests the amount of GDDs accumulated and this indicates which insects may be active. For example, bagworm (*Thyridopteryx ephemeraeformis*) hatch begins to occur, and young larvae become active around the same time that Kousa dogwood (*Cornus kousa*) bracts are in full bloom. This is when bagworm larvae are most vulnerable and a good time to initiate control measures.

Traps for specific insects can also greatly assist in monitoring and effectively control certain populations. Ambrosia beetles (*Xylosandrus* spp.) have a wide host range of woody ornamentals. The adults bore into the heartwood and lay their eggs inside the tree, which hatch and result in larvae that are difficult to control at this stage. So, controlling the adults is essential for effectively addressing this problem. The adult females are attracted to ethylene (which is a hormone that is released by stressed trees). However, ethylene traps can be used to attract the females and identify when they are present at a particular location. When adults start showing up in the ethylene traps, it is time to apply preventative materials to the bark of the trees so the insects will be controlled before they have a chance to burrow in and lay their eggs.

Effective IPM programs can be challenging for ornamental crop producers because there are many different species of insects and host plants involved. Developing an understanding of key IPM principles, understanding which insects may be encountered, and having a plan for control before the problem starts are all strategies that can be employed to reduce crop losses. The Rutgers Nursery IPM Program provides resources and updates throughout the growing season to assist growers and other green industry professionals in achieving these goals.

#### Additional Resources

Rutgers Plant and Pest Advisory - <https://plant-pest-advisory.rutgers.edu/>

Rutgers Nursery and Landscape Pest Scouting Guide - <https://plant-pest-advisory.rutgers.edu/wp-content/uploads/2023/03/LONT-PSG-DISTRIB-2023.pdf>

University of Maryland Landscape IPM Report and Pest Predictive Calendar - <https://extension.umd.edu/programs/agriculture-food-systems/program-areas/ornamental-horticulture/ipmnet/ipm-alerts-landscape-nursery/>

Network for Environmental and Weather Application (NEWA) - <https://newa.cornell.edu/>

U.S. Pest - <https://uspest.org/wea/>

Michigan State University GDD Tracker - <https://gddtracker.msu.edu/>



## MANAGEMENT & TREATMENT OPTIONS FOR BEECH LEAF DISEASE

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Beech leaf disease (BLD) entered the United States in 2012 and quickly spread to Northern New Jersey by 2020. Currently, its range is throughout 16 of New Jersey's 21 counties. BLD poses significant challenges to forest health and management as well as nursery production, sales, and ornamental landscape management. This disease is deadly to American beech (*Fagus grandifolia*) and the many commonly grown and planted cultivars of European beech (*F. sylvestris*) in the horticultural trade. Unless properly treated the beech in nurseries will become infected and the dominant species of beech in New Jersey landscapes will decline and die within two to ten years.

BLD is caused by an invasive foliar nematode *Litylencenchus crenatae* subsp. *mcannii* (*Lcm*) infects next year's leaf buds. Most of the damage to the leaf tissue is caused in the bud stage. In May, the infected leaves reveal damage which is observed as the diagnostic banding pattern between the pinnate venation; this banding is opaque when viewed against a light source, like the sky (Figure 1). The banded infected leaf tissue thickens as the tree attempts to fight the infection but struggles to photosynthesize properly. Severely infected leaves shrivel and defoliate. More advanced infection causes bud abortion, twig dieback, and canopy loss.



**Figure 1. Symptomatic beech leaves afflicted with beech leaf disease. These photos are Photo Credit: Jean Epiphan, Rutgers Cooperative Extension**

Research has shown that adult nematodes can exit the leaf tissue to attempt to reach next year's buds between mid-July through October, with the height of dispersal in September. The adult nematodes have multiple vectors including arthropods, birds, other wildlife and humans. However, newer research has shown that wind and rain are the primary vectors as infections are usually flushed to the lower canopies first and the regional spread is strongly eastward with general wind directions. The confirmed timing of *Lcm* dispersal and methods helps to inform the optimal treatment timing and methods.

Arboricultural treatment options depend on the size of the beech tree. Large beech are best treated with Thiabendazole as Arbotect 20-S, which has been used as a fungicide to treat Dutch elm disease and sycamore anthracnose. Thiabendazole is also a nematicide that does directly kill nematodes and can reduce BLD symptoms by 100% if proper application is executed. Thiabendazole as Arbotect 20-S is now emergency use authorized in New Jersey and can be applied once every two years. Thiabendazole treatment is applied as an injection to the sides of the root flare of mature beech (larger than 10 inches caliper). The side of the root flare injection location is particularly vital to target as this area shows the best compartmentalization and wound closure potential; trunk injection or root flare ridge injection will not fully close and can cause damaging decay to ensue. Timing of this injection is critical as it should be performed in June before adult nematodes exit leaf tissue and when leaves are fully expanded. To ensure proper xylem uptake, the treatment should be timed in the morning when the temperatures are between 75 and 85 degrees.

Treatments on smaller beeches in the landscape or in nurseries include foliar sprays and soil drenches. Fluopyram has been shown effective as a foliar spray when applied every 21 days from late July through October. In the landscape it cannot be applied near water and is only effective on smaller beeches, not in dense beech forests. In nurseries, it can also be effective; fluopyram directly kills nematodes on contact. Other foliar sprays have not been tested, but those comprised of chitosan may decrease nematode numbers and can be used near water as it is an organic product. Soil drenches of polyphosphate-30 fertilizer have shown to improve health of beech and decrease nematode numbers on pole size beech. It is suggested to apply soil drenches between May and August at least one month apart. Chitosan products can also be used as a soil drench, but they have not been tested.

Proper cultural care is also critical to improve health of beech and decrease stress, such as watering deeply during droughts, removing lawn and lawn care above beech roots, removing competition for resources and light in the vicinity (especially invasive plants), and mulching properly with native leaf litter or conifer-derived natural mulches.

Beech in areas like forestland are likely to decline. Mitigation steps involve natural plant community reforestation in current beech stands as they lose their canopy cover over time. It will be important to protect understory from deer damage with barriers to ensure proper growth of replacement trees, such as native oaks (*Quercus* spp.), hickories (*Carya* spp.) and black gum (*Nyssa sylvatica*). Invasive plant management in and near these future canopy gaps will be paramount. In forests, tree removal will not be required and stems should be left in place to senesce and return their nutrients back to the forest; plus, their snags and coarse woody debris provide habitat.

# **Vegetable Disease Control**

# TAR SPOT IN CORN: WHAT WE'VE LEARNED ABOUT THE DISEASE IN THE MID-ATLANTIC AND ITS MANAGEMENT

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## Distribution and Severity

Tar spot is a relatively new disease of corn in the United States, first discovered in northern Illinois and Indiana during the 2015 growing season. Tar spot is caused by the fungal pathogen, *Phyllachora maydis*, which is thought to be endemic to areas of Latin America. By 2018, tar spot spread throughout many counties in the US corn belt and caused significant epidemics and yield loss. Tar spot was first confirmed in the Mid-Atlantic region in Lancaster County, PA late in the 2020 growing season. In late August 2022 it was confirmed in Maryland, followed by Delaware and New Jersey in 2023.

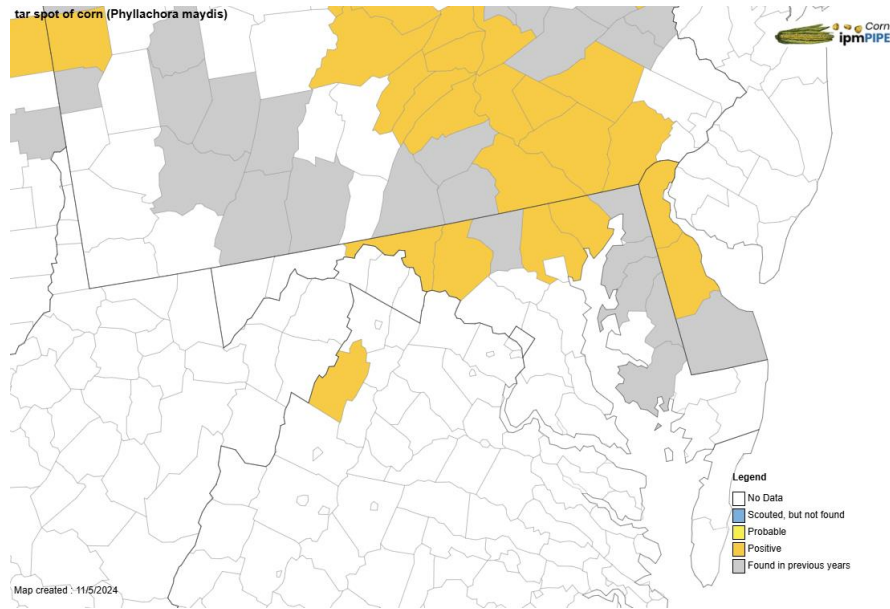


**Figure 1.** Tar spot on corn leaf.

Tar spot causes small, raised, black lesions on corn leaves, stalks, and husks (Figure 1). These lesions contain the spore-producing structures of the fungus, which can be wind or splash dispersed to new corn tissues. *Phyllachora maydis* can only infect corn and is not a pathogen of any other crop. Spores overwinter in old corn crop residue and are the source of primary inoculum.

In 2023, we set out to conduct preliminary research on the distribution and severity of tar spot in Maryland. Surveys of fields in Harford County, MD near the epicenter of the first report in 2022 were conducted during the 2023 growing season, as well as select locations across the state. We also solicited reports from farmers, crop consultants, and field scouts. Surveys were conducted in additional fields in 2024.

Several fields were scouted for tar spot during late vegetative growth stages and frequency and intensity of scouting was increased from tassel through harvest. Initial scouting was focused on fields in Harford County near fields where tar spot was confirmed in 2022. The first reported and confirmed incidence of tar spot in Maryland for 2023 came from a corn silage field in Cecil County on August 22. The second came from Carroll County on August 31, followed by Harford County on September 3. We confirmed tar spot in the additional counties of Kent and Queen Anne's on September 19; Baltimore County on September 22; Caroline County on September 25, and Dorchester County on October 6 (Figure 2).



**Figure 2.** Map showing confirmed distribution of tar spot for the 2023/2024 growing season. Yellow counties were confirmed in 2024 and grey were confirmed in years prior but not in 2024. Map generated from corn.ipmPIPE.org.

Several fields were scouted in Northern Harford County throughout the year surrounding fields where tar spot was confirmed in 2022. By the end of the season, tar spot was found in over 50% of these fields (9/16) at levels ranging from 2% to 25% severity. It was observed that tar spot severity continued to increase after black layer for as long as there was green, living tissue remaining on the plants. This increase in severity after physiological maturity does not affect yield but does make for a notably increased level of severity present at harvest and thus the potential for an increase in overwintering spores that will provide inoculum for the following year.

A comprehensive survey of 12 fields on Maryland's Eastern Shore from Cecil to Queen Anne's County was conducted on September 19. During this time, two fields were confirmed with tar spot. Severity was very low (<2%) in the field in Queen Anne's County, and high in the field in Kent County (30%).

Altogether, tar spot was confirmed in 16 out of 34 fields (47%) scouted/reported throughout the state, with samples coming from as far west as Washington County (no confirmed samples) east to Cecil County (two confirmed samples) and south on the Maryland Eastern Shore as far as Dorchester County (one sample confirmed).

For 2024, tar spot was first reported in Baltimore County on August 22. The second came from Harford County on August 26. Samples from Frederick County and Washington County were collected on September 17 and 19, respectively, and were confirmed positive for tar spot. These are the first confirmations of tar spot in these two counties, although we suspect it has been present for 1-2 years. Tar spot was confirmed in several Eastern Shore counties in 2023, but we did not receive any positive reports in 2024; however, it was likely present at low levels.

Several fields were scouted in Northern Harford County throughout the year surrounding fields where tar spot was confirmed in 2022 and 2023. By the end of the

2024 season, tar spot was found in 100% of these scouted fields (6/6) at low levels of severity.

Based on the surveys conducted in 2023 and 2024, tar spot appears to be established in all the northern Maryland counties east of Allegany County and south on the Eastern shore to at least Dorchester County (Figure 2). Judging by the confirmed occurrences in other counties in different states, it is likely that tar spot is present in more Maryland counties than determined by this survey. To date, significant yield losses in grain corn yield have not been reported or observed in Maryland, likely due to the fact that tar spot has infected corn late in the growing season beyond the critical growth stages necessary for grain fill.

## **Fungicide Trials**

Fungicides can be an effective management tool for foliar diseases of corn, including tar spot. Research from the Midwest has shown a positive response to fungicide applications in fields where tar spot disease severity is high. However, there is debate as to if one fungicide application made around VT is sufficient to control tar spot, as yield losses have been reported as late as R4. In 2023, we established an on-farm trial to evaluate the response to a single fungicide application compared to a two-pass program for managing tar spot in grain corn.

Fungicides were applied at the VT and R2 growth stages using a DJI T30 drone calibrated to deliver 2.8 gallons per acre spray volume to the entire length of the 12-row plots. VT applications were made on July 12 and R2 applications were made on August 5. Trivapro 2.1 SE was used for all applications. Trivapro was selected because previous research has demonstrated that multi-mode-of-action products have the best efficacy against tar spot.

Tar spot was first confirmed in the plots on August 29 present at a very low level (less than 2% severity). Overall tar spot disease severity was low throughout the season in these plots. One possible explanation for this is the early planting date (April 11), which likely allowed the corn to complete its critical growth stages (VT-R2) before weather conditions were favorable for tar spot development.

Early disease ratings revealed a significant difference in tar spot severity ( $p=0.0176$ ) in treated plots vs. nontreated plots (Table 1). However, late disease ratings collected at harvest show an overall increase in tar spot severity, but no difference between treated and nontreated plots. This is likely because fungicides can only offer around 14-21 days of protection. In this trial, the second fungicide application did not provide improved tar spot control compared to the single pass treatment; however, the single fungicide application at VT delayed tar spot infection compared to the nontreated control.

Overall trial yield was slightly below average for this farm, although strong for the early plant date and dry spring. The control plots averaged 192.56 bu/acre with a low of 169.7 and high of 214.6; the single pass (1X pass) program yielded an average of 199.05 bu/acre with a low of 177.5 and high of 228.6 bu/acre; and the two-pass (2X pass) fungicide treatment yielded an average of 201.56 bu/acre with a low and high of 194.4 and 222.7 bu/acre, respectively. However, there are no statistically significant

differences in yield between treatments ( $p=0.2123$ ). Likewise, there was also no significant difference in grain moisture. Tar spot disease severity was relatively low; likely too low to impact yield in this trial, leading to no yield response. The 2X pass fungicide program did improve standability of the crop at harvest, with 0.0% lodging, significantly better than the 1X program (5.0%) and the control (10.0%).

**Table 1.** 2023 Tar Spot Fungicide Trial Disease Rating and Harvest Data.

Treatment	Tar Spot Severity (%)		Lodged Plants (%)	Grain Yield (bu/acre)	Grain Moisture (%)
	9/11/23	10/12/23			
Control	3.05 a*	3.75	10.0 a	192.56	19.06
1X Pass	1.18 b	2.88	5.0 a	199.05	19.41
2X Pass	0.85 b	4.00	0.0 b	201.56	20.31
<i>p-value</i>	0.0176	0.4133	0.0680	0.2123	0.4343

\*Treatments connected by the same letter are not significantly different from each other ( $\alpha=0.10$ ).

### Tar Spot in Sweet Corn and Management Considerations

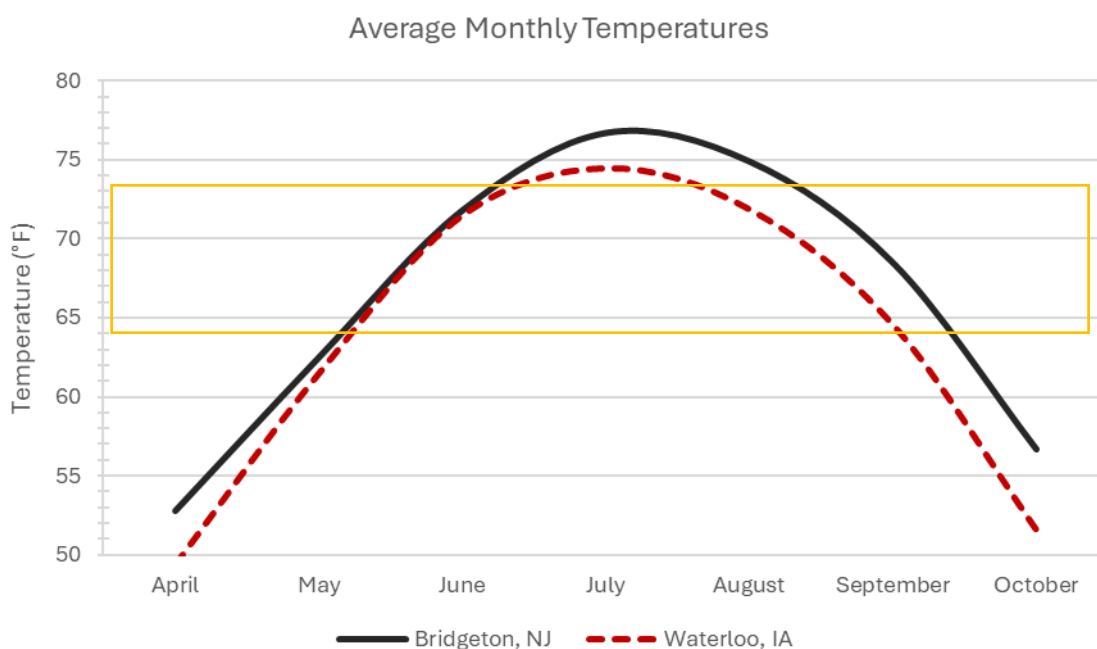
Very little data exists on the effect of tar spot on sweet corn yield and quality. Reduced yield, ear size, and ear quality in sweet corn have been observed in northern states such as New York and northern Indiana, but also southern states like Florida and Georgia. There are no commercial corn hybrids resistant to tar spot, but there are known differences in susceptibility. Seed companies have started evaluating and rating tar spot susceptibility in corn hybrids for field corn, but ratings are lagging for sweet corn varieties. Sweet corn growers should be aware that there can be significant differences in variety susceptibility to tar spot, but identifying and selecting these tolerant varieties can be difficult.

The tar spot fungus overwinters in previous corn crop residue. For this reason, tillage can influence tar spot severity; although, the effect is often minimal because tar spot spores can blow in short distances from other fields, especially in areas where no-till corn acres are prevalent.

Fungicides can be effective at managing tar spot infections. Fungicide efficacy trials on tar spot in sweet corn are non-existent to this point, but research from field corn experiments have shown that most fungicides labeled for corn are effective at reducing tar spot infection. Products with two and three-way modes of action (MOA) tend to be more effective than single MOA products. Growers using fungicides to manage other common foliar diseases of corn, such as grey leaf spot and northern corn leaf bight, will also get suppression of tar spot through these applications. Research from field corn fungicide trials indicates that a single application between VT and R2 is the most effective. Growers also need to be cognizant of restricted entry interval (REI) and pre-harvest intervals (PHI) for sweet corn, which could make most fungicide applications unworkable at VT-R2, as many fungicides have PHIs of 14-30 days. Always check the label before applying a fungicide to ensure compliance with REI and PHI.

It is important to consider weather conditions that favor tar spot development. Unlike many other common fungal diseases of corn, tar spot development is driven heavily by cooler temperatures. Recently published research has uncovered new information regarding tar spot epidemiology in the United States. Webster, et al. (2023) found that temperature was the most crucial variable impacting infection, with the average 30-day temperature between 64-73°F, coupled with 2-3 weeks of relative humidity under 90%, favored tar spot infection. Temperatures above 73°F significantly inhibited tar spot spore germination. Furthermore, leaf wetness aided spore germination and infection early, but prolonged leaf wetness inhibits tar spot spread.

This new information on environmental conditions is critical and should be taken into consideration when managing this disease and could play into our favor here in the Mid-Atlantic region where our summers tend to be hotter and more humid than regions in the corn belt where tar spot has been more severe (Figure 3).



**Figure 3.** Average Monthly Temperatures for Bridgeville, NJ vs. Waterloo, IA (1990-2020). Yellow box indicates optimum temperature range for tar spot development.

Sweet corn growers should scout for tar spot throughout the growing season, but especially just prior to tassel emergence through harvest. Make note of any field or hybrid differences in tar spot severity; avoid using varieties that give you problems. Fields where tar spot is established may benefit from tillage to bury infested corn residue and/or rotations to other crops to reduce inoculum may help. However, this will not prevent tar spot from blowing in from nearby fields. Based on what we know to this point, tar spot may not be a major disease problem for corn, especially the further south you go in the region where summer 30-day average temperatures exceed 73°F. Where tar spot could be an issue are in later planted fields that are tasseling later in August through September. These fields will be exposed to lower temperatures and will have a greater probability of tar spot infection. These plantings should be managed more intensively, and fungicides may be beneficial. Choose fungicide products that are short



PHI and preferably 2-3 MOA. The major driver of tar spot disease development is the 30-day average temperature, so growers should consult historic weather data to determine averages for their region which will help determine risk of tar spot development. Tarspotter is an app for smartphone that uses regional weather data to predict tar spot epidemics and is available for download for free at <https://ipcm.wisc.edu/apps/tarspotter/>.

## UPDATE ON DISEASE CONTROL IN PEPPER AND EGGPLANT

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### **Controlling anthracnose fruit rot in pepper.**

Anthracnose fruit rot has been an increasing problem in pepper production during the past 15 years. The pathogen, *Colletotrichum* spp., also causes a fruit rot in strawberries and tomatoes. The pathogen can infect pepper during all stages of fruit development resulting in serious losses if not controlled properly. Symptoms of anthracnose fruit rot include sunken (flat), circular lesions. In most cases, multiple lesions will develop on a single fruit. As lesions enlarge, diagnostic pinkish-orange spore masses develop in the center of lesions. During warm, wet weather spores are splashed onto healthy fruit through rainfall or overhead irrigation.

Managing anthracnose fruit rot begins with good cultural practices. The pathogen overwinters on infected plant debris and other susceptible hosts. The fungus does not survive for long periods without the presence of plant debris. Pepper fields should be thoroughly worked (i.e., disced, plowed under) after the season to help break down and bury old debris. Heavily infested fields should be rotated out of peppers for at least three years. Do not plant or rotate with strawberries, tomatoes, eggplant or other *solanaceous* crops. Once areas in fields become infested, management of the disease can be difficult. Prevention is critical to controlling anthracnose fruit rot.

Prevention is critical to controlling anthracnose fruit rot. Infected fruit left in the field during the production season will act as sources of inoculum for the remainder of the season, and therefore, should be removed accordingly. Thorough coverage (especially on fruit) is extremely important and high fertility programs may lead to thick, dense canopies reducing control. Growers have had success in reducing the spread of anthracnose by finding 'hot spots' early in the infection cycle and removing infected fruit and/or entire plants within and immediately around the hot spot.

### **Controlling Phytophthora crown and fruit rot.**

Phytophthora blight (*Phytophthora capsici*) is one of the most destructive soil-borne diseases of pepper in the US. Without proper control measures, losses to Phytophthora blight can be extremely high. Heavy rains often lead to conditions which favor Phytophthora blight development in low, poorly drained areas of fields leading to the crown and stem rot phase of the disease. Infections often occur where water is slow to drain from the soil surface and/or where rainwater remains pooled for short periods of time after heavy rainfall. Always plant phytophthora-resistant/tolerant cultivars to help minimize losses to the crown rot phase of the disease. For an updated cultivar list please see the 2024/2025 Commercial Vegetable Recommendations Guide.

### **Managing bacterial leaf spot in pepper**

Bacterial leaf spot (BLS) in pepper has increased in some areas of the mid-Atlantic region over the past few years. There are 10 races of the pathogen and in the past few years all races have been detected in New Jersey. The pathogen can be seed-borne and can cause significant problems in the field if transplants are exposed to the pathogen during transplant production. Hot water seed treatment can be done to help mitigate potential problems due to BLS. Any seed suspected of carrying BLS should be hot water treated, this is especially important in heirloom varieties or organic seed where BLS problems have been suspected or an issue in the past. Some of the most commonly grown commercial bell and non-bell pepper cultivars in the region carry resistance packages to different races of the pathogen, or in some cases all of them (e.g., X10R varieties). Many of the bell peppers grown in the region also have resistance/tolerance to phytophthora blight. Growers with past histories of BLS and/or phytophthora blight on their farm should only grow those cultivars that carry resistance/tolerance to both pathogens. For an updated cultivar list please see the 2024/2025 Commercial Vegetable Recommendations Guide.

Specific control options for important diseases in pepper and eggplant will be discussed in the session.

# Field Crops

## ENDANGERED SPECIES IMPACT ON PESTICIDE USE – HOW TO PREPARE

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The Endangered Species Act was first passed in 1973 and requires government agencies to ensure any actions they take do not jeopardize a species (or their habitat) that has been listed as endangered or threatened. Because the use of pesticides can affect animals and plants, pesticide registrations are considered “actions” that could impact an endangered species. As such, US Fish and Wildlife and The National Marine Fisheries Services are included in a consultation to ensure endangered and threatened species are protected. Due to the complex nature of the process, in the past the EPA has not fully completed the required endangered species consultations with the Services for pesticide registrations, which has left many of those pesticides vulnerable to lawsuits. Courts have annulled pesticide registrations which has led to their removal from market. To make pesticide registrations more secure from litigation, eventually all pesticide registrations will comply with the Endangered Species Act (<https://www.epa.gov/endangeredspecies>). The changes will not occur at the same time for all pesticides, rather they will be included during the registration and re-registration process moving forward. This means many pesticide labels will likely have changes that could include requirements to check the EPA's Bulletins Live! Two website (<https://www.epa.gov/endangered-species/bulletins-live-two-view-bulletins>), require measures to reduce spray drift, and mitigations to reduce runoff/erosion. As a result, farmers and applicators should expect to see some new application requirements on their pesticide labels. EPA has developed the Mitigation Menu website (<https://www.epa.gov/pesticides/mitigation-menu>) to help explain and provide examples of mitigation strategies that may be required before a pesticide is applied. The Weed Science Society of America is providing resources as well to help understand the implications for farmers and applicators (<https://wssa.net/endangered-species/>).

# **Environmental Issues in Agriculture**

## PFAS 101 (PER- AND POLYFLUOROALKYL SUBSTANCES) FOR FARMERS

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Per-and-polyfluoroalkyl substances (PFAS) are a broad class of anthropogenic chemicals of emerging concern that have recently been in the spotlight due to the potential risks they pose to human and environmental health. While the public attention to PFAS is relatively new, the chemicals have been used globally since the 1940s. PFAS chemicals have strong carbon-fluorine bonds in the chemical structures, making them highly stable, thermally resistant, and able to repel oil and water (Su & Rajan, 2021). Due to these properties, PFAS have been incorporated into a vast array of products with an equally wide variety of military, industrial, and domestic applications (Salvatore et al., 2022). In consumer products, they have been used in food packaging, stain-resistant textiles, waterproof apparel, nonstick cookware, cleaners, personal care products, etc., and industrially, PFAS are key ingredients in electroplating, firefighting foam, textile impregnation, etc. (Glüge et al., 2020; Kotthoff et al., 2015).

### Pathways of PFAS into Agriculture

**Wastewater by-products:** Wastewater treatment plants (WWTPs) treat waste streams from both domestic and industrial settings. Because of PFAS use in various consumer and household products and industrial processes, influent to WWTPs can contain different types and concentrations of PFAS. The chemical characteristics of each compound largely influence PFAS removal in WWTPs. For instance, PFAS that are hydrophilic or water-loving will remain in the treated effluent that is re-used for irrigation or discharged to surface water sources. On the other hand, PFAS that are hydrophobic or water-hating will prefer to stick to the sludge, the solid by-product formed during treatment. Sludge is further treated via physical and chemical processes to produce the nutrient-rich byproduct called biosolids. PFAS present in sludge can, therefore, be detected in biosolids. Not all biosolids are heavily contaminated by PFAS. The concentrations of PFAS in biosolids are not only influenced by the chemical properties of PFAS, but also the concentrations of PFAS in WWTP influent, such that higher concentrations in biosolids are observed if the WWTP also treats wastewater from industrial sources (Helmer et al., 2022). Land application of biosolids is federally regulated by the EPA and state governments. However, there are currently no federal regulations in place with respect to PFAS levels in land-applied biosolids

**Proximity to PFAS sources:** PFAS can also be introduced to farms as a result of close proximity to heavy PFAS use sites like military bases, firefighting training, and manufacturing industries, among others.

### The Fate of PFAS in Agriculture

PFAS introduced to farms can be retained in the soil, washed off to surface water sources, leached to groundwater, or absorbed by planted vegetation. The fate is influenced by the physicochemical properties of PFAS, soil composition and characteristics, and distribution of precipitation events. PFAS contamination in farms

can present challenges for drinking water sources, animal feed, and plant and animal by-products.

### **Managing PFAS Issues in Farms**

**Drinking water:** Because PFAS exposure has been associated with human health effects, including links to cancer, immune system issues, and hormonal disruptions (ATSDR, 2021), regulatory agencies are taking action by reducing exposure to PFAS from drinking water. The US Environmental Protection Agency (EPA) finalized maximum contaminant levels (MCLs) for six PFAS that will be enforced in 2029 for public water supplies. State and federal agencies do not regulate private water systems (e.g., private wells, springs, and cisterns) that serve people outside public water supply service areas. Farm owners who use private water systems are responsible for testing their water supply and implementing ideal treatment to ensure safe drinking water. If you are concerned about the levels of PFAS detected in your water source, point of use (POU) or point of entry water treatment devices can be implemented to lower PFAS levels in drinking water. Common techniques include sorption using granular activated carbon (GAC) or ion exchange resins, as well as reverse osmosis systems. In order to function effectively, these water treatment devices need to be operated and maintained according to the manufacturer's guidance.

**Animal by-products:** Animals can be exposed to PFAS if they eat or drink contaminated feed or water. While some PFAS are excreted by the animals, some can accumulate in the tissues and products like milk (Death et al., 2021). PFAS are persistent, but some studies have shown that stopping the use of PFAS-contaminated feed, grazing on contaminated fields, and using drinking water with elevated PFAS can help the animals gradually purge PFAS in their bodies. Stopping PFAS exposure to the animal can be achieved by using PFAS-free water, feed, and grazing lots. The PFAS elimination rates from the animal body are slow and vary from one animal to the other, but are achievable (Van Asselt et al., 2013).

**Soil and farm produce:** Managing contaminated soil is challenging; however, there is ongoing research on how to remediate large-scale soil contamination and crops that can still be profitable to the farmer but do not result in secondary contamination issues. For example, some studies have indicated that there is a possibility of switching to growing plants that can help remove PFAS from the soil (Nason et al., 2024).

### **Assessing PFAS Risks in Farms**

To evaluate if PFAS is an issue at your farms here are some steps to follow:

- Determine the farm's history: This can entail researching through farm records to establish if there has been land application of biosolids in the farm or any land use changes in close proximity that can contribute to PFAS contamination.
- Conduct sampling: If you suspect that there is a potential for PFAS issues, you can confirm this through targeted sampling of soil, water, plant tissue, or animal products for PFAS.
- Evaluate test results: Compare test results with established maximum contaminant levels (e.g. for drinking water) or screening levels. Use these results to establish if there is a need for management options. Work with locale Extension agents and government agencies.



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## **HACKING AGRONOMY: THE SCIENCE BEHIND BIG CLAIMS FROM NOVEL INPUT PRODUCTS**

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Most of us are familiar with a “hack”, anyone active on social media has been inundated with posts or videos championing “mom hacks” or “life hacks”. The word “hack” was initially applied to computer programming, as is “hacking into a computer system” but the word hack can be defined as, “a quick job that produces what is needed, but not well; an appropriate application of ingenuity; a clever technique; a shortcut”. When we apply this term to agronomy, in recent years it tends to represent a class of “novel” products that can be generally marketed as “silver bullets” or “tested on all soils” that claim to short-circuit some process of nutrient behavior in soils or plant uptake or plant growth. As an agronomist, I am often asked “do these products work?” and my response ranges from “no” to “it depends” to “let’s try it out” depending on my level of enthusiasm for the day. But to give these products a fair shot, the question must be reworded, because, unlike nitrogen fertilizer, we all innately know these products cannot work everywhere. Let’s begin asking the question, “how does the product work?” so we can compare this mode of action to conditions on individual operations to decide if the outcome will be beneficial or not.

As a means of introduction, I must state that I am generally skeptical of the general category of “agronomy hacks”; partially because I have been professionally trained to be skeptical, but partially because I have not observed data demonstrating the general efficacy of these products – beyond marketing materials. However, there are likely existing data demonstrating the efficacy of these products, as the ones I have included in this presentation are all commercially available, indicating companies have invested money into commercializing these products and would not likely do so if data were not available to indicate efficacy. My personal frustration with these types of products is focused on the marketing gimmicks, which only compounds the confusion in the decision-making process for farmers. Despite my skepticism, in performing research on these products over the last two growing seasons, I am working to open communication between academic agronomists and industry representatives to identify where, when, and how these products may benefit farmers. While I will share my personal thoughts on these products throughout this presentation, after studying their marketing materials, executing field trials, and interpreting field data, I am in no way recommending the use or non-use of these products, but trying to identify where, when, and how these products may be useful.

The popular “agronomy hacks” that are commercially available can generally be categorized as 1) biological input products, where a living organism is added to the soil or plant system; 2) enhanced efficiency fertilizers, that are formulated to slowly release N; and 3) fertilizer additives or organic amendments that add P to the soil or plant

system. It is important to discuss products that provide nitrogen (N) and phosphorus (P) separately, as from a nutrient management perspective, N and P behave differently in the soil and we have to manage them differently. Generally, the N products discussed here and beyond either amplify an input component of the N cycle, namely mineralization or increased fixation of atmospheric N, or aim to minimize a loss pathway of the N cycle, namely decreasing volatilization or denitrification of N. The focus of N management is timing: providing N to a growing crop at the appropriate growth stage without relying on the soil to store N. Conversely, the focus of P management is placement, ensuring crop roots will grow into proximity of P adsorbed to the soil surface and can adequately remove the P from the soil. Phosphorus products either prevent or reverse the adsorption of plant-available P to soil minerals or amplify the natural processes that plant roots employ to access soil P. The next sections will discuss individual, commercially available biological input products and descriptions of the products or the reported “mode of action” have been gleaned from their marketing materials on their websites.

### **Nitrogen Biological Input Products – Source**

The Source product is produced by Sound Ag and claims to provide up to 25 lb N in the soil. It is marketed as “caffeine for soil microbes, which wakes up soil microbes that are snoozed by high nutrient concentration in soil”. There are multiple pools of N present in the soil; ammonium or nitrate, which are immediately available for plant uptake, and organic forms of N, which are not immediately plant available. Organic N can be mineralized, or transformed into plant available forms, however this transformation is mediated by microorganisms present in the soils. When high concentrations of plant-available N are present in the soil, the activity of these microorganisms is low, mineralization does not take place, and organic N is conserved. The application of Source, therefore, reverses the signal to slow mineralization and signals the microorganisms to mineralize organic N even when plant available N is present in the soil, thereby adding N to soil and theoretically increasing crop yield. The product is applied in corn at V4-V6 or VT-R1 and can be tank mixed with herbicides and fungicides.

The proposed mode of action theoretically could be beneficial, especially in high organic matter soils or soils where organic N is present. The success of the product depends on ideal soil and weather conditions to ensure microbial activity to mineralize organic N. Moreover, it is unclear how to ensure that organic N is mineralized at a rate that aligns with the crop growth stage and demand for N. Furthermore, if the product must be applied in-season, to ensure timing of N application with plant demand, it may be more beneficial to apply inorganic N than a biological input product. However, this product may be beneficial in a situation where a farmer anticipates equipment or labor logistics that may prevent timely in-season N application or where major price difference between inorganic N and biological input products exists.

### **Nitrogen Biological Input Products – Proven 40**

The Proven 40 product, available from Pivot Bio, claims to provide up to 40 lb N and is a N-fixing bacteria applied at planting that forms a symbiotic relationship with corn roots and will continuously fix N throughout the growing season. This product, which transforms a cereal crop, like corn, into a legume crop, utilizes microorganisms to fix atmospheric N. Pivot Bio has genetically modified a wild-type *Klebsiella* bacteria, which

is a biological N fixing microorganism, to continue to fix atmospheric N despite receiving signals to decrease fixation activity.

As with Source, the proposed mode of action of Proven 40 could have huge impacts on N management in agronomic crops, but these microorganisms must be evaluated for their efficacy or ability to survive in all soil conditions and across various microbial communities as well as their potential pathogenic impacts on humans or animals. Finally, further guidance is necessary to understand how N management should be modified with the use of Proven 40, that is, should N application rate decrease with the addition of Proven 40. For both N input products, the decision to use may be an economic decision, with the decision changing annually as the price of fertilizer and biological input products shifts.

### **Phosphorus Biological Input Products – Utrisha P**

The Utrisha products (N and P available) are sold by Corteva and feature a *Bacillus* bacteria applied in-furrow at planting which colonizes corn roots to increase production of enzymes used by corn roots to solubilize P adsorbed to soil surfaces. Additionally, the product claims to increase root growth, pushing corn roots into soil where additional P is adsorbed. Unlike N, P tends to exist in the soil primarily in recalcitrant forms that are not available to plants. There are varying degrees with which the soil complexes with P: from the most recalcitrant form where oxygen atoms that form phosphate ( $\text{PO}_4^-$ ) molecules form inner sphere complexes with iron ions at the soil surface (i.e. the oxygen atoms become part of the soil surface) to less recalcitrant forms of phosphate that form outer sphere complexes, where oxygen atoms are shared between two phosphate molecules, one that has formed an inner sphere complex and one that has formed an outer sphere complex. Plant roots deploy multiple pathways to make soil P more plant available, including pH change in proximity to plant roots, exuding organic acids, phosphatases, and other enzymes, or enlisting the assistance of nearby microorganisms to release P bound to soil surfaces.

Great potential for this product exists, likely in the majority of US soils with relatively low soil P concentrations. However, in Maryland where we have some areas with high soil P concentrations due to a history of animal manure applications at high rates, further research must be performed to evaluate the ability of Utrisha bacteria to survive in our high P soils, as it is possible the high P concentrations could decrease bacterial activity. There are environmental concerns in the Mid-Atlantic about solubilizing soil P, as increasing plant availability also increases the potential for environmental loss. This product has potential though to be an available tool for Maryland farmers who may be restricted from P application due to state regulations.

### **To Hack or Not to Hack**

As farmers consider using commercially available biological input products, they should understand that there are likely limited conditions in which these products will be beneficial, with the understanding that most commercially available products are primarily tested in and marketed to the Midwest states as opposed to the Mid-Atlantic region. Therefore, these products may be promising in regions with greater soil organic matter or less soil variability, but there is the potential for these products to aid farmers in specific scenarios where logistics or regulations prevent or restrict timely nutrient applications.

It is crucial that local evaluations of these products are conducted to determine specific areas of a state or region where they can be beneficial; and this local guidance must be provided to farmers as they are deciding when or how to use the products, by either the companies or crop consultants. Overall, farmers in Maryland, and the broader Mid-Atlantic region, are generally efficient with their N management and have soil P concentrations in areas that are orders of magnitude greater than other regions of the country, which potentially limit the utility of the biological input products presented here. However, it is possible that there are regions of a state or zones of individual fields where these products are likely to provide benefits, and on-farm testing and evaluation, in partnership with Extension personnel or crop consultants, is crucial to identify these areas.

# CLIMATE TRENDS, FUTURE OUTLOOK, AND WEATHER DATA YOU CAN USE FOR CROP MANAGEMENT DECISIONS

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New Jersey's middle-latitude position leaves the state exposed to most every weather and climate variable imaginable. While the state's coastal location often shields it from some of the most extreme conditions, on occasion, NJ bears the brunt of major storms, this being abundantly evident with post-tropical cyclones Sandy (2012) and Ida (2021). As witnessed in fall 2024, NJ can be vulnerable to periods of exceedingly dry weather too. Meanwhile, underlying the daily, seasonal, and annual variability in temperature and precipitation are the impacts humans are having on the state's climate system, with temperatures warming and increasing evidence that a new precipitation regime and changes in the strength and frequency of severe events is underway.

The increasing New Jersey warmth is evident in figure 1. It is generally recognized that an anthropogenic global warming signal emerged from a naturally "noisy" climate system around 1980. Examining a linear regression of NJ annual temperatures since 1980 shows a warming trend of 7.3°F per century, making NJ one of the nation's fastest warming states.

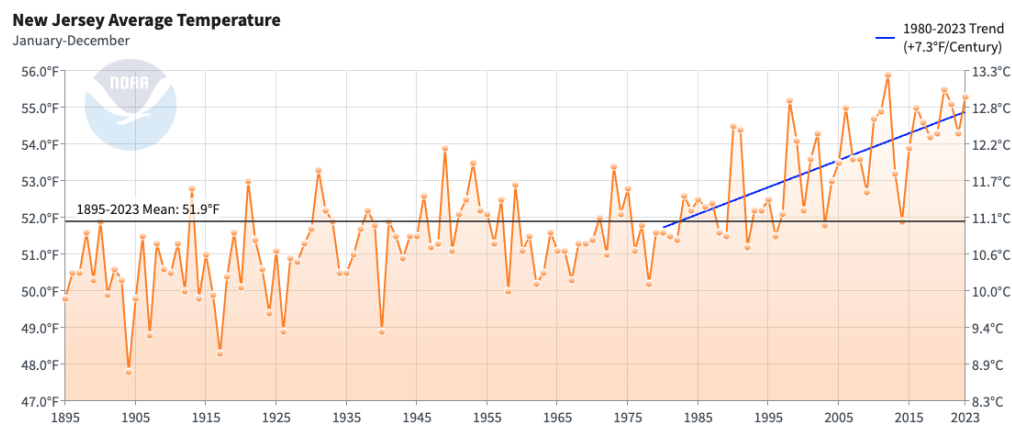


Figure 1. NJ annual temperatures from 1895-2023. Values are based on an average of several dozen stations located throughout the state. Linear regression (blue line) is shown for the 1980-2023 period (NCEI Climate at a Glance).

Considerable inter-annual variability in precipitation is common throughout the past 130 years. Consecutive years with precipitation 5" or more below the long-term mean are uncommon, with the mid 1960s having three such years (1963-1966). Only twice (1902-1903 and 2018-2019) have two consecutive years been 5" above average. In recent decades NJ has become wetter compared to previous periods, including the two wettest years on record in 2011 and 2018 (figure 2). The 1980-2023 interval has seen an upward annual precipitation trend of 14.16" per century. This has been accompanied by increasing interannual variability. Also, more of NJ's precipitation is

falling in larger events, contributing to increased flash flood and river flooding events in recent decades.

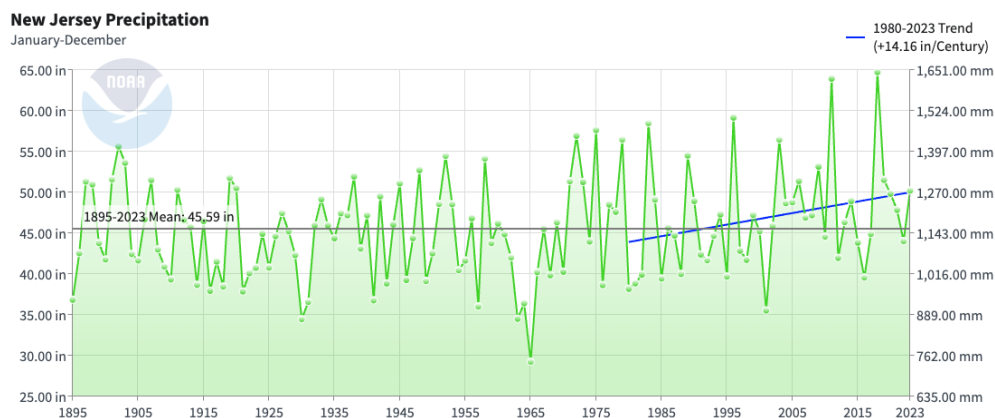


Figure 2. Same as figure 1, except for annual precipitation.

What does the future hold for NJ weather and climate? Climate models suggest a continuation and likely acceleration of the current warming. Models also suggest that this region will become wetter with a continued increase in stormy events. Exactly how much change is in store for NJ and surroundings is not possible to know, in large part due to uncertainties in just whether or how quickly or how much humankind will do something to minimize future changes. This will dictate future levels of greenhouse gases generated by the burning of fossil fuels, along with other human activities that impact the climate system. At least several additional degrees of warming are likely by midcentury with more to follow. Increasing atmosphere and ocean temperatures are likely to generate more precipitation, yet when triggers are not available to generate precipitation the increasing warmth results in enhanced evaporation and short term “flash” droughts. Also, sea level is expected to rise several feet by the end of the century as ice sheets melt and warming oceans thermally expand.

Certainly, changes in temperature and precipitation, along with enhanced variability of conditions will exacerbate challenges to those managing Garden State crops. The Office of the NJ State Climatologist (ONJSC: [njclimate.org](http://njclimate.org)) is available to assist the agricultural community in meeting such efforts. The ONJSC mission is threefold: 1) gather and archive data on NJ weather and climate conditions, 2) conduct and foster research concerning the climate of New Jersey, and 3) educate and inform the citizens of New Jersey on matters related to climate. By providing experienced consultation and operating the Rutgers NJ Weather Network (NJWxNet), the ONJSC helps keep agricultural decision makers informed and ahead of NJ’s dynamic environment.

The 69-station NJWxNet serves as a comprehensive information resource for NJ weather and climate monitoring, weather forecasting, and agricultural decision making. Real time data and derived products are available via the NJWxNet website ([njweather.org](http://njweather.org)) within minutes of being observed. NJWxNet data are transmitted daily to Cornell where crop production tools and IPM forecasts are made available through the Network for Environmental and Weather Applications (NEWA). The ONJSC is always interested in partnering with sectors of the agricultural community to generate additional products associated with irrigation needs, temperature extremes, degree-day assessments, and other tools to assist with crop management.

## Carbon Sequestration and What Farmers Need to Know

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Agricultural practices have long been recognized as a critical component of environmental sustainability. The role of farming in carbon sequestration - a natural process by which atmospheric carbon dioxide (CO<sub>2</sub>) is captured and stored in soil, plants, and biomass - is one of the most critical concerns facing growers today (Paul et al., 2023). Sequestering carbon not only has the potential to mitigate climate change but also offers economic and agronomic benefits to farmers. Thus, producers need actionable knowledge to harness the opportunities presented by carbon sequestration while navigating its challenges.

Carbon sequestration in agriculture primarily occurs through soil organic carbon (SOC) storage and biomass accumulation. Healthy soils act as carbon sinks, capturing CO<sub>2</sub> from the atmosphere - process primarily mediated by plants through photosynthesis - and store it in the soil in the form of SOC (Crookston et al., 2021). Practices such as reduced tillage, cover cropping, crop rotation, and agroforestry enhance SOC levels by promoting root growth, organic residue deposition, and microbial activity (Lal, 2018). Simultaneously, perennial crops and afforestation initiatives enable long-term biomass accumulation, further sequestering carbon (Lorenz and Lal, 2014).

Understanding the complexities of carbon sequestration is crucial for New Jersey growers, given the unique climatic conditions, soil types, and crop diversity in the state. Marked differences in temperature and a wide variability of soils translate into a diverse agricultural landscape, offering challenges and opportunities for implementing carbon sequestration practices. For example, sandy soils, common in some regions, have lower organic matter content and require tailored management to optimize carbon storage. Conversely, clay-rich soils in other areas exhibit a higher capacity for carbon retention. Farmers must consider these factors to maximize sequestration potential while maintaining productivity.

Adopting carbon sequestration practices also aligns with broader goals of enhancing soil health, water retention, and biodiversity. For example, reduced tillage and cover cropping improve soil structure and water infiltration while reducing erosion (Singh et al., 2022). Similarly, agroforestry systems diversify farm income streams by integrating tree crops or timber with conventional agriculture (Chabbi et al., 2022). These co-benefits make carbon sequestration an attractive strategy for sustainable farming.

Economic incentives related to carbon sequestration are growing. Programs such as carbon credits and voluntary carbon markets enable farmers to monetize sequestration efforts by selling verified carbon offsets to industries aiming to reduce their carbon footprints. However, these strategies demand rigorous verification protocols, which can be challenging to navigate. Farmers need access to reliable tools and support systems for measuring, reporting, and verifying (MRV) carbon sequestration outcomes. Federal and state efforts include funding programs like the USDA's Conservation Stewardship Program (CSP) and Environmental Quality Incentives Program (EQIP), which provide financial assistance for adopting sustainable practices.



Research and innovation play a pivotal role in advancing carbon sequestration in agriculture. Emerging technologies, such as remote sensing, precision agriculture, and soil carbon monitoring tools, are transforming how farmers manage and measure carbon (Keenor et al., 2021). Agricultural extension services and research institutions in New Jersey are well-positioned to provide farmers with information and practical guidance. Collaborative efforts between researchers, policymakers, and the farming community can accelerate the adoption of best practices and ensure that carbon sequestration initiatives are scientifically robust and economically viable.

In conclusion, carbon sequestration represents an opportunity for New Jersey growers to contribute to climate change mitigation while enhancing farm resilience and profitability. By adopting sustainable practices, leveraging emerging technologies, and participating in carbon markets, farmers can play a pivotal role in shaping NJ agriculture and contribute to global climate solutions.

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# **Nursery and Ornamentals II**

## Rapidly Spreading Box Tree Moth – Updates

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Box tree moth (*Cydalima perspectalis*) (BTM) is rapidly spreading throughout the northeastern and north central regions of the United States. This Lepidoptera (caterpillar) species primarily infests and completes its lifecycle on Boxwood (*Buxus spp.*). BTM is native to regions of Asia, has rapidly spread across Europe since its introduction in 2007, and has been reported in North America since 2018 (Ontario, Canada). Currently, most active populations are centered around the Great Lakes region, however the pest has been reported closer to the Atlantic coast in landscape

plantings and nursery stock. The adult moths are capable of flying 2+ miles depending on prevailing winds. However, due to the cryptic nature of early instar caterpillars, the pest can be missed and shipped with nursery stock across much greater distances. To slow the spread of this destructive, yet manageable caterpillar all green industries (and the civilians they support) need to be able to (1) identify the pest and its damages at varying timepoints,

(2) know where to report these observations, (3) effective management and avoidance practices, and (4) basic understanding of the other key pests and diseases of boxwoods.

**Fig. 1 Box Tree Moth (*Cydalima perspectalis*)**



Photo credits (A,B,C) : Joe Boggs OSU Extension

Photo credit (D): Safian, UWH, Bugwood

Research is being conducted throughout the region to further describe BTM biology in the North American landscape where it has few natural enemies and varied climatic effects on life stage progression. BTM is known to complete multiple generations per year, and overwinter in hibernaculum (protective webbing structure, to secure leaves closely around the juvenile) (Fig. 1 A, B), thus populations can be explosive once established in a boxwood planting. Note there are NO native caterpillars that defoliate

boxwoods in North America; BTM are conspicuous striped, green to yellow, with black dots which remain throughout their caterpillar phase (**Fig. 1 C**). Although growing degree-day models in North America are still being validated, adult (**Fig. 1 D**) populations have been shown to peak around 2052-2876 GDD50, yet overlapping generations have been observed, further obscuring this monitoring method.

## Fig 2. Box Tree Moth Damage and Diagnostic Features

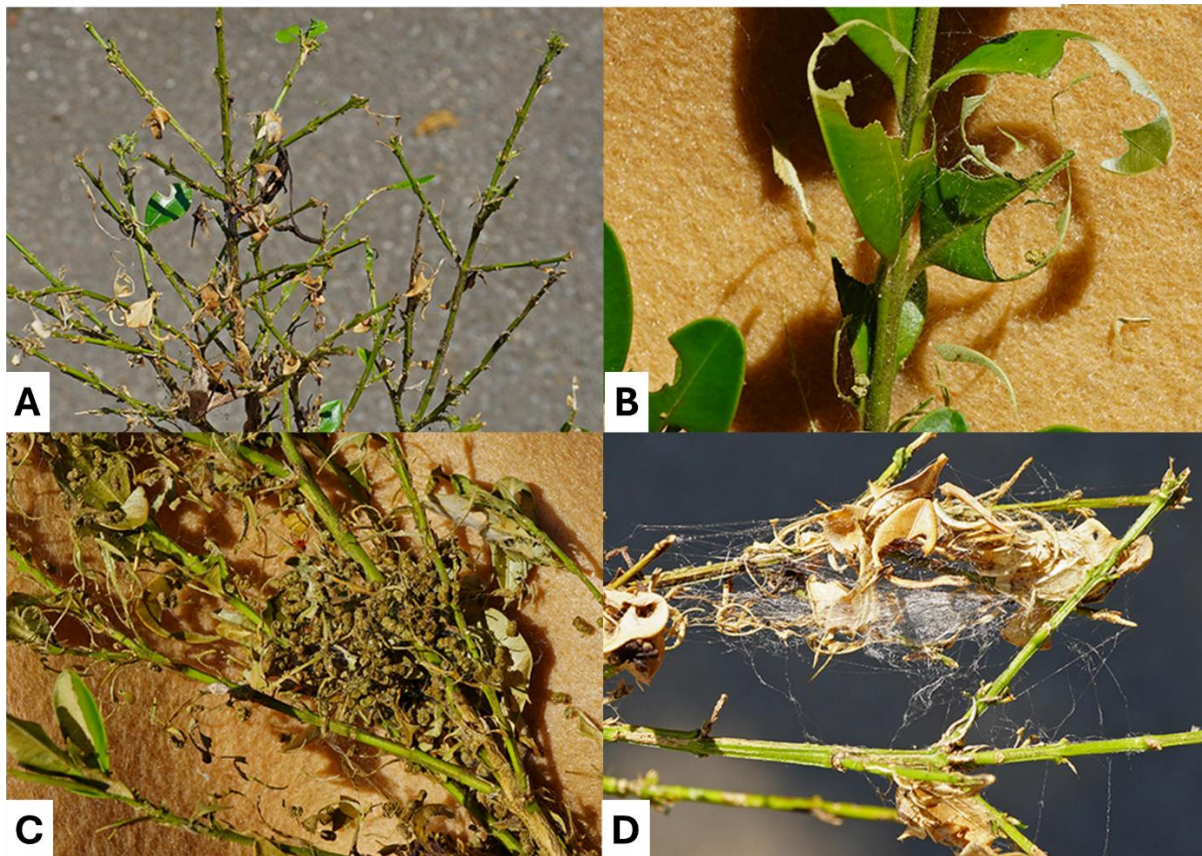


Photo credit: Joe Boggs OSU Extension (Adapted from: Box Tree (Boxwood) Moth: New Detection, What to Look For, and Management)

As noted, there are no native North American caterpillars that defoliate boxwoods, meaning if caterpillars are observed on a defoliated boxwood there is an extremely high likelihood of BTM infestation (**Fig. 2 A**). BTM caterpillars defoliate through chewing / feeding damage (**Fig. 2 B**). Often as population size increase and the caterpillars approach pupation, frass (insect defecation) will be noticed at the interior of defoliated branches, trapped by leaf debris and webbing (**Fig. 2 C**). Webbing is another key diagnostic observation for BTM (**Fig. 2 D**). Evolutionarily, this webbing promotes reduced predation and parasitism, however in the context of chemical management, this webbing can slow penetration and absorption of pesticides. Management differs depending on where these insects are located. In the landscape, BTM must be positively identified, then treated, as compared to erroneous protective insecticide applications for lepidoptera that will only cause more pest issues and disrupt local beneficial insect populations. However, in commercial nursery settings, preventative applications can be incorporated into an IPM-centered, pesticide regime that encompasses regular scouting and eradication efforts. For more information on BTM chemical management please see (Box Tree Moth: Fact Sheet, Management & Visual Guide, referenced below).

## Fig. 3 Easily Confused, Common, Boxwood Diseases

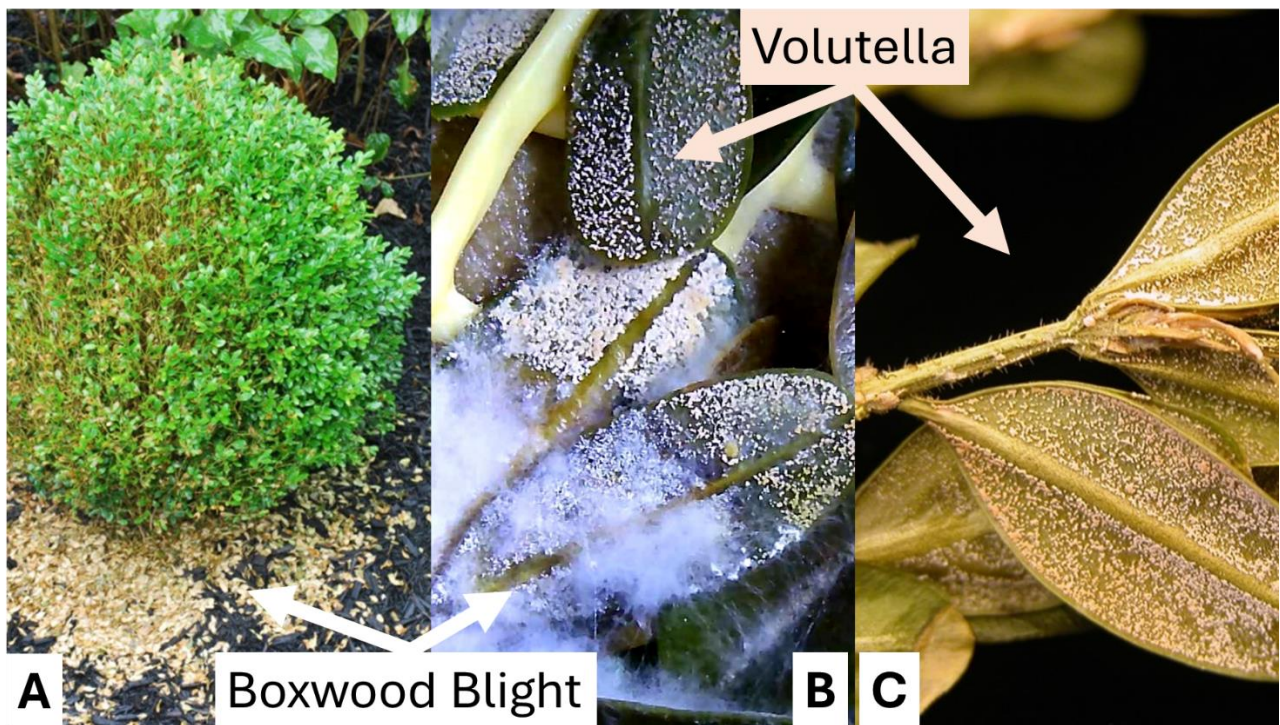


Photo credits: (A, C) Rutgers Plant Diagnostic Laboratory, (B) Timothy Waller – Rutgers Cooperative Extension.

**Common Boxwood Diseases:** In the production and maintenance of *Buxus spp.* two fungal diseases are prevalent, Boxwood Blight (BWB) (*Calonectria pseudonaviculata* and *C. henricotia*) and Volutella [Canker] Blight (*Pseudonectria buxi* and *P. foliicola*). Upon closer inspection of these diseases, they differ greatly from symptoms of BTM caterpillar infestation, however the key differentiators must be noted. BTM caterpillar's defoliate boxwoods by consuming leaves, Boxwood blight triggers leaf abscission (falling from plant) leaving the classic leaf litter symptom (**Fig 3 A**). In the case of Boxwood Blight, once leaves appear necrotic, they quickly *drop from the plant*, compared to Volutella Blight where infected leaves stay firmly attached to the boxwood plant, and often begin sporulating. The mycelium and fruiting body (signs) of each disease also aids in diagnostics as Boxwood Blight produces a white fluffy mycelium containing the sticky spores (**Fig.3 B**) and Volutella Blight produce salmon-pink color sporodochia (appear at salmon-pink to orange droplets) on the underside of leaf tissues (**Fig. 3 B,C**). Knowing the differences between Boxtree Moth and these fungal diseases will aid in monitoring, reporting, and management of all three issues.

### Quarantine as of December 2024 & IF YOU SEE SOMETHING REPORT IT!

Excerpt from USDA-APHIS Federal Order: DA-2024-47. "To prevent the spread of BTM, APHIS considers it necessary to regulate the interstate movement of regulated articles of boxwood from quarantined areas. Boxwood plants may only be moved interstate from a quarantined area from an establishment operating under a compliance agreement, and only if accompanied by a certificate issued by a state agricultural authority certifying that the requirements of this Federal Order and the compliance agreement have been met. These requirements will prevent producers and distributors of boxwood from

moving infested plants interstate. State agricultural authorities may prescribe additional safeguards and protocols. APHIS prohibits movement of all other regulated articles of boxwood, including plant parts, pieces, cuttings, clippings, debris, and any portion of the plant, alive or dead, except for decorative purposes.”

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#### **References:**

APHIS BTM Quarantine Map: <https://www.aphis.usda.gov/plant-pests-diseases/box-tree-moth/box-tree-moth-federal-quarantine-boundary-viewer>

Ohio State - **Box Tree (Boxwood) Moth: New Detection, What to Look For, and Management:** <https://bygl.osu.edu/node/2262>

Collaborating Universities Factsheet - **Box Tree Moth: Fact Sheet, Management & Visual Guide:**

[https://ir4.cals.ncsu.edu/EHC/InvasiveSpecies/BTM\\_FactSheet\\_VisualGuide.pdf](https://ir4.cals.ncsu.edu/EHC/InvasiveSpecies/BTM_FactSheet_VisualGuide.pdf)

**Boxwood Blight Insight Group** (Multistate Horticultural Research Institute (HRI) Initiative): <https://www.boxwoodhealth.org/> (*all things boxwood health*)

## **NURSERY IRRIGATION MANAGEMENT: ASSESSING REQUIREMENTS, DURATION AND FREQUENCY OF APPLICATIONS**

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Water is the main driver of plant growth through cell expansion, and thus any reductions in its supply or availability leads to loss of turgor (wilting) and plant growth (Hsiao, 1973). Water stress, even if mild, can be a common issue in container grown crops, as the reduced volumes of substrate represent a reduced water holding capacity that, if not replenished frequently through irrigation can significantly reduce the growth and quality of these crops compared to those growing in a loamy soil.

Maximum growth, and the most efficient use of water by crops, can actually happen when water is freely available or provided, without physical or chemical restrictions to container crops through the growing season (Cabrera, 2021), allowing transpiration to proceed or continue at its maximum potential rate (Hanan, 1998).

Regardless of the irrigation systems used or available to a containerized crop, continuous decisions need to be made concerning the volume and frequency of water application (Bilderback et al., 2013; Fulcher and Fernandez, 2014a). Growers have traditionally used clocks or timers to run irrigation on fixed time intervals (Fulcher and Fernandez, 2014b), or employ qualitative or subjective criteria, like 'look and feel' of a plant and soil/substrate water status, to determine when and how much to irrigate. However, quantitative approaches are needed to exercise an efficient use of water, particularly under scarcity (due to drought and/or competition with other uses). Also, an efficient use of water will also reduce drainage effluents and agrichemical loads, thus reducing the potential of polluting nearby bodies of surface and ground water (Bilderback et al., 2013; Cabrera, 2021; Fulcher and Fernandez, 2014b).

A container nursery with 70% of its area under effective production could use up to 20,000 gallons of water per acre per day during the summers when irrigated with overhead sprinklers (Fulcher and Fernandez, 2014a). Unfortunately, as much as 80% of this overhead irrigation will miss the intended container surface depending on the container spacing (Bilderback et al., 2013). Increases in overall water use efficiency require attention to the type, design and uniformity of the irrigation system and the application of water volumes that closely match the actual or potential crop water use and the water holding capacity of the substrate in the containers (and their size).

Actual water use by a containerized crop can be measured gravimetrically (weighing the potted crop plants after and before irrigation events) with a weighing lysimeter or a leaching lysimeter (Fig 1.), where the water used by one or a few plants located within a crop is measured daily. Alternatively, the potential water use of a crop can be estimated using reference or potential daily evapotranspiration (ET) (Fereres et al., 2003) estimated from climatic models and available from a local weather station (Steduto et al., 2012). This daily ET information from the weather station closer to you can be accessed by consulting the Rutgers NJ Weather Network (<https://www.njweather.org/data/daily>). The estimated crop ET is calculated from this

reference value multiplied by empirical coefficients available for crop types at different stages of development (Fereres et al., 2003).



**Figure 1.** Instrumentation and techniques to estimate potential or actual crop water use: weather station with companion weighing lysimeter (upper left), Class A evaporation pan (upper right), atmometer (lower left) and measuring leaching fraction (lower right).

If climate data are not available, ET can be estimated from formal pan evaporation devices, or even from pans filled with water (Fig. 1). Alternatively, ET can be estimated with the use of atmometers (Fig. 1), which measure the amount of water evaporated from a wet porous ceramic surface covered with a fabric and mounted on top of a cylindrical water reservoir (Hanan, 1998). The operation of an atmometer is simple,



reading the depletion of the distilled water in the reservoir from the sight tube mounted on its sidewall. By covering the ceramic surface with a neoprene fabric, the atmometer can simulate water loss from a reference crop at full canopy cover. Compared to static (manual or timers) irrigation practices, water savings of 50 - 75% can be achieved when referencing water applications to measured or reference ET methods (ET values from weather station, pan evaporation, atmometer).

Irrigation scheduling also requires knowledge on the maximum water holding capacity of the substrate or field capacity of the soil (in the case of field nurseries). Monitoring of substrate or soil moisture is the most popular quantitative irrigation scheduling technique used in ornamental crops (Incrocci et al., 2014). Tensiometers provide a relatively simple mechanical means of monitoring plant available moisture content in the rootzone (Fig. 1). There are also electronic soil moisture sensors that provide a volumetric measure of soil/substrate moisture content based on various electrical properties, e.g. resistance, capacitance and time-domain reflectometry. These sensors are gaining acceptance and use in large commercial container-grown crops (Lieth and Oki, 2019). It should be noted that when these volumetric water content sensors are used, they must be first calibrated to the specific substrate and container volume and dimensions, and where the sensors need to be positioned within the pots.

There are some additional or alternative plant-based irrigation systems, such as those based on leaf temperature measurements, plant water potential (whose readings require destructive leaf or stem sampling) and stem diameter fluctuations. However, these methods and systems do not account for root-to-shoot signaling and are very challenging to automate (Fulcher and Fernandez, 2014b).

Once you have determined when and how much water you need to irrigate employing the methods or approaches mentioned above, you need to verify whether your irrigation application rate/volume is adequate. One of the methods used to determine whether the applied volumes were excessive or deficient is based on the container leachate fraction, that is, the percentage of water applied that drains (leaches) out of the container (Fulcher and Fernandez, 2014b). While a leaching fraction of 10% percent or less allows for water and nutrient conservation, a leaching fraction of 20 to 30% ensures that soluble salts (from water chemistry and those added by fertilizers) do not accumulate in the substrate and cause an osmotic (salinity) stress to the crop (Cabrera and Johnson, 2014). The difference between the applied and drained (leached) volumes measurements (having reached water holding capacity, also known as container capacity) also allow for an indirect estimation of actual crop ET, which can then be compared to the reference or potential ET values obtained from the closest weather station.

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# **Beyond Grapes - Farm Based Alcoholic Beverages**

## **Growing High Quality Grain and Hops for the Beverage Industry**

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Craft beer and other farm-based beverages are in many ways a reflection and driver of the local food movement. In an age of massive corporate brands, people are thirsty for experiences like riding a bike or hiking to the local brewpub and having a beer produced with local ingredients. Very similar to the consumer's desire to source and purchase locally produced fruits and vegetables. Unlike a chef in a restaurant, craft brewers can find it difficult to source locally grown hops, barley and other ingredients. That's changing as brewers seek out local ingredients. The rise of the local drink movement has led to a surge in beer made with local "wet" (green) hops and grains. As brewers attempt to source local ingredients, NJ farmers are gaining interest in producing these ingredients. The most readily apparent market for grain farmers is the craft brewing and distillery markets. Fueled by previous hop shortages, the support for local food systems, and the developing success of the NJ Wine industry numerous NJ farmers have attempted to establish a hops industry in New Jersey.

The establishment of a hops industry is not a simple task due to economic, production and marketing challenges. Planning a hopyard is much like planning an orchard, requiring thinking 15-25 years ahead. While there is always space for experimentation, designs and implementation must take permanence into consideration. Materials must walk the fine line between short-term economy and long-term durability. Any grower of hops must be very familiar with the uses of hops and the desired acid and oil profiles for any given variety. Producers must also source information on trending varieties, harvest quality considerations, market locations, and packaging needs.

The idea of producing specialty and niche market crops is a fairly unfamiliar concept to traditional grain farmers in the northeast region. Grain farmers are typically geared to producing for the commodities market where price is largely determined by CBOT pricing. In this model there are generally no price premiums paid for producing superior products. The typical measure of success is measured solely in terms of yield. Many opportunities for specialty or niche market crops presented to farmers at extension and industry meetings are vegetable or fruit crops. Grain producers tend to shy away from such ventures as it often would require investing in additional equipment for production, packaging etc. These opportunities often require the grain farmer to operate outside of their comfort level. However, opportunities for producing specialty and niche grains have become increasingly more available. This is particularly attractive to existing grain farmers as they have the knowledge and understanding to produce grain crops. In addition, there are generally minimal capital and infrastructure changes which must be made to produce these crops. An emphasis on higher quality products over traditional commodity grade is one of the usual defining characteristics the specialty markets are

seeking. Organically produced and GMO free may also be additional considerations. Alterations to crop production and management are generally the predominate changes that must be made.

Presented in this presentation will be quality standards and production practices required to meet the needs of the farmed based beverage industries.

## CHOOSING AND GROWING APPLES FOR CIDER PRODUCTION

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With increased land, labor and farm material costs, growers in New Jersey are seeking ways in which to diversify their farm operations. New Jersey grows 2,481 acres of apples (NASS 2022). This production acreage has consistently increased over the past 20 years and is forecasted to continue growing. Importantly, that acreage may be well suited for hard cider apple varieties and farm diversification.

Studies have shown, hard cider production is profitable, and there is potential for vertically integrated on farm cider mills to be profitable as well, with a variable payback period of 10-16 years (Miles et al. 2020). However, due to historical trends shifting away from hard cider production and focusing on dessert apple production many apple varieties best suited for cider have not been grown in New Jersey for decades. Ongoing research (including this project through NJAES) is needed to evaluate which varieties are best suited to New Jersey growing conditions.

In 2018 a plot of 60 5 year of trees (rootstock M.9T337) and interstem (Daybreak Fuji™) were grafted with 30 hard cider cultivars in duplicate. This plot is located at the Snyder Research and Extension Farm in Pittstown, NJ where the trees are growing on well drained Quakertown silt loam soil.

Over the course of this project (2021-2024) data has been collected on flowering time, juice analysis (sugars, acids, tannins), average yield per tree and percentage juice production. Yield and juice percentage are highlighted in Figures 1 and 2.

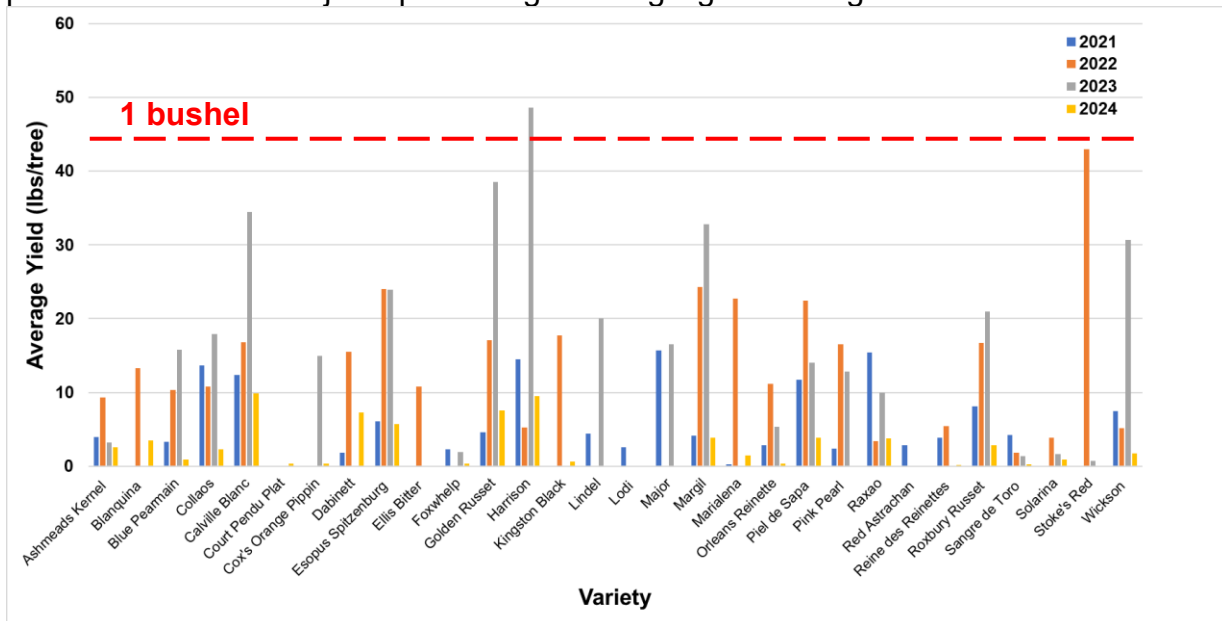


Figure 1. Average yield per tree (lbs/tree) of each of thirty apple varieties harvested in 2021-2024.

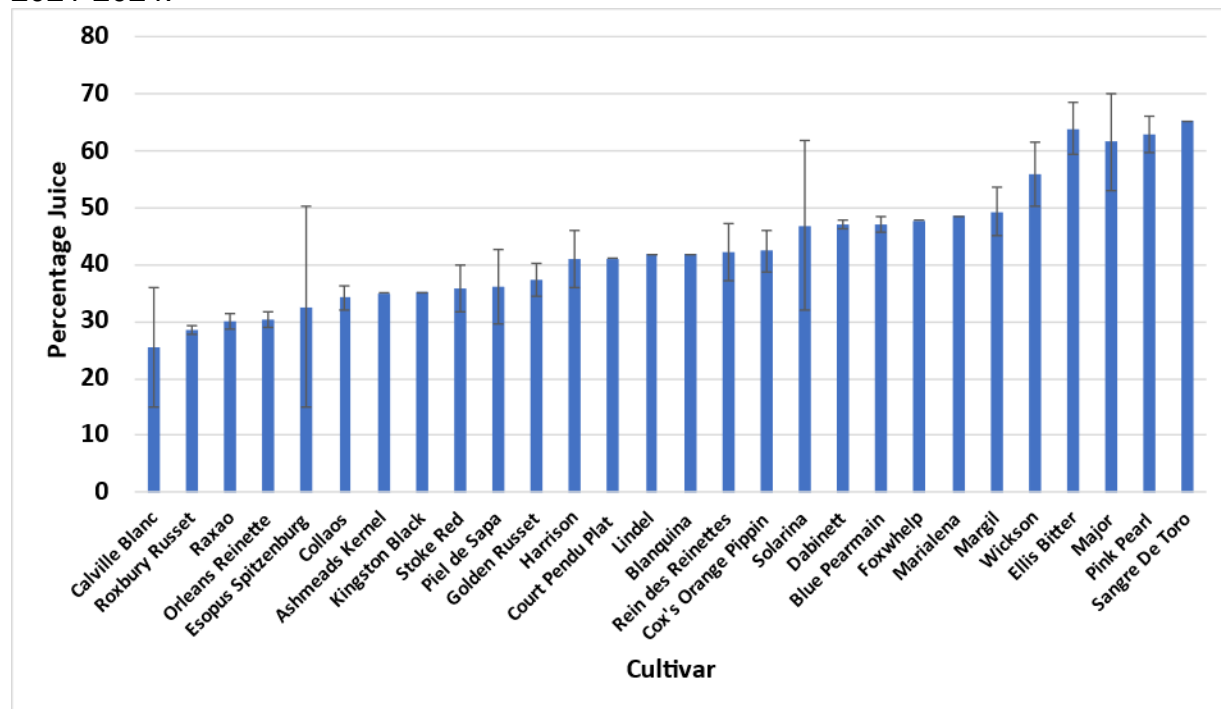


Figure 2. Average percentage of juice [volume (ml)/weight (g)]\*100 collected from each of 28 varieties harvested in 2023.

Data shows, the variety Harrison (2023) has a higher average yield than any other variety. The varieties Stoke Red (2022) and Golden Russet (2023) had the second and third highest yields respectively. Unfortunately, over the past four years many of the varieties studied have displayed significant trends towards biennial fruiting. An additional challenge seen from the data is that the varieties that yield the greatest amount of juice are some of the lowest yielding varieties: Ellis Bitter, Pink Pearl and Sangre de Toro.

Further research will be needed to mitigate biennial bearing and improve yields of the highest juice producing varieties.

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## **DEVELOPING A WINERY / CIDER MILL ON AN EXISTING ORCHARD FROM THE GROUND UP**

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Farm viability continues to be an ongoing issue for New Jersey Farmers. Our farm decided to enhance our viability by diversifying what we offer to consumers. We decided to add a winery/cider mill after our pick your own orchard had a year of high yields after it came into full production in 2021. Stony Hill farms is a 500 acre farm in Morris County. We grow a variety of fruits, vegetables, hay, and grain and direct market all our products. We also run an agritourism operation, CSA program, Greenhouse, and Florist business. Most of our product is sold at community farmers markets through NJ and NY. While these markets provide us with an outlet to sell our produce they also are very hard to predict what will sell on a daily basis. Boxes of fruit go out on the non refrigerated truck for an hour drive then get unloaded and set up on tables and then reloaded for the hour ride home then unloaded again once we return to the home farm. This causes damage to fragile fruit that makes it unsellable to our customers. In our efforts to reach zero waste and become more sustainable we decided that fermenting our excess and damaged fruit would create a new value added product we could sell to our customers.

From the first thought of opening a winery to actually opening a winery took almost 4 years. The regulatory tape, cost of equipment, educational classes, and conversion of our existing space took a lot of time, money, and persistence which slowed the process down. That being said there were a few positive things that we had going for us that some others with dreams of opening a winery do not have in their back pocket. First, we already were farmers. We already had the crops in the ground and they were at full maturity. Second, we already had a retail space that we could use for our tasting room. Third, we already had a customer base with our farmers markets and agritourism operation. Lastly, we had competent employees able to take on new roles to allow us to expand.

### **Main Reasons For Opening a Winery/Cidery**

1. Increase revenue
2. Decrease food waste
3. Expand customer base
4. Retain employees
5. Diversify our farm
6. Become more self reliant

### **Biggest Challenges**

1. NJ ABC
2. Equipment Costs



3. Learning Curve
4. Consumer Acceptance
5. Workload
6. Paperwork

“PRO” tips

1. Get a lawyer
2. Look for grants
3. Find a consultant
4. Be flexible

## **PRODUCING AND SOURCING LOCAL INGREDIENTS FOR DISTILLED BEVERAGES**

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Imagine you are in Soviet Russia and in the 1980s – the resurgence of the Cold War, stymied economic growth, increasingly prevalent corruption and a seemingly out-of-touch leadership is your reality. Crisis after crisis is the norm and tumultuous times are bearing down on the people. The masses find solace in a few things - one of which was vodka which can only be produced and distributed through the state. Yet, General Secretary Mikhail Gorbachev decides that now is the perfect time to battle alcoholism and ration vodka to two bottles per month. This led to a huge backlash from the people - riots and demands for more alcohol plagued Moscow but the government was unyielding. As we know from the prohibition here in the United States - banning alcohol didn't solve any issues and even generated more problems like a rise in organized crime. The Soviet people turned to producing their own moonshine - or Somagon (Sohma-GON) as they called it. How does all of this relate to making distilled spirits and liqueurs from local New Jersey ingredients in 2025?

3BR Distillery – short for 3 Bottles or Riot Distillery is a Soviet-Prohibition-themed distillery inspired by this period established in 2021. Our 'Grandfather' Oleg Pichenikin was a rebellious man who didn't hesitate to distill when this soft prohibition went into effect. He used a family recipe based on the one food that was always plentiful in the USSR: split peas. Most moonshines in the USSR (like the US) were not good and even in some cases dangerous but Oleg's split pea spirit was carefully crafted using hyper-local ingredients because that is all he had. Unsurprisingly, people came to prefer his moonshine to even the government-supplied stuff and he became a central figure in his neighborhood. Grandpa Oleg's desire to build community and his creativity with local ingredients is baked into our DNA at 3BR.

3BR Distillery was founded by five Rutgers alumni - Maks, Aleks, Yulia, Will and Rob (myself). Each majored in different things but our combined appreciation for Slavic culture and quality craft food, cocktails and spirits brought us together. Maks, the co-CEO of the company studied Finance while his twin brother and co-CEO Aleks took a keen interest in distilling and spirits apprenticing under multiple Master Distillers. Yulia studied Russian History and Literature at Rutgers but became a marketing expert at multiple companies before 3BR officially launched. Will studied engineering and now sits as our COO and manages all of the production logistics. Rob studied Plant Science as an undergraduate and received his Masters Degree in Plant Breeding and Genetics with Dr. Tom Molnar. He is currently finishing his Ph.D in Plant Breeding and Genomics

with Dr. Jim Simon and leads the Rutgers Basil Team as their Research Project Coordinator. At 3BR he is the Head Mixologist in charge of taking our craft spirits and developing craft cocktails in the tasting room.

All five founders of 3BR Distillery have a passion for high-quality craft ingredients. Each came to this in their separate ways - but my love of plants is at the heart of our collaborations with locally grown and sourced produce. As part of our outreach and extension work in the Plant Science program at Rutgers, I have been fortunate to have had first-hand experience with local growers and understand the high quality and incredible diversity of produce available in New Jersey. The team at 3BR understands that knowing where your produce comes from and minimizing our reliance on fruits and vegetables grown thousands of miles away will not only help bolster our local farmers and economy but also increase our sustainability and shrink our climate footprint. Sustainability is important to 3BR - Spirits like MENDEL vodka made from field peas, have a lower carbon footprint because peas fix nitrogen unlike traditional sugar sources like grain and sugar cane all of which require many inputs. Our distillation equipment was designed to recycle wastewater in the production process allowing us to save tens of thousands of gallons of water per year. Ultimately sourcing local and regional ingredients minimizes the food miles of our products.

Fostering community and networking with local artisans, growers and craft producers is key to what 3BR represents. Our mission is to create high-quality spirits & liqueurs and we believe we can only achieve this with high-quality, locally grown ingredients. Our goal is to expand palates and cultivate a community that also believes in sharing our passion for 'Made and Grown in New Jersey'. Out of the many different products we have produced many were many with locally produced ingredients. 3BR has produced three different whiskeys: VISKI, BEARBON and RYOT – all from grain grown and malted in south Jersey by Rabbit Hill Malthouse. Rabbit Hill also malts peas for our MENDEL vodka which is our flagship product and most widely sold spirit. Another flagship product of ours SOCHNY utilizes New Jersey-grown hops grown by Monmouth County-based Fir Farms. Each year during the hop harvest we make a fresh hopped version of SOCHNY which is widely considered by our guests and staff to be the favorite version of this spirit. Our 'elevator series' which is our limited batch products all focus on unusual ingredients - especially locally produced. Our first example was our 03 GINGER liqueur which used Monmouth County grown (by Bill Erickson the Monmouth County Agent) baby ginger and cranberry blossom honey from Neshanic Valley Beekeepers. We also collaborated with Bill the following year when he grew turmeric - turning the fresh turmeric into a liqueur as well. We've collaborated with NJ-NOFA and Fir Farms to make 04 DANDELION which was a dandelion amaro and used dandelion in every stage of the process. Fresh organic dandelion flowers were the base of the wine and it was distilled, sweetened with dandelion honey and bittered with roasted dandelion root. One of our most popular products 08 PEACH+BASIL was a peach brandy made in collaboration with Melick's Town Farm out of Hunterdon County whom grew the peaches and the RutgersDevotion DMR basil was grown as part of Rob's Ph.D dissertation project. Our most recent release 012 GRAPPA was a collaboration between Cedar Rose Vineyards in Cumberland County - also founded by a Rutgers alum. It features New Jersey-grown Norton grapes. Lastly, we have several products yet to be released born from more of these NJ collaborations. One courtesy of Megan Muehlbauer, the Hunterdon County Extension Agent, in which we were donated New

Jersey-grown apples that will become apple-jack and another with Beneduce Vineyards also in Hunterdon County in which we received the pumice from their production which is being turned in absinthe.

From the perspective of the distillery, the past four years have taught us that the key to producing local ingredients for a distilled product is to ensure you're growing a high-quality product. The innate process of fermentation and distillation is about concentrating the innate flavor and terroir from the raw ingredients which means they must be flavorful for a high-quality spirit. Unusual or unique ingredients can be attractive to craft alcohol producers to experiment with new flavors and provide something novel for their customers. The biggest key is to create an open dialogue with those craft spaces and find out what they need or want. With this open dialogue approach, you can find a home for a product you are struggling to sell or even have a buyer for a product before you have plants in the ground. Small craft producers will not need large amount of product but multiple craft businesses can pool together resources to purchase larger quantities which is exactly what we've done in collaboration with Alternate Ending Brewery in Matawan on all NJ grain whiskey and also with Beach Bee Meadery where we split the cost of a 55 gallon drum of specialty honey.

There are a few key approaches to sourcing high-quality local produce to make spirits. One of the biggest takeaways the 3BR team has learned is to meet growers and producers of craft ingredients where they already are - like farmer's markets, pick-your-own farms and extension meetings. Open dialogue, creativity and willingness to collaborate are essential to establishing these relationships. There is already a plethora of growers in New Jersey choosing to grow fun and unusual produce which in turn has fueled even more consumer interest in unique offerings. Reaching out to your county's agricultural extension agent and establishing a friendly relationship there can also help you find and source quality ingredients right in your own county.

Craft beer, wine and spirits are a burgeoning industry in New Jersey but frequently craft alcohol does not mean using craft ingredients. In New Jersey, craft distilleries can source mass-produced alcohol and slap their own label on it. At 3BR, we believe that building a community of craft ingredient growers and producers while directly interfacing with the people who grow your raw ingredients is absolutely essential to growing our business and the NJ/NY craft spirits market in general.

So come join us in Keyport!  
3BR

# **Sweet Corn and Pumpkin**

## SWEET CORN PEST IDENTIFICATION AND CONTROL

David Owens

Extension Specialist, Entomology

University of Delaware Carvel Research and Education Center

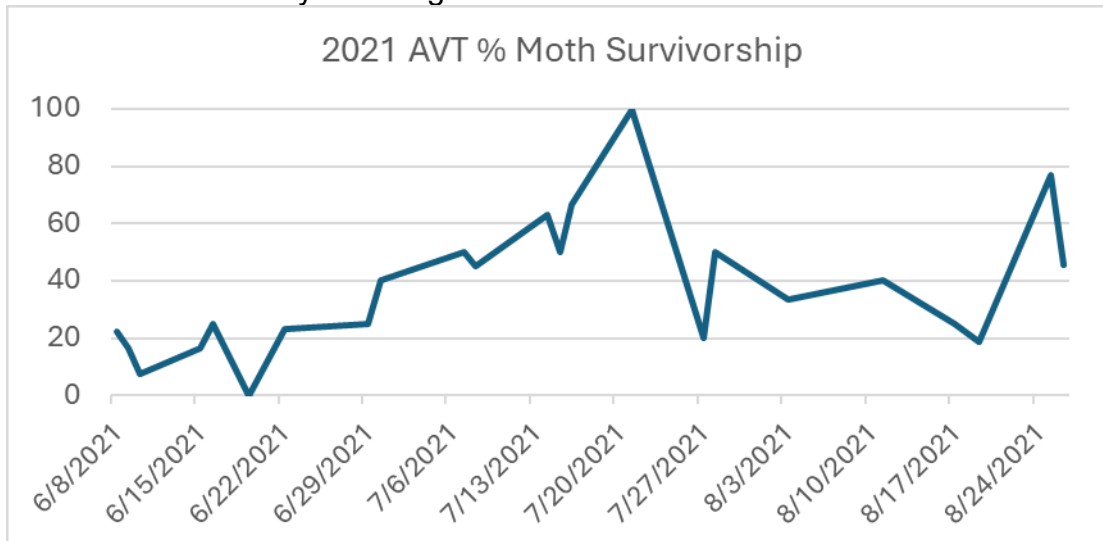
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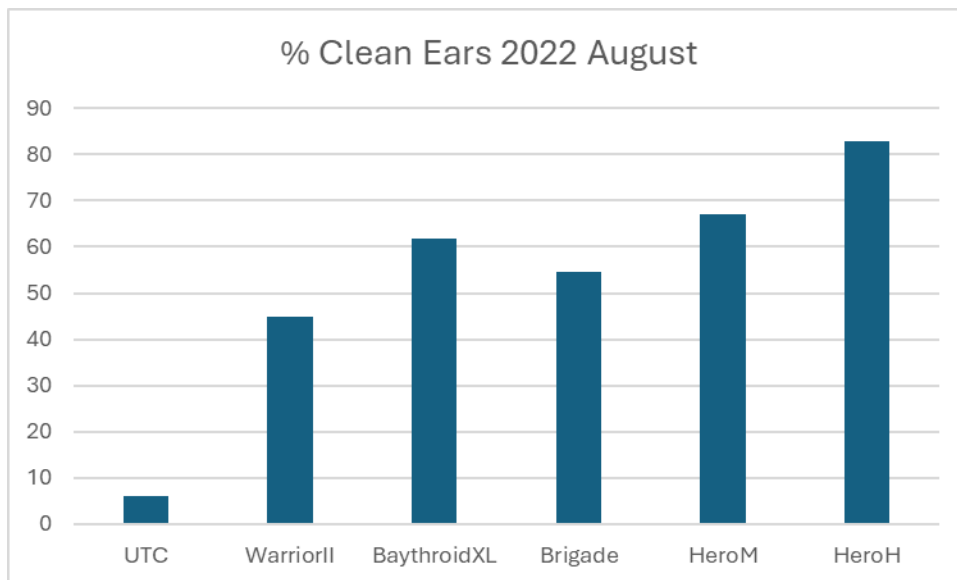
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There are multiple insect pests that may affect a sweet corn crop from seeding to harvest. A few brief moments will be spent identifying cutworm, wireworm, stink bug and slug injury to seedlings. The primary whorl pests are fall armyworm, European corn borer, and corn earworm, and whorl insect pest management will be discussed. Non-replicated UD fall armyworm sweet corn spray trials from 2024 will be discussed. The trial reenforced recommendations to save chlorantraniliprole applications until silking. Reproductive stage pests include fall armyworm, stink bug, sap beetle, aphids, mites, and last but not least, corn earworm. This presentation will focus on corn earworm. Using pheromone or blacklight traps can help time insecticide application for earworm. High temperatures may require a tightening of spray intervals depending on product use, and rainfall may require sooner reapplication. The backbone of spray programs is the pyrethroid insecticide class. Earworm resistance to pyrethroids is well documented and monitored each year using adult vial tests.



Resistance monitoring suggests that early season June moths are more susceptible to pyrethroids, but after mid-July, resistance levels increase. UD spray trials from 2019-present focusing on individual pyrethroid active ingredient suggests that bifenthrin and beta cyfluthrin are more effective pyrethroids than lambda cyhalothrin, at least in Delaware. Hero, a premix of bifenthrin and zeta-cypermethrin, tends to be very effective but at high rates. It should be noted that in no way are pyrethroids recommended for corn earworm control alone.



Some producers have expressed desire to move away from Lannate in spray programs. Several spray trials conducted in the last three years have consistently shown that spinosyns tank-mixed with a pyrethroid can be as effective as a Besiege or Elevest rotation. Two disadvantages though are significantly increased expense and lack of secondary aphid control.

Anytime pyrethroids are used extensively in a cropping system, there is risk for aphid or spider mite flare ups. There are no good thresholds for either. Aphid identification may help with selecting the most appropriate products in case large populations that threaten to cover ears with honeydew develop.

All of these challenges can be mitigated with Vip Bt varieties (Attribute II or Attribute Plus). University of Maryland's 2024 sentinel resistance monitoring program continues to show high efficacy of the trait against corn earworm. Sap beetle pressure is going to be significantly lessened with a Vip variety, but may still require an insecticide application during the wilting/browning silk stage. Bt varieties with herbicide traits may help simplify crop rotation schemes and save applicator exposure, time, and money in later plantings. Aphid and spider mite outbreaks are also much less likely due to the reduction of pyrethroid application. Currently only methomyl and group 4 insecticides which do not have earworm efficacy are labeled for aphids.

## **SWEET CORN WEED CONTROL**

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Many people use the term “Weed Control” with a heavy emphasis on “control” and do not consider the “weed” portion. When growing crops that have a variety of robust herbicide options the consideration of weeds in the field only comes up when poor weed control occurs. Understanding ecology of individual species is particularly important when herbicides choices are limited.

Some of the characteristics associated with difficult to control weeds include seed size, period of germination, growth rate, and ability to capture sunlight. Generally, weeds with larger seeds can germinate from deeper in the soil allowing them to be less susceptible to soil-applied herbicides or the larger seeds allow the weeds to emerge through plant residue. All weeds have an emergence period when most plants emerge, and this can be as short as a few weeks or throughout the growing season. Those species with a prolonged germination period are the most challenging to control, this includes Palmer amaranth, smooth pigweed, common cocklebur, and jimsonweed.

Weeds have a peak growth rate based on an optimum temperature for that species, meaning some species grow better in warmer temperatures than others. Thus, some species maybe more problematic with early planted sweet corn while others are more troublesome with a later plantings. Rapid, early growth rate also leads to higher probability that a weed is likely to capture sunlight and shade out sweet corn and other weeds.

These characteristics are hard to manipulate in your favor. But being aware of the characteristics of the most troublesome weeds is critical for planning effective weed management programs. This information can be difficult to find. A free publication from Sustainable Agriculture Research and Education (SARE) entitled “Manage Weeds on Your Farm” is an excellent resource for this type of information (<https://www.sare.org/resources/manage-weeds-on-your-farm/>). The relative effectiveness of various integrated weed management programs can be challenging and a useful resource from Get Rid of Weeds (<https://growiwm.org/>) is a Weed Management Planner (<https://growiwm.org/the-weed-management-planner/>). These two free on-line resources complement each other and are very effective for developing an effective integrated approach to weed management.



## **Pumpkin Disease Identification and Controls**

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Plectosporium blight, also known as White speck, can cause significant problems in cucurbit production. Plectosporium blight is favored by cool, humid or rainy weather. The fungus can overwinter on crop residue and can persist in the soil for several years. No pumpkin or summer squash varieties are known to be resistant to the disease. Spores are spread by rain-splash and wind. Lesions are small (<1/4 inch) and white. On vines, the lesions tend to be diamond shaped; and on fruit they are small, round and irregular. The lesions increase in number and coalesce until most of the vines and leaf petioles turn white and the foliage dies. Severely infected pumpkin vines become brittle. Early in the infection cycle, foliage tends to collapse in a circular pattern before damage becomes more universal throughout the field. These circular patterns can be easily detected when viewing an infected field from a distance. Fruit lesions produce a white russetting on the surface and stems that render the fruit unmarketable. The fruit lesions may allow for entry of soft rot pathogens that hasten the destruction of the crop (Boucher and Wick) (<http://vegetablemndonline.ppath.cornell.edu>).

In recent years downy mildew has become a significant problem in cucurbit crops throughout the US. Symptoms of downy mildew include irregular, chlorotic (yellow) spots which develop on the upper leaf surface of cucurbit crops. These lesions expand and cause leaves to turn from yellow to brown often resulting in a scorched appearance in a few days if left untreated. Diagnostic characteristics of downy mildew are the purplish-brown spores which develop on the bottom side of infected leaves. Spores can easily be seen with a 10x hand lens. Control of downy mildew begins with the early recognition of symptom development and preventative fungicide applications. Fungicide resistance to downy mildew has been reported and there is some evidence that new race(s) of the pathogen may be present in the US. Since fungicide resistance to other important cucurbit diseases, such as powdery mildew and gummy stem blight already exist in our area, proper preventative fungicide application programs must be followed.

Powdery mildew (*Podosphaera xanthii*) continues to be one of the most important foliar diseases of cucurbit crops in New Jersey. Symptoms of powdery mildew include white 'fluffy' colonies which develop on upper and lower leaf surfaces, vines and handles of fruit. Control of powdery mildew begins with planting powdery mildew resistant/tolerant cultivars and early detection of symptoms along preventative fungicide maintenance programs. Fungicide resistance to powdery mildew has been detected in NJ and growers need to follow fungicide labels and restrictions accordingly.

The diagnosis and control of these diseases and other important diseases of cucurbit crops will be discussed. An update on the newest fungicide chemistries available for controlling important diseases in cucurbit crops will also be presented.

## 2024 SMALL PUMPKIN VARIETY TRIAL RESULTS

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Pumpkins are an important vegetable crop for growers in New Jersey for both on-farm retail operations and also local wholesale markets. The Garden State has approximately 9 million people living in the state. This concentrated population makes for a strong market for pumpkins in fall for retail sales and agritourism operations. Rutgers Cooperative Extension and the New Jersey Agricultural Experiment Station conducts research to improve production of crops for farmers and to update recommendations. In 2024, research was conducted to evaluate 10 small pumpkin varieties that were not already included in the *2024-2025 Mid-Atlantic Commercial Vegetable Production Recommendations* guide, recommended pumpkin varieties.

The 10 pumpkin varieties were planted at 3 commercial vegetable farms in Gloucester County, New Jersey. Unfortunately, due to wildlife damage, field conditions, and weed pressure, two farms did not result in measurable yields for data collection. The third farm selected for this trial was extremely successful and had excellent yields and quality. This farm was located in West Deptford, New Jersey. The pumpkin field was not irrigated. Soil type was sandy loam and soil test reports indicated optimum or higher for all fertility levels. Calcium nitrate was applied twice via broadcasting: at planting and one week after initial fruit set at a rate of 20 pounds of actual N per acre for at total rate of 40 pounds of actual N per acre. The field was hand-seeded on May 27, 2024 into holes that were made by running a waterwheel transplanter down the row to provide for accurate spacing between plants at 4 feet in the row and for 8 feet between row spacing for all varieties except 'Apprentice' and 'Kandy Korn Plus' that were planted at a spacing of 2 feet by 8 feet, since they were very small fruited varieties of approximately 1 pound per fruit. Generally recommended pest control methods for insects, diseases and weeds were employed during crop management throughout the growing season. On this farm, honeybee hives are managed for honey production and 7 hives were kept within 200 feet of the pumpkin field for enhanced of pollination.

Table 1 lists the varieties that were included in the study, the reported average weight per fruit of each variety, the days to harvest, and any claimed disease tolerances or resistance listed in seed company catalogs.

**Table 1.** Pumpkin variety information.




Variety Seed Catalog Photo	Variety Name	Seed Company Reported Ave. Weight	Days to Harvest	Reported Disease Tolerance/Resistance
	Apprentice	1 lb.	90	Fusarium, Phytophthora
	Blaze	3 lbs.	100	Powdery Mildew Resistance
	Cinnamon Girl	3-5lbs	85	Intermediate Powdery Mildew Resistance
	Early Abundance	4-6 lbs.	90	Powdery Mildew Resistance
	Grizzly Bear	6-10lbs	90	Powdery Mildew Resistance
	Jack of Hearts	6-7lbs	100	Powdery Mildew Resistance
	Kandy Korn Plus	1 lb	85	Powdery Mildew Resistance
	Little Giant	2-4lbs	95	Powdery Mildew Resistance
	Mischievous	3 lbs.	85	Powdery Mildew Resistance
	Pipsqueak	4-8lbs	100	Powdery Mildew Resistance

Table 2. Yield data from 2024 small pumpkin variety trial at farm in West Deptford, NJ. Harvested on September 4, 2024.

<b>Variety</b>	<b>Ave. Weight Per Fruit in lbs.</b>	<b>Number Fruit Per Acre</b>	<b>Yield Per Acre Tons</b>
Apprentice	1.19	36,413	21.78
Kandy Korn Plus	1.1	30,288	16.68
Blaze	3.21	17,016	27.31
Cinnamon Girl	4.25	11,911	25.35
Mischief	3.19	8,848	14.12
Early Abundance	5.29	6,466	17.1
Little Giant	3.81	6,296	12
Jack of Hearts	7.1	4,935	17.53
Pipsqueak	6.65	6,976	23.23
Grizzly Bear	8.62	3,573	15.4

In conclusion, of the 10 pumpkin varieties that were evaluated in this trial the variety 'Cinnamon Girl' performed the best for quality and yield. This variety had good handle quality, good fruit quality and highest yields among varieties in its weight category. The other variety that was notable was 'Mischief' for number of fruit per acre and fruit quality. However, 'Mischief' had shorter handles than other varieties. 'Early Abundance' and 'Little Giant' had similar numbers of fruit per acre and both had good quality handles and fruit, but yields were lower than 'Cinnamon Girl' and 'Mischief' for fruit per acre in this trial. 'Jack of Hearts' and 'Pipsqueak' had much lower fruit per acre and fruit quality for both was not as good as other varieties. 'Apprentice' and 'Kandy Korn Plus' were both very small and would be more "gourd-like" for sales than would be in a pumpkin category due to size. 'Grizzly Bear' was quite interesting and is a warty variety with a more orange-brown color than a true orange. 'Grizzly Bear' must be harvested at late maturity or the warts will remain tender and bruise or shrivel. After harvesting mature fruit of 'Grizzly Bear' the warts may begin to russet and look dried out, but still hold their form. This is an attractive variety and a very heavy fruit for its size.

# Soil Health

## BEST MANAGEMENT PRACTICES FOR SOIL HEALTH: WHAT IT MEANS FOR DIFFERENT SOIL TYPES AND DIFFERENT CROPS

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The USDA – Natural Resources Conservation Service provides general guidance, technical assistance, and funding for production practices that enhance or restore soil health. The principles of soil health include: Minimize disturbance; Maximize living roots; Maximize soil cover; and Maximize diversity.

Examples of practices:

Minimize disturbance: reduce tillage, or no-til; perennial crops

Maximize living roots: cover crops, intercropping; perennial crops

Maximize soil cover: cover crops; maintain crop residue as mulch

Maximize diversity: crop rotation; intercropping; cover crops; livestock grazing

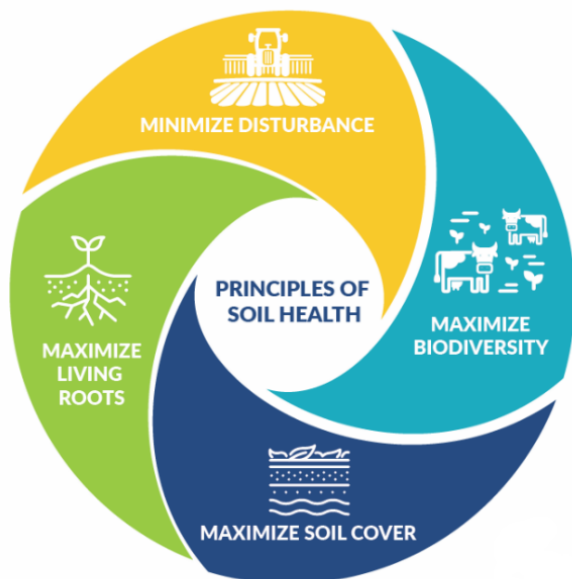


Figure 2. USDA-NRCS Principles of Soil Health.

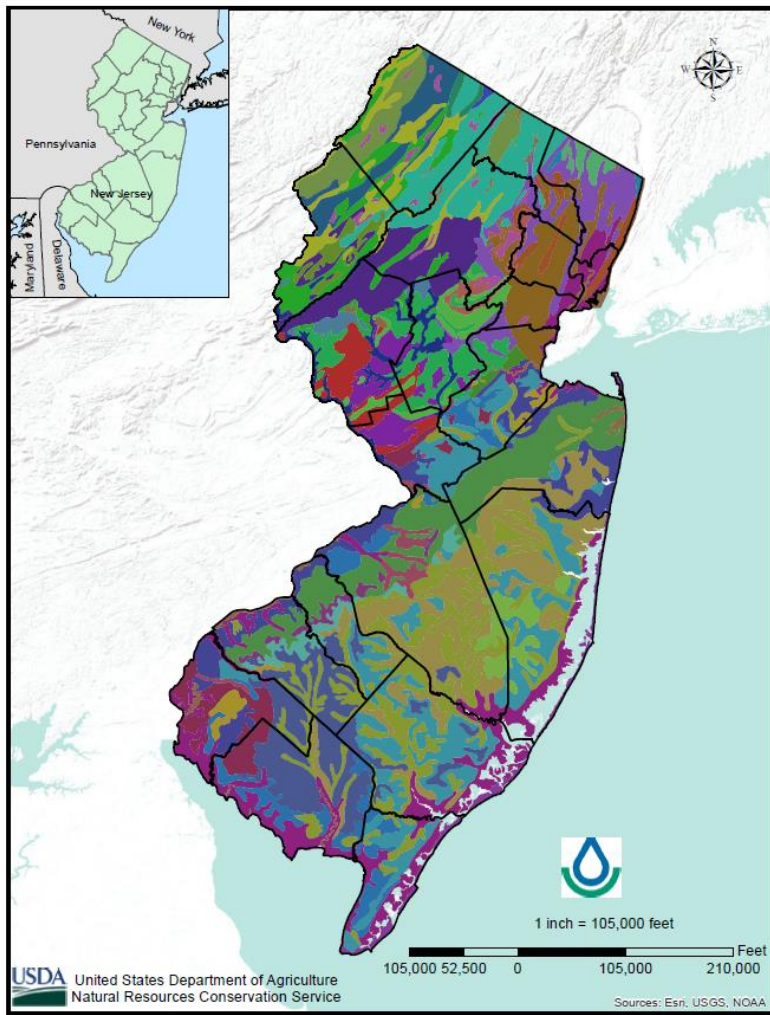
credit:

<https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/soil-health>

Although these are broadly applicable principles recommended for building or maintaining soil health, it is also widely acknowledged that each farm or field situation must be evaluated independently, with consideration of multiple farm-level factors, to determine

the best strategies and practices for each specific case. While putting all of these principles into practice may not be possible for every field, NRCS staff and technical service providers can work with you to determine the most appropriate specific practices to implement based on soil type, site limitations, crop/rotation, costs, markets, etc. to move soil health to the next level.

Despite being a relatively small state in total acreage (47<sup>th</sup>/50), the diversity of parent material and topography have resulted in a wide variety of soil types across New Jersey.



**Figure 3. General soils map of New Jersey.**

**credit: Edwin Muniz, USDA-NRCS-NJ**

In this presentation, a broad overview of the range of soil types associated with various regions of the state will be demonstrated, along with discussion of the considerations relating to soil type and other factors, such as crop and equipment, etc.

## **Plant Responses to Soil Physical Conditions**

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The wellbeing of society depends on healthy soils that can support food production for a growing population. Soils have the capacity to absorb and store large amounts of water in microscopic void spaces of various sizes called pores. Healthy soils have a well-connected network of macropores that ensure fast exchanges of water and gases between the soil and the atmosphere and a balanced proportion of smaller pores that retain water and dissolved nutrients and release them slowly to plant roots and microbes. The spatial arrangement of pore networks and the associated solid particles is known as soil structure. Soil structure is influenced by endogenous factors such as texture and organic matter content and it is easily altered by soil management.

Soil structure in agricultural soils differs from soil structure in non-managed soils in that the top layer of agricultural soils is regularly disrupted by tillage. Compared to natural soils, tilled layers tend to be compacted (i.e., greater bulk density and penetration resistance) and contain fewer and less stable macropores than the subsoil. Following tillage, there is a temporary increase in soil porosity that promotes seed germination and root growth, but the additional aeration exposes soil to oxygen and accelerates soil organic matter decomposition. Over the course of the growing season, the tilled layer gets progressively denser by the selective collapse of macropores. Furthermore, heavy farm vehicle traffic tends to extend compaction to the subsoil. Another consequence of tillage is that frequent loosening of the topsoil leads to the discontinuity in soil structure characteristics between the tilled layer and the subsoil, which impact the growth of roots and water movement into deeper soils.

Plants are ecosystem engineers that alter the soil environment in complex ways through their roots. Plant roots and microbes colonize pores and find in them oxygen and dissolved nutrients needed for growth. Roots modulate soil conditions by releasing exudates that modify soil pH, absorb and retain soil water, and attract specific microbial communities that help with nutrient adsorption and to combat pathogens in some cases. As a result, the properties of the soil in contact with roots (or rhizosphere) differ from the properties of the bulk soil. Roots react to mechanical impedance by decreasing total length and increasing root diameter and tortuosity. These morphological modifications allow roots to exert greater pressure to displace particles and decrease frictional resistances by growing along planes of weaknesses between soil aggregates. Decrease in root length may translate into a smaller root-to-shoot ratio. The carbon that is not



allocated to root biomass is released into the soil in the form of mucilage, which further reduces frictional resistance. Overall, compaction causes about 20-25% reduction in yield, but losses could be as high 50–75% when compaction happens in conjunction with other constraints such as drought.

Plant roots play key roles in the soil hydrological cycle. In general, roots increase rates of water absorption in soils as root decay promotes the formation of well-connected pores, but they can also have the opposite effect when active roots clog pores. Indirect effects of roots on field water balances include the increase of plant available water through improved aggregation and the occasional development of water repellency (hydrophobicity) from root exudates. A vital role performed by roots is the uptake of water from soil and its return to the atmosphere in the form of transpiration, which globally represents 38% of precipitation falling on land (or about 300 mm). This process is facilitated by root exudates that preserve water in the rhizosphere while serving as pathways for its transport towards the roots.

Managing soil in the context of food production must consider the various aspects in which plants interact with soils. Strategies aimed at improving soil health while maintaining high productivities require understanding the impacts that crop management and climate extremes have on soil structure and the properties of pore networks.

**Managing Micronutrients for Crop Health**  
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The market for micronutrient fertilizers is expanding. The increasing demand for micronutrients maybe associated with increasing crop yields and concern for depletion of micronutrients reserves from soils. Another factor maybe the publication of *Mineral Nutrition and Plant Disease* by the American Association of Phytopathology. This book shows how optimizing all essential nutrients to protect crop health can help offset the demand for pesticides.

Rutgers NJAES uses the following soil test (Mehlich-3) general reference values as adequate for micronutrients: Boron 0.5 to 1.5 ppm, Copper 0.5 to 20 ppm, Manganese 15 to 50 ppm, and Zinc 1 to 50 ppm. However, interpretation of these soil test levels varies depending on the crop and soil pH. For example, crops such as cabbage and alfalfa require higher soil fertility levels for boron. In the case of manganese, soil pH has a major influence on nutrient availability, decreasing in availability as soil pH increases. Some micronutrients (Molybdenum, Nickel, Chlorine, and Cobalt) are not directly evaluated by soil test but soil pH, field history, fertilizer source materials, and cropping system should be taken into consideration.

Plant tissue analysis can be used as a diagnostic tool for micronutrients. While interpretation of nutritional status varies by crop and plant part that is sampled, general sufficiency guidelines for tissue concentrations on a dry matter basis are as follows: Boron in monocot plants 6 to 8 ppm, Boron in dicot plants 20 to 60 ppm, Copper 5 to 20 ppm, Iron 50 to 250 ppm, Manganese 20 to 400 ppm, Molybdenum 0.3 to 1.0 ppm, Nickel 0.1 to 1.0 ppm, Cobalt 0.02 to 0.5 ppm, Zinc 20 to 300 ppm, Chlorine 2000 to 10,000 ppm.

Boron is the most often needed micronutrient for many crops grown in New Jersey. Manganese is frequently found to be deficient in soybean, wheat, and occasionally vegetable crops grown on sandy coastal plain soils. Iron deficiency occurs on blueberry and other crops that require strongly acid (pH near 5.0) soil conditions. Zinc deficiency is common in tree fruit crops and tends to be associated with periods of cool, wet, cloudy growing conditions. Molybdenum requirements are higher for legume crops; keeping soil pH in the 6.5 to 6.8 zone enhances its availability.

Certain agronomic practices can help to prevent micronutrient deficiencies. Careful choice of macronutrient fertilizers can impact supply of micronutrients. For example, common Potassium fertilizers typically supply an ample amount of Chlorine. Because many micronutrients are very sensitive to soil pH conditions, it is important to apply limestone carefully to meet the needs of the crop without exceeding the target pH. The use of ammonium source fertilizers enhances availability of Manganese, Iron, and zinc from soil. A firm soil seed bed can improve Manganese availability.

When a deficiency of Manganese or Iron occurs, application of the nutrient to the soil is generally not economical or effective for correction. Manganese and Iron fertilizers are most effective when sprayed on the plant foliage. In many cases, repeated foliar applications of the micronutrient is necessary. A soil test should be performed to see if excessive pH may be a contributing factor to the deficiency. Acidification of high pH soils can help to correct Manganese and Iron deficiencies.

An emerging factor that may account for the greater demand for micronutrient fertilizers is the widespread use of glyphosate in weed control, “burn down” no-till farming systems, and crop desiccation. Glyphosate is a potent mineral chelator and antibiotic. A recent investigation (Saga of Soggy Sauerkraut, HortScience 2024) found that glyphosate residues interfere with availability and function of several key micronutrients: Iron, Copper, Manganese, and Zinc. High levels of residual glyphosate may immobilize nutrients by chelation, decrease their availability, or normal function within the plant. Glyphosate may also act as an antibiotic against soil microbes which play a role in nutrient availability. Growers should be aware that fields with a legacy of glyphosate use may be more vulnerable to micronutrient deficiencies.

Even in organic farming systems where glyphosate use is prohibited can suffer micronutrient deficiency caused by the indirect use of this herbicide. Organic growers are allowed to use manures obtained from non-organic farms as a soil fertility input. These manures often contain glyphosate residues that suppress micronutrient nutrition of the organic crop. Organic growers should attempt to build soil fertility by cover cropping, legume crop rotations, and clean compost, and minimize importation of manure-based fertilizers from non-organic farming operations.

Where organic growers need to apply a micronutrient, they can generally use many of the same micronutrient fertilizer sources as non-organic farms. However, the organic grower must first use soil testing or plant tissue analysis to document that the specific micronutrient is needed. Also, they are advised to check with their organic certifier to ensure that the micronutrient fertilizer source is approved.

All growers may benefit by consulting the previously mentioned book: *Mineral Nutrition and Plant Disease* by APS Press. This volume provides a wealth of information on how to manage soil fertility and plant nutrition for crop health. Mineral nutrition when properly managed has the potential to sustainably reduce the use of pesticides. For an introduction on how to use this approach to crop health, visit The Soil Profile newsletter: <https://njaes.rutgers.edu/soil-profile/pdfs/sp-v29.pdf>

Web search Rutgers NJAES for specific soil fertility recommendations on Boron, Chlorine, Copper, Iron, Manganese, Molybdenum, and Zinc.

## PROGRESS IN BIOLOGICAL INDICATORS OF SOIL HEALTH

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The modern scientific term “soil health” traces its origins back to the mid-1990s. Prior to that, it was referred to as “soil quality,” a concept championed by soil scientist John Doran, who first established the Soil Quality Institute (Doran, 1994). I had the privilege of collaborating with John, both in my lab in Maine and during visits to his Nebraska research center. At the time, one of our biggest challenges was determining how to measure key aspects of soil biology in ways that were both meaningful for farmers and scientifically credible. In some respects, this proved to be more difficult than we anticipated, but in others, it was surprisingly straightforward. This presentation will explore the history behind these analytical developments and offer practical suggestions for effectively using soil health metrics.



Figure 4 In a 1995 article, farmers' view on soil health was related to subjective features, such as a pleasing aroma. Reproduced with permission of the Soil and Water Conservation Society

During this period—what I like to call the "Doran era"—I developed the idea for the Solvita® test, a simple gel-based tool designed to capture carbon dioxide (CO<sub>2</sub>) released by soil microbes as they respire. At the same time, John Doran was using a more complex method: burying soil cylinders in the field, collecting CO<sub>2</sub> with syringes, and analyzing it in the lab using gas chromatography—a precise but labor-intensive process. Remarkably, John was able to adapt his method to use the Solvita probe, which simplified the process considerably. From there, we worked to develop equations that could translate field measurements into meaningful units—whether as parts per million (ppm) in the air or pounds of carbon per acre (see Table 1). Every solution we came up with felt overly simplified, a challenge that continues to plague the soil health testing industry today.

I originally got the idea for this form of CO<sub>2</sub> measurement from my post-grad time in Europe working on soil fertility studies in Switzerland and Sweden. Those studies revealed something fascinating: soils enriched by crop rotations, and additional compost or manure not only respired more CO<sub>2</sub> but also released more nitrogen for crops—an emergent property of healthier soils acting like an integrated system (Lori et al. 2017; Brinton 2021). Even today, we don't fully understand this phenomenon.

Much of the early lab work relied on European methods of the 1950s, such as 'base-trap CO<sub>2</sub> titration.' After conducting countless tests using this time-consuming approach, I

realized that while effective for research, it could hinder broader adoption. Recognizing this, Doran and I sought to make soil respiration more practical by simplifying technique and making a chart to translate respiration data into an acre-based measure of carbon loss—helping farmers better grasp the scale and significance (Table 1).



Figure 5 Long-Term field plot studies that triggered soil health tests evaluated crop rotations and organic matter management such as manure, compost and fertilizers. Photo; W. Brinton, Sweden

Fast forward to now, and the challenges around measuring soil carbon in its fixed form rather than active form, have grown even more complex.

The concept of *carbon sequestration*—storing carbon in soils to combat climate change—took center stage after the 2015 Paris Climate Accord. Policymakers proposed increasing global soil carbon by 0.04% per year (“4-per-thousand”), a figure based on simple math: dividing annual global carbon emissions by the estimated 2,400 billion

Table 1. General soil respiration class ratings and soil condition at optimum soil temperature and moisture conditions, primarily for agricultural land uses (Woods End Research, 1997).		
Soil respiration (lbs CO <sub>2</sub> -C/a/d)	Class	Soil condition
0	No soil activity	Soil has no biological activity and is virtually sterile.
< 9.5	Very low soil activity	Soil is very depleted of available organic matter and has little biological activity.
9.5 - 16	Moderately low soil activity	Soil is somewhat depleted of available organic matter, and biological activity is low.
16 - 32	Medium soil activity	Soil is approaching or declining from an ideal state of biological activity.
32 - 64	Ideal soil activity	Soil is in an ideal state of biological activity and has adequate organic matter and active populations of microorganisms.
> 64	Unusually high soil activity	Soil has a very high level of microbial activity and has high levels of available organic matter, possibly from the addition of large quantities of fresh organic matter or manure.
Conversion of Woods End Solvita respiration levels: (mg CO <sub>2</sub> /kg/wk) x 0.039 x (1.2 g/cm <sup>3</sup> ) x (7.6 cm depth) - 10 x 0.89 = (lbs CO <sub>2</sub> -C/acre/day). It was assumed all respiration was coming from a 7.6 cm depth with an average bulk density of 1.2 g/cm <sup>3</sup> (Doran et al., 1997).		

metric ton of soil carbon worldwide (Minasny, 2017). Sounds impressive, but there's a catch: Is the goal to *store* carbon for climate benefits, or to *use* it for healthy crops?

This tension between using and storing carbon was highlighted recently by Canadian soil scientist who asked: “*Carbon: Shall we use it or hoard it?*” (Janzen, 2021). To grow healthy plants, soil microbes need to break down organic matter which contains carbon, releasing in the process nutrients contained in it. But slowing this breakdown is key for carbon storage—a paradox that farmers face daily. To store more carbon, you implement practices such as soil cover to lower soil surface temperatures; you can implement No-Till, also slowing down metabolic soil rates. Paradoxically, it has been shown that the use of inorganic ammonium fertilizer acidifies soil over time, and this effect can slow down microbial respiration, and thereby increase carbon retention.

The rush to capitalize on carbon sequestration has also sparked controversy. Recent reports question the credibility of carbon markets, describing them as a “Cash-for-Carbon Hustle” (The New Yorker, 2023). A recent extensive study revealed that more than 90% of rainforest carbon offsets were not properly validated. Who benefits from these schemes, and where does that leave the farmers?

Meanwhile, soil health science has been advancing at, well - a snail's pace. Back in 1995, an article in the *Journal of Soil and Water Conservation* described soil health as “a set of sensory traits—like the scent of healthy soil”. That same year, another American paper proposed an early frameworks for measuring microbes' role in soil quality (Kennedy et al 1995). Yet it wasn't until 2019 that the USDA NRCS published its *Soil Health Technical Note 450-03*, listing certain methods as tentative. Even then, debates over methods persisted.

For example, the Solvita soil test appeared in early drafts of the NRCS Soil Health Manual, was removed in subsequent revisions, and then reinstated in the final version. A similar case involves the Illinois Soil Nitrogen Test (ISNT), developed by Richard Mulvaney at the University of Illinois (Kahn & Mulvaney, 2001). The NRCS manual overlooked this method

because one study reported it

did not reliably predict corn yields in Iowa. However, the ISNT is highly effective for measuring stored organic nitrogen in soil. This reflects a broader issue: the tendency to

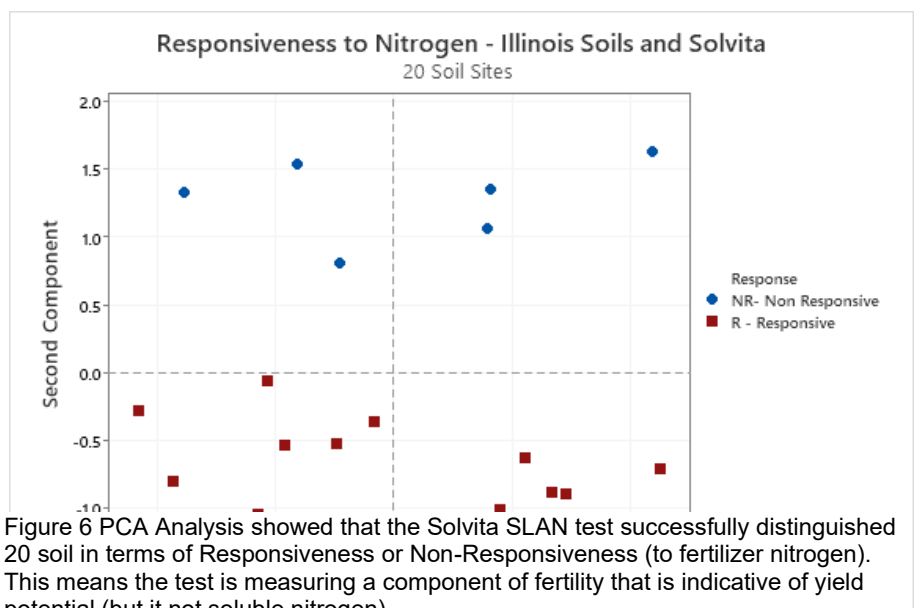


Figure 6 PCA Analysis showed that the Solvita SLAN test successfully distinguished 20 soil in terms of Responsiveness or Non-Responsiveness (to fertilizer nitrogen). This means the test is measuring a component of fertility that is indicative of yield potential (but it not soluble nitrogen).

judge soil health tests based primarily on their ability to predict short-term crop yields, rather than their capacity to reveal long-term soil fertility.

At an Illinois Soybean Association conference, Mulvaney and I demonstrated the practical value of organic nitrogen testing using both the ISNT and Solvita SLAN methods. The results showed that soil types responded differently, allowing us to classify 20 soils across the state into N-responsive and N-non-responsive categories. This suggests that soil health tests are capturing hidden yield factors that traditional tests often miss (see Figure 3), highlighting their broader relevance to growers.

Growing evidence suggests that soil health tests, such as Solvita, offer practical insights while also revealing unexpected complexities. In a recent study co-authored with Michigan State University (Fowler et al., 2023 – Fig. 4), we demonstrated that total soil carbon, CO<sub>2</sub> respiration, and several other soil health indicators—whether used individually or in combination—effectively captured key landscape features, including soil density, slope, aspect, and water flow. These features, in turn, correlated with long-term aggregated satellite yield data. This highlights that soil health metrics are not only relevant for short-term assessments but also for understanding long-term agricultural productivity. Such findings bring us closer to establishing clear connections between soil carbon, its health-related proxies, and crop viability—an essential consideration for farmers and land managers.

At its core, the story of soil health is about patience, curiosity, and persistence. The relationship of farming to science – practicing vs testing - remains dynamic. Whether we’re burying soil cylinders, debating carbon markets, or questioning what “health” really means, one thing is clear: there’s still so much to learn.

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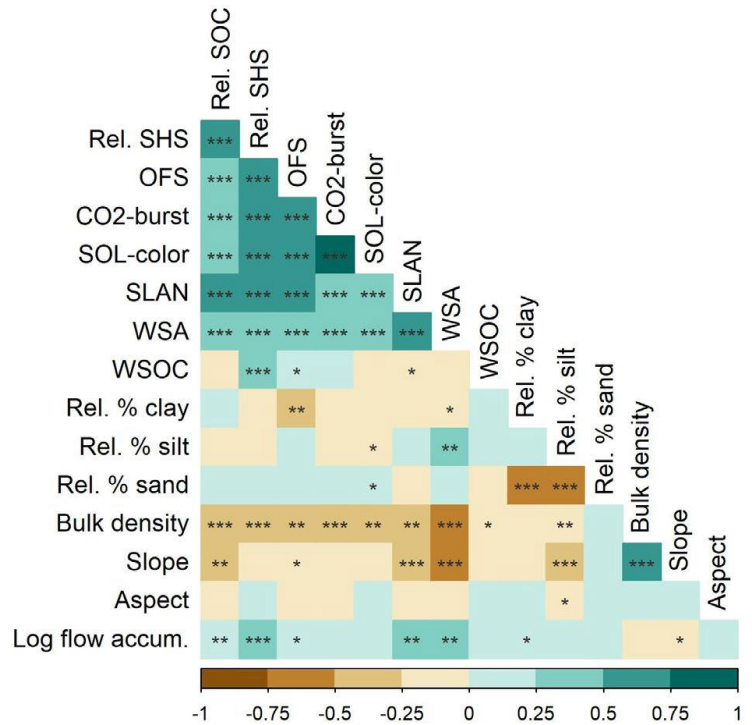


Figure 7 Local correlation of relative (0–30 cm depth) soil organic carbon (SOC), soil health score (SHS), and overall fertility score (OFS) with the measured metrics of SHS (CO<sub>2</sub>-burst, Solvita (SOL) color (SOLcolor), Solvita labile amino nitrogen (SLAN-N), water stable aggregates (WSA), water-soluble organic carbon (WSOC), and soil texture, bulk density, and topography. From Nature: Scientific Research. 2024

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# **Agrivoltaics**

## **Agrivoltaics-101**

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Agrivoltaics (a.k.a. dual-use solar) is the practice of simultaneously using a piece of land for agricultural or horticultural production and for solar energy generation. Racking systems for solar panels are installed in the field in such a way as to allow agricultural or horticultural production similar to such production in a regular field without solar panels. The rows of panels are spaced far enough apart and in some cases the panels are raised to allow for farming equipment to pass with little impact on the farming practices. The benefits of agrivoltaics for New Jersey are: 1. It keeps our farmland in agricultural or horticultural production, and 2. It contributes to the state's mandate to produce all of its electricity from renewable energy sources. For farmers, agrivoltaics can reduce the risks involved with agricultural or horticultural practices by providing an additional reliable and predictable source of income. While adding solar panels to an agricultural field can reduce crop yields, the goal is for any yield losses to be offset by the additional income from the generated electricity.

The Rutgers Agrivoltaics Program (RAP; <https://agrivoltaics.rutgers.edu/>) is conducting research trials at three different agrivoltaics installations in Pittstown, New Brunswick, and Upper Deerfield. These installations were specifically designed to study a variety of crops grown underneath and around two different types of agrivoltaic systems: Single-axis trackers (Figures 1 and 2), and vertical bifacial systems (Figure 3). The rows of our single-axis tracker systems are oriented North-South and the bifacial (meaning that both sides of the panels can produce electricity when exposed to sunlight) panels are mounted eight feet above the ground. The panels then rotate throughout the day, starting with facing East in the morning, horizontal at solar noon, and facing West during the afternoon. Our single-axis trackers are able to rotate up to  $\pm 60$  degrees from the horizontal position, but other single-axis trackers exist that can rotate  $\pm 90$  degrees from horizontal. Our vertical bifacial system also has rows of panels that are oriented North-South. However, these panels are stationary and produce electricity whether the sun hits the front or back side of the panels. As a result, peak power production occurs during the morning and afternoon and not during the middle of the day as is the case for the single-axis trackers.

This presentation will review common agrivoltaic systems and their features, and discuss some of the challenges we encountered during construction and operation.



Figure 1. Single-axis trackers installed at the Clifford E. & Melda C. Snyder Research & Extension Farm in Pittstown, NJ. 10 rows of 21 panels for a total installed capacity of 94.5 kW<sub>DC</sub>.



Figure 2. Single axis trackers installed at the Rutgers Agricultural Research and Extension Center in Upper Deerfield, NJ. 18 rows of 21 or 42 panels for a total installed capacity of 255.2 kW<sub>DC</sub>.



Figure 3. Vertical bifacial system installed at the Cook Campus Animal Farm in New Brunswick, NJ. 18 rows of 21 panels for a total installed capacity of 170.1 kW<sub>DC</sub>.

# **Agritourism**

## IS YOUR FARM READY FOR AGRITOURISM?

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Agritourism can be a great alternative for farms looking to diversify their income while strengthening ties with the community and educating them on agriculture. However, not all farms can offer agritourism. There are several factors that need to be considered before opening a farm operation to visitors. The factors to be assessed will vary from farm to farm, as their unique context will influence how much or if they would have any effect on the agritourism endeavor.

A SWOT analysis is a tool that can help identifying and aiding in the evaluation of external and internal factors that play a role in offering agritourism. Internal characteristics are factors within the farm operation that the farmer has control over and therefore could change if needed. There are two categories of internal characteristics: strengths and weaknesses. External characteristics are those outside of the operation, and therefore it is unlikely a farmer has any control over them. There are two categories of external characteristics: opportunities and threats.

<b>Characteristic</b>	<b>Description</b>	<b>Examples</b>
Strengths	Internal characteristics that represent an advantage or a differentiation factor from competitors	<ul style="list-style-type: none"> <li>- Skills and abilities</li> <li>- Loyal customers</li> <li>- Established products</li> </ul>
Weaknesses	Internal characteristics that could put the endeavor at a disadvantage and need to be improved.	<ul style="list-style-type: none"> <li>- Lack of strategic plan</li> <li>- Lack of experience in agritourism</li> <li>- Increased costs of production</li> </ul>
Opportunities	External factors that have the potential to make the endeavor competitive and should be capitalized on	<ul style="list-style-type: none"> <li>- Interest in outdoor activities and other trends</li> <li>- Partnerships with other agribusinesses</li> <li>-</li> </ul>
Threats	External factors that could potentially harm the endeavor and prevent it from being successful.	<ul style="list-style-type: none"> <li>- Zoning and other regulations</li> <li>- Liability and insurance issues</li> <li>- Weather events</li> </ul>

It is advised to perform such analysis in a detailed and thorough manner as to identify the greatest amount of factors, both internal and external, that can be taken advantage of or can be used to boost the agritourism endeavor and increase the likelihood of

success, and all factors that could prevent its success, by identifying ways to minimize their negative impacts in the operation.

This analysis can be aided by incorporating input from staff and other actors, and by asking the following questions:

<p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>- What resources do we have?</li> <li>- What are we doing better than other competitors?</li> <li>- What are we recognized for?</li> </ul>	<p><b>Weaknesses:</b></p> <ul style="list-style-type: none"> <li>- In what aspects are we not performing best?</li> <li>- What could we be doing better?</li> <li>- What criticisms or feedback have we received?</li> </ul>
<p><b>Opportunities:</b></p> <ul style="list-style-type: none"> <li>- What are the current trends in agritourism?</li> <li>- What markets could we target that we currently aren't?</li> </ul>	<p><b>Threats:</b></p> <ul style="list-style-type: none"> <li>- What regulations could prevent us from offering agritourism?</li> <li>- How many other farms are offering agritourism in my area?</li> </ul>

Once all characteristics have been identified, a strategy should be developed for each. Even in positive aspects such as strengths and opportunities, strategies could help us maximize the benefits we can garner from them, and they can also be used to minimize the negative effects the weaknesses and threats may have in the agritourism endeavor. For more information on areas that should be assessed as part of the SWOT analysis, please review the SWOT Analysis for On-farm Direct Marketing toolkit:

[https://sare.rutgers.edu/pdfs/SWOT\\_Toolkit.pdf](https://sare.rutgers.edu/pdfs/SWOT_Toolkit.pdf).

## THE ART OF PRICING: STRATEGIES FOR AGRITOURISM VENTURES

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A national survey of agritourism operations found that more than half (66%) of the farms reported profit under \$10,000, and 79% reported challenges with cash flow management and availability of operating capital (Hollas et al., 2021). The survey also found that positive revenue and profitability are most strongly associated with on-farm sales and entertainment experiences (Hollas et al., 2021). For agritourism operations that offer activities and experiences, pricing becomes key to having adequate cash flow, operating capital, and profitability.

Beyond profitability, pricing contributes to the perception of your agritourism operation; that is, when consumers see your prices, it sends signals to them about quality, match with them, the target consumer, expectations for the experience, and so forth. Numerous opportunities exist to generate income depending on the type of agritourism activities and experiences you offer. These include:

- Admission fee
- Activity fee (tour, tasting, craft table, etc.)
- Lodging
- Facility rental
- Food service
- Souvenir sales
- Sales of farm products
- Sales of value-added products

When determining how to price your agritourism activities and experiences, it is important to remember the three C's of pricing – costs, customers, and competition. Just as when setting prices for tangible products, your costs for providing activities and experiences need to be accounted for when setting agritourism prices. These costs include:

- Labor, supervision
- Products, inputs
- Facilities, infrastructure & maintenance
- Taxes and insurance
- Marketing
- Depreciation

Setting prices doesn't occur in a vacuum, however. Understanding current and potential customers is the second element of pricing. You should understand the motivations and demand for your activities and experiences. A 2014 study found that the top five motivations for visiting a farm were (1) view the scenic beauty, (2) do



something with their family, (3) enjoy the smells and sounds of nature, (4) learn more about nature, and (5) have a change from their daily routine (Sotomayor et al., 2014). The ability to charge more increases when what you offer aligns with visitor motivation. Trends in agritourism activities and experiences can affect visitor demand for various activities and experiences. For instance, consider the rising popularity of activities such as apple cannons, sunflower mazes, and photographic opportunities.

In addition to understanding visitor motivations, understanding their spending habits and willingness to pay for various activities and experiences will also help determine prices. Databases regarding consumer spending do exist and can be valuable, but accessing this information can be costly. Instead, surveying current and potential visitors about how much they would pay for different activities can be done. Depending on how a survey is carried out, you may also gain insight into visitors' perceived value of an activity or experience.

Competition, of course, plays a role in setting prices as well. Take the time to analyze the pricing of activities and experiences other agritourism businesses offer. Look at operations that offer both similar and differing activities as well as businesses in your geographic area and different parts of the country.

Agritourism operations that host numerous activities and experiences, particularly during a specified time period, such as a fall festival weekend event, may struggle with deciding whether to charge an admission fee or individual activity fees. Each strategy has benefits and drawbacks, so it is important to consider both the individual event/experience and the full farm operation. For instance, an admission fee offers visitors the knowledge of exactly what they will spend during their time at your operation (Eckert and Kline, n.d). This can be vitally important for families with children or those with limited disposable income. On the other hand, you will then be faced with marketing the value of the admission fee to visitors. They will want to know exactly what they can expect to receive by paying the fee.

Charging individual activity fees, rather than an admission fee, can give visitors a sense of control since they will only pay for activities/experiences they want to participate in. Two downsides of this pricing approach are that a transaction must occur at each activity (whether cash, credit, or ticket), and numerous transactions can leave visitors feeling "nickel and dimed" (Eckert and Kline, n.d). Clearly posted and accessible prices are also crucial when charging by individual activity. Consider having signs at each activity showing the fee and having an activity list with prices on your website. Several other options for pricing can be used as well. These include:

- Membership fee/Season pass
- Group pricing
- Bundling of activities
- Frequent visitor/loyalty rewards
- Discounts/Promotions
- Online only pricing
- Tiered pricing
- Adjustable pricing – e.g. higher prices on the weekends or no-school days

Additional considerations when pricing agritourism activities and experiences include:

- Uniqueness of activity/experience – an activity/experience that is not available elsewhere can provide an opportunity for higher pricing.
- Using pricing strategies such as bundling of activities, group pricing, frequent visitor/loyalty rewards or discounts.

Knowing the costs for offering agritourism activities, events, or experiences is key in profitable price setting. Enterprise budgets, partial budgets, and breakeven analysis are three tools available for not just calculating costs, but also in assessing profitability at a given price.

An enterprise budget is a valuable tool for tracking the revenue(s) and costs associated with an individual enterprise (e.g. corn, heifers, strawberries) (Cornelisse, Gauker, and Phenicie, 2023). While often associated with crop or livestock production, enterprise budgets can also be developed for agritourism activities, events, and experiences. Enterprise budgets allow you to calculate the cost of production, ensure that all costs and revenue streams are accounted for, and simulate different scenarios for an enterprise.

Partial budgeting may be an appropriate tool if only making a change to an existing activity, event, or experience, for instance, adding a weekend to u-pick operations or offering flower bouquet arranging classes in place of goat yoga classes. In a partial budget, you only show the financial impacts – added returns, reduced costs, added costs, and reduced returns – resulting from the proposed change (Cornelisse and Hyde, 2023).

Breakeven analysis is the third tool to assess the practicality of a proposed price (Schilling et al., n.d.). This method will calculate the minimum of sales required for activity or experience using the formula:

$$BE = TFC / (P - VC),$$

where TFC = Total Fixed Costs, VC = Variable Costs, and P = Price.

The activity or experience would be profitable if you could sell more than the break-even (BE) calculated.

Profitable pricing requires you to evaluate the pricing of your agritourism activities and experiences regularly. This requires that you maintain comprehensive and accurate records. You should not be afraid to adjust prices.

In summary, the keys to setting profitable prices include:

- Knowing your costs - fixed and variable.
- Understanding opportunities for charging fees for activities and experiences.
- Performing a breakeven analysis to know the breakeven price or quantity.
- Performing sensitivity analyses to understand how changes in sales quantities or changes in price impact profitability.
- Adjust based on product characteristics, a specific pricing strategy, customer price sensitivity and values, and other factors.

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## **ATHLETIC ACTIVITIES ON AGRITOURISM FARMS**

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Agritourism has emerged as a profitable venture for on-farm direct marketing operations, especially in the Northeast where population centers are in close proximity to farms. This industry is ever-changing and offering service and hospitality opportunities to the public along with offering the traditional products grown on the farm. Over the past decade, utilizing the farm for activities that include forms of exercise and athletic events has become popular. Some of the most up-and-coming activities include variations of yoga, running events, some team sports and play areas for youth activity. Exercise has long been known to benefit the mind as well as the body. Also, well known are the relaxation benefits of being out in nature. Therefore, exercise and farm visits seem like a winning combination.

Before discussing some athletic and exercise activities that may be done on the farm, it is important to consider the business end of offering these events. As with any agritourism offering it is important to know local, state and federal regulations related to the activity. Additionally, making sure insurance policies will include the offered activities and cover the possible risks associated with these events is necessary to protect a business. Lastly, if a group is coming on the farm to host a sporting or exercise activity, they should provide the farmer an insurance rider to prove they have coverage. This places the burden of responsibility not just on the farmer, but also on the vendor for the activity. Once rules and regulations, liability protections and event management is planned the activities and fun can begin.

The health benefits of yoga have been discussed in many circles. Yoga is a simple form of exercise that can be done just about anywhere. This allows for yoga to be done on the farm where there is an area large enough to accommodate a mat, an instructor and the students. One consideration is to make sure the yoga instructor is certified to teach yoga and that they themselves carry insurance. Although yoga seems like a benign activity, persons have been known to injure themselves and many states require instructors to be certified. Additionally, there are other complimentary offerings that can be coupled with the yoga class. Some creative yoga classes have incorporated goats, beer or wine to enjoy along with your “downward dog” position. The goal of yoga is to create a healthy mind and body in a relaxing setting. Many people perceive farms to be relaxing settings and enjoying their favorite alcoholic beverage while performing yoga moves seems to further relax some participants. Nevertheless, this activity has become quite popular in recent years and hosting yoga on farms has increased.

Running opportunities, like 5K events, have also gained popularity just about everywhere. Runners are continually looking for new landscapes and challenges. So why not run on the farm? Picturesque venues like orchards, vineyards and wide open field spaces have all attracted groups of runners primarily for 5K runs or walks. Many events include a charity theme or a seasonal theme, where participants pay entry fees to

run a set course on the farm. Often prizes are offered for winners and may just include a small medal or other prize for crossing the finish line first. Most participants just run for fun or to support the event's charity. As with every agritourism offering, preparation needs to take place for a successful and safe event. Making sure the course is free of debris, smooth, firm and well marked will make for runner safety. Knowing the plan for the race and if any obstacles will be added on the course by the event planners is important. Is it a mud run? Is it a color run? How many people are they registering for the event? Will the event planners need to make any alterations to the farm roads or fields? Make sure there are no surprises. Also, have a contract and know what is expected well in advance of the run. In most cases, hosting a running event on the farm should not at all alter any areas of the farm and should not take tremendous efforts to plan or execute.

Hosting events on farm fields for athletics or exercise in production areas should not harm the production area for future use. One such alternate use for a farm field came about on a Southern New Jersey turf farm in recent years. Soccer is one of the largest youth team sports in the U.S. and in the world. Children now play soccer year-round and finding venues to host large tournaments can be challenging with regards to scheduling fields and parking. Soccer requires natural or synthetic turf and a flat surface. Where is natural turf readily found on flat surfaces? Turf farms have abundant acres of natural turf growing year-round. Therefore, hosting multiple soccer games for large tournaments could easily be done on a turf production field. Think about this, a standard youth soccer field is 100 yards long by 50 yards wide for a total of 15,000 square feet. An acre is 43,560 square feet. You could easily fit 2 soccer fields per acre with buffer spaces between each field. Hypothetically, on a 100 acre field of turf, that means 50 soccer fields could be erected for a soccer tournament with plenty of room inbetween. If the field is 200 acres, then there is plenty of space for close by parking, portable bathroom facilities and food vendors to service the event. Not every farm will have the ability to host soccer tournaments, but it has been done.

Although not an official athletic activity, youth play areas on farms has become a park-like attraction for some families. Having swings, slides, bounce areas, pedal tractors and carts, and other offerings has made agritourism farms family destinations. Be aware of all regulations, safety measures and employee management of these areas when adding them to the farm.

With each activity comes the chance of injury and lawsuits. Before implementing any new activity for an agritourism business, be sure to have all the details, protections and plans worked out to protect your business and to create positive experiences for your customers.

# **Strawberry Production and Marketing**

## UPDATE ON SPOTTED-WINGED DROSOPHILA RESEARCH AND MANAGEMENT

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### The Pest

Spotted-wing drosophila (*Drosophila suzukii*; Fig. 1), an invasive pest from southeast Asia, was first detected in New Jersey in 2011. It attacks a variety of thin-skinned fruits, including blueberries, strawberries, raspberries, and cherries. Overwintering as adults, SWD lays eggs in ripening fruit, where multiple larvae may develop in a single berry. The egg, larval, and pupal stages last from 1–3, 3–13, and 4–5 days, respectively. In New Jersey blueberries, SWD populations become active in late May-early June, peaking later in the season, making late-ripening varieties more vulnerable. Several generations occur within a single growing season.

SWD larvae cause direct damage by feeding within the fruit. Initially, infested berries show no visible damage but eventually shrink, become misshapen, and deteriorate as larvae mature.

### Current Management Practices

SWD is primarily managed with calendar-based insecticide applications, typically applied weekly during fruit ripening. To mitigate resistance, growers are advised to rotate insecticides across different IRAC classes. Resistance is a concern, particularly following reports of insecticide-resistant populations in California.

Sanitation practices also play a critical role in reducing SWD populations. While SWD females prefer ripe fruit for oviposition, they will use rotting fruit as well. Cultural controls such as keeping rows clean, covering fallen berries, and thorough harvesting are recommended to minimize population buildup in blueberry fields.

Despite these efforts, SWD remains challenging to control due to its wide host range, rapid development, and multiple generations. Moreover, biological control agents in invaded regions have been largely ineffective against this pest.

### Current Research

Ongoing research at the Rutgers P.E. Marucci Center focuses on developing effective behavioral and biological control strategies for SWD management. Two promising behavior-based products under evaluation are ACTTRA SWD and Combi-protec (Fig. 2).



Fig. 1. A male spotted-wing drosophila (SWD). Photo by Elvira de Lange.

ACTTRA SWD (ISCA Technologies Inc., California, USA): This product combines chemical attractants, visual cues, and a phagostimulant with an insecticide to attract and kill SWD adults. Laboratory studies have shown its effectiveness, although its performance is influenced by factors such as the physiological state of the insect and the availability of host fruits.

Combi-protec (Andermatt Group AG, New Jersey, USA): An adjuvant feeding stimulant that enhances the efficacy of insecticides without containing an attractant. Tests in New Jersey and other states have shown that insecticides combined with Combi-protec at half the recommended rate perform as effectively as full-rate applications.



Fig. 2. Behavior-based products under evaluation for SWD management include ACTTRA SWD (left) and Combi-protec (right). Photos by Robert Holdcraft.

Biological control efforts are also advancing. A permit to release *Ganaspis kimorum*, a parasitoid native to Asia, was recently approved in the United States. Unlike existing parasitoids, *G. kimorum* is well-adapted to parasitize SWD larvae. From 2022 to 2024, releases of *G. kimorum* have been conducted in wooded areas near blueberry fields in New Jersey. Studies on its overwintering capacity have also been conducted, with the goal of establishing self-sustaining populations.

### Conclusions

Emerging behavioral and biological control tools show promise in managing SWD. ACTTRA SWD and Combi-protec have demonstrated potential to reduce infestations, while the release of *G. kimorum* represents a significant step in biological control. Future research will focus on the compatibility of these strategies to provide integrated solutions for sustainable SWD management.

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# **Farmer Health and Safety**

## PREVENTING HEAT STRESS

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The nature of agricultural work can be both strenuous and time-sensitive, which, during times of high heat, may increase the risk of heat stress in agricultural workers. Increased frequency of extreme heat conditions has brought nationwide attention to worker safety across all sectors, including agriculture. As a result, proposed legislation aimed at preventing occupational heat-related illness and injury has been introduced at the state and federal level.

Consequently, in 2024, the Rutgers Farm Safety and Health Working Group launched an educational outreach program entitled “Don’t Sweat Heat Stress in Agriculture”. Through review and synthesis of existing literature on occupational heat stress and prevention, the working group prepared educational materials for farmers in multiple formats: an updated publication of the Rutgers factsheet on “Preventing Heat Stress in Agriculture”, fourteen “Beat the Heat” articles on the Rutgers Plant and Pest Advisory, two webinars, and in-person presentations to two stakeholder groups. Outreach efforts focused on the following topics related to heat stress:

- Heat stress risk factors
- Tools for environmental monitoring
- Heat-related illness recognition and first aid
- Worker training
- Management strategies to reduce the risk of heat-related illness
- Developing a farm-specific heat illness prevention plan

In preparation for the growing season ahead, winter is an ideal time for farm owners and managers to familiarize themselves with resources pertinent to preventing heat stress in agricultural workers.



Updated  
Rutgers  
Factsheet  
#747:  
Preventing  
Heat Stress in  
Agriculture



“Beat the Heat”  
articles on the  
Rutgers Plant  
and Pest  
Advisory E-  
Newsletter



Rutgers Heat  
Stress and  
Agriculture  
Resources  
Webpage



NIOSH/OSHA  
Heat Safety  
Tool Phone  
App



Occupational  
Safety and  
Health  
Administration  
'Heat Illness  
Prevention'  
Website

# Beginning Farmer

## Overview of RU Ready to Farm Program in NJ – Resources and Lessons Learned

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New Jersey's combination of high-quality farmland acres and access to some of the most densely populated and diverse markets in the world make it fertile ground for agricultural innovation. Yet for all of its advantages, New Jersey still faces many of the same problems that impact the agricultural industry nationwide. The rising cost of land, equipment, and inputs as well as the lack of a skilled next generation of farmers to work the land has contributed to the increasing average age of New Jersey farmers, which now stands at 58.7 years, notably above the national average of 58.1 (USDA Census of Ag, 2022). Successful continuance of agriculture in the “Garden State” depends upon developing a skilled next generation of farmers. The RU Ready to Farm program was developed to address this problem. It is a multi-year, statewide program providing technical education, mentorship, and land access opportunities to the underserved population of beginning farmers. The three-year program has been carefully developed to teach and support beginner farmers through all stages of creating a successful farm business operation. This work is supported by the Beginner Farmer and Rancher Development Program grant no. 2024-05237 from the USDA National Institute of Food and Agriculture.

The RU Ready to Farm program consists of three phases. **Phase 1 (Online Farm Education)** provides nearly 40 hours of pre-recorded online education covering the basics of starting a farm business in New Jersey, four Rutgers team and farmer-guided farm tours per year, and bi-weekly online “office hours”. In **Phase 2 (On-Farm Training)**, students work with the program team to develop a Community Supported Agriculture (CSA) farm share business that the students manage on a program-provided plot of land. **Phase 3 (Ongoing Support)** is tailored to the specific needs of each beginner farmer; all are provided with ongoing support to further develop and implement their farm business plans. One pathway is to begin their farm business on incubator plots at the Rutgers Specialty Crop Research and Extension Center.

First-year students in the program receive the following:

- Nearly 40 hours of online video lectures and training.
- “Office hours” Q&A interaction with program staff every two weeks
- At least 4 in-person farm tours of 4-6 hours each

- As-requested meetings with program staff to discuss business plans, evaluate farm properties, and ask questions about course content.

Second-year students receive the following:

- At least 200 hours of on-farm training as part of the year 2 CSA Training program
- 20 hours of online check-in and crop planning sessions as part of year 2
- As-requested meetings with program staff to discuss business plans, evaluate farm properties, and ask questions about course content.
- Ongoing discussion threads and chat groups with program staff and peers where they can share resources, ask questions, and coordinate farm activities.

Third-year students receive the following:

- Support and feedback to develop and implement their farm business plans
- Assistance with placement in agricultural job opportunities
- Opportunity to apply to rent a  $\frac{1}{4}$  or  $\frac{1}{2}$  acre plot to begin their farm business under program guidance

During the 2024 year, the third consecutive Phase 2 cohort of students worked together with each other and the program staff to plan and implement a functional farm business on the program-designated 1-acre plot of land at the Rutgers Specialty Crop Research and Extension Center in Cream Ridge, NJ. This portion of the program ran from February through October, with weekly online planning meetings and in-person work and training days at the farm. Each student was responsible for researching and managing the production of three crops. During the summer months, the students worked on the Cream Ridge farm a minimum of one day per week to manage their crops; the whole group then worked together to bundle harvests into Community Supported Agriculture (CSA) style bagged produce shares. 5,800 lbs of produce were harvested during the 2024 season, and over 600 lbs were donated to local food pantries. A typical weekly farm share included a variety of leafy greens, vegetables, fruits, and cut flowers. The students learned to utilize integrated pest management practices, which minimized pesticide use. The Phase 2 students continued to harvest and maintain their plots after the conclusion of the CSA.

Based on participant feedback and research conducted on other beginner farmer training programs, the main keys to success for our participants have been the continued program support and the strong community building that is fostered through program activities.

There are several excellent programs that offer education and resources to beginner farmers, but they often take the form of brief workshops that only cover a limited breadth

of information. While these workshops are important and an extremely valuable resource, the program team has learned that beginner farmers who are starting from scratch require more long-term and involved guidance to maximize their chance for success. The RU Ready to Farm program is structured to offer this type of long-term support. Phase 1 of the program involves about five months of online lessons, assignments, and meetings to give beginner farmers a solid educational foundation. They are then able to build on that foundation and apply their knowledge in the real world during the phase 2 hands-on training. By taking participants through an entire farming season, from production planning and seed purchasing all the way through field cleanup and winter preparations, participants learn about every aspect of a farming season and gain a realistic understanding of the time and labor commitment that farming entails. In phase 3 of the program, participants are able to rent a plot of land to test out their farm business plan with frequent support and feedback from program staff. This is a crucial step for beginner farmers before buying or renting land of their own, as it allows them to learn from their mistakes and make adjustments to strengthen their farm business plan while in a lower-risk environment. Even if participants do not take part in phases 2 and 3 of the program, they still have access to all program materials for life and are able to reach out to program staff any time for guidance and support.

Participants of the RU Ready to Farm program also frequently mention the community built through the program as one of their main keys to success. Starting to farm can be an overwhelming and isolating journey for beginner farmers. The RU Ready to Farm program offers several avenues through which beginner farmers can connect with one another and begin to form their own community. Starting in phase 1, the first course assignment is an introduction and summary of each participant's farming goals; this allows participants to find other beginner farmers who have similar goals. The farm tours during the summer months provide a chance for participants to meet each other in person and begin to connect. The process of working together for an entire farm season during phase 2 has created a remarkably strong community each year. Even after the conclusion of phase 2, continuing support and community is fostered by the program Discord chat server, which was created to provide participants an easy way to keep in touch and maintain easy access to program staff as they continue on their farming journey. The Discord chat server has flourished into a valuable resource for beginner farmers to share opportunities, ask questions, and provide emotional and mental support for each other.

Over the past four years, the RU Ready to Farm Program has delivered 6,834 hours of in-person training and 3,369 hours of online educational meetings. The program has won multiple national awards, garnered the attention of news and media outlets, including a national feature on CBS News, and has directly impacted 188 beginner farmers.

## **SADC Next Generation Farmer Program Update**

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The SADC is actively developing a Next Generation Farmer Program to help new and beginning farmers address the challenges they face when getting started and establishing viable farming operations.

The overall goal is to not to duplicate existing efforts but rather collaborate with partners to create a coordinated, comprehensive system to identify, train, equip, and support the next generation of farmers in New Jersey. This includes providing support to a diverse range of potential next generation farmers in New Jersey, including those from farm families, newcomers from non-farming backgrounds, veterans, women, urban growers, and others in historically underserved communities.

The program is currently working to develop a detailed report on the challenges and barriers faced by next generation farmers, the current landscape of support, and recommendations for addressing the challenges and enhancing support.

Please reach out to the program coordinators share your thoughts, or fill out a survey at <https://www.nj.gov/agriculture/sadc/nextgen/surveys/>.

The report's recommendations will be based on an analysis of the major obstacles and opportunities and could include the development of new programs, resources, and partnerships, as well as changes to policies, regulations, and statutes that could improve overall agricultural viability in New Jersey. The report is expected to be completed in Spring 2025.

The Next Gen team is conducting ongoing outreach to the agricultural community to get stakeholder feedback and help guide the development of the program. This includes connecting with new and beginning farmers from all backgrounds, established farmers, agricultural service providers, government entities, non-profits, and others involved in New Jersey agriculture. Dozens of farmers, service providers, government officials, and others have provided input so far, with additional feedback being gathered every week through in-person and remote interviews as well as surveys, focus groups, and meetings. Additionally, the program is also researching beginning farmer programs from across the country to identify successful models that could be adapted to New Jersey.

In addition to these outreach and research efforts, Next Generation Farmer Program is also providing a number of services including:

### **Direct Assistance**

- The program provides direct assistance to next generation farmers through resource referral, technical assistance, networking connections, and farm visits.
- If you are a new or beginning farmer who is in need of assistance and is not sure where to turn, please reach out to the Next Gen Program team.

### **NJ Land Link**

- NJ Land Link is an interactive website where farmers and landowners can search listings of farming opportunities available/sought, create a listing for themselves, and connect with other farmers and landowners regarding those opportunities.
- New users who register on NJ Land Link and who request a follow-up to discuss resources will get a call from Next Gen Program staff to discuss their farming plans and to share resources and contacts relevant to their specific needs.

### **Collaborative Events**

- The program is working to collaborate with and support the efforts of agricultural partners, including those who are already working on next generation farmer issues. Collaborative events will be posted on the SADC Next Gen site, <https://www.nj.gov/agriculture/sadc/nextgen/>, and through social media.

### **Resources**

- The program maintains and updates several pages of resources for farmers and landowners.
  - <https://www.nj.gov/agriculture/sadc/farmlink/resources/newfarmers>
  - <https://www.nj.gov/agriculture/sadc/farmlink/resources/farmtransition>
- Additional resources will be developed over time, including an expanded central clearinghouse of resources for next generation farmers.

If you have any questions about getting started in farming, establishing and maintaining a farm business, connecting with organizations, finding resources, using NJ Land Link, or other topics, please reach out to the Next Gen Program team.



## USDA FSA Resources and Programs for New and Established Farmers

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The Farm Service Agency is an agency within the United States Department of Agriculture that provides programs and loans to assist farmers, ranchers, and agricultural partner organizations. Farm Service Agency is equitably serving all farmers, ranchers, and agricultural partners through the delivery of effective, efficient agricultural programs for all Americans. FSA provides a variety of programs and types of assistance to aid different types of agricultural operations in order to provide food, fuel, and fiber to millions of people worldwide.

Within FSA, programs are designed to assist all farmers, including beginning farmers, military veterans, and socially disadvantaged and historically underserved producers. A beginning farmer or rancher is an individual or entity who has not operated a farm or ranch for more than 10 years. For a loan application, the producer must meet the eligibility requirements for the program which they are applying for, and in the case of a Farm Ownership loan, not own a farm greater than 30% of the average farm size in their county. A socially disadvantaged applicant is one who is a member of a socially disadvantaged group whose members have been subjected to racial, ethnic, or gender prejudice because of their identity as a member of a group, without regard to their individual qualities; SDA groups are African Americans, American Indians, Alaskan Natives, Hispanics, Asians, Pacific Islanders, and Women. A veteran farmer or rancher is an applicant who has served in the Armed Forces (as defined in section 101 (10) of title 38) and who has not operated a farm or ranch for more than 10 years total or has obtained status as a veteran (as defined in 38 U.S.C. 101 (2)) during the most recent 10-year period. For entities requesting to be considered a veteran farmer or rancher, at least 50% of the interest must be held by veteran farmers or ranchers.

FSA has county offices across the state to service all of New Jersey. Our county offices are located in Hackettstown (Warren County), Frenchtown (Hunterdon County), Freehold (Monmouth County), Columbus (Burlington County), Woodstown (Salem County), and Vineland (Cumberland County). Our online Service Center Locator has a map of the offices, and will assist you in finding out which office services your area.

FSA offers farm loans designed to provide supervised credit to those whose needs are not met through commercial lenders. The agency offers Direct Loans through FSA as well as guaranteed loans through commercial agricultural lenders. Applicants must be unable to obtain sufficient credit elsewhere, be a citizen or legal resident alien, possess legal capacity to incur the loan obligation, have acceptable credit history, be the owner-operator or tenant-operator of a family farm, and possess appropriate agricultural experience for the type of loan requested. Additionally, operations must be considered an eligible enterprise.

FSA offers direct Farm Ownership Loans, Farm Operating Loans, and Emergency Loans. Farm Ownership Loans may be used to purchase farmland, as well as to construct or repair buildings. A maximum loan amount of \$600,000 may be requested in direct Farm Ownership funds, with a maximum term of 40 years. Interest rates are fixed for the term of the loan. No down payment is required, but can optionally be made to lessen the collateral required for the loan. For beginning, veteran, or SDA producers, a 5% down payment may also be made as part of a Down Payment Farm Ownership loan, in which FSA may only provide a portion of the funding for the operation but which can offer lower interest rates. Farm Operating Loans may be used for 1-year annual operating purposes or may be multiple-year term loans for other loan uses. Loan funds may be used to purchase items such as livestock, farm equipment, fuel, chemicals, feed, insurance, and other purposes. A maximum of \$400,000 may be requested through a Farm Operating Loan. Interest rates are fixed for the term of the loan, and terms may range from 1 to 7 years. Emergency loans are also available to assist with physical or production losses as the result of a disaster. Up to \$500,000 may be requested through Emergency Loan assistance.

Loans up to \$50,000 qualify as Microloans, which are designed to be simplified, accessible, and flexible. Microloans are available for farm operating and farm ownership purposes, and have accessible eligibility requirements for applicants.

FSA also offers a variety of Farm Programs which provide price support, emergency assistance, assistance for organic producers, and more. These programs are also available through your local Service Center. Program requirements and benefits vary, but a number of programs offer benefits specifically for beginning, veteran, and socially disadvantaged farmers and ranchers.

## GRANT OPPORTUNITIES FOR NEW AND ESTABLISHED FARMERS

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### Introduction

The New Jersey Department of Agriculture offers a variety of grant programs to support projects pertaining to agriculture, conservation, rural development and other relevant agricultural focal points in the State of New Jersey. These programs are designed to fund projects with clear, identifiable objectives and outcomes, supported by existing farm operations and/or established organizations who operate within the NJ agricultural landscape.

The goal of this presentation and associated proceedings article is to provide new and established farmers with the tools to compete for funding made available by state grant programs. Much of the discussion below can be summarized as a broad, 30,000 ft. view of the agricultural grant landscape. Such a discussion is crucial in order to better understand the level of commitment needed from applicants looking to pursue grants offered by the NJDA and other government funders. Included in this article: tips and suggestions to consider when applying for state grants, a brief listing of current and forecasted grant programs, and examples of state-funded grant projects from different agricultural industries.

### Getting Started: Preparing your Organization for a Successful Grant Application

The key to any successful grant application is organization, organization, organization. Since the average grant application period is roughly 2-3 months, it is important that essential project and/or business information is organized ahead of time. Depending on the program, this could include permits, licenses, estimates for proposed project expenses, and other supporting business documentation.

All grant programs offered through State, Federal, or philanthropic organizations have explicit guidelines for how you must apply. These guidelines vary program-to-program, but are typically listed in the Request for Applications (“RFA”), Request for Proposals (“RFP”) and/or Notice of Funding Availability/Opportunity (“NOFA/O”). It is imperative that you check every “box” and submit all required documentation as outlined in the above program document, as funders will disqualify your application if certain required materials are omitted.

Along with organization, it is important that new and established farmers, first-time grant applicants and even seasoned grant veterans, understand what the grant program aims to fund. Ensuring your project aligns with the intent of the program, its priorities and its eligibility requirements *before* you even begin your application will save you from applying for a grant you were never eligible for. A useful tool to use when reading program documents is to click “CTRL -> F”, then search for keywords such as “eligibility”, “allowable costs”, “apply” etc. to determine best fit.

In summary, each grant program will present a unique set of requirements, funding priorities, scope of work, and allowable activities. However, the more you familiarize yourself with the grants process, the quicker you will be able to discern your eligibility, and draft compelling, qualified projects that have a greater chance of being funded through any given program.

### **Current and Forecasted Grant Programs – NJDA**

Every year, the New Jersey Department of Agriculture (NJDA) offers a variety of programs to fund a variety of different activities. Funding for these programs comes from either State funding or from USDA cooperative agreements or specified appropriations.

*Note: Pilot or novel grant programs are often introduced into NJDA's grant offerings yearly. Check the NJDA's Grant's webpage often to keep up to date with the latest grant opportunities.*

Below is a list of current and forecasted grant programs that are offered for new and/or established farmers.

#### **1. Specialty Crop Block Grant Program (SCBGP)– USDA / NJDA**

The U.S. Department of Agriculture (USDA), Agricultural Marketing Service's (AMS) Specialty Crop Block Grant Program (SCBGP) awards states such as New Jersey with funding for projects up to \$40,000 (no-cost share) that aim to enhance the competitiveness of specialty crops. Specialty crop producers are defined as those who produce vegetables and fruits, including grapes for wine, nuts, horticultural products including Christmas trees, honey, herbs, potatoes, sweet corn, and other specialty crops.

Projects can request funding for activities such as research, promotion, marketing, nutrition, trade enhancement, food safety, food security, plant health programs, education, "buy local" programs, increased consumption, increased innovation, improved efficiency and reduced costs of distribution systems, environmental concerns and conservation, product development, and developing cooperatives.

The USDA encourages states to fund projects that benefit small farms, new and beginning farmers, underserved producers, veteran producers, and/or underserved communities.

Eligibility is defined by USDA, and applications are open to a variety of different organization types. However, the strongest, and often most frequently funded applications are submitted by organizations whose projects have an impact greater than their own operation. As a new farmer, we recommend partnering with a larger farm or organization who can successfully lead your grant project.

*SCBGP opens in Early 2025, and typically closes at the end of March-early April.*

#### **2. Underserved, Beginning and Military Veteran Farmer Mini-Grant Program - NJDA**

The Underserved, Beginning and Military Veteran Farmer Mini-Grant Program (UFN Mini-Grant) is a no cost-share grant program funded through New Jersey's existing USDA Specialty Crop Block Grant. The purpose of the program is to fund grant projects that enhance New Jersey's specialty crop industry through our community of underserved farmers, including those who are Socially Disadvantaged, Beginning or Military Veteran farmers of Specialty Crops in the state of New Jersey.

Grants are available for qualified businesses and producers who seek to develop projects that will increase production, marketing, and research of specialty crops. To qualify, organizations must be majority-owned (51% or greater) by individuals who identify as either Socially-Disadvantaged, Beginning, or Veteran Farmers. This is verified by a self-certification process via the applicant.

Projects can include activities such as: Researching new cultivars, providing outreach opportunities on specialty crops to youth, families, seniors, and the overall community, marketing specialty crops through a targeted promotional campaign, hiring personnel, purchasing special purpose equipment, holding an educational workshop, planting specialty crops, and distributing product promotional materials.

The UFN Mini-Grant has funded over 60 farms and farm organizations, with over \$295,000 in funding administered over the last year.

*A final Request for Proposals (RFP) will be announced in early 2025.*

### 3. Wildlife Fencing Grants (Unpreserved Farmland) – NJDA

The NJDA Wildlife Fencing Program makes cost-share funding available for the installation of wildlife fencing on unpreserved farms. Unpreserved farm owners, operators, or tenants in New Jersey may receive up to 50 percent matching funds (\$50,000 maximum) if their application is approved.

Grants are awarded on a first-come, first-served basis until all funds for each fiscal year are expended. Applicants who operate but do not own the farmland described in their application must receive written authorization from the landowner to install wildlife fencing on the land.

*Applications can be submitted at any time. Funding will be awarded on a rolling basis.*

#### **Examples of Grant Projects from New Jersey**

A common sentiment expressed by farmers and farmer groups who are either beginning farmers or beginning grant-writers is that they often have trouble understanding what a successful grant application, and thus a successful grant *project*, looks like in practice. Our grants team at the NJDA has read hundreds of applications for a number of different grant programs, and have developed a general idea of what works and what doesn't.

To see how applicants translated a basic need into the language of a successful grant, here are some examples of applications that received approval and funding to conduct some outstanding work for New Jersey's agricultural industry.

*Note: Even if you do not identify with the type of work conducted by the organizations listed below, pay close attention to the activities, partnerships and scope of work that were approved by the funding agency. This will help you craft compelling narratives to include in any grant application.*

#### Chickadee Creek Farm (CCF) – UFN Mini-Grant

##### **What they needed:**

Leafy greens wash station, including a spinner and bubbler.

***How they wrote it:***

CCF's gross sales are dominated by cut salad greens, such as spinach, mesclun, arugula, and baby leaf lettuce. These crops account for 20% of revenue. However, the current post harvest handling of these crops is time consuming and inefficient. Currently harvested products are dumped into a still-water tank to cool and rehydrate. A post-harvest slotted basket is used to push the product underwater, and thus minimally agitates the product through the water providing some rinsing. The product is then scooped into a large mesh bag which lines a slotted basket. The net bag with product is placed in a retrofitted top-loading washing machine and put on the spin cycle to spin out the excess water.

While this method has been examined by the RU Food Safety Team and received a reluctant passing grade, the system has several areas where improvement would increase the quality, safety, and marketability of this important crop category.

1. *Food safety* - the many bends in the product contact surfaces of the retrofit washers make sanitization challenging. The purchase of equipment meant for this purpose eliminates undue risk.
2. *Efficiency* - dedicated greens bubblers in the dunk tanks automate cleaning and reduce product damage as compared to our current methods. The dedicated greens spinners are time and force-specified for the exact purpose of greens drying and eliminated over-long spins or too-short spins.
3. *Quality* - rapidly cooling and minimizing handling improves the shelf life of the final product, and with the proposed equipment upgrades, the friction of the mesh net would be eliminated, the manual pressing of the product in to the dunk tank is eliminated, and the faster processing time allows the product to reach the cooler faster.

These improvements will allow us to market our cut greens as pre-washed and spun dry, increasing our sales potential and providing a model for local producers to adopt similar equipment into their operation. These improvements will allow us to improve our post-harvest efficiencies and increase our production of these important, but time-consuming, crops.

***What they did right:***

All CCF needed was new processing equipment for leafy greens. Instead of simply stating the need, they provided regulatory concerns about the existing operation, identified priorities from the program that their project would contribute towards, and discussed a larger impact outside of their own business.

*Franklin Township Food Bank – Specialty Crop Block Grant*

***What they needed:***

Funding for a registered dietician, and marketing materials to promote nutrition classes for food bank clients.

***How they wrote it:***

Access to healthy food is a hallmark of food insecurity. Understanding how to identify, cook and incorporate fresh fruits and vegetables as a lifestyle requires more than just access, it requires support, training and demonstration. The benefits of eating fresh, local produce is well-documented and the implications for preventive health, disease management, longevity, school performance and well-being are too numerous to mention. Unfortunately, for too many in the "Garden State," access and application are out of reach. Since 1975, the Franklin Food Bank has worked to meet the food needs of our neighbors. In recent years, we've partnered with several local farms, retailers and co-ops to bring fresh, seasonal and (as often as possible, local) crops into our Client Choice Market and community distribution packages.

With support from the State Department of Agriculture, Franklin Food Bank will contract with a registered dietitian to lead monthly nutrition classes with emphasis on cooking demonstrations. In addition, the dietitian will develop recipes and educational materials for distribution throughout our food outreach programs - putting this vital information into the hands of over 25,000 families and the community at large.

***What they did right:***

Franklin Township Food Bank clearly outlined their needs, their capability to execute the project, listed their requested expenses, and provided an estimated quantitative impact (25,000 families) as a result of their project.

# **Agriculture Technology**



## **A CONTAINER GROWN SYSTEM FOR BLUEBERRY (*Vaccinium Corymbosum*)**

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**Introduction** – Production problems in growing commercial high bush blueberries include declining farm soil quality, inadequate berry-land soil acreage matter, transplant problems with entrenched soil pathogens and rising costs of peat moss and nitrogen fertilizer.

After investigating container grown blueberry operations in South Africa, our initial Northeast US trials were located in Forked River, NJ and rooftops in New York City. Following our blueberry team's local research results and demonstrations, other container systems were initiated in commercial block in North Carolina and Florida, and a University trial in Ohio and are elsewhere in progress.

**Goals** - Our research and demonstration goals of economic and environmental sustainability for these container-grown blueberries were:

- A. Assess chemical, physical and biological status
- B. Baseline survey for soil and media health
- C. Chlorophyll efficiency and soil microbe quantification, identification and correlation
- D. Develop measurement tools and incorporate IPM monitoring
- E. Evaluate and observe crop growth and fruit production
- F. Foster farming practices with sustainable methods

**Methods** - This study compares a broad baseline analysis of established and newly transplanted highbush blueberry containerized above-ground in 15-gallon fabric bags. Primary aims and methods of measurement in our replicated study include:

1. Standard soil chemistry and media content
2. Solvita CO<sub>2</sub> soil respiration test for general soil health
3. Specific multi-species identification & soil biology via the Cornell Food-web lab system
4. Apogee Chlorophyll meter to assess photosynthetic efficiency
5. Growth observation and measurements of foliage and fruit

**Media mixes** included pine bark, Coco-coir, peat moss, native soil, sterile compost, organic fertilizer and microbial additions of beneficial bacteria and fungi. These mixes produced a very rich substrate for the blueberry rhizosphere compared to historical NJ Pinelands soils as Berry-land, Downer, Atsion, Evesboro Sassafras and Lakewood sandy soils used commercially. These new media mixes were also treated with a commercial blend of Ericoid mycorrhizal fungi versus a natural slurry of natural NJ Pinelands soils with centuries of wild/indigenous blueberry growth compared to an untreated check.

### **Preliminary Results**

1. The Solvita CO<sub>2</sub> respiration tool clearly showed containers had improved media health, higher microbial populations and fertility compared to native soils in the walkway and farm soil used in traditional commercial production.
2. The coco-coir based media mix showed good drainage and typical plant growth; similar to peatmoss-based media, both with compost and other materials.
3. The Apogee meter established baseline values for key cultivars and accurately correlated chlorophyll efficiency in the 400-500 micro-mole range with occasional crop problems being lower due to lack of weekly fertilizer or irrigation drip issues.
4. Transplanted 1- and 2-year-old organic blueberry stock of Duke, Legacy, Suzi Blue and Ventura trended to grow better with the native Pinelands soil slurry compared to the check and a commercial fungal blend from Oregon
5. The established 10-acre block of 8-year-old Duke, Legacy, Top Shelf and a test block of six new cultivars over the last 5 seasons yielded an annual farm total from 2019 to 2023 of approximately 10,000, 20,000, 40,000, 55,000 and 75,000 pounds marketable fruit, respectively.
6. The inclusion of high overhead retractable netting and IPM monitoring showed reduced insect and disease pressure with a limited agri-chemical program.
7. Pollination, leaf color, fruit set, Brix at harvest and taste were typically high in values; similar or better than typical in-soil commercial production.

# **Produce Safety**

**FOOD SAFETY MODERNIZATION ACT: PRODUCE SAFETY RULE (FSMA/PSR)  
AG WATER RULE – NEWLY FINALIZED AND VERY DIFFERENT FROM THE FIRST  
RELEASE OF THE RULE**

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There are two parts to the water rule (pre-harvest and harvest/post-harvest) and they are handled differently which I will review. Agricultural water must be safe and adequate sanitary quality for its intended use.

**Pre-Harvest Water**

The pre-harvest water (irrigation, spray water, frost protection, fertigation, dust abatement, etc.) requirements for the FSMA/PSR became effective on July 5, 2024, however this does not mean a grower needed to start complying on that date. Compliance dates are staggered over the next three years depending on the size of the operation.

<b>Size of Operation</b>	<b>Compliance Dates</b>
Operations over \$500,000	April 7, 2025
Small operations (> \$250,000-500,000)	April 6, 2026
Very Small operations (> \$25,000-250,000)	April 5, 2027

It is important to understand what is considered Agricultural Water. Water that is intended to or will likely touch produce is considered agricultural water. In the context of pre-harvest water that means any water you are using for irrigation, frost protection etc. that touches the harvestable crop. If you are using drip irrigation for staked tomatoes this is NOT agricultural water as the water is not touching the fruit. If you are using drip irrigation on carrots, this IS agricultural water, as the water is touching the crop. A grower needs to think about how each water source is used before they decide whether it is agricultural water or not.

Water testing is not a requirement for pre-harvest water but can be part of the agricultural water assessment of the whole water system. This means an inspector will ask the grower to explain their system and how they minimize risks to the covered crops.

Requirements for Inspecting and Maintaining Agricultural Water Systems

As part of the rule, growers must inspect the whole water system (pre-harvest, harvest and post-harvest) at the beginning of the season and make a written report. This includes:

- The water source (well and surface); the extent of the grower's control and how each source is protected. This includes knowing where all the water lines are located, checking for leaks and making repairs at the beginning of the season.
- Use of adjacent and nearby land (e.g., horse or cattle farm next door; runoff from roads). What is the possibility that this will impact a production field?
- If surface water is used (e.g., stream, lake, or pond)- what is the chance a food safety hazard could enter the water before it got to your farm? (e.g., dairy farm upstream where cows get in the stream).

### Requirements for Agricultural Water Assessment

**The rule requires that a pre-harvest water assessment must be completed at the beginning of the season, the assessment only applies to pre-harvest water use!**

The assessment must be written, dated and signed at the beginning of the season, annually or anytime major changes are made to the system or water source. The inspection report can be incorporated into the assessment. The initial assessment must identify conditions that are reasonably likely to introduce know or reasonably foreseeable hazards into or onto cover produce or food contact surfaces.

- Parts of the assessment
  - Location and nature of water source (e.g., ground water/wells, surface water/pond, stream, etc.)
  - How water is distributed (e.g., underground main, lay flat, canals, etc.)
  - How system is protected from contamination (animals, runoff from nearby land, manure applications, etc.)
  - How water is applied and time between last irrigation and harvest
  - Crop characteristics (e.g., waxy surface-cabbage, netted surface-muskmelons, etc.) and likelihood of surface adhesion or internalization of hazards.
  - Environmental conditions e.g. possible damage from frost, hail, blowing sand, sunburn, high temperatures, etc.)
  - Other factors - Water testing, but the assessment cannot be based just on water testing. It is only part of the assessment.

If the operation meets any of the following, they can be exempt from performing a water assessment.

- No untreated surface water applied.
- Untreated groundwater is tested following the protocol for harvest and post-harvest water (four samples the first year for generic E. coli and one sample every year after if no generic E. coli is found).
- Public water system water use.

- Water is treated, monitored and to be of a safe and adequate sanitary quality.

### **Outcome from the assessment**

Based on the assessment there are several options for reducing risks. If the water source is not safe or is not of adequate sanitary quality, you must stop use immediately and take one of the following corrective measures or mitigation measures.

1. If the problem is related to biological soil amendments of animal or human origin on adjacent or nearby land, mitigation measures to stop and prevent the contamination must be implemented the same growing season (e.g., building a berm around the field to avoid runoff from a horse pasture).
2. Any other conditions not related to animal activity impacting the quality of the water must be remediated as soon as practical and no later than the following year. The other option is to test the water source as part of the assessment and implement changes if needed.
3. If no know or foreseeable hazards have been identified, the system should be inspected and maintained with a new inspection at least annually.

Corrective measures are activities that must be taken before using the water source. Such as re-inspecting the water system making and verifying any changes or treating the water following FSMA/PSR standards.

Mitigation measures can take many forms including making a repair, increasing the time from the last irrigation to harvest, die off rate, changing the water application method or source, etc.

### **Harvest and Post Harvest Water**

FDA defines harvest and post-harvest agricultural water as water used in harvesting, packing, and holding activities, such as water used to prevent dehydration, for transport, cooling and washing. This includes water used to make ice that contacts covered produce or food contact surfaces and water used for handwashing.

The rule is now in affect for all uses that fall under the Produce Safety Rule. Inspectors will want to review the inspection report.

As with the pre-harvest water, the harvest and post-harvest water system must be evaluated at the beginning of the season. This is to insure there are no leaks or parts that may be contaminated prior to use. This inspection must be written, dated and signed off by a supervisor. Also, for the first year four water sample must be collected and tested for generic E. coli before use. The results must show no detectable E. coli for the four samples. After the first year only one sample is required as long as there is no detectable generic E. coli. If the one sample does have detectable generic E. coli, then four samples must be collected.

If the water source/distribution system is found to be unsafe the operation must immediately stop using it, reinspect the entire system under the grower's control, make necessary changes or treat the water with approved an antimicrobial material. The

treatment must meet the no detectable generic E. coli standard and monitored to ensure it is maintained. The same exemptions apply to harvest and post-harvest water as under pre-harvest water.

There are additional water management and monitoring requirements for harvest and post-harvest water including:

- Establishing a water change schedule for non-single-pass water
- Visually monitoring the water for buildup or organic material
- Maintaining and monitoring the water temperature that is appropriate for the commodity to reduce the chance of infiltration of microorganisms.

#### Additional Information

FSMA Final Rule on Produce Safety:

<https://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm334114.htm>

• FSMA Produce Safety Rule, Subpart E- Agricultural water (§§ 112.40-112.50)

<https://www.ecfr.gov/current/title-21/chapter-I/subchapter-B/part-112#subpart-E>

• FSMA Final Rule on Pre-harvest Agricultural Water <https://www.fda.gov/food/food-safety-modernization-act-fsma/fsma-final-rule-pre-harvest-agricultural-water>

• Equivalent Testing Methodologies for Agricultural Water <https://www.fda.gov/food/laboratory-methods-food/equivalent-testing-methodology-agricultural-water>

# **Blueberry Production**



## INFESTATION AND PARASITISM RATES OF SPOTTED-WING DROSOPHILA IN NON-CROP HOSTS: IMPLICATIONS FOR MANAGEMENT

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Spotted-wing drosophila (SWD), an invasive fruit fly native to Southeast Asia, has posed significant challenges for small fruit crops since its introduction to the continental United States. It was first detected in California in 2008 and in the northeastern United States by 2011. SWD primarily targets blueberries, raspberries, blackberries, and strawberries, making these crops especially vulnerable. Its arrival triggered extensive research to develop integrated pest management (IPM) strategies, including biological control measures.



Fig. 1. *Ganaspis kimorum*, a parasitoid of SWD. Photo by Kent Daane.

In its native range, SWD is not considered a major pest, largely because of effective biological control agents that suppress its populations. However, in invaded regions like the United States, SWD lacks these natural enemies.

Compounding the problem, SWD larvae possess a strong immune response, enabling them to evade parasitoids found in these areas. As part of a biological control program, researchers at the USDA's Beneficial Insects Introduction Research Unit in Newark, DE, identified potential natural enemies for safe introduction to the U.S. Among these, the parasitoid *Ganaspis kimorum*, a small wasp native to Asia (Fig. 1), emerged as a promising candidate due to its narrow host range. In 2019, regulatory authorities approved its release in the U.S. Interestingly, the same year, *G. kimorum* was discovered inadvertently in British Columbia, and by 2021, it was found in Washington State. *G. kimorum* targets SWD larvae by laying eggs inside them. When parasitized, instead of an adult SWD emerging, an adult wasp emerges, effectively disrupting SWD population. This wasp is highly specific to SWD and, unlike existing parasitoids in the United States, can overcome the fly's immune defenses.

Our goal is to release *G. kimorum* in wooded areas on farms containing wild host plants, where SWD overwinters and disperses in spring, and assess its establishment in NJ. By establishing populations of *G. kimorum* in these habitats, we aim to reduce SWD numbers migrating to cultivated crops, potentially delaying the need for chemical sprays and, over time, minimizing their use altogether.

### Release of *Ganaspis kimorum* in New Jersey

In a collaborative effort between Rutgers University and the New Jersey Department of Agriculture's Phillip Alampi Beneficial Insect Rearing Laboratory, a total of 25,000 *G.*

*kimorum* wasps have been released in non-crop habitats surrounding 15 commercial blueberry farms in Atlantic and Burlington Counties (Fig. 2). These releases occurred during June, July, and August from 2022 to 2024.

### Establishment of SWD Parasitoids in New Jersey

From 2022 to 2024, surveys for SWD parasitoids were conducted from June through September. Three methods have been employed to evaluate parasitoid establishment: 1) Sentinel traps baited with SWD-infested fruit; 2) Direct collections of wild fruits from non-crop areas surrounding the farms; and 3) Scentry-baited traps, used in 2024, were included to assess their attractiveness to SWD parasitoids.



Fig. 2. Mass releases of the SWD parasitoid *Ganaspis kimorum* near blueberry farms in southern New Jersey. Left: vial containing the wasps; Right: MS student Jack Collins. Photos by Max Leavitt-Shaffer.

Our findings indicate low establishment of *G. kimorum* thus far. However, during these surveys, we discovered the presence of another Asian parasitoid, *Leptopilina japonica*, which has been detected consistently across all years of sampling. These results suggest that adventive populations of *L. japonica* are already widely established in New Jersey.

### Future Plans

We plan to continue releasing *G. kimorum* and monitoring its establishment in New Jersey. We will analyze data from previous releases to refine release strategies and optimize conditions for parasitoid establishment. Additionally, we aim to expand monitoring efforts to include more farms and habitats to better assess *G. kimorum*'s impact on SWD populations and its interaction with adventive parasitoids like *L. japonica*.

### Acknowledgements

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## NEW APPROACH TO EXPLORING THE BLUEBERRY UNDERGROUND

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The soil in the root zone (rhizosphere) of plants and the organisms that grow within it have been shown to be critical contributors to plant health. Blueberry health in New Jersey has declined in some fields ('bad' soils), while other fields continue to be productive ('good' soils). Members of the 'Blueberry Soil Health' team are studying the variation in good vs. bad soils as this is the first step in developing approaches to remediation.

The team is multidisciplinary and covering a host of soil characteristics (e.g. pH, organic matter, drainage, fertility) and developing bioassays to better characterize the soils in terms of their effects on plant health.

My group is specifically interested in characterizing the living organisms in the rhizosphere of blueberry plants growing in good vs. bad soils. These organisms together make up the rhizosphere microbiome. Traditional methods of exploring the microbiome include culturing, microscopic examination, and more recently, targeted sequencing of the bacteria and fungi in the soil. Each of the traditional methods has drawbacks. Some of these drawbacks can be alleviated using an approach called shotgun metagenomics. This technique provides DNA sequence data from all the organisms in a rhizosphere sample. Data can be analyzed to determine what organisms are present, their relative abundance, and their biological activity.

We processed samples from 12 fields with contrasting soil health as well as a forest sample control. Total DNA was isolated from all samples and processed for shotgun metagenomic sequencing through a company specialized in providing services for these assays. In preliminary analyses of the data, we have determined: fungal composition, ericoid mycorrhizae levels, bacterial composition, and nitrogen cycling genes that are active in the soil. Details will be discussed at the convention.

# **Direct Market Tool Box**

## LEVERAGING ARTIFICIAL INTELLIGENCE TO ENHANCE FARM DIRECT MARKETING

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Artificial Intelligence (AI) technology offers promising solutions for marketing challenges that farms and agricultural businesses face. By leveraging AI, direct farm marketers can improve their marketing strategies, enhance customer engagement, and streamline operations to increase productivity and profitability. AI is a valuable tool in the marketing toolbox, helping to understand market trends better, personalize outreach, and make data-driven decisions.

Artificial intelligence is “the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings” (Britannica). AI has existed as a field of study for several decades, tracing its roots to the work of Alan Turing. You are probably familiar with the following examples of products that many of us use in our everyday lives and that use AI.

- Siri, Alexa, and other smart assistants
- Self-driving cars
- Google searches
- Conversational bots on websites
- Email spam filters
- Netflix recommendations

Marketing is both an art and a science. Creativity is needed to develop marketing content that resonates and engages with the desired consumer segment. Analytical skills are necessary to study marketing trends and determine the effectiveness of marketing strategies. For small and farm businesses with only a few people responsible for operating and managing all aspects of the business, dedicating sufficient time to marketing can be a challenge.

There are AI tools to assist with all aspects of marketing – content creation (text/copy, image, video, and music), scheduling, market research, data analysis, and communication, to name a few. Having an AI tool at hand can be very useful for anyone whose strength is not in marketing or those simply pressed for time. For instance, with artificial intelligence (AI) tools it is possible to quickly generate content in a matter of seconds, freeing business owners or employees to focus on other tasks. Additionally, AI tools can quickly generate content for use in various marketing formats – from long-form articles and blog posts to concise text for tweets or as part of a Facebook post. For cash-strapped businesses, utilizing AI can be a cost-effective option compared to hiring marketing consultants or developing an in-house marketing department.

### AI Tools

Abundant AI tools exist for various purposes and continually evolve while others are developed. Some of the AI tools, by function, that can be used for farm direct marketing include:

**Audio & Video** – Designs.ai, Canva, Vidyo.ai, Descript, Adobe Firefly

**Design** - Canva, Adobe Express, Designs.ai

**Content Generation** – ChatGPT, Gemini, Designs.ai, Meta AI, Castmagic, Swell AI

**Social Media** – Sprout Social, CoSchedule, ContentStudio

**Images** - Dall-E, Meta AI, Craiyon, Canva, Shutterstock, Adobe Firefly, CoPilot

**Research** – Perplexity.ai, ChatGPT, Gemini, CoPilot

**Competitive Analysis** - crayon.co, Klue, Brandwatch

You may already be familiar with several of these tools, even if you have not yet tried using them for your farm marketing.

### Marketing Application Example

Since it can be helpful to see examples of how AI can be used, let's look at a marketing scenario and the use of ChatGPT. ChatGPT, a language model developed by OpenAI, is among the most popular platforms currently available. It is designed to understand and generate human-like text based on the input it receives. There are both free and paid versions available.

Here is an example of using ChatGPT (2024) for a marketing task to generate ideas for social media content.

**Prompt:** Give me 10 ideas for Facebook posts to promote a u-pick strawberry patch

**ChatGPT:** Sure! Here are 10 engaging Facebook post ideas to promote your u-pick strawberry patch:

1. **Opening Day Announcement:** "We are excited to announce the opening day of our u-pick strawberry patch! Join us this Saturday for fresh, juicy strawberries straight from the field. 🍓🌞  
#FreshFromTheField #StrawberrySeason"
2. **Photo Contest:** "Share your favorite photo from our strawberry patch for a chance to win a free basket of strawberries! 📷🍓 Don't forget to tag us and use #BerryBestPhotos."
3. **Family Fun Day Event:** "Bring the whole family for a fun day at the strawberry patch this weekend! We have face painting, games, and, of course, delicious strawberries to pick. 🍓👨👩👧👦 #FamilyFunDay #StrawberryPicking"
4. **Recipe Sharing:** "What's your favorite way to enjoy strawberries? Share your recipes with us! Here's a delicious strawberry shortcake recipe to get you started. 🍰🍓 #StrawberryRecipes #Yum"
5. **Behind the Scenes:** "Ever wonder how we keep our strawberries so fresh and tasty? Check out this behind-the-scenes look at our daily farm activities! 🚜🍓 #FarmLife #BehindTheScenes"
6. **Customer Spotlight:** "Meet Jane, one of our regulars who has been picking strawberries with us for 5 years! 🍓❤️ Tell us your strawberry picking stories in the comments! #CustomerSpotlight #BerryLoyal"
7. **Special Discounts:** "Midweek special! Come pick strawberries on Wednesday and get 10% off your total purchase. 🍓👛 #MidweekSpecial #FreshSavings"
8. **Health Benefits Post:** "Did you know strawberries are packed with vitamins and antioxidants? 🍓💪 Read more about the health benefits of our fresh strawberries here! #HealthyLiving #BerryGoodForYou"
9. **Sunset Picking Event:** "Experience the magic of sunset picking at our strawberry patch. Join us this Friday evening for a unique and beautiful picking experience. 🌅🍓 #SunsetPicking #EveningHarvest"
10. **Seasonal Updates:** "Strawberry season is in full swing! Keep an eye on our page for updates on the best picking times and the sweetest spots in the patch. 🍓🌟 #StrawberrySeason #FarmUpdates"

*These posts should help engage your audience, promote your u-pick strawberry patch, and encourage more visitors to come and enjoy the experience.*

The generated results provide ideas on topics to post about, as well as suggested language for posts which could be used as is or edited to match the ‘voice’ of the business and suggestions for other marketing content (e.g. the vague reference to a blog or webpage in #8). While this example was performed for an imagined strawberry operation, other farm businesses could easily adapt and apply the suggestions.

### **AI Limitations and Considerations in Use**

While the potential uses for artificial intelligence are vast, there are several limitations that anyone considering it should be aware of.

- **AI can generate incorrect or cite inexistent data and/or sources.** It is critical to check the accuracy of generated content. It can be risky, for example, to rely upon AI to provide correct information on current regulations about the licensing and sales of food products in your geographic area. Thus, caution should be used when asking for increasingly detailed information. Further, since AI tools may not disclose the sources of information for the content generated, there is the potential that output includes copyrighted or plagiarized material. While AI tools have begun incorporating citations, these should also be verified.
- **AI results can be biased and/or unethical.** Bias in AI results can be the consequence of programmer bias and/or data bias. AI tool output may also be biased if the person training the tool has a bias that impacts the choice of data used in development. Additionally, the bias is embedded in much of the real-world data used to train AI tools.
- **Overreliance.** It is important not to become dependent on AI. While its use has many benefits, it is crucial to review the outputs and results generated to determine accuracy and appropriateness. Overreliance on AI can also result in the loss of job skills and empathy when faced with in-person interactions.
- **Privacy concerns.** The use of AI can raise concerns about privacy as it collects large amounts of personal data, such as location, social media activity, information on expenditures, etc. This content remains accessible to the tool for continued training, therefore caution should be used before entering private and personal data.
- **Brand dilution.** Savvy consumers and some of your target market will recognize AI-generated language and augmented photos. It’s important not simply to use the text output as generated verbatim. Your marketing must feel authentic to the consumer, so ensuring that the “voice” of your marketing content matches real life and your business’s brand is essential.

### **Tips for Using AI for Farm Direct Marketing**

If you decide to try integrating AI into business functions and activities, here are some tips for success:

- **Understand the tool.** It is important to understand the AI tool's functionality, including how it processes information. This will assist in determining the appropriateness of its application to each instance of use and the veracity of output.
- **Provide specific prompts.** When using AI, provide specific prompts to improve output. Numerous online guides and articles provide examples of how to best word prompts to generate the desired type of output. As you gain experience using an AI tool, you will also learn how to phrase prompts to generate desired output.
- **Be prepared to work through iterations of requests to generate a final product.** The accuracy and appropriateness of results improve with the level of information provided to the AI tool through prompts. Providing the “right” amount and type of information typically takes multiple tries, particularly if the user wants a highly detailed response specific to their operation.

- **Ensure accuracy of information.** AI output is only as good as the data on which it is trained. Therefore, ensure that the output generated in response to your prompts fits your understanding and knowledge of the topic.
- **Personalize output.** Even with prompts that are specific to your business and situation, responses should be tailored to fit your personal voice and brand before using in your marketing. Remember that consumers want to connect with businesses on a personal level, something that AI can't replace.
- **Transparency and citation.** There continues to be a discussion on when and how to cite AI-generated tools. Consider whether and under what circumstances you will indicate that AI is/was used. In situations where consumers or employees may expect a personalized experience, not sharing that AI is/was used may be viewed as a breach of trust.

Artificial intelligence can be a helpful tool, just as any number of tools. However, just because AI can be used does not mean it must or should be. A basic understanding of AI's potential opportunities and benefits is helpful, and it should be used with full awareness of its capabilities and limitations. Farm business owners should view AI as an additional tool in their toolbox, not a replacement for human experience, knowledge, and personal touch. The decision to use an AI tool or application should be made based on individual circumstances and goals, recognizing that these may change over time.

*Where trade names appear, no discrimination is intended, and no endorsement by Penn State Extension is implied.*

*Note: Portions of this content have previously been published on the Penn State Extension website.*

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# **Field Grown Cut Flowers**

## **Cut Flower Production and Marketing for Market and Events**

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### **Our Farm**

In addition to U Pick Peach and Apples we do U Pick Flowers, bunches of cut flowers, and floral design for weddings and events. We grow about an acre of cut flowers on plastic and source additional floral from various wholesale markets, co ops and flower farmer friends.

### **U Pick Cut Flowers**

When we originally started U Pick Flowers we priced per stem. We didn't get much traction until we switched to charging per cup. We use 32 oz plastic deli containers and charge \$12 per cup. We realize our pricing is low however we are priced at \$12 a cup for two reasons: the first being that the cut flowers is an add on to our U-Pick fruit and secondly we want to be a place that a family can come for an hour, have something to take home, get outside and spend less than \$20.

We provide visitors with the cup filled with some water and clippers that they return after cutting. They take the cup with them so the flowers make it home somewhat hydrated and alive.

### **Cut Flower Bunches**

- Standard bunches are 10 stems for pretty much everything minus large celosia we do 5 stem bunches.
  - These are wrapped in steak paper (coated paper that holds up to moisture and comes in fun colors like pink, burnt orange and black)
- For mixed bouquets we do 16-20 stems based on a recipe.
  - We have streamlined our mixed bouquets and do our 3 plantings based on what we need.
    - 3 marigolds (chedi)
    - 3 zinnias (queen lime series or benary series)
    - 3 strawflowers
    - 3 butterfly bush or frosted explosion or something with fluff
    - 3 smaller celosia
    - 1 center flower (sunflower, dahlia, larger celosia)
      - Occasionally sub in cosmos, salvia, statice, rudbeckia in place of strawflowers or fluff.

Seeds are sourced from Johnny's Seeds and Geo Seed.

We grow on black plastic with 2 rows per bed, 3 plantings per season.

## Weddings and Events

### Sourcing Floral

- Our Farm
- Wholesale Markets
  - Sieck Wright, Hightstown, NJ
  - Pennock Pennsauken, NJ
  - Halex (order through Sieck Wright and it gets shipped there)

### CRM (Customer Relationship Management) Program

With weddings and events you'll need contracts, to have an easy stream of communication and also be able to take payments

We use Honeybook. Everything goes through Honeybook from start to finish. The pipeline starts with an inquiry then moves to menu of services, from there proposal, contract, payments and payment reminders. You can automate as much or as little as you'd like.

### Starting out and Styled Shoots

I wise woman once said, "Look busy even if you aren't busy."

Styled shoots are where everyone involved donates their time and expertise. These are very expensive for florists but can be a good way to build a portfolio.

## Types of Weddings and Events

- DIY Pick Up Brides (\$)
- A la Carte Pick Ups (\$-\$\$)
- Basic Full Service Personals/Centerpieces/Candles (\$-\$\$\$)
- Full Service with large Installations (\$\$\$\$-\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$)

## Wedding Week Overview and Workflow

- Monday
  - 2 Mondays before/ 12-13 days prior order flowers
  - Monday of, double check we have all hardware and supplies
- Tuesday
  - Clean buckets
- Wednesday
  - Pick up flowers/Pick flowers
  - Cleaned and processed

- Separate out bouquet flowers
- If Friday wedding start design work
- Thursday
  - Centerpieces and bridesmaids bouquets
    - If Friday wedding you're doing it all!
- Friday
  - Bride's Bouquet
  - Any free-standing pieces for ceremony/reception greened
  - Hard goods packed
- Saturday
  - Boutonnieres and Corsages
  - Go Time!!!!!!!!!!!!

## **Pricing**

- 3-5x's wholesale price on floral per stem
- 1.5 - 2.5x's on hard goods
- pricing per foot
  - garlands, table runners based on how many flowers but \$20-\$250 per foot
- Bridal Bouquets \$175-\$350
- Bridesmaids \$90
- Boutonnieres \$16
- Corsages \$30

## **Classes**

Classes are a fun way to use your floral expertise!

Some classes I've done:

- Thanksgiving Centerpiece
- Galentine's Day Centerpieces
- Wreath Workshops

- Mother's Day Floral Garden for Liquor Bottle at a Distillery

Some other class ideas:

- Hand tied bouquets
- Boutonniere/Corsage Making
- Big installations
- Flower Crowns/Wearable Floral

## Field Grown Cut Flower Pesticide Program Implementation and Considerations

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Designing a pesticide regime must consider numerous factors that target both anticipated and perceived threats to plant production. This can seem overwhelming and lead to the use of more, or less, materials than are required to solve a particular suite of pest issues. In the world flower production pollinator health and safety must be a high priority. Chemical use does not guarantee complete pest management, rather incorporation of pest awareness, damage thresholds / tolerances, historic information, cultural practice modifications, chemical mobility and application understanding, and ultimately lifecycle information, culminate into a successful regime. Ultimately, what are the targets, and how do the tools available work towards alleviating these issues.

To address the steps taken towards regime design and implementation a series of questions must be considered. Gathering knowledge about these issues, especially when are these pests critically controlled and what they look like will give an applicator more control than simply “spray and pray”. The below topics offer a stepwise approach that build upon each other to deliver acceptable pest management levels, while using the least, and least expensive materials that provide the safest working conditions and greatest ecological stability.

**1. What are the pest issues I am trying to mitigate?** Pest here refers to insects (aphids, caterpillars, weevils, borers, etc.), arachnids (particularly mites like two-spotted), diseases (bacteria, fungi, oomycetes, viruses, phytoplasmas), and weeds (that either compete for resources and or devalue products). Understanding where these pests overlap in management timeframes greatly aids in increased efficacy per management pass. Keeping good logs of this information year over year will greatly aid in troubleshooting why this issue has been a regular problem. Taking time to write out what the problems are, when they must be treated for, and overlaying this with when cut flowers will be planted, trimmed, and duration of saleable flower collection will start to frame the year into manageable periods.

Insect and arachnid pests - How and where do they feed- chewing, sucking, underground etc.? What is their lifecycle, when is the most important management timeframe, what do they look like at the critical control window, what do you do when you see the adults but no juveniles or eggs? The Rutgers Plant and Pest Advisory, Rutgers Pest Scouting Guides – Scouting with Growing Degree-days, and the University of Maryland Cut Flower Production page (see references) are great tools for this application. Does the pest migrate into the production area or overwinter in place? Does it overwinter in tubers or rhizomes and we, the producer, facilitate it spread year over year? Are we moving them throughout the production area? These questions are

all central to establishing what, when, and where a pesticide regime should be implemented.

Diseases - Has this disease been a problem before, which years or seasons? What is the host range of the disease? Many diseases have narrow host ranges, others not. What is the lifecycle, does this overlap with other regularly managed diseases? Note many diseases are active near bloom, again in the summer near drought or flood conditions, and again as the temperatures begin to cool in the autumn. Are the diseases at a management threshold? In the case of botrytis petal blight, this is a serious and immediate problem, whereas minor foliar anthracnose on lower foliage may not be a serious concern if the variety is close to exiting the profitable production season.

Weeds – What species are you dealing with? Can you manage these weeds with cultivation or design rows to accommodate mounted or hand operated cultivation tools? Where are they most prevalent if there are difference between fields, this should be noted with care not to move these populations to other production areas. Have control measures failed previously? Have you experienced phytotoxicity in host crops with specific herbicides? Have you noticed years with herbicide damage, versus others with no damage? All these factors come into play when designing crop layout, application methods, and material selection.

**2. What materials do I have or need?** Selection is principally addressed by understanding the spectrum of activity per material (what is the range of pests mitigated and labeled for on a particular material) and whether this lines up with actual and perceived pest threats within the management area or crop type. Additionally, how these materials move and how they can be applied is critical when implementing a management regime. For example, if white grubs or root diseases are the target, a material must either be amphimobile (xylem and phloem), phloem mobile, or be delivered directly to the root system through a drench. Residuals (how long does the material last, and through what conditions) and the worker restricted entry interval (REI) also play practical roles in chemical selection. For all materials, pesticide resistance should be managed through rotations of groups (FRAC, IRAC, HRAC) and the use of multi-site pesticides that “clean up” potential resistant populations. Remember spray by the numbers to avoid pesticide resistance.

Mobility of materials / translocation:

**Contact** materials – non-systemic insecticides (ex. carbaryl), protectant fungicides (ex. chlorothalonil), burn-down herbicides (ex. fatty acids). These materials are non-mobile within plant tissues and are typically fast-acting and are often formulated with spreader-stickers to prolong their residual activity. This residual activity can be greatly decreased by rain or irrigation events that effectively wash off the material, or diluted through rapid plant growth that effectively minimizes the covered area.

**Translaminar systemic** materials – many pesticides offer some level of translaminar mobility meaning the material moves from the surface of the plant (where it may or may not be toxic to pests) into the plant tissues to allow for a reservoir of toxic compounds and often protects both top and bottom surfaces of foliage. These materials can have longer residual periods, however, they are not translocated to new growth, or areas missed by applicator error. Given these materials are not readily translocated far distances, complete coverage is essential.

**Xylem mobile systemic** materials – imidacloprid containing insecticides that primarily moves upwards in plant tissues (xylem), many root disease treatments (ex. mefenoxam), and most herbicides. These materials often take longer to realize pest control yet have very long periods of residual activity (weeks to months), which if use incorrectly can have devastating impacts on off-target populations. The residual activity again is subject to dilution through vigorous plant growth but will be translocated at some level to actively growing regions. Xylem mobile systemics are often confused with complete systemic activity which is only observed with phloem and amphimobile (bi-directional) movement as described below.

**Amphimobile and Phloem mobile systemic** materials – Amphimobile materials are rare, especially within fungicides, however the phosphonate group of fungicides [P07] move in both the xylem and importantly the phloem towards the root systems. Many more herbicides are phloem mobile, with notable examples within the Group [4] (Auxin Mimics) 2, 4-D and Dicamba. Some insecticides can also be translocated through the phloem such as Thiamethoxam, which is notably different that imidacloprid which is translocated within the xylem, even though both are Group [4a] materials.

**How will these materials be legally applied; do I have the equipment to apply them?** Understanding how any pesticide moves, or does not move, in plant tissues is critically important to how a pest will be controlled. Delivery methods are predicated on this, for example if a xylem mobile root disease material is used, the root systems must be targeted as xylem mobile materials will not translocate to the root system. Another example, if a translaminar insecticide is used, the material must be reapplied to actively growing areas as the material does not translocate along with the growing region. This can greatly inform if a material should be chemigated, drenched, foliar applied, top dressed granular, etc. however, the label must clearly state your panned application method, and planned use timeline as it correlates to the bloom period and pollinator activity- **The Label is The Law.** A question one should ask is how will effective delivery change my regime, i.e., can less application frequency lead to greater control with proper delivery?

**What are my worker safety and harvesting needs?** All materials have different timeframes for reentry (REI) and personal protective equipment (PPE) that must be followed. In some cases, it may be advisable to use a material with a longer REI if that material has proven success with a given pest, i.e., managing wants versus needs for a particular pest issue. PPE should always be top of mind for all potential handlers and those designing the application regimes. We are after all talking about materials designed to kill (-cides).

**Information is the key first step in designing or updating a pesticide regime.**

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Rutgers Plant and Pest Advisory: <https://plant-pest-advisory.rutgers.edu/category/landscape-nursery-turf/>



Rutgers Pest Scouting Guides – Scouting with Growing Degree-days:

<https://go.rutgers.edu/iz41f8pr>

University of Maryland – Cut Flower Production webpage:

<https://extension.umd.edu/programs/agriculture-food-systems/program-areas/ornamental-horticulture/ipmnet/cut-flower-production/>

# Livestock

## WHAT'S IN MY FEED BAG?

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### **Introduction:**

"What's in my feed bag?" is a crucial question for new livestock owners and beginning farmers to ask. Understanding the feed tag is the first step in ensuring your animals get the right nutrition. Each ingredient in the feed provides specific nutrients, from protein and energy to vitamins and minerals, that help maintain health, promote growth, and improve production. By learning how to read the feed tag, you can make informed decisions about your animals' diet, ensuring they receive the appropriate balance of nutrients.

### **Livestock Digestion:**

Livestock will slightly differ based on the type of diet they can consume, which is due to their digestive systems and special features that provide them the ability to digest certain feeds. Swine and poultry are defined as "monogastric" or simple-stomached, meaning they only have one gastric stomach (which is similar to that of humans). Usually, grains are the main part of their diet. Ruminants include cattle, sheep, and goats. Their digestive system allows them to efficiently digest and absorb most of their nutrients from plant material (forages, hay, silage, etc.). There are four compartments in their stomach, the largest being the rumen, which contains fluid and ingested feeds and forages. The rumen has a large population of microbes, mainly bacteria and protozoa, which will aid the ruminant animal in the breakdown of feeds. Llamas and alpacas are also ruminants, although they are referred to as "pseudo-ruminants" because they only contain 3 of the 4 stomach compartments as compared to ruminant animals. However, their digestive process is the same as ruminants.

### **The Basic Nutrients:**

Similar to humans, livestock require water and a balanced diet that includes essential nutrients. The diet for livestock is usually referred to as a ration and a balanced ration is the amount of feed that will supply the proper type and proportions of nutrients needed for an animal to perform a specific purpose. Generally, ruminant rations include a forage source (hay, silage, pasture, etc.) and other component feeds (grains) that balance the nutrients that the forage is not providing. Rations for swine and poultry typically come from grain sources. There are six general components in livestock rations: water, protein, energy, fiber, minerals, and vitamins. Each of the six general components in these rations are performing specific functions for the animal.

### **Water:**

Water is often an overlooked nutrient, but it is the most critical component of any ration. It is required for most physiological functions in the body. Also, the consumption of water will influence intake in animals. Livestock water requirements can be achieved through drinking (free-choice water), the food (pre-formed water), and through metabolism of nutrients (metabolic water). In some cases, when ruminant and pseudo-

ruminant animals consume high-quality pasture, browse, or both, it could satisfy its daily water requirement due to the high-water content of the forage. The estimated water requirement is adjusted for the effects of season, ambient temperature, breed, growth, reproductive status, and when stressed or ill.

### **Protein:**

Proteins are organic compounds composed of amino acids linked by peptide bonds; there are 22 amino acids, and every protein will contain a variety of amino acids in different quantities. Many amino acids are synthesized in the body of animals, but there are 8 amino acids that are not synthesized and need to be provided in the ration (called essential amino acids). Proteins are crucial for life, serving as major structural components of animal tissues (skin, muscles, tendons, wool, hair, mohair, feathers, and eggs). They also play roles in biochemical processes, immunity, lipid (fat) transporters, and hormone regulation. Protein synthesis is vital for maintaining life processes, as it supports tissue structure and metabolic functions.

On a feed tag, protein is labeled as crude protein, which is the total protein content of feed. Protein requirements will vary to meet requirements for: maintenance (amount needed to replace protein tissue that is continuously being broken down), age (younger animals having higher protein requirements than older animals), milk synthesis, pregnancy, and breed (meat, dairy, or fiber production). Regarding breed, animal breeds have specific protein requirements based on the animal's capacity for milk, meat, and/or fiber production. There are specific requirements for the growth of wool, hair, and mohair. Also, meat breeds will have a greater protein requirement for weight gain than dairy breeds due to the increase in muscle deposition and capacity for growth. There are multiple sources of protein for livestock: dietary, microbial (in ruminants, pseudo-ruminants, and poultry), and endogenous (that comes from gastrointestinal cells). In ruminants and pseudo-ruminants, dietary protein can be categorized into rumen degraded protein (RDP) and rumen undegraded protein (RUP; can also be referred to as bypass protein). Rumen degradable protein is broken down by the microbes in the rumen, while rumen undegradable protein will bypass microbial digestion and instead begins digestion in the abomasum (gastric stomach compartment) and finishes digestion and absorption in the small intestine. For monogastric animals, protein only begins digestion in the stomach (gastric digestion) and finishes digestion and absorption in the small intestine. Microbial protein is bacteria and protozoa that flow from the rumen and becomes an amino acid source for ruminant (and pseudo-ruminant) animals; microbial protein is also present in poultry, the microbes that reside in their ceca (first section of their large intestine) can become an amino acid source for these animals.

### **Energy:**

Energy in the feed/diet can exist as carbohydrates, fats, and fiber. Energy sources are responsible for proper body condition maintenance, animal growth, pregnancy, physiological functions in the body, and animal performance (i.e. lactation, reproduction, etc.). The amount of energy needed is generally stable, though requirements will increase when the animal is cold (i.e. more energy is required to maintain body temperature). Energy can be measured using different chemical, mechanical, and mathematical methods. The most common energy measurement on feed bags is total digestible nutrients (TDN). Every feed ingredient in a ration will have different digestible

energy values, each feed will differ in how energy is utilized and metabolized by the body.

### **Fiber:**

Fiber is the structural carbohydrates (hemicellulose and cellulose, sugars found in the plant cell wall, and lignin (typically indigestible, providing bulk)) that are found in forages and grains. Fiber reduces the energy value of plants for swine; however, ruminants, pseudo-ruminants, and poultry have the capacity to digest fiber. Fibrous feeds will ferment in the rumen (for ruminants and pseudo-ruminants) and in the ceca (for poultry) via microbial action (enzymes action on the feed), resulting in the production of volatile fatty acids (VFAs; acetate, propionate, and butyrate). Volatile fatty acids are the main energy source for the ruminant (and pseudo-ruminant). Fiber also provides bulk in the digestive system, which regulates rate of passage (or the time it takes for feed to pass through and digest in the digestive system).

There are two ways to measure fiber content in feed (which is provided if you sent the feed off for nutrient analysis): acid detergent fiber (ADF) and neutral detergent fiber (NDF). Acid detergent fiber (ADF) is a measure of the feed's digestibility; as ADF increases, the feed's digestibility decreases. When it comes to forages, mature plants are less digestible (stay in the digestive tract longer, so the animal eats less because rate of passage decreases) and younger plants are more digestible (because they contain more digestible carbohydrates and less lignin). Neutral detergent fiber (NDF) is a measure of gut fill, or how much an animal can consume before its digestive tract is full and no more can be consumed. A feed that is too high in NDF may limit consumption to a point where the animal cannot consume enough to meet its energy requirements.

On a feed tag, ADF and NDF are not provided. Instead, what you will see is crude fiber (CF). Crude fiber is a measurement of the cellulose, hemicellulose, and lignin portions of the feed combined. It is measuring both digestible and indigestible fiber but does not decipher between the two (as more precise measures (ADF and NDF) would).

### **Vitamins and Minerals:**

Minerals and vitamins are essential nutrients that support the body's physiological functions. Minerals, inorganic elements, play a critical role in a wide range of biological functions, including gene expression, enzyme regulation, cellular function, osmotic balance, immunity, detoxification, and structural support (e.g., bone growth). They are integral to nearly all metabolic processes. Vitamins, on the other hand, are organic compounds needed in small amounts for various physiological functions. Although they don't provide energy or serve as building blocks, vitamins act as coenzymes or enzyme precursors, supporting numerous metabolic processes.

Vitamins are grouped into two categories- fat soluble (vitamins A, D, E, and K) and water soluble (vitamin C and all B vitamins). Water soluble vitamins don't typically have a set required amount, as any excess would be urinated out by the animal. However, fat soluble vitamins have set requirements in the ration. In ruminants and pseudo-ruminants, vitamin K and all B vitamins are manufactured in the rumen; this means these animals have requirements for vitamins A, D, and E. The requirements for A, D, and E are met through feed and forage consumption, and can also be obtained from

sunlight (specifically vitamin D).

As for minerals, there are two classifications- macro and micro (trace) minerals. Macro minerals (calcium, phosphorous, sodium, chlorine, magnesium, potassium, and sulfur) are those that are required in higher amounts in the ration compared to micro minerals (iron, copper, molybdenum, manganese, zinc, cobalt, iodine, and selenium, and others) which are needed in less amounts.

Livestock can be greatly affected by vitamin and mineral toxicity and deficiencies, so these micronutrients need to be well balanced. In a feed bag, vitamins and minerals are typically included in the required amounts, or to a certain percentage of the requirement to balance out what forage does not provide. If a vitamin/mineral premix has been incorporated into a grain, free-choice minerals are not needed.

### **General Nutrient Requirements:**

Generally, nutrient requirements will vary amongst the following animal and physiological factors:

- Meat, fiber, and milk breeds
- Gender
- Physiological state:
  - Growth (i.e., young lambs, kids, piglets, and calves)
  - Late pregnancy
    - Very important!!
  - Lactation
    - For dairy production or maintenance of offspring
  - Maintenance
    - i.e. during a dry period
- Age
- Climate
- Body composition
- Parasitism/illness

The National Academy Press publishes a series of texts that include information regarding nutrient requirements for livestock. The National Research Council (NRC) compiles data for small ruminants, swine, and poultry, and the National Academies of Sciences, Engineering, and Medicine (NASEM) compiles data for dairy and beef cattle. These texts are available for purchase or to read for free online.

In addition to knowing the nutrient requirements, it is also necessary to know the nutrient composition of each feedstuff per ration. This talk provides the information needed to understand the nutrients provided by the feeds included in a pelleted grain or feed bag. It is also important, for ruminants and pseudo-ruminants, to test forage for nutrient composition to assist in ration formulation. More information regarding this process will be provided in the talk “Don’t Guess... Test: Overview of Forage and Soil Testing”.

## **FROM FARM TO FORK AND EVERYTHING IN BETWEEN: MEAT PROCESSING AND MARKETING PANEL**

Panelists: Jeff Bringhurst, Rachel Sickler, Joseph Silvestri, and Danielle Wainwright

Moderator: Tess Stahl

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Livestock and Dairy Extension Specialist, Tess Stahl, will facilitate a panel discussion regarding meat processing and marketing strategies used by farmers and processors in the state.

The panel includes farmers who manage both the raising and processing of their livestock for direct sale at on-farm stores, a custom livestock processor, and a poultry raiser and processor. Between audience and pre-prepared questions, the panelists will delve into the intricacies of meat processing, from animal care and harvesting to ensuring quality and meeting regulatory requirements. Additionally, the discussion will cover effective marketing strategies for selling directly to consumers, navigating challenges in the local meat market, and the growing demand for sustainable, locally sourced meats.

Background information for each panelist:

- Jeff Bringhurst is the owner/manager of Bringhurst Meats, which is celebrating its 90<sup>th</sup> anniversary this year. The company specializes in custom livestock harvesting and processing, operates a retail meat store, provides full-scale catering services, and processes large game. Until 2012, Bringhurst Meats was under USDA inspection, but the business then transitioned to being fully custom retail exempt. Jeff started the business in 1971 and took over management in 1982. Today, Jeff remains actively involved in both the managerial and hands-on aspects of the plant, overseeing a dedicated team of 30 employees.
- Rachel Sickler is the co-owner of Sickler's Circle View Farm, alongside her husband, Dave. Together, they manage a cow/calf herd of black and red Angus, finish cattle for processing, raise feeder hogs, and maintain a flock of laying hens. The farm also grows grain crops, including corn, soybeans, wheat, rye, and forages to feed their livestock. In 2019, Rachel launched the farm's website and began selling meat by the cut, offering order pick-up "by appointment only." In 2020, as consumer interest in purchasing meat directly from the farm surged, the Sicklers quickly transitioned from appointment-based pickups to a farm store with regular business hours. While Dave grew up on a generational dairy farm, Rachel did not come from a farming background. She worked as a full-time registered nurse until 2021, when the farm's livestock production and store traffic had scaled to a point where she could leave her job and join the farm full-time. In addition to managing the farm store and raising their three young boys, Rachel oversees daily operations. The farm works with a USDA processor to harvest cattle and hogs monthly and collaborates with local farmers to supply the farm

store with seasonal pasture-raised chicken, lamb, and veal. They sell their meat and eggs through several channels, including their farm store, restaurants, private event chefs, and other local roadside stands.

- Joseph Silvestri is the third-generation co-owner and operator of Goffle Road Poultry, alongside his son Brian, the fourth-generation co-owner and operator. The business was founded in 1948 by Joseph's grandfather, Dominic, shortly after his high school graduation. Initially, the local operation focused on raising and processing poultry for the nearby market. As Bergen County, NJ, continued to grow, the poultry operation was relocated to Amish Country in Pennsylvania. There, traditional methods were combined with modern free-range production to raise all-natural birds for the New Jersey and New York markets. Today, the operation processes approximately 6,000 birds a day and is actively working toward expansion to better serve its customers. This includes providing additional USDA-approved custom processing for local farms across the state. Goffle Road Poultry was one of the first businesses to receive a national grant aimed at expanding meat processing in the United States. The company is now in the process of securing approvals to modernize and equip an existing building adjacent to its current facility. Once completed, this expansion will allow the facility to process up to 18,000 birds per day.
- Danielle Wainwright is the co-owner of Clover Valley Farm, alongside her husband, Fred. The farm's story began in 1955 when Fred's parents, Fritz and Jean Wainwright, started a farm in Florence, NJ. In 1974, they officially incorporated as Clover Valley Farm Inc., named after a local map that featured their section of town as "Clover Valley," surrounded by fields of lush clover. Originally a dairy farm with 100% registered Holsteins, Fred took over the dairy operation in 1987, eventually selling the dairy cows in the late 2000s. In 2012, Fred and Danielle revived the farm by starting a beef herd. They moved to Southampton, NJ, in 2014, where they expanded the herd, added laying hens, and had two sons. The Wainwrights' mission is to provide superior products to the community while farming regeneratively. As stewards of the land and animals, their vision is to ensure the health of their herd while leaving the land in better condition for future generations. In 2018, the Wainwrights introduced American Wagyu cattle to their herd, known for their intense marbling and superior flavor. The farm continued to grow, adding 200 acres in 2022 to support their expanding cattle herd and hay production. Clover Valley Farm offers a variety of high-quality products, including homegrown beef, eggs, chicken, seasonal produce, and honey (from their farm's honeybees). Along with the expansion in 2022, the Wainwrights also purchased the historic "Farm on the Point" in Vincentown, NJ, which had been owned by the Haines family for generations. They preserved the legacy of the farm while transforming it into a market offering their homegrown products, alongside other locally sourced products.



## **FLOURISHING FIELDS: STRATEGIES FOR EFFECTIVE PASTURE MANAGEMENT**

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What is effective pasture management? We might be tempted to think that ruminants (namely cattle, sheep and goats) and horses can just go forth and eat any and all green plants. But flourishing animals require flourishing fields—and that requires careful planning and execution on the farmer's part. This presentation will share the essentials of pasture management – from studying and amending soil to using flexible infrastructure to rotating herds quickly through diverse grasses, and timing it all just right. When orchestrated correctly, these systems function as a vibrant, living ecosystem, naturally sustaining plants which in turn nourish the grazing animals. Plants working with soil microorganisms to harvest available sunshine, water and air to manufacture the sugars they need to grow. And if we farmers take good care of the grasses, they will grow to become plentiful and nutritious forage for our grazing animals.

### **LEARN YOUR SOIL**

We start by learning what it is we're managing and that starts with the soil. Learning the soil profiles of our fields through USDA's Web Soil Survey, we can better understand the potentials, and limits, of our fields. Soil structure, slope, drainage characteristics, restrictive layers, rockiness and parent material are all factors in how a field may be managed to reach its potential. It's also important to understand the field's fertility, especially its pH, organic-matter levels and amounts of phosphorus and potassium. Gathering soil samples and amending as recommended will allow the grasses, forbs (broad-leafed plants) and legumes in our fields to maximize their potential by promoting root development, facilitating water transport, increasing stress tolerance and growth.

### **ANIMALS ARE GOOD**

But to truly flourish, a field needs more than soil. Fields in fact can benefit from the very animals that graze them. This interplay between plants and a trampling, grazing herd of bison and other herbivores maintained the meadows and prairies. This same interaction of plant growth and the planned grazing of domesticated ruminants should instruct our strategies of pasture management to revitalize and maintain flourishing fields on our farms.

### **ROTATE!**

To cultivate this dynamic in our fields, implementing a rotational grazing system coupled with planned rest and recovery for the grasses is our most important pasture management strategy. Just as herds of bison moved across the Great Plains, grazing, trampling and moving on, we need to move our cattle frequently and with purpose. The primary focus needs to be on the plants' rest and recovery, ensuring that they're not grazed too short and that they're given the proper amount of recovery before being grazed again. A good rule of thumb is to take half, leave half" of the plant biomass and then wait for the grasses and legumes to sufficiently recover before animals are allowed to re-graze them, which can be two months or more, in a hot, dry summer. Plants ready to be grazed can be identified by either canopy height or by the number of leaves. For most grasses, an 8" height (at least 10" for warm season grasses if prussic acid is not a concern and 4" for bluegrass) is considered ready to be grazed. And if counting grass leaves, we should see 2.5- 3 leaves (4 full leaves for warm season grasses). Time is of the essence—just as the bison moved across the plains, clipping just the

more tender and nutritious upper tops of the plants and moving on, our animal movements should mimic this as well. When leaving a field, we should leave at least 4” of plant height (6” for warm season grasses, 2” for bluegrass) so the plant can recover with less stress. Studies have concluded that root growth pauses when animals harvest more than half of the plant. To accomplish the proper recovery, we need to create multiple divisions within our farm to exclude animals from recently grazed plants. Our strategy is to move animals typically twice each week at a minimum. This timing helps ensure that animals aren’t re-grazing plants that may already be mobilizing resources and growing new tender leaves. Even when we may feel pressure to let animals overgraze—like through periods of drought and other factors that may limit plants’ recovery times—we still need to provide the time for plants to rest and re-grow. While it’s standard to feed our animals stored forages in a sacrifice lot or barn during winter when plants are dormant, it may be necessary during stressful summer periods as well.

### **FLEXIBLE INFRASTRUCTURE**

Flexible infrastructure is essential to rotational grazing, primarily temporary fencing and having water available in adaptable situations. If animals’ access to water becomes too tied to particular locations, besides not being able to move animals more effectively, we also begin to see animal trails and bare spots where animal traffic is concentrated. Fixed locations of fencing and water also concentrate manure deposits and heavier impact while encouraging uneven grazing. While grazing most plants in a field can be beneficial, allowing animals to preferentially graze the plants they most desire over and over ultimately benefits the “undesirable” weedy plants if they’re not touched at all. Flexible infrastructure facilitates more even distribution of nutrients and animal impact.

### **NO BARE SOIL**

Using flexible infrastructure and distributing animal impact also helps keep the soil armored. Bare soil can easily erode via wind and/or water. Without the benefit of a plant canopy, heavy rain can break down soil aggregate, leading to erosion. Through rotational grazing, manure is more evenly distributed across a field and dead plant material is trampled onto the soil surface, further protecting the soil. This trampled plant material also provides food for soil organisms, increasing soil organic matter. Knowing the fertility of our fields also helps determine on which fields to spread this year’s manure pack or compost. Continuous grazing creates more bare openings by killing desirable plants as well as by intensifying the sheer physical impact of animals allowed to stay in one area for too long. Bare soil also inhibits soil life by becoming as much as 20 degrees warmer than soil shaded by a grass canopy. These increased temperatures cause more evaporation and drier soils less resilient to drought conditions.

### **PLANT DIVERSITY**

A flourishing field’s resilience is also fostered by a diversity of plant species. Each season brings fresh challenges and having a diversified “portfolio” of pasture plants helps buffer the extremes. A mix of grasses, broad-leafed plants and legumes can better weather the challenges of drought, flooding, etc. The different depths of roots, stages of maturity, nitrogen-fixation, chemical composition, digestibility, stress tolerance, and tannins all will help the fields and ultimately feed our animals a diverse diet to meet their nutritive needs. Fostering this diversity includes incorporating warm season grasses, perennials and annuals, in our rotations, allowing various fields to flourish at different times.

### **SWITCH UP CONFIGURATIONS**

Correlated to encouraging plant diversity is to manage our overall grazing rotations in a diversified manner. We shouldn’t prescriptively graze our fields in the same pattern year after year. Starting rotations each spring in a different field, adjusting field configurations with

temporary fencing can help us vary our impact, allowing plants to respond differently. As long as plants can flourish and reproduce every few years, most will persist – as they have for thousands of years of dynamic and unpredictable growing conditions. If we manage the same way each year, some plants may thrive, but others may never get the conditions they need, putting them at risk of dying out.

### **POSITIVE ANIMAL IMPACT**

A herd of animals manuring and fertilizing uniformly across a field, clipping just the tops of grasses, and trampling dead vegetative matter onto the soil surface all bring vitality to a field. But this energetic boost is only positive if the time animals graze in that area is limited to a few days maximum—possibly even less, depending on conditions. By adjusting stocking densities (animal weights per acre per amount of time), animals can also be trained to graze undesirable species, ultimately allowing the desirable plants to better compete and become an even more prominent part of a flourishing field.

### **PREVENT SOIL COMPACTION**

When managing for positive animal impact, we also need to prioritize pore spaces for air and water in the soil. By volume, healthy soil is approximately 45% minerals, 5% organic matter with the remaining 50% being air and water within the soil's pore spaces. Compaction can reduce the pore space in soil by nearly half ... that means only half as much pore space for water to infiltrate and be available for the plants' roots and only half as much air space for roots and soil microbiota. It's estimated that the weight of the microbiota in the soil of an acre of healthy pasture would equal the weight of the grazing animals supported by the grass growing from that acre. Compacted soils can struggle with ponding and decreased soil aggregation. Compaction will also limit root growth, making it even more difficult to utilize what restricted water is available. The emphasis needs to be on *maintaining* soil pore spaces. Deep compaction is much better *avoided* than corrected. Strategies include reducing traffic, especially when soil is wet. "Traffic" includes animals as well as vehicles. Dedicated laneways can be used to concentrate traffic and its compaction to a more limited amount of the field. The art of maintaining these pore spaces is understanding current soil conditions and the potential impact of animals and ancillary activities and equipment - anything heavier than a farmer's footprint.

### **LOOK TO LEARN**

This artful management is expressed in the maxim, "A farmer's footprint is the best fertilizer." While alluding to a light touch on the soil and its plants, it really highlights the power of observation. Even though scientific tools, like soil or forage testing, can help us "see," identifying, learning about and closely observing the plants and animals is the real secret to successful pasture management. The Latin origin of the word for observing was "to attend to." It's looking as an act of service. What do our observations lead us to do in service to the field, its plants and our animals? Studies have also demonstrated that observing our fields in a more objective manner through the adoption of assessment tools with prescribed criteria, like a pasture condition score enhances a field's resilience. As a group of body condition scores can help us to look beyond the more noticeable fatter or thinner animals and get more accurate overall picture, a pasture assessment tool can help us more objectively evaluate our fields.

Managing our pastures and animals to mimic bison grazing across the Great Plains is both a science and an art. While the sciences can help us with the planning of projected grass growth, stocking rates and densities, etc., the artful observer assesses and adapts the plan in real time. Managed well, our flourishing fields can be the source of a low cost, nutritious, resilient feed for our grazing animals and an enduring natural resource, flourishing now and into the future.

# **Stop the Bleed – Bleeding Control Workshop**

# FROM INJURY TO INTERVENTION: TACKLING LIFE-THREATENING BLEEDING IN AGRICULTURAL COMMUNITIES

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There is high risk of life-threatening injury and death for workers in the agricultural industry. Farmers often recount stories and firsthand experiences of dangerous injuries sustained by themselves or colleagues while on the job. One such incident occurred on New Year's Day in Burlington County, NJ, where a farmer fell from a grain hopper trailer, severing his arm. Fortunately, a registered nurse was nearby and able to control the bleeding, saving the farmer's life.<sup>1</sup> Swift actions taken by community first responders, as in this case, are crucial in addressing preventable death sustained by traumatic blood loss.

Data further underscores the dangers of agricultural work. The U.S. Bureau of Labor Statistics reports that farmers experience the highest rate of work-related fatalities in the country, with 23.5 deaths per 100,000 workers in 2022.<sup>2</sup> Among trauma-related injuries, uncontrolled bleeding is the leading cause of preventable death.<sup>3</sup> In the case of a severe bleed, an individual can bleed to death within 3-5 minutes, which is half the average time it takes for emergency responders to arrive on scene. In rural settings, this response time can extend up to 14 minutes, with 1 in 10 individuals waiting almost half an hour for emergency medical services (EMS) to arrive.<sup>4</sup>

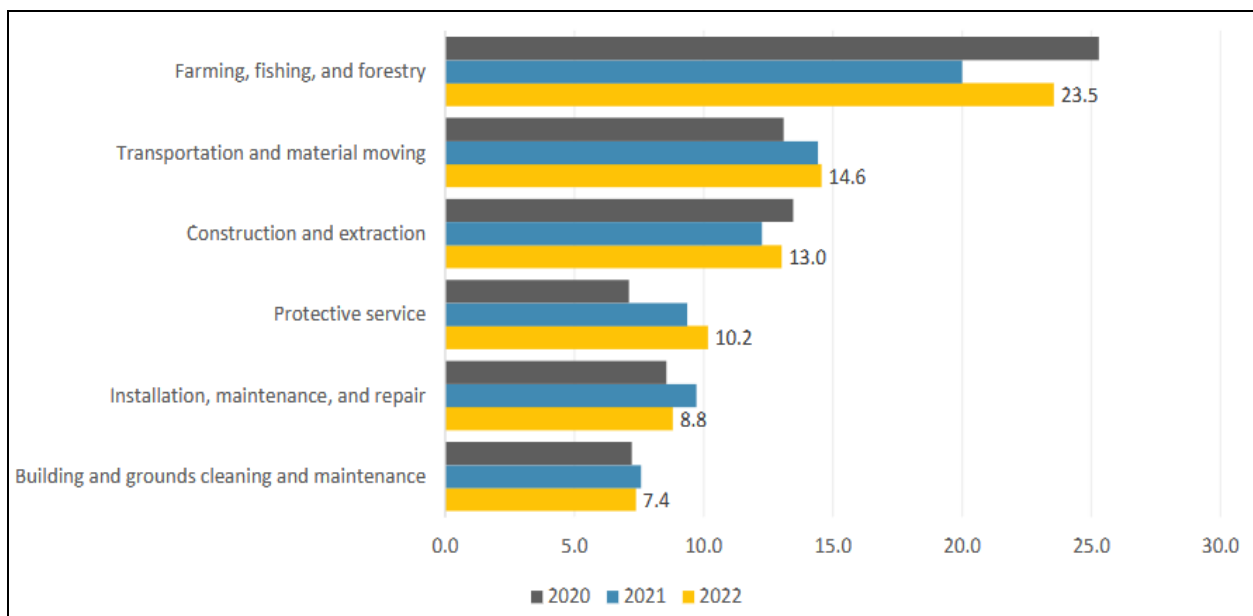


Figure 1: Fatal work injury rates per 100,000 full-time equivalent workers by selected occupational groups, 2020-22 according to the Bureau of Labor Statistics<sup>2</sup>

Given the high rate of workplace injuries in agricultural work, particularly traumatic injuries, there is a large unmet need for first aid training in this community. The Rutgers New Jersey Medical School Bleeding Control (BCON) organization is run by medical students who teach first aid for life-threatening bleeds to local community members using the STOP THE BLEED® curriculum. STOP THE BLEED® is a national program developed by the American College of Surgeons Committee on Trauma that seeks to empower bystanders to take life-saving action in cases of severe bleeding before first responders can get to the scene. Controlling a life-threatening bleed requires quick and decisive action. This program aims to save lives by building a community proficient in responding to severe bleeding, bridging the gap between the time when accidents occur and the arrival of medical professionals. The core principles of STOP THE BLEED® are as follows<sup>5</sup>:

**1. Ensure the environment is safe:**

Before helping, assess the surroundings for potential dangers such as heavy machinery, unstable surfaces, or ongoing threats. If the environment is unsafe, prioritize your safety, so as not to become a victim yourself. If possible, move the victim to a safer location as well.

**2. Call 911:**

Contact emergency services to ensure professional medical help is on the way. Provide clear information about the situation, including the location, type of injury, and the condition of the injured individual. Calling 911 immediately will help the victim receive definitive treatment faster.

**3. Locate the source of the bleed:**

Carefully examine the victim's body to identify the most urgent bleeding injury. Major, life-threatening bleeding can often be identified by bright red, pulsating bleeding or steady, large-volume bleeding that soaks clothing or bandages rapidly. Focus your attention on the area where the bleeding is most severe.

**4. Control bleeding using one or more of three compression methods:**

- a) **Direct Pressure:** Apply firm, consistent pressure directly over the bleeding wound. Use a clean cloth, gauze, clothing, or even your hands if no other materials are available. Maintain pressure without releasing it until professional help arrives. Most of the time, direct pressure is effective for controlling external bleeding.
- b) **Wound Packing:** For deep wounds, use gauze or clean fabric to pack the wound, applying pressure directly to the source of bleeding. Use one finger to identify the origin of the bleeding and push the material directly against the bleeding vessel to slow or stop the flow. Then use the remaining material to pack the wound creating pressure to maintain compression directly on the bleeding vessel. You can also apply direct pressure on top of the wound after it is packed. This technique is particularly useful for injuries in areas like the groin, where tourniquets cannot be applied. It is important to note that packing is not functional for injuries to the torso and abdomen as these regions do not provide adequate back pressure to stop the bleed and packing here can lead to further injury when performed outside of a hospital.

- c) **Tourniquet Application:** For injuries on extremities, apply a tourniquet 2-3 fingers above the wound, closer to the torso, and not over the knees or elbows. Tighten the tourniquet strap as much as possible before twisting the windlass until the bleeding stops. Leave the tourniquet in place and note the time of application so medical professionals are aware of how long the limb has gone without proper blood supply. Modern tourniquets, such as Combat Application Tourniquets (CAT), are highly effective when used correctly.

By following these steps, individuals can stabilize a life-threatening bleed until emergency medical services arrive. Quick action and the use of these techniques can be the difference between life and death in an emergency.



**No matter how rapid the arrival of professional emergency responders, bystanders will always be first on the scene. A person who is bleeding can die from blood loss within five minutes, so it's important to quickly stop the blood loss.**

**Remember to be aware of your surroundings and move yourself and the injured person to safety, if necessary.**

**Call 911.**

**Bystanders can take simple steps to keep the injured alive until appropriate medical care is available. Here are three actions that you can take to help save a life:**

**1. Apply Pressure with Hands**  
**EXPOSE** to find where the bleeding is coming from and apply **FIRM, STEADY PRESSURE** to the bleeding site with both hands if possible.

**2. Apply Dressing and Press**  
**EXPOSE** to find where the bleeding is coming from and apply **FIRM, STEADY PRESSURE** to the bleeding site with bandages or clothing.

**3. Apply Tourniquet(s)**  
 If the bleeding doesn't stop, place a tourniquet as high on the extremity as possible above the wound. The tourniquet may be applied and secured over clothing.

**PULL** the strap through the buckle, **TWIST** the rod tightly, **CLIP** and **SECURE** the rod with the clasp or the Velcro strap.

If the bleeding still doesn't stop, place a second tourniquet next to the first tourniquet.

The 'Stop the Bleed' campaign was initiated by a federal interagency workgroup convened by the National Security Council Staff, The White House. The purpose of the campaign is to build national resilience by better preparing the public to save lives by raising awareness of basic actions to stop life threatening bleeding following everyday emergencies and man-made and natural disasters. Advances made by military medicine and research in hemorrhage control during the wars in Afghanistan and Iraq have informed the work of this initiative which exemplifies translation of knowledge back to the homeland to the benefit of the general public. The Department of the Defense owns the 'Stop the Bleed' logo and phrase.

Figure 2: STOP THE BLEED® Infographic from the U.S. Department of Homeland Security<sup>6</sup>

### Acknowledgements:

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