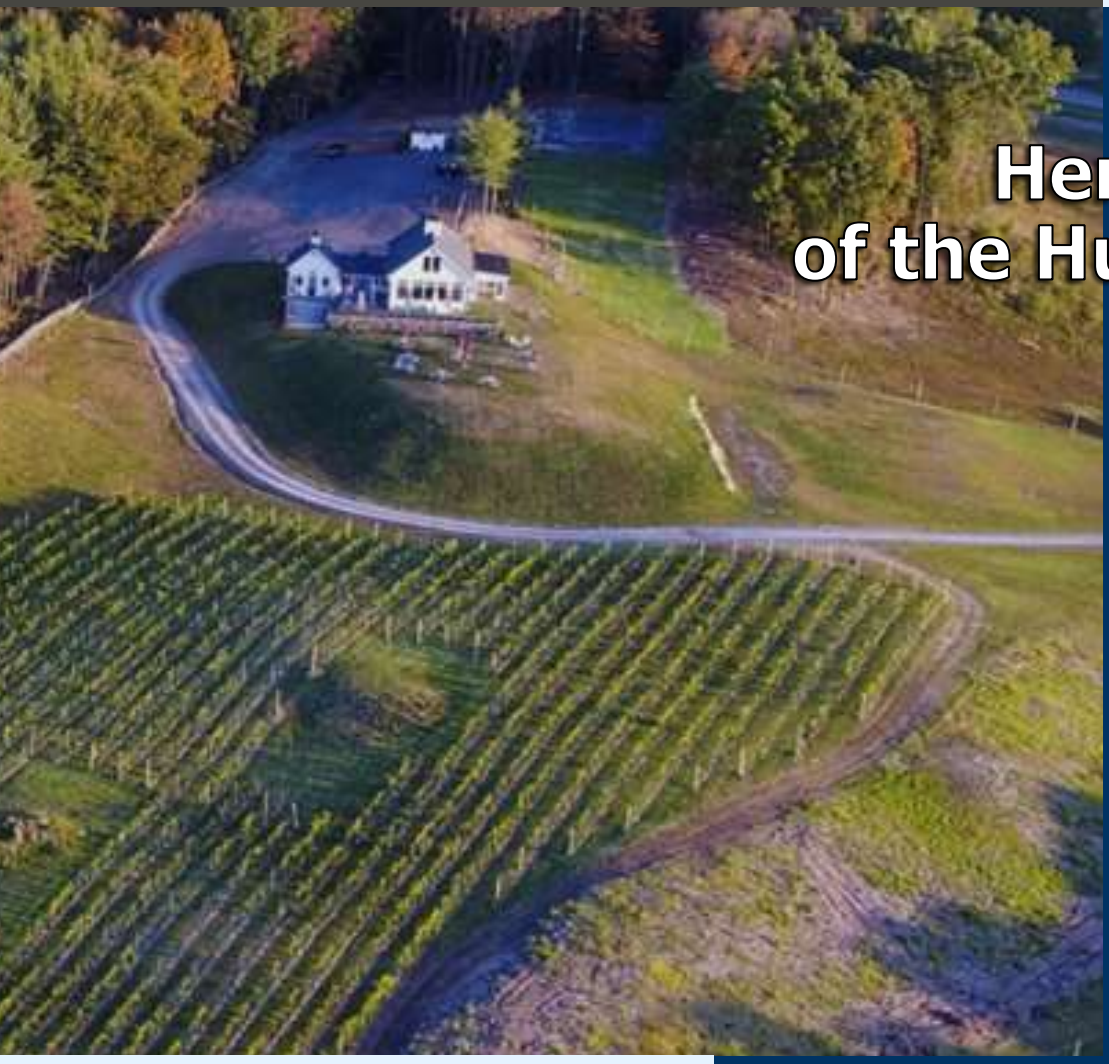
February 2022

The Produce Pages

Serving the fruit and vegetable growers of Eastern New York



Milea Estates, www.mileaestatevineyard.com

Cornell Cooperative Extension
Eastern NY Commercial Horticulture Program

Feature Story

Heritage Wines of the Hudson Valley

Jim Meyers, CCE ENYCHP

American viticulture and wine culture is rooted in the 19th century northeast. New York, in particular, produced the first commercial wines in the United States at a time when several grape breeding programs were active in the Hudson Valley. Despite this history, your local wine shop is not selling wines made from the old cultivars of New England and New York. Today, most of the products found in the wine shop are made from traditional European cultivars (e.g. Cabernet Franc and Riesling is readily found on shelves), even when grown and produced in New York.

Having said that, there are plenty of wines grown and made in New York using non-traditional European cultivars, but it is unlikely that you will find them in a local wine shop, as they are mostly sold directly by their producers. Patrons of New York winery tasting rooms are familiar with French-American hybrid cultivars such as Baco Noir, Noiret, or Traminette. Those living in the northern parts of the state are certainly familiar with Marquette and La Crescent.

The collective effort to produce wine everywhere in New York has led each region to adopt the cultivars that work best for them. In simple terms, most growers want to make wines that resemble European wines. To that end, New York vineyards that are capable of growing European cultivars typically do that, but outside of Long Island and the lower Hudson Valley most vineyards are too cold for European cultivars. Thus, they grow the familiar

(Continued on page 3)

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Serving the Educational and Research Needs of the Commercial Small Fruit, Vegetable and Tree Fruit Industries in Albany, Clinton, Columbia, Dutchess, Essex, Fulton, Greene, Montgomery, Orange, Putnam, Rensselaer, Saratoga, Schoharie, Schenectady, Ulster, Warren and Washington Counties.

(Continued from cover)

cold hardy varieties that are found in tasting rooms across the state. These cultivar selections are also influenced by the fact that susceptibility of European cultivars to American native pathogens complicates viticulture.

While these 'standard' cultivars have enabled New York's current robust wine industry, they obscure historical events and cultivars. Have you ever come across a bottle of wine made from 19th century favorites such as Croton, Iona, Black Eagle, or Eumelan? Almost certainly not. There are, however, some people who are putting substantial effort into changing that. One of those people is local grape grower and wine maker, J. Stephen Casscles who, in partnership with Milea Vineyards in Staatsburg NY, is Project Director of the Hudson Valley Heritage Wine Project.

J. Stephen Casscles and Hudson Valley Heritage Wine Project

Stephen Casscles has been growing grapes in the Hudson Valley since he was in High School in the 1970s. A long-time professional and hobbyist wine maker, Stephen first learned about 19th century Hudson Valley grape varieties from his grandfather, Joseph Casscles, who was a fruit grower in Marlboro, NY. His grandmother, a fruit broker, sold some of these cultivars at the Boston Market and Hunts Point – including Bacchus, Croton, Iona, Jefferson, and Dutchess.

Stephen's interest in French-American hybrids motivated him to write the 2015 book "Grapes of the Hudson Valley and other Cool Climate Regions of the United States and Canada " which further advanced his interest in French hybrids, Hudson Valley Heritage grapes, and the history of their development and use. Stephen maintains his own vineyard of rare grapes, many of them sourced as cuttings from local vineyards, from the nursery catalog of Philip Wager of Boordy Vineyards, and cuttings from the Geneva Germplasm facility, including the 19th century Hudson Valley developed varieties.

A Heritage Wine, as defined on the Hudson Valley Heritage Wines website, is "An indigenous, native or historically notable grape variety found in a region which becomes part of the region's cultural or historical legacy." Working with Milea Estate Vineyards in Staatsburg, NY, Stephen will be making his rare grape variety wines including Baco Noir, Chelois, Le Colonel, Verdelet, Bacchus, Croton, Jefferson, and Iona.

As explained by Stephen, the goal of the project is to encourage the study and production of locally produced wines from heritage grape varieties that

1. Were developed and bred in the Hudson Valley in the 19th century by pioneering Hudson Valley grape breeders from Newburgh, Iona Island, Poughkeepsie, Marlboro, and Croton Point,
2. Include French-American hybrid grape varieties that were introduced to the Hudson Valley from the 1950s to 1970s that helped to revitalize and greatly expand local grape acreage and the number of wineries established in the Hudson Valley, and which
3. Can be grown in an environmentally sustainable manner that helps to protect our Valley's eco-system, but which are productive, fungus disease resistant, and produce unique and quality wines.

Moreover, the Heritage Wine Project seeks to conserve these beloved local and historically relevant grape cultivars for future generations, while simultaneously elevating their expression to new heights of world class wine quality.

Stephen believes that heritage grape varieties are worth preserving because, "many are winter hardy, fungus disease resistant, very productive, and can do well in our changing climate that is resulting in more violent weather patterns and widely varying rain and temperatures and frost dates. Further, many make unique and quality wines that will add a new dimension and depth to Hudson Valley wines produced here that is unique to our area and are not being produced anywhere else in the United States or the world."

Spreading the word and the wine

As Project Director, Casscles, along with Milea's expert wine and cider making and culinary staff, will conduct wine tastings of Milea produced heritage grape wines at the winery. They will also sponsor symposia and dinners, whose themes will be about the history of fruit growing in the Hudson Valley and about the prominent role the Valley's horticultural leaders, nursery owners, breeders, and growers had to expand the knowledge of plant sciences in the United States and Europe. In addition, the Milea Estate Vineyards website will regularly post information on the continuing work of our Hudson Valley Heritage Wine Project.

Potential showcase red wines include the French-American hybrids Baco Noir, Chelois, Le Colonel, Burdin Noir, and some red blends that include Leon Millot, Foch, Chambourcin, and SV 18-307. For hybrid whites, look for Seyval Blanc, Vidal, Vignoles, and Verdelet. Potential 19th century Hudson Valley red varieties include Bacchus, Clinton, Eumelan, and Black Eagle. Whites may include Jefferson, Iona, Empire State, and Croton. There will also be blended Heritage whites and reds produced in the French tradition.

Where to learn more

Additional information on the Hudson Valley Heritage Wine Project can be found at the Hudson Valley Heritage Wines website, including a catalog of grapes with photos and cultivar details. Also, look for an updated release of Stephen's book, "Grapes of the Hudson Valley and Other Regions of the United States and Canada" which will include two new chapters on 19th century Heritage grape varieties that were developed in New England. The book is expected to be available by Christmas of 2022. Stephen can be reached at cassclesjs@yahoo.com.

The Core Grape Genome and Cheap DNA Sequencing: A New Roadmap for Grape Breeders

Tim Martinson and Bruce Reisch, Cornell University

Those who are familiar with the Cornell grape breeding program realize that it has been very productive in releasing new varieties. Since Bruce Reisch released "Horizon" in 1982 (a sibling of Cayuga White), there have been several successes, including Traminette, Geneva Red (GR7), Corot noir, Noiret, Valvin Muscat, Aromella, and Arandell. It's fair to say that these were the 'needles in the haystack' that resulted from continuing cycling of new accessions (around 3,000 seedlings per year) through a 15–20-year process of evaluation.

But understanding the underlying genetic traits that produce disease-resistant, high-quality table and wine grapes has lagged. Grapes are expensive to grow, and until recently, extracting the underlying genetic basis of desirable traits such as disease resistance and cold-hardiness was time-consuming and tedious. Corn breeders have been able to produce thousands of seedlings each year and evaluate them at the end of a single growing season. This (and a few other tricks like inbred breeding lines) allowed them to learn a lot about traits and their inheritance starting in the early 1920s. Corn yields have quintupled (5x) since the 1930s as a result.

Grape breeders can only screen around 2,000 seedlings annually and have to continually winnow them down to a handful of 'advanced selections' they retain for several years of evaluation. Low numbers, slow turnaround, and high cost to retain seedlings are three factors that handicapped grape geneticists and breeders in determining inheritance of traits and the genes responsible for them.

Cheap DNA Sequencing is a Game Changer

Inexpensive DNA sequencing and the "Polymerase Chain Reaction" or PCR reaction has changed the landscape. Since 2007, according to the National Health Institute, the cost of sequencing a human genome has dropped from $10 Million to $1,000. Its 10,000 times less expensive now than it was ten years ago. To sequence one million DNA base pairs now costs around 1.2 cents – down from $500 in 2007.

This opened up the possibilities for grape breeders to map the grapevine genome and discover DNA markers that were related to traits such as disease resistance. By 2010, European researchers published the first complete genome of an inbred Pinot noir line called "PN40024" – a major accomplishment, and the result of a research investment of millions, and several years of effort.

It worked well with Vitis vinifera genetics – but less well when it came to North American Vitis species that are the source of many disease resistance and cold-hardiness traits in breeding programs. Simply put, markers from PN40024 were not informative for North American Vitis species used in many breeding programs.

One of the reasons for this is the fact that European Vitis vinifera diverged from North American Vitis around 20 million years ago.

Figure 1. Breeders at Cornell and elsewhere have identified several powdery mildew genes that they are incorporating in new varieties that will require fewer fungicide sprays. DNA markers allow them to know which vines have which resistance genes by testing leaf tissue at the seedling stage. Photo: Lance Cadle-Davidson

Twenty million years is a lot of time for the European species to diverge from the North American species. The ~20 North American species and the European Vitis are all recognizable as grapevines and nearly all make fertile hybrids with V. vinifera – but their genomes have structurally rearranged themselves in the meantime.

Core Genome and Transferable Markers

This led Cornell genetics researchers Qi Sun,Cheng Zou and postdoc Avi Karn, along with USDA researchers Lance Cadle-Davidson and Jason Londo to sequence nine North American Vitis genomes and try to align the 'core genome' (i.e. the genes coding for what makes a grapevine a grapevine) that all of the species shared in common with the existing reference PN40024 genome.

The result is that there was about 10% commonality among all species. By using the 'core genome' sequences, the team was able to come up with DNA markers that spanned the 19 chromosomes (good coverage) and worked just as well with Vitis riparia and Vitis cinerea as they did with the Vitis vinifera PN40024 genome. See (Grape Breeders Search for Reliable DNA Markers: Why the Pinot noir PN40024 Reference Genome is Not Enough).

Current Situation

Now, breeders have access to a suite of 2,000 DNA markers, more or less evenly spaced throughout the 19 grape chromosomes, that work across the diverse Vitis genus. This marker platform allows them to look at families of siblings called mapping populations and determine which combination of markers each vine has. Like human brothers and sisters, these siblings of two different parents harbor different combinations of traits from each parent.

Researchers can then find out from these siblings where in the genome the genetic trait is located. And do so at a reasonable cost of about $10 per vine.

Disease Resistance Markers and Their Use

Since 2000, several DNA markers for powdery mildew (10) and downy mildew (27) have been identified (see Figure 2). These markers – designated by a three-letter code involving the scientific name of the pathogen and a number (for example Ren2 = Resistance to Erysiphe necator 2 for powdery mildew) – are easily identified with simple DNA tests. In practical terms, it allows the breeders to test each seedling they generate every year – and to learn which resistance genes the seedling contains.

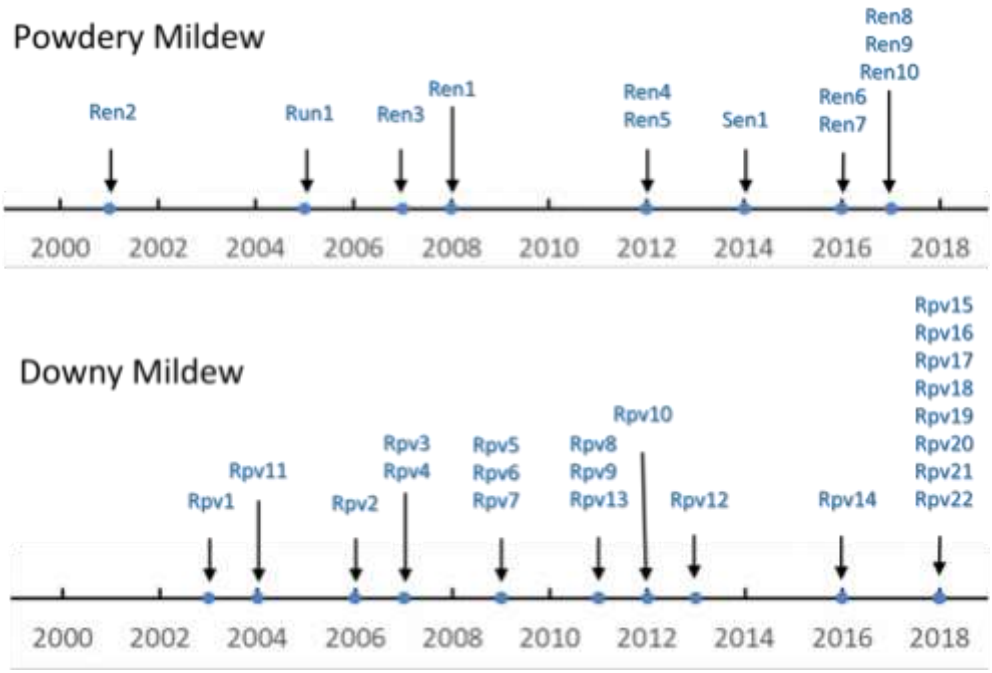

Figure 2. Powdery and downy mildew resistance DNA markers discovered since 2000. These markers, designated with a three-letter abbreviation and a number, are now available to grape breeders for marker-assisted selection.

Instead of planting them out in the field and looking for natural powdery mildew infections, breeders can test tissue and discard those that don't contain the genes they want. This process, called Marker Assisted Selection is allowing breeding programs to stock the pipeline with vines that have known characteristics – and save time, space, and money. As these new selections build up within the breeder's plantings over years, the investment in testing they are making now will pay increasing dividends in the future.

Figure 3. This numbered selection called 4427075 is a new wine selection in the Cornell-Geneva grape breeding program. It has two genes for powdery mildew resistance (Run1 and Ren2), and one for downy mildew resistance (Rpv1). The cross was made in 2014, and though we have no wine results yet, the flavors of the fresh fruit reflect a lack of wild grape off-flavors, and presence of pleasing fruity flavors. Fruit ripen mid-season.

Bruce Reisch's program already has several selections with known powdery mildew and downy mildew disease resistance in his program. For example, (Figure 3), a new selection called 4427075, with two powdery mildew (Run1 and Ren2) and one downy mildew (Rpv1) marker, produced in 2014, is currently being evaluated by the program.

Incorporating disease resistance genes into new varieties will pay dividends for grape growers worldwide. Instead of needing to spray a variety like 'Chardonnay' 10 to 14 times, the disease-resistant varieties offer the prospect of reducing the number of spray applications down to two to three. The economic, environmental, and social benefits of a potential 80% reduction in fungicide sprays as these new varieties are planted will be substantial.

The VitisGen2 project, led by Reisch and USDA scientist Lance Cadle-Davidson, is a nationwide project funded by the USDA's Specialty Crops Research Initiative involving researchers in California, Minnesota, Missouri, North Dakota, South Dakota, and New York. Its aim is to discover DNA markers, and particularly those associated with powdery mildew resistance and fruit quality, that breeders can use for marker-assisted selection of new varieties. To date, the project and its predecessor (Vitisgen1) have discovered over 70 DNA markers for desirable traits. These DNA markers provide grape breeders with a roadmap for producing a new generation of more sustainable and resilient grapes of the future.

Tim Martinson is senior extension associate and Bruce Reisch is professor of grape breeding and genetics in the horticulture section of Cornell's School of Integrative Plant Sciences. Both are based at Cornell AgriTech in Geneva, NY.

First Year Impressions: Using Low Tunnels to Improve June-Bearing Strawberry Yield

Elisabeth Hodgdon & Laura McDermott, CCE Eastern NY Commercial Horticulture Program

June-bearing (JB) strawberry growers know that the first berries to market in the spring fetch the highest prices and draw in customers. With more and more high tunnels being constructed on farms every year, growers are interested in the utility of tunnels for strawberries versus tomatoes and other warm-season crops. We see a wide variety of strawberry production under cover around the state, ranging from sophisticated greenhouses with hydroponic production to high tunnels and smaller caterpillar tunnels. These structures help extend the season for JB strawberries, hastening maturity in May. They also protect plants from rain and extreme weather events, reducing disease pressure. Although larger tunnel structures are a more common site in NY farms, we seldom see low tunnels—waist-high plastic structures—on farms. These tunnels offer many of the same benefits as larger tunnels, but at a lower cost: approximately $20,000 for materials to construct one acre of low tunnels (see *References*).

Benefits of low tunnel use

Low tunnels offer a variety of benefits for improving crop yield and quality:

- Season extension: earlier harvests in spring and later harvests in fall (for day neutral varieties)
- Larger fruit size
- Improved fruit quality
- Decreased disease pressure, including *Botrytis* and anthracnose
- Increased total yield

The plastic covering of tunnels creates a beneficial environment through increased daytime temperatures and protection from precipitation and wind. Keeping rain and hail off fruit decreases diseases pressure, resulting in a higher percentage of marketable yield. In our experience, the tunnels are fairly simple to setup. They consist primarily of hoops, clear plastic, stakes, and bungee cords holding covering in place. In comparison to larger, more sophisticated structures, they allow for more flexibility for movement from field to field according to crop rotation. Growers and researchers report day neutral (DN) strawberry yields from low tunnels of up to nearly double that of unprotected culture. Results vary tremendously according to weather; in wet years, tunnels offer protection that greatly improves crop quality and overall marketable yield, whereas in dry years there may be less yield benefit. Despite these benefits, cons to the low tunnel systems include labor for installation, maintenance, and deconstruction, as well as initial material costs.

Fig. 2. Inner tunnel environment at Farm A, with plastic cover draped in bird netting.

Fig. 1. Three low tunnels draped in bird netting at Farm A in April 2021.

In 2021, we set up three low tunnels at two farms in the ENY region to gather grower input on whether they impacted maturity, yield, and quality of JB strawberries. While research has been done on DN strawberries in tunnels, little is known about whether low tunnels are worthwhile for JB production. At each site, the grower compared quantity and quality of berries grown under the tunnels versus in the open air in adjacent rows. At the end of the strawberry season, we recorded our observations and those of the grower host. Here, we discuss our findings from last season.

On-farm demonstrations

Farm A

Farm A is a diversified organic small fruit and vegetable farm that sells strawberries through farmers markets and CSA. The growers manage their small-scale production intensively, utilizing multiple high tunnels for season extension. Grower A was intrigued by the use of high tunnels for earlier harvests of berries to bring to spring markets.

We installed low tunnels over three sections of their rows of 'Chandler' strawberries in late April. The plants had just started to bloom. Due to deer and bird pressure, grower A uses netting as a deterrent (Figs. 1 & 2). We draped the bird netting over the tunnels. Unfortunately, due to a freeze later in May (several hours of temperatures in the 20's), Farm A lost most of the primary blossoms. Due to the warming effect of the tunnels, the plants and flowers within the structures were slightly more mature, and therefore may have lost a higher number of primary blossoms than the uncovered plants.

Lessons learned from Farm A:

- Low tunnel structures do not provide protection from low nighttime temperatures. Additional frost protection (e.g. row cover or irrigation) is still needed to protect flowers from late

(Continued from page 6)

frosts/freezes.

- Bird netting plus the tunnel structures created an overly complex harvesting environment for employees. Netting had to be removed, and the sides of the tunnels needed to be raised at each harvest.
- Despite yield losses due to the freeze, grower A observed improved fruit quality under the tunnels.

Conclusion: Low tunnels were not worth the management effort for Farm A.

Farm B

Farm B is a conventional diversified fruit and vegetable operation offering strawberries at their retail store and for pick-your-own. Grower B was interested in using low tunnels to determine whether the structures would hasten berry harvest; earlier berries in May would draw customers to their farm store.

On Farm B, we installed the low tunnels over 'Dickens' strawberries (Figs. 3 & 4). We were limited in where we could install the tunnels, because only one field had drip irrigation set up. Shortly after setup, we needed to replace and repair plastic over the tunnels due to ripping during spraying with a boom sprayer. In addition to the farm workers' harvests, we harvested some of the berries for comparison between the tunnels and adjacent bare rows.

Lessons learned from Farm B:

- Low tunnels require drip irrigation, which not all growers use.
- Strawberry yield early in the season was higher under the tunnels.
- Strawberry season was very dry in northern New York, thus there was little disease pressure from *Botrytis* and anthracnose overall. Workers reported firmer, higher quality berries under the tunnels nonetheless.
- Harvesting under the tunnels was less efficient. While workers typically straddle rows to harvest, one can only harvest one side at a time under a tunnel.
- Spraying with a boom sprayer is challenging with low tunnels. Tunnel plastic could be rolled up to its highest point on the hoops during spraying, but it is difficult to navigate the structures in the field.

Conclusion: Low tunnels would be useful for a small proportion of the farm's early strawberry varieties to achieve earlier harvests. They would be too challenging to implement on a larger scale. Farmer B is interested in constructing more low tunnels in 2022 to give them a second chance, particularly for early varieties that could boost spring sales.

Low tunnels were evaluated in 2015 across NY, but in those field trials the low tunnels covered DN strawberries. The same advantage of increased marketable yield was found to be true with DN strawberries as was found with JB strawberries. On years with high pest pressure from SWD, tarnished plant bug and even anthracnose, growers would need to be prepared to improve their spray program to adjust for low tunnels. From the perspective of tunnel management, a longer DN production season allowed managers and pickers more opportunity to adjust work-flow to the low tunnels (*see References*).

Conclusions

While low tunnels are used in Europe and elsewhere with great success, they are not appropriate for all operations. The major challenges observed in our first year of trials included difficulty harvesting and applying pesticides, and overall increased labor requirements. We plan to conduct on-farm demonstrations again during the 2022 season, which may bring differing weather conditions to test the tunnels' effects on strawberry yield and quality. In a changing climate, the Northeast experiences an increase in extreme weather events. Low tunnels may be an important tool in mitigating effects of heavy rain, hail, and wind brought by spring and early summer storms. Additional research and grower input on utility of these systems for JB strawberries is needed to determine whether they are worth the added effort.

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Fig. 3 (left) Low tunnels installed at Farm B in May 2021. Fig. 4 (right) Sides rolled up to allow for air flow and temperature control at Farm B.

Integrative Management of Bitter Pit in 'Honeycrisp' Apples from the Extension Perspective

Daniel J. Donahue, CCE Eastern NY Commercial Horticulture Program

Introduction

This article is a "meat and potatoes" summary of an American Society of Horticultural Science (ASHS) Postharvest Group webinar I presented on January 18, 2022. The webinar audience was a mix of research, extension, and commercial industry fruit workers from North America and Europe. As such, it was necessary to introduce the NYS apple industry, the Hudson Valley in particular, the Honeycrisp (HC) apple, and an overview of the 6-years of results from a Honeycrisp bitter pit (BP) research project for the most part conducted in the Hudson and Champlain valleys. Since our CCE-ENYCHP Produce Pages readers have seen much of this data presented at fruit schools and in previous articles, I'm going to focus on specific recommendations that you can implement for the 2022 growing season. If you would like to review the research in more detail, a list of links to relevant articles will be provided at the end. A recording of the full webinar is available to ASHS members by following this link https://ashs.org/page/ArchivedWebinars .

Bitter Pit and Honeycrisp: General Observations & Recommendations

It's a "bitter" pill to swallow, but after 6 seasons of research in the Hudson Valley, and much more by others in Honeycrisp regions, it's clear to me that our current level of mitigation technology and understanding of the causal mechanism for BP will not lead to the commercially satisfactory control of bitter pit in Honeycrisp. By this I mean "control" at the levels we expect from our currently available pest management technologies (Figure 1). Our strategy is little different from that of the great coach Vince Lombardi and his "4 yards and a cloud of dust" football playbook. Commercial producers must implement a series of tactics that individually may not work from year to year, but as an integrated program will serve to significantly reduce losses.

The three most significant BP variables under the control of the commercial producer and marketer are first, the region where you decide to grow Honeycrisp and second, the rootstock you choose to produce it on, and third, how well you manage annual crop load. Cool geographic regions such the Champlain Valley of New York State reliably produce Honeycrisp with much less BP than warmer regions such as the Hudson Valley of New York State. This realization is of cold comfort to the Hudson Valley producer and marketer, but it is reality. In the future if we continue to move towards an oversupply situation, lower FOB's will inevitably make HC from warmer regions less financially attractive attributably to BP and color challenges. The second variable, rootstock, is a management choice which is under producer control independent of the growing region. The third variable, crop load, is completely under the control of the orchard manager. We really can't "reduce" BP through good crop load management, we can only balance crop load, BP incidence, and fruit quality in such a way to maximize profitability over the economic life of the orchard.

Fig. 1. We expect our management technologies to produce clear, consistent results. Unfortunately, this is not the case with bitter pit.

Finally, HC orchard profitability over the long term is essentially a decision matrix in that all of your management decisions have consequences, usually effecting more than one variable. For example, not investing in the hand thinning of a heavy crop not only impacts fruit size, but it will reduce return bloom in the next year, reduce fruit color and Brix at harvest, delay maturity, and perhaps result in an off flavor. Yes, BP will be reduced, but at a very heavy cost. The light crop produced with next year will be characterized by excessively large fruit ravaged by BP. I think it's unlikely you can successfully implement any practices that will mitigate the BP under those circumstances. Bottom line, HC is a variety that requires hands-on management and close attention to detail, nothing like the other varieties we grow.

General Recommendations for Eastern New York State:

- Condition Honeycrisp for 7 days post-harvest at 50°F, then store at 38°F in both the Hudson and Champlain Valleys. The objective is to reduce chilling injuries such as soft scald and soggy breakdown. Yes, conditioning, and warmer storage temperatures increase BP somewhat. However, losses to chilling injury in the Hudson Valley appear to be increasing and when they happen, soft scald losses make BP look like a poser.
- The Hudson Valley is a world of many varieties generally stored on-farm. With Gala, McIntosh, and Honeycrisp harvest timings colliding with each other and closely following Paula Red and Jonamac, producers rarely have a free storage room to devote to 50°F conditioning or even dedicated HC storage. Consider how to best balance your storage risk in high BP situations by mixing varieties in rooms of limited storage duration where the warm HC temperature will have only a minimal impact on those varieties which are best when stored at 33°F. Short on HC conditioning space? At least in lower volume situations, a reefer body running at 50°F can handle 50 bins, although in that case removing the initial field heat is best accomplished in a standard cooler. Not as efficient as a dedicated storage room, but it can work when space is tight on smaller farms.
- Consider the customer satisfaction consequences of putting high BP risk fruit, say over 30%, into the marketplace. A tough decision but balance the cost of an unhappy buyer and load

Fig. 2. Honeycrisp bitter pit in the wholesale supply chain. For your eyes only, not your customers!

rejections (Figure 2). As quality standards tighten, those high BP M.26 blocks may be more of a liability than they are worth.

- Avoid excessive irrigation in the second half of the season. I included a link below to ta Good Fruit grower article which discusses the research of Dr. Lee Kalcsits (WSU) on the deficit irrigation of HC.
- The early, physical removal of fruit buds (precision pruning), flowers (pollen tube model thinning) and aggressive early thinning strategies (precision thinning) can aggravate bitter pit. The effect may not be noticeable in low BP orchards like those on B.9, but can be significant if BP exceeds 20% as many Hudson Valley orchards do. I've not observed the same effect from bloom thinning with NAA. Again, every management decision with HC is a tradeoff. In this case the balance between crop load and return bloom. Since early HC thinning doesn't seem to reliably enhance return bloom, its best to pick your battles on this one.
- Avoid the combination of G.41 and HC. Terrible bitter pit in most situations coupled with a reduced fruit set issue, not to mention the potential for graft union breakage.

Recommendations for new 'Honeycrisp' plantings in bitter bit prone regions of NYS:

- Plant high-color strains
- Plant B.9 (for now) and choose a planting density compatible with your site and local experience. I prefer 2.5' x 10' for the B.9/Honeycrisp combination in ENY.
- Avoid replant sites or at least implement a multi-year remediation plan on replant ground. Sorghum/Sudan is a nice cover crop mix prior to planting apples. The fallow period also provides a window to gain control over difficult perennial weeds.
- Adjust soil to a pH of 7.0 and incorporate amendments to correct mineral deficiencies.
- Take all necessary steps to maximize vegetative growth during the first few years.
- Avoid cropping in the second leaf, HC tends to settle down quickly once it's allowed to crop. Unfilled canopy space = low yields for the life of the planting.

Recommendations for an established orchard planted on B.9:

- Maintain pH and a balanced program of soil fertility. Follow Dr. Lailiang Cheng's and Mario Miranda-Sazo's recommendation to moderate potassium fertilization. Muriate of Potash can become quickly available to the tree if water is applied. Less K is required in an off year.
- Avoid the use of Prohexadione calcium (commercially formulated and sold as Apogee and Kudos) at any timing, as you already have a low-BP rootstock with low-vigor characteristics.
- Maintain a consistent annual cropping program based on NAA at bloom, followed by NAA & carbaryl as needed according to the carbohydrate thinning model.
- If needed, hand-thin early to touch-up or correct thinning mistakes and apply 4 summer NAA sprays at 5 ppm to encourage return bloom.
- Set the kings, avoid doubles. Lower BP in king fruit, at least under low-BP conditions.
- Start a foliar calcium program at petal fall, 5-weekly applications, continue every two weeks into mid-August.
- No need to spend time or money on bitter pit prediction. BP will be reliably low, fruit from B.9 orchards will be your go-to for longer-term storage.
- Allocate your 2nd and 3rd picks into longer-term storage (90d+).
- Allocate your 1st pick into 60-90d storage, maximize the economic potential of your low-BP orchards by prioritizing them for storage and later sale at higher FOB's.

If an established orchard is planted on M.9, M.26 or others, then:

- Maintain pH and a balanced program of soil fertility. Follow Dr. Lailiang Cheng's and Mario Miranda-Sazo's recommendation to moderate potassium fertilization. Muriate of Potash can become quickly available to the tree if water is applied. Less K is required in an off year.
- Apply a single application of Prohexadione calcium (Apogee or Kudos) at pink stage. Adjust the timing slightly to catch a 60°F application window.
- Do Not Apply Prohex after bloom. Research has demonstrated that there is a significant risk of aggravating BP with post-PF applications and research has also shown that whatever competition occurs between shoots and fruits, especially in the summer, it does not reliably aggravate BP.
- Maintain a consistent annual cropping program based on NAA at bloom, followed by NAA & carbaryl as needed according to the carbohydrate thinning model.

(Continued on page 10)

(Continued from page 9)

- If needed, hand-thin to touch-up or correct thinning mistakes and apply 4 summer NAA sprays at 5 ppm to encourage return bloom.
- Set the kings, avoid doubles. Lower BP in king fruit, at least under low-BP conditions.
- Start a foliar calcium program at petal fall, even as early as pink (but not tank-mixed with your Prohex application) 5-weekly applications, continue every two weeks into mid-August.
- Implement the bitter pit prediction protocol of your choice. The EMR prediction model and the "Passive" prediction protocol were developed in NYS and were properly validated. Identifying potential BP storage disasters is worth the cost of $70 for HC orchards up to 5 acres in size. BP prediction is not only for the large wholesale producers. Smaller retail operations that want to continue in operation supplying quality HC through the winter and spring need low BP fruit as well.
- Allocate your 3rd picks into longer-term storage (90d+) if you must to marketing conditions.
- Allocate your 2nd pick into 60-90d storage.
- Allocate your 1st pick for immediate sale if your prediction model suggests BP in the 10-20% range. As mentioned earlier, predicted BP over 30% (reality check: 50% of HV orchards experienced BP over 30% in 2021) presents a rejection risk in the retail supply chain.

Future Direction: What do we need?

Follow all the steps above, and unfortunately you'll often continue to be disappointed with the BP observed in many orchards:

- We need to identify a low-BP rootstock for 'Honeycrisp' that is a little more vigorous than B.9 for replant situations and sites with weak soils.
- Continue work with plant growth regulators to find materials or combinations that improve the delivery and distribution of calcium ions within the fruit.
- Identify the gene(s) which influence the delivery and distribution of calcium within the fruit and deal with them through conventional plant breeding techniques, genetic engineering, or even using plant growth regulators to influence gene expression.
- We need production economics studies of established Honeycrisp orchards that are producing too much lower quality fruit. At what point do we fire up the dozer?

To conclude, the goal of this article was to suggest action items that you can implement to reduce losses to bitter pit. The causation question is another matter entirely. What we see expressed on the fruit's surface visually is the death of individual cells through desiccation following the structural failure of the cell membrane. However, this result is clearly not a random event attributable to the "global" status of calcium content in the fruit. We see variability of symptom expression at the fruit, tree, orchard, and storage level. I say "symptom expression" because we only know what we can see. Are there other groupings of weakened cells in a particular fruit that might have expressed visual symptoms of cell membrane failure if only they experienced a differing set of conditions during development and/or storage? Colleagues and I describe BP as a "calcium-related disorder", which is different than saying it's a straight-up global calcium deficiency. What exactly constitutes "related" is the open question, we have several hypotheses, but no consensus. The topic of causation is its own discussion; work continues……

Resources if you're interested in a deeper dive into the data

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Interseeding Summer Cover Crops Between Vegetable Beds: Trial Results Year 2

Deborah Aller, Agricultural Stewardship Specialist, and Erin Myers, Agricultural Stewardship Technician, Cornell Cooperative Extension of Suffolk County

Source: Agricultural News, Volume 105, Number 12, December 2021

Managing weeds between vegetable beds remains an on-going issue for vegetable growers, both organic and conventional. It is common practice for vegetable growers to transplant crops into beds covered with black plastic mulch. This strategy provides excellent weed control in the planted row but leaves soil between beds exposed and vulnerable to erosion, compaction, and weed growth. Conventional growers often use herbicides for weed control, but herbicides applied at crop establishment do not provide season long control. Organic growers can mow or use tillage to control weeds, but this can be difficult between beds with plastic mulch and the soil is continuously disturbed decreasing soil health over time. Planting cover crops to protect and improve soil health is not new and the potential benefits of cover crops are well known. Cover crops planted between plastic-covered, vegetable beds have similar potential to reduce tillage and erosion, build soil health, minimize pesticide use, and suppress weeds if the appropriate species and management strategies are implemented.

Trials conducted in 2020 at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY and on-farm identified buckwheat and teff as the most promising cover crop options for weed control between vegetable beds (Agricultural News, November 2020). We hypothesized that abnormally dry weather at planting in 2020 was at least one reason for the reduced germination and poor establishment of some of the cover crops. However, with a changing climate, spring is predicted to be cooler and wetter and summers hotter and drier in the Northeast. Therefore, determining the best date for seeding summer cover crops to improve germination rates and the likelihood of good establishment is critical. If summer cover crops can be seeded earlier, at field preparation (in May) instead of at transplanting (in June), the likelihood of capturing spring soil moisture to improve germination may be higher. Also, there is growing interest in more heat- tolerant cover crops such as teff. Additionally, due to equipment availability and time, many growers decide to broadcast fertilizer to the entire field being planted prior to laying the plastic instead of targeting the fertilizer to only the planting row under the plastic and the roots of the cash crop. Fertilizing the entire field means fertilizing weeds, but this practice may also provide the opportunity for cover crops to capture the added nutrients and establish before the weeds.

Thanks to another year of support from the Friends of Long Island Horticulture, we expanded the 2020 trial to evaluate cover crop species (teff, buckwheat), seeding date (early, mid, at transplanting), and fertilization method (in-row vs. broadcast) on weed suppression, cover crop biomass production, soil properties, and crop yield.

Fig. 1. Overview photo of trial after all treatments had been planted on July 6th, 2021. Photo: Erin Myers

Materials and Methods

A replicated research trial was conducted at LIHREC using a randomized complete block design with four replications per treatment. Three in-between row treatments, two cover crops (teff and buckwheat) plus control (straw mulch), were established between plastic mulch beds (Fig. 1). Buckwheat is a quick growing short-season summer cover crop, good for weed suppression and attracting pollinators and beneficial insects. Teff is a heat and drought tolerant, warm-season grass useful for suppressing weeds, and requires little maintenance. Jalapeno peppers, Jedi variety, were grown on raised beds covered with black-plastic mulch with drip tape for irrigation. Pre- and post-trial soil samples were collected and analyzed to evaluate differences in soil properties between treatments. Fertilizer was broadcast applied to half of each block and applied only within the planting row on the other half prior to laying the plastic. The cover crops were drill seeded, using a Jang 5-row push seeder, on three different dates: early (at field prep, 5/26/2021), mid (2 weeks later, 6/8/2021), and late (at transplanting mid-June, 6/22/2021).

Cover crop and weed height, determined as the average of six random measurements per plot, weed species present, and percent weed biomass using the Canopeo App, were determined weekly. Aboveground cover crop biomass weight, determined using a 1x1- ft sampling grid with three samples per plot, was collected twice during the growing season (mid and end season). End-of-season biomass was analyzed for carbon and nitrogen content. Harvest data was collected weekly on the middle six plants per plot to assess any treatment effect on pepper yield and quality. Statistical analysis was conducted using analysis of variance (ANOVA) for a balanced, completely randomized, full factorial experiment in JMP. Statistical significance was assessed at the 5% alpha level.

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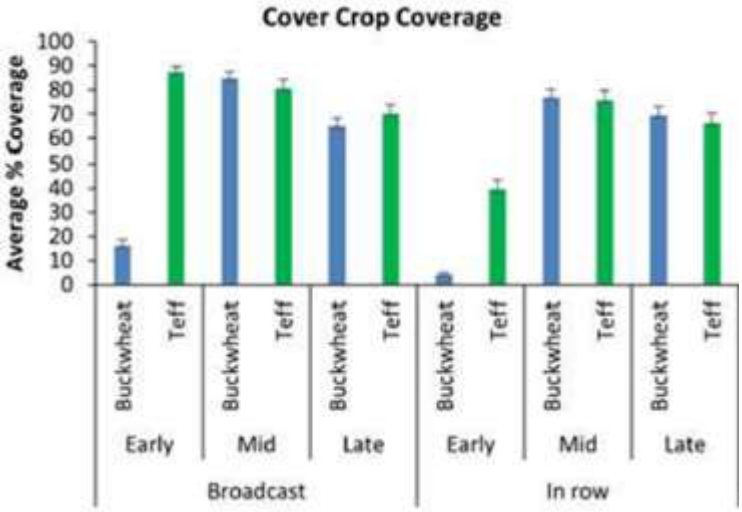

Fig. 2. Percent cover crop coverage across all treatments. Average of three random samples per plot with standard error bars.

Results and Discussion

Average cover crop and weed height were significantly affected by cover crop species, fertilization type, and planting date ($p<0.0001$). For the early planting date, teff produced the tallest biomass compared to buckwheat and the control treatments, but for the middle and late planting dates buckwheat was the tallest followed by teff then the control. Weed height was comparable to cover crop height across all treatments. Weed species present included purslane, pigweed, lambs quarter, grasses, chickweed, nightshade, knotweed, sedges, and ragweed. Weed height was surprising considering the percent cover crop coverage, except for the early buckwheat seeding which failed to germinate due to old seed (Figure 2).

Pepper yield, determined as the number and weight (lbs) of peppers harvested from the center six plants per plot, was significantly impacted by planting date, cover crop species, and fertilization type ($p<0.0001$). For all three planting dates, there was a strong interactive effect of cover crop species and fertilization method. Overall, the mid and late plantings yielded more peppers, and the control in-between bed treatment had the smallest adverse impact on pepper yield ($p<0.05$). Management of the cover crop likely impacted pepper yield, as the cover crops were not mowed or trampled until the end of the experiment so cover crop growth was high or in some cases above the pepper crop. This resulted in the pepper plants growing vertically.

Aboveground cover crop biomass was harvested after four weeks of growth for each respective planting date and at the end of the experiment. Cover crop carbon and nitrogen content differed between species, but this was impacted by fertilization type and planting time. Mid-planting date resulted in significantly higher C/N in the cover crop compared to the early and late plantings ($p<0.0001$), but no difference between cover crop species was found ($p<0.05$).

End-of-season soil samples showed no effect on organic matter content, potential nitrogen release, and some micronutrients (Fe, Mn, Cu, Zn). Soil pH was impacted by planting date, cover crop species, and fertilization type ($p<0.0001$), and several other soil nutrients were affected by the different treatments (P, K, S, Ca, Mg, K, Na, B, Al). No clear effect of an individual treatment accounted for these differences.

Overall, cover crop biomass production was greater than in 2020, which we attribute largely to weather. The summer of 2020 was a drought year with conditions abnormally dry from mid-June through July and then becoming a moderate drought the entire month of August. Meanwhile, there was adequate rainfall throughout summer 2021 and no abnormally dry or drought period was observed (US Drought Monitor, 2021). Sufficient rainfall and high temperatures likely contributed to the prolific growth, particularly of the teff cover crop. Additionally, this research suggests that if buckwheat or teff are used between beds, they should be seeded at least 2 weeks after the crop is transplanted because of rapid growth particularly under optimum growing conditions and may require mowing or trampling.

Not all details and results of this study are included here, for the full report please contact da352@cornell.edu.

Thank you to the Friends of Long Island Horticulture for funding this research!

Fig. 3. Teff cover crop produced significantly more biomass than in 2020. Growing on average 36 inches, which was unexpected. Photo credit: Lousie Koepele

References and Further Reading

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Cold Temperature and Herbicide Storage

Lynn Sosnoskie, Assistant Professor, Weed Ecology & Management for Specialty Crops, Cornell University

Cold temperatures can affect herbicide performance; applications of postemergence products under cool conditions may result in delays in symptom development and some treatments may fail altogether. Cold temperatures are also a concern for stored herbicides, particularly liquid products. Freezing (which may occur at temperatures below 32 F for some formulated products) can result in the active ingredient settling out of solution. Some, but not all, labels will provide advice regarding resuspension. If in doubt, call your pesticide dealer or the product manufacturer to determine if the herbicide contents can be re-dissolved and used, safely and effectively. While degradation of the herbicide itself is an important concern, don't overlook potential damage to pesticide storage containers under cold conditions. For example, freeze-thaw cycles can cause liquids to expand and contract, which may result in cracks in bottles. Cold weather conditions may make some plastics more brittle and prone to leaking. While dry formulations are less affected by low temperatures, they are sensitive to moisture; keep these products dry to prevent them from degrading or solidifying.

Always review herbicide labels for information regarding minimum temperature storage restrictions, which can vary greatly among products. For example, while many dry-formulated products have no limitations, Prowl H2O and Nortron should not be stored below 40 F and Reflex and Stinger should not be stored below 32 F. Other products have lower limits of 10 F or even less. Some labels may not report a specific temperature requirement but may have other handling recommendations such as "protect from freezing". Don't forget to review the storage requirements for your adjuvants as well.

Some general notes about herbicide storage:

- Always store products in original containers and make sure that the containers are sealed tightly. Store dry formulated products above liquid products to minimize the potential for contamination due to leaking.
- Keep containers away from children, pets, and livestock; also, human and animal food/feed. Store products away from houses, gardens, wells, irrigation canals, creeks and/or other waterways.
- Store pesticides in a locked and well-ventilated space that is both fire- and flood-resistant. Make sure that the space is properly identified as being a pesticide storage facility (to alert first responders or other personnel in case of an emergency). Keep current and detailed records of which products are at a site.
- To prevent cross contamination, do not intermix insecticides and fungicides with herbicides.

For more information about temperature extremes as pesticide storage, please see:

pdf\PI\PI16000.pdf (ufl.edu)

Temperature Effects on Storage of Agricultural Pesticides | MU Extension (missouri.edu)

Watch winter storage temperatures of herbicide (montana.edu)

22 Ways to Optimize High Tunnel Production in 2022

Vern Grubinger, University of Vermont Extension
(Source: VERMONT VEGETABLE AND BERRY GROWER NEWS, January 6, 2022)

High tunnel systems vary a lot – from super simple to all the bells and whistles – depending on grower goals, crops, finances, etc. so it's hard to make one list of improvements that fits everyone's situation. Maybe you've done all these things, or maybe you don't need to. Hopefully there's something in the list below that's helpful to your high tunnel management in the coming year!

1. **Replace greenhouse plastic before it's too old**. Most greenhouse plastic is rated for 4 years of use. Although they may hold up longer than that physically, all plastic films lose light transmission capabilities over time. Even with UV stabilizers that slow degradation, dust, dirt, and air pollutant accumulation can reduce light available to crops for photosynthesis. Tests of UV-stabilized plastic covering on a multi-bay greenhouse revealed a 6.8% reduction in transmission in Photosynthetically Active Radiation (PAR) after 4 years. Using a PAR meter, or quantum sensor, I have observed this on farms myself. The difference in PAR transmission between old and new covers is more important to crop growth when sunlight is limited, as it is early in the season, or on cloudy days.

2. **Add ground post extensions** to increase height of short tunnels. Many older tunnels were shorter than the norm today, so they have small interior volumes and short sidewall openings that limit passive ventilation. When replacing plastic, consider adding sidewall extensions to raise the height of the structure, which will reduce temperature fluctuations by increasing the volume of air. This also improves ventilation and lowers humidity more when bigger sidewalls are fully open. Depending on tunnel design it can also allow for growing taller crops and make room for workers to stand up next to tunnel edges. Cross braces or other structural improvements may be needed to ensure tunnel stability after ground post extensions are added.

3. **Optimize roll up sides**. Back in the day, a piece of pipe was how most sidewall plastic was rolled up. Today, there are many easier and

(Continued on page 14)

(Continued from page 13)
safer methods available that use geared systems powered by hand or electricity. There are also automated systems that use sensors to raise and lower the sidewalls depending on environmental conditions. These are not inexpensive but growers I've talked to say they help optimize crop growing conditions by avoiding exposure to hot/cold temperatures when someone is not available to change the sidewall opening, and they offer some peace of mind if you're away from the farm when the weather changes significantly.

4. **Add drip lines if needed** to wet the entire root zone. The extent to which irrigation water moves sideways in soil after it is applied depends on capillary movement. Capillary movement is enhanced by clay and organic matter content of soil. So if your soil is on the sandy side then there may be large dry areas between your irrigation lines if they are widely spaced. That can limit root growth and prevent plants from taking up nutrients even though they were applied. Adding extra drip lines is a low-cost way to make sure that water is distributed uniformly across the entire tunnel growing area. Set up irrigation timers, even inexpensive ones can help provide a consistent water supply.

5. **Improve ventilation**: add a ridge vent or install hinged gable vents in endwalls. Good ventilation not only provides a consistent supply of fresh air and thus CO2 for plant growth, it's also critical to managing humidity which can shut down photosynthesis if it's too high, as well as promote foliar plant diseases. Ridge vents are very effective and promoting air flow and ventilation in high tunnels, though they are not inexpensive, and I hear growers complain about changing the plastic with them. A lower cost alternative, albeit with less impact on air flow, is to install large openings near the top of tunnel endwalls, or gable vents. These can be hinged to open inward, or in "butterfly" fashion. Outward openings are more susceptible to wind damage. Typically, rope and pulley systems are used to operate gable vents.

6. **Improve air circulation** with HAF fans. Air circulation is not the same as ventilation. Circulation mixes internal air, reducing gradients in temperature, humidity, and CO2 that may be present. Ventilation without circulation can lead to corners or other areas of a tunnel not having sufficient air exchange. Properly installed horizontal air flow fans are a good investment in many high tunnels. Small, 1/10 to 1/15 hp HAF fans with permanent split capacitor motors work well. They move more air yet use less electricity than cheap box fans with shaded pole motors that are often seen in high tunnels.

7. **Size ventilation and circulation systems properly**. Ventilation flow rates are expressed as cubic feet per minute per square foot of growing area. Good mechanical ventilation requires the right size fans and/or openings. With passive ventilation it's just openings. An old article by John Bartok, former UConn Extension Ag Engineer, states that roof vent areas should equal the combined sidewall vent area, and each should be at least 15% of the floor area. That seems like a lot, and it suggests that many high tunnels have insufficient passive ventilation. Guidance for circulation flow rates is 25% of the overall growing volume per minute. See Chris Callahan's blog post on greenhouse ventilation for a summary of how to size these systems.

8. **Have furnaces professionally serviced** before the heating season. Quoting John Bartok once again: "Keeping the greenhouse heating system in good repair and operating condition can save money in several ways. Fuel consumed may be reduced as much as 20 percent. Heat distribution may be more uniform resulting in a lower thermostat setting and better plant growth. The system is less likely to fail causing crop losses." Here's a checklist for heating system maintenance.

9. **Seal gaps to avoid heat loss**. Whether you heat a high tunnel with solar energy alone or with supplemental heat, avoiding heat loss at night and on cold days is a good thing. I've seen many tunnels with gaps around doors and roll up sides, and louvers that don't seal. Some growers use old drip tape or used bicycle tire tubing as weatherstripping in door frames. Some brands of ventilation louvers work better than others (see Chris Callahan's blog post, above). And it's standard to have an extra panel of plastic cover left in place that overlaps with each end of the roll-up side, to create a better seal at the corners of a tunnel.

10. **Prepare for climate extremes**. The weather is getting whackier. Large, sometimes rapid, fluctuations in temperature and precipitation make tunnel growing more and more attractive compared to the field, but tunnels are not immune from extreme weather impacts. Options for coping include perimeter drainage, perimeter insulation, shade cloth, shade spray or paint. Don't forget to plan for worst case winds and heavy snow load to avoid collapse of tunnel structures.

11. **Thoroughly mix soil to re-distribute salts** that have moved up to the surface. A SARE-funded research project conducted by UMaine, UNH, and UVM found that during winter months, high tunnel soil can became strongly stratified in terms of soluble salt levels. In two test sites, there was a 10-fold difference in soluble salts between measurements from the top inch of soil vs. a sample 2-3 inches deep. This has implications in terms of soil sampling and seed germination. Although no-till has many upsides, it may not be appropriate in tunnels. Mix your tunnel soil well before testing it or sowing crops.

12. **Soil test** well in advance of planting seeds and transplants. For in-ground vegetable production we recommend the use of both the saturated media extract (SME) and the regular field soil test (modified Morgan's extract) to assess the levels of soluble and reserve nutrients, respectively. The UMaine Testing lab offers a "combined high tunnel package" for $30 that includes both tests. SME also measures soluble salts and soluble forms of nitrogen. The SME was developed as a potting soil test, it should be used to test your potting soil mixes well in advance of planting to avoid problems. The cost is $18 at UMaine, and many other labs also offer this test.

13. **Apply plenty of K** but avoid fertilizers with large granules. The same study cited above found that high tunnel tomatoes are heavy consumers of K, such that 500-600 lbs./acre of applied K minimized yellow shoulder and maximized yields. Sources of potassium sulfate, a common tunnel fertilizer, vary widely in particle size, and this, in turn affects solubility and release rate. This study found that when a fertilizer with very large particles (several mm diameter) was applied, some large particles were still intact 2 years after application. These would not be available for plant uptake despite being measured by

soil tests. Thus when incorporating fertilizers like potassium sulfate, it is advisable to use "fines" that are formulated for more rapid solubility.

14. **Test your irrigation water**. In the high tunnel, irrigation is the only source of water whereas for crops grown outside, irrigation water is diluted by rainfall. It makes sense to test your tunnel irrigation water to optimize yields and to avoid potential toxicity issues. Penn State's guidance advises testing water for pH, alkalinity, conductivity, hardness, chloride, and sodium at a minimum. Their lab offers irrigation water tests starting at $35. Their fact sheet shows the ranges found in over 400 water tests submitted, which provides some idea of the variation out there. If your water has high alkalinity, this UMass fact sheet offers management guidance.

15. **Evaluate and possibly adjust planting density**. High density plantings can increase yield, as Becky Maden's on-farm research with high tunnel tomato growers has shown. The highest yielding tunnels typically had 4 sq. ft. or less per tomato leader. Similarly, packing leafy greens into tunnels, even eliminating walkways, can also increase total yield. Of course, higher densities can lead to less air movement and more foliar disease. Thus the importance of air ventilation and circulation, see above!

16. **Use "guardian plants"** as part of your IPM program. Guardian plants help protect plants by supporting biological control agents that kill pests. For example, marigolds can be used to manage western flower thrips in combination with predatory mites and a granular form of a commercially available insect-killing fungus to create a self-sustaining IPM system. The UVM Entomology Lab offers this do-it-yourself guide. If you've ever had thrips in your tunnels, you know they can be difficult to control.

17. **Establish a pest monitoring and scouting program**. Using traps and inspecting plants on a regular basis can keep pest problems from becoming unmanageable. Consider assigning one person to be your "IPM scout" performing a weekly walk-through of all tunnels, documenting insect and disease populations, and taking pictures of any symptoms needing identification. UMass Extension has a simple scouting form for common greenhouse insect pests. Yellow sticky cards are handy monitoring tools, but they require getting familiar with what gets stuck on them; see guidance like this from NC State Univ. There are many biological control options for tunnels and greenhouses. These should be preordered in many cases. You can store ladybugs in a fridge if you have a history of aphid problems.

18. **Install sensors and alarms**. An air temperature alarm and an emergency heater are basic examples of this, but there are many more options for monitors, which should be associated with backup systems or plans in the event of a system failure. Sensors to consider for tunnels are air temperature, soil temperature, relative humidity, irrigation water tank temperature, water pressure, electric voltage, door open/close, carbon monoxide, propane tank level and more. For more info on remote monitoring see the UVM Ag Engineering blog post.

19. **Minimize 'edge effect' yield losses**. I can't find any article about this but many of you have seen it, too – reduced growth of crops in beds or rows along tunnel edges. It's probably due to several factors: colder soil (add perimeter insulation), colder air (see HAF fans, above), uneven distribution of nutrients, especially when spreading bulk materials like composts, and maybe just less TLC because it's often harder to work in the edges of the tunnel. Whatever the reasons, loss of yield along both edges can be significant, so try to avoid the possible causes.

20. **Prepare for rodent control** (they can move in fast). Options include active measures like traps, rodenticides, cats, etc.) and passive measures like sealing doors, packing up produce, hardware cloth for exclusion, accepting the loss, selling everything early. For more info on these options see a detailed post on the UVM Ag. Engineering blog.

21. **Enhance labor efficiency**. Take a step back and consider ways to perform tasks more efficiently. Start with tasks that require a lot of time. How long would it take for a flat filler to pay back? How much walking could be avoided when harvesting with the use of carts, or a trolley conveyor? Do you have SOPs to support workers in performing time-consuming tasks efficiently? Check out this overview of ways to lower greenhouse labor costs by, you guessed it, John Bartok. The short section on workstation design for repetitive tasks is worth a read for most growers.

22. **Set up systems to track what you want to improve**. As Yogi Berra once said, if you don't know where you're going, you'll probably get there. Want to improve the yield of a crop, or the amount of time spent on certain tasks? You'll need to have a baseline. Weighing all harvests and timing all tasks is unrealistic, so start with the most important crops and tasks, and set up a simple way to measure them. It could be by counting boxes or other units of harvest over time, perhaps from one representative area of a tunnel. How will data be recorded? Maybe old-fashioned clipboards with harvest tally forms, or dry-erase boards, or iPads with spreadsheets. Set up a system that works for your farm.

Bonus points: Take time to celebrate. The world's a crazy place and you and your team are doing good by growing plants that help people stay healthy in body and spirit! It's important to acknowledge this meaningful work--however you choose to do that.

NY Hemp Samplers Needed

NYS Dept of Ag & Mkts (NYSDAM) will be administering the new USDA-compliant hemp program. This first year of this new program, (2022), all hemp grown in NYS will need to be tested for total THC content prior to entering commerce. This new program does not allow hemp growers to sample their own hemp for THC compliance.

NYSDAM needs:

- Individuals must pass a 20-question exam to be certified as a Sampler.
- Only certified individuals will be allowed to sample hemp in NYS.
- Certified Samplers will be listed on our website for hemp growers to contact as well as a list of all hemp growers for the samplers to contact.
- Samplers are free to charge the fee they require for sampling and mailing the hemp to the lab of the grower's choice. NYSDAM will have a list of approved labs on the website as well. There is no fee to take the training or the exam.

NYSDAM will need Certified Samplers across the State.

Individuals to attend a short training, (60-90 minutes), (probably online) on how to sample hemp for NYSDAM.

Samplers will set their own fees, hours, and geographic service area.

Certified samplers must be 21 years of age and pass a FBI Identity History Summary, (background check) as well. This is an easy and low-cost process. The link to do so is: https://www.fbi.gov/services/cjis/identity-history-summary-checks

NYSDAM will work directly with anyone interested in becoming a Certified Sampler and are happy to answer any question potential applicants have. Contact email and phone number are listed below.

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DEC Announces Actions to Protect New York's Pollinators by Restricting Use of 'Neonic' Pesticides

New Requirement for Neonicotinoids Will Help Prevent Potentially

New York State Department of Environmental Conservation (DEC) Commissioner Basil Seggos today announced actions to limit the unrestricted use of pesticides that can harm bee and other pollinator populations. DEC is reclassifying certain products containing the neonicotinoid (neonic) insecticides imidacloprid, thiamethoxam, and acetamiprid as "restricted use" to ensure applications are limited to trained pesticide applicators in specific situations. Restricting the use of these pesticides enables DEC to collect new data to determine where, when, and how they are used, as well as their potential impacts.

"Protecting pollinators is a top priority, and today's action to restrict the use of these neonicotinoid pesticides is another important step in our ongoing efforts to safeguard these species that are crucial to New York's environment, agricultural economy, and biodiversity," **Commissioner Seggos** said. "Reclassifying these pesticides will ensure they are only used in targeted instances by qualified professional applicators, and only available for sale to certified applicators which will further protect public health and the environment."

New York is committed to promoting the health and recovery of pollinator populations, as highlighted in the State's Pollinator Protection Plan (PDF). Pollinators contribute substantially to New York's environment and economy. According to the U.S. Department of Agriculture, pollinators provide approximately $344 million worth of pollination services to New York and add $29 billion in value to crop production nationally each year. The state's ability to produce crops such as apples, grapes, cherries, onions, pumpkins, and cauliflower relies heavily on the presence of pollinators.

Pesticides represent one of many factors that stress pollinators, and neonicotinoids in particular have been identified as a group of pesticides that, in general, are highly toxic to pollinators. While commercial application of all pesticides is reported to DEC as part of the State's stringent regulatory oversight, residential applications and sales of general use products to consumers are not. The reclassification ensures proper use by trained applicators and enables DEC to collect sales and use data to estimate and monitor the quantities and locations where these products are used.

The reclassification will take effect on Jan. 1, 2023, allowing time for registrants, distributors, and retailers to prepare for the change in classification. Neonics will be reclassified under DEC's pesticide regulation authority and pesticide registrants have been notified of the intent to reclassify the applicable products. Products labeled for "limited directed application" to tree trunks and the ground at the base of trees, shrubs, and plants are not included in the reclassification. These products provide cost-effective and unique pest control for residential applications, particularly for invasive species, and limit potential exposure to pollinators.

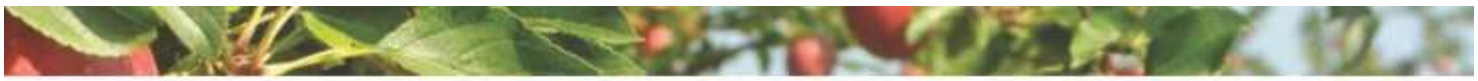
"Getting 'over-the-counter' neonic products off of store shelves marks an important first step in reining in widespread neonic contamination, which we see in New York State's water and in record yearly losses of bees," said **Dan Raichel, Acting Director of Natural Resources Defense Council's Pollinator Initiative**. "We look forward to continued work with the DEC on even more protections for people and pollinators from these neurotoxic pesticides."

"Reclassifying the neonic insecticides imidacloprid, thiamethoxam, and acetamiprid as 'restricted use' takes these dangerous pollinator-

killers out of circulation for the everyday consumer and helps to curb their misuse and overuse," said **Caitlin Ferrante, Conservation Program Manager, Sierra Club Atlantic Chapter**. "The Sierra Club Atlantic Chapter commends Governor Hochul and DEC for this important action to help reverse the pollinator crisis and we hope today's announcement will lead to further restrictions of this dangerous insecticide, and recovery of plummeting bird and insect populations."

"Over the last decade, neonics have come under increasing scrutiny because of their impacts on pollinators-but new evidence demonstrates that these chemicals are harming an even wider range of wildlife," said **Erin McGrath, Policy Manager for Audubon New York**. "Exposure to neonics can prevent songbirds from orienting themselves for their migration, cause significant weight loss, and interfere with their reproductive success. We thank Governor Hochul and DEC for taking action to curtail the unrestricted use of neonic pesticides in consumer products, which will help protect birds and the places they need."

More information about DEC's pesticides program.



NEWA 3.0 Tutorial — Online Workshop

February 7, 2022 — 9:00am—12:30pm

The new NEWA 3.0 system is online (https://newa.cornell.edu/), and 2022 will be the first year when you will not be able to use the old version. If you have not yet looked at the new web-site, or if you have looked at it but weren't sure how to best use it, the "NEWA 3.0 Tutorial Online Workshop" is perfect for you.

Register now:
https://cornell.zoom.us/meeting/register/tJIldempqjoqH9DBksZXqKQ_B3epoAHmT64P

You will get the most out of this tutorial if you are able to access the NEWA website at the time as viewing the we-binar, either on the same or on different computers, as there will be "practice problems" to work through on your own during the tutorial. It is not necessary to take part in the practice problems, but they will help you to get the most out of the training.

Workshop Agenda

- 9:00 Webinar begins
- 9:10-9:35 Introduction to NEWA 3.0, including info regarding best browsers to access the webpage through, how to submit questions/concerns, info about buying a weather station, and general intro-duction to the Zendesk and online tutorials
- 9:35-10:00 Registering, logging in, setting up a profile to use your NEWA Dashboard; fruit models overview, biofixes, default biofixes, accessing and downloading weather data
- 10:00-10:30 Fire blight model – how to use the new interface, when/why to use this model, exam-ples and hands-on activities
- 10:30-10:45 Quick stretch break
- 10:45-11:15 Apple Scab model – how to use the new interface, when/why to use this model, exam-ples and hands-on activities
- 11:15-11:45 Plum Curculio – how to use the new interface, when/why to use this model, examples and hands-on activities
- 11:45-12:15 Internal lep models – how to use the new interface, when/why to use this model, exam-ples and hands-on activities

NEWA Cornell Cooperative Extension IPM New York State Integrated Pest Management Program

Upcoming Events & Important Information

Mid-Atlantic Fruit and Vegetable Conference
February 1-3, 2022
Hershey, PA. For more information and to register https://www.mafvc.org/.

Agricultural Supervisory Leadership Certificate Program: Organizing Work for High Quality Results
January 27-March 3 (online course)
Organizing Work for High Quality Results is a six-week online course that is part of a new Agricultural Workforce Development Agricultural Supervisory Leadership certificate program. Organizing Work for High Quality Results helps new and experienced managers learn how to develop clear expectations and standard operating procedures, delegate effectively, and diagnose and correct performance problems. Registration closes and materials release January 21, 2022. Live weekly Zoom discussions will be held from 1 to 2 PM EST each Thursday from January 27 through March 3. Participation in the live sessions is highly encouraged and provides a valued opportunity for peer to peer learning and networking. To learn more: https://agworkforce.cals.cornell.edu/agricultural-supervisory-leadership-certificate-program/.

8th Annual Hudson Valley Value-Added Grain School: Best Management Practices for Processing and Storing Food & Feed Grains
February 4, 2022
Learn how to plan and operate your food or feed grain operation to ensure food and feed safety; what NYS Ag & Markets requires for a food processing facility; how to control rodent and insects pests in a grain processing facility. For more information and to register: https://caahp.ccext.net/civicrm/event/register?reset=1&id=155

Eastern NY Fruit & Vegetable Conference
February 15-17

The CCE Eastern NY Commercial Horticulture Team is happy to invite vegetable and berry growers to our virtual series of webinars! DEC credits available for many of the sessions.

Conference Agenda

Feb 15, 8:15am - 10:00am: Strawberry Soil Health

Feb 15, 10:15am - 12:00pm: Strawberry Production Systems

Feb 15, 12:45pm - 2:30pm: Raspberry & Blackberry Production

Feb 15, 2:45pm - 4:30pm: Blueberries

Feb 16, 9:00am - 11:45am: Vine Crops

Feb 16, 1:00pm - 3:30pm: Sweetcorn

Feb 17, 9:00am - 11:00am: Climate Change

Feb 17, 1:30pm - 4:00pm: Brassica Crops

For more information and to register: https://cce-enychp.teachable.com/p/2022-eny-fruit-vegetable-conference-sessions

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Compendium of Herbicide Adjuvants, Purdue Extension:
https://ppp.purdue.edu/wp-content/uploads/2016/11/PPP-115.pdf

The 2016 Compendium of Herbicide Adjuvants is the 13th edition of the biennial publication and contains 779 entries from 38 companies. This Compendium organizes adjuvant products by type (such as nonionic surfactants, crop oil concentrates, etc.). And each listing includes the product name, manufacturer/distributor, principal functioning agents, use rates, and comments.

Northeast Fruit Consortium Winter Webinar Series
The Northeast Extension Fruit Consortium will be once again presenting its Winter Fruit Meeting Series. Below you will find registration information for some of the 2022 series offerings. Webinars are hosted on Tuesdays at noon from February through March. Many of the programs provide DEC credits. For a list of programs, and registration links, visit the following link: https://ag.umass.edu/fruit/news-events/northeast-extension-fruit-consortium

Diversity and Inclusion are a part of Cornell University's heritage. We are a recognized employer and educator valuing AA/EEO, Protected Veterans, and Individuals with Disabilities.