Cornell Cooperative Extension
Eastern NY Commercial Horticulture Program

Tree Fruit News

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Common Storage Disorders of Apple Fruit

Yosef Al Shoffe and Christopher Watkins, Cornell University; and Michael Basedow, CCE ENYCHP

The harvest season will soon be here. With that in mind, we thought it would be worthwhile to review some of the physiological and pathological disorders we commonly see in stored fruit so that we can do all we can to prevent them from popping up in storage rooms this season.

Bitter Pit

A disorder that perhaps needs no introduction at this point, bitter pit is a common disorder of 'Honeycrisp' and other varieties across Eastern New York. This calcium deficiency-related disorder displays on the fruit as dark, sunken lesions on and beneath the fruit surface. Lesions may be present at harvest, but it is also very common to have clean fruit at harvest developing lesions within the first two months in storage. Many factors affect the likelihood of bitter pit development. A deficiency of calcium relative to other nutrients within the fruit is a main determinant. Excessive pruning, light crop loads, water stress, high temperatures during the growing season, and early harvest dates are just some of the factors that can exacerbate bitter pit incidence in stored fruit.

As far as mitigation practices are concerned, regular foliar calcium sprays from petal fall through harvest, balanced crop load and fertility management, and application of prohexadione calcium at pink are some of the recommended strategies. Many of these were discussed earlier this season in Dan Donahue's 'Honeycrisp' Playbook Series. Where bitter pit is more problematic than soft scald in 'Honeycrisp', based on the block history and passive method, skipping conditioning and putting fruit directly into rooms at 38°F may reduce levels of bitter pit.

Bitter pit in 'Honeycrisp'.
Photo: Y. Al Shoffe

For 'Honeycrisp', storing fruits at temperatures lower than 38°F can also reduce bitter pit incidence, but is not recommended because of the increased risk of low temperature related disorders such as soft scald. CA storage can also help, as can keeping rooms at a higher relative humidity. However, do not expect any silver bullets if everything else has been out of balance so far this season.

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Leather blotch

Leather blotch develops as extended dry, rough, and brown lesions on the skin, with corky flesh under the affected peel. The disorder develops toward the calyx end of the fruit. It is often associated with 1-MCP treatment, especially fruits treated with PGRs, but also can occur in untreated fruit. The disorder has been observed in many varieties including 'Honeycrisp' and NY1.The disorder is often associated with bitter pit. The etiology of the disorder is still unknown but it appears late in storage. Any pre- or postharvest treatment that reduces bitter pit is likely to suppress leather blotch.

Wrinkly skin

This is a new disorder, and factors associated with its development are not well understood. It might be associated with low temperature storage as in 'Honeycrisp' apples or from unclear factors after late storage as in NY1.

Soft Scald

Soft scald appears as sharply defined areas of smooth, light brown tissues on the skin and in the flesh of the fruit. It is often observed in fruit stored at low temperatures. 'Honeycrisp' is very susceptible to this disorder. To prevent its development, we recommend conditioning fruit at 50°F for 7 days prior to moving fruit to 38°F for storage. Soft scald is also aggravated when fruit are harvested later than the optimal harvest timing, so timely harvest is important if you have had issues with soft scald in previous years. Soft scald is often worse on vigorous trees with light crops of large fruits (as is bitter pit), so proper crop load management is critical in 'Honeycrisp'.

Soggy Breakdown

Symptoms of soggy breakdown appear as moist, spongy browning in the outer fruit cortex. Its extent can range from a few small spots to a complete ring of brown tissue. This brown flesh is usually surrounded by an outer ring of clean tissue just beneath the skin surface. This disorder is a chilling injury, and is commonly observed in years where harvest conditions have been cool and wet. It is often aggravated when fruit are stored at temperatures that are too low. Soggy breakdown often occurs with soft scald in 'Honeycrisp', but sometimes occurs without it. Fruit should be conditioned at 50°F for 7 days, and stored at 38°F.

Core Browning

Core browning appears as light browning in the core area, and usually is related to cold temperature injury. It develops after several months of storage. The disorder can be enhanced by 1-MCP treatment in varieties such as 'Honeycrisp', 'EverCrisp', and 'Empire', but decreased by 1-MCP in varieties such as NY2 where is it associated with senescence.

Mitigation includes harvesting fruit at more advanced maturity (unlike soft scald and soggy breakdown), delayed cooling after harvest, and storing fruit under low O2 conditions. Avoid 1-MCP application on susceptible varieties.

Leather blotch on 'Honeycrisp' (A) and NY1(B).

Wrinkly skin in 'NY1' (left). Soft scald in 'Honeycrisp' (right).

Soggy breakdown in 'Honeycrisp' (left). Core browning in 'Honeycrisp'.

Diffuse browning in 'Empire' (A), vascular browning in 'Honeycrisp' (B).
All photos by Y. Al Shoffe

Internal Flesh Browning

Internal browning appears as a grayish brown discoloration of the fruit, with no definite outline. It may affect both the outer flesh and the vascular regions. Internal browning is usually worse in apples grown in cooler regions of the state. It is often aggravated by harvesting at more advanced maturity, and when fruit are stored at lower temperatures and under elevated levels of CO2. The

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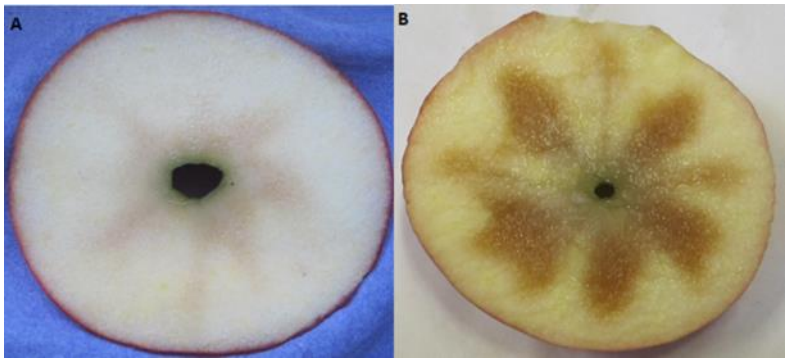
application of 1-MCP can enhance the disorder in some cultivars such as 'Empire'. Vascular browning can appear as chilling injury in 'Honeycrisp'.

Perhaps the best way to mitigate against this disorder is to harvest fruit at the early end of the harvest window based on the variety, understand the susceptibly of the specific variety to 1-MCP, and store the fruit at the recommended storage temperature.

Stem End Flesh Browning

Symptoms include radial or diffuse browning beginning at the stem end, which can progress down towards the calyx. Likely related to chilling injury, there is a higher incidence in fruit stored at lower temperatures. Retain and Harvista, conditioning at harvest, and storage at 0.5% O2/ 1% CO2 can be used to reduce this disorder in 'Gala'. ***In NY1, stem end flesh browning is enhanced by 1-MCP.***

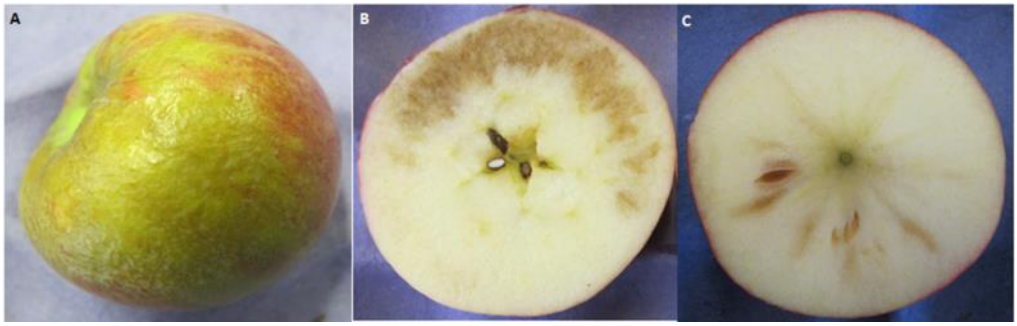


Stem end flesh browning in 'Gala' (A), in 'NY1 (B).

Senescent breakdown in 'Honeycrisp'. Superficial scald in 'Cortland' apple.

Senescent Breakdown

Senescent breakdown appears as browning that begins in the flesh directly beneath the peel, and the tissues become mealy at the affected area. It often extends to and darkens the skin, and it can be found in any part of the fruit. Like soft scald, senescent breakdown is more common in late harvested fruit and by prolonged storage. It is also more common in fruit with low calcium concentrations, and in fruit stored at warmer temperatures, and during shelf life. Timely harvesting, rapid cooling after harvest, and CA storage may help to mitigate against this disorder.



External CO2 on McIntosh (A), internal CO2 injury (B), and cavity (C) in 'Honeycrisp'. All photos by Y. Al Shoffe

Superficial Scald

This skin browning disorder develops after several months of storage, and symptoms include browning of the skin, often on the non-blushed side of the fruit. The level of incidence is related to varietal susceptibility (particularly high on 'Cortland' and 'McIntosh') and is worse in early harvested fruit and at low temperature storage. Delaying cold and CA storage following harvest can aggravate symptoms. DPA is commonly used to reduce this disorder, and can be combined with fungicide treatments prior to putting fruit into storage. 1-MCP can also reduce superficial scald.

CO2 Injury

External CO2 injury appears as rough, depressed, brown areas on the non-blushed side of the fruit. External damage is often observed in early harvested fruit, and is aggravated when CA is rapidly established before fruit are completely cooled, as warm fruit will have higher respiration rates. Low O2 concentrations, 1-MCP, and moisture on the skin can also aggravate symptoms.

Internal CO2 injury shows as brown cavities developing within the fruit flesh. It is generally worse in late harvested fruit. Damage is commonly observed in CA-stored fruit, and in air-stored fruit where fruit are kept in conditions that allow for the accumulation of excessive CO2 levels. It is also aggravated by low O2, delayed cooling, and low storage temperatures. Delaying the establishment of CA by 4- 8 weeks has been shown to reduce CO2 injury in NY trials at the Watkins lab. DPA inhibits development of CO2 injury and is the predominant means of control at present.

Blue Mold and Gray Mold

Blue mold appears as soft, light brown, watery spots that begin around injuries or lenticels on the fruit surface. Grayish blue masses of spores may also appear on the fruit surface. Gray mold appears as pale tan areas, turning dark brown as the decay spreads further on the fruit. The rot is firm on less mature fruit, but becomes soft on riper fruit. White or gray white mycelium may develop on the surface of the decayed tissues under humid conditions.

Blue mold is caused by species of *Penicillium*, while gray mold is caused by *Botrytis cinerea*. These fungi enter fruit through cuts, bruises, and stem punctures. Fruit should be properly handled and cooled quickly following harvest. Excellent sanitation in the storage

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facility and packinghouse will help to limit the spread of these pathogens. Bins can be disinfected with steam or fungicides, and fungicides labeled for their control can be used in fruit dips prior to storage.

Water Core and Stress Water Core

Water core appears as water-soaked areas associated with vascular bundles of the core line. Stress water core appears in the cortex and extends from the calyx end toward the stem end in severe cases. Varieties vary in their susceptibility to water core, as in 'Fuji' and 'Red Delicious', and stress water core, as in 'NY2' and 'Jonagold'. Many preharvest factors affect this disorder development such as warm weather during growing season and late harvest.

To mitigate this disorder during storage, fruit should be harvested at optimum harvest, conditioned before long-term storage, and stored in air storage for a specific period, based on disorder severity, before starting CA/ DCA storage.

On the next page is a summary table of many of the disorders we just discussed for quick reference.

Blue mold (A) caused by Penicillium expansum on 'Honeycrisp'. Grey mold (B) caused by botrytis cinerea on 'Empire'.

Water core (A) and water core breakdown (B) in 'Fuji', stress water core (C) and stress water core breakdown (d) in 'NY2'. All photos by Y. Al Shoffe

References

Al Shoffe, Y., Nock, J.F., Baugher, T.A., Marini, R.P., Watkins, C.B., 2020. Bitter pit and soft scald development during storage of unconditioned and conditioned 'Honeycrisp' apples in relation to mineral contents and harvest indices. Postharvest Biol. Technol., 160, 111044. 10.1016/j.postharvbio.2019.111044.

Al Shoffe, Y., Nock, J.F., Zhang, Y., Zhu, L., Watkins, C.B., 2019. Comparisons of mineral and non-mineral prediction methods for bitter pit in 'Honeycrisp' apples. Sci. Hortic., 254, 116-123. 10.1016/j.scienta.2019.04.073.

Beaudry, R., 2014. Watercore in Apples: Causes, concerns, detection and sorting. Postharvest Laboratory, MSU. Michigan, 526-531.

DeEll, J.R. 2017. Managing Disorders in Honeycrisp Apples. Ontario Ministry of Agriculture, Food, and Rural Affairs. July 14 2021. <http://www.omafra.gov.on.ca/english/crops/hort/news/orchnews/2017/on-0217a11.htm>

Doerfingler, F.C., G. Sutanto, J.F. Nock, Y. Al Shoffe, Y. Zhang, and C.B. Watkins. 2017. Stem-end flesh browning of 'Gala' apples is decreased by pre-harvest 1-MCP (Harvista) and conditioning treatments. Fruit Quarterly. 25(3):9-14.

Peter, K.A. 2017. Apple and pear disease – blue mold. Penn State Extension. July 14 2021. <https://extension.psu.edu/apple-and-pear-disease-blue-mold>

University of Maine Cooperative Extension. Storage Disorders. University of Maine. July 14 2021. <https://extension.umaine.edu/fruit/harvest-and-storage-of-tree-fruits/storage-disorders/>

Watkins, C.B. 2003. Principles and Practices of Postharvest Handling and Stress, p. In: D.C Ferree and I.J. Warrington (eds.). Apples: Botany, Production, and Uses. 1st ed. CABI Publishing, Wallingford, UK.

Watkins, C.B., Mattheis, J.P., 2019. Apples, In: de Freitas, S.T., Pareek, S. (Eds.), Postharvest physiological disorders in fruits and vegetables. CRC Press, ISBN 9781138035508.

Watkins, C.B., Al Shoffe, Y., Nock, J. 2021. Dynamic controlled atmosphere (DCA) storage delays development of stem end flesh browning in 'Gala' apples. Fruit Quarterly. 29(1): 5-8.

Common Apple Storage Disorders			
Disorder	**Susceptible Varieties**	**Conditions Favoring Development**	**Mitigation Strategies**
Bitter Pit	Honeycrisp, NY-1, Jonagold, Granny Smith, Cortland-Golden Delicius- Braeburn-Granny Smith	Inadequate Ca, excessive N and K, light crop load, excessive tree vigor, rootstocks, early fruit harvest, geographical location	Rootstock selection, calcium cover sprays, enhance pollination, postharvest calcium application, optimum harvest time, high humidity during storage, rapid cooling, CA /DCA storage
Leather blotch	Braeburn, Gala, Fuji, Honeycrisp, Golden Delicious, Red Delicious, NY1, NY2	Increase with fruit suscepitble to bitter pit, 1-MCP enhances the disorder, high CO_2 with 1-MCP increase the symptoms	Management that can reduce bitter pit might decrease leather blotch incidence, establishment of CA soon after harvest
Wrinkly Skin	Honeycrisp, NY1, NY2, EverCrisp, Pinklady	Low temperature storage	Storage at optimum storage temperature
Soft Scald	Honeycrisp, Golden Delicious, McIntosh, Fuji	Advanced fruit maturity at harvest, wet conditions and low temperature prior to harvest, low temperature storage	Harvest fruit at proper maturity, crop load management, managing tree vigor, condition fruit ahead of low temperature storage, apply 1-MCP
Soggy Breakdown	Honeycrisp, Golden Delicious, McIntosh, Fuji	Advanced fruit maturity at harvest, low temperature storage	Harvest fruit at proper maturity, store fruit at proper temperature, condition fruit ahead of low temperature storage
Internal Browning (diffuse, vascular, stem end)	Empire, McIntosh, Fuji, Braeburn, Empire, Gala, Honeycrisp, NY1	Advanced fruit maturity at harvest, low temperature storage , 1-MCP for Empire, Gala, NY1	Harvest fruit at proper maturity, store fruit at proper temperature
Core Browning	Braeburn, Empire, Fuji, Hneycrisp, McIntosh, Granny Smit, Red Delicious	Early harvest, delayed cold storage, prolonged storage, water loss during storage, water core at harvest, cool weather during fruit development, low calcium content	Harvest at optimum maturity, CA/ DCA storage, dip in DPA, apply 1-MCP
Senescent Breakdown	Most cultivars	Low Ca, advanced maturity and late harvest, delayed cooling, warm storage temperatures, high humidity, extended storage, watercore	Foliar calcium, harvest fruit at proper maturity and storage for appropriate duration, optimum storage temperature, CA/ DCA storage, 1-MCP
Superficial Scald	Cortland, Red Delicious, McIntosh, Granny Smith, Fuji, NY2	Early harvest, delayed cold storage and CA establishment, low storage temp, high O_2 concentration	Do not harvest too early, DPA or 1-MCP prior to storage, low O_2 concentration during storage
CO2 Injury (External and internal)	External: Cortland, Empire, Golden Delicious, McIntosh Internal: Honeycrisp, Braeburn, Fuji	Rapid CA establishment before apples have cooled, low O_2, 1-MCP	CA Storage, monitor CO_2 levels carefully, DPA dipping prior to storage
Water Core and Water Core breakdown	Red Delicious, Fuji, NY2, Jonagold	Late harvest, warm weather prior to harvest, high sorbitol at harvest, high CO2 level during CA storage enhance the breakdown	Harvest before water core developing, apply preharvest ReTain or Harvista, apply DPA before storage, delay CA, lower CO_2

August Insect Pests

Art Agnello, Cornell University; and Michael Basedow, CCE ENYCHP

As harvest preparations are being made, it is worth keeping in mind the late season arthropod pests that can still pop up and complicate life during the dog days of August. Take some time to ensure that your pest management program is not overlooking the following potential problems during this period.

Apple Maggot

We typically get the highest trap captures during the first week of August. We started catching them in our Eastern NY traps in late June this year, and began to reach treatment thresholds in some blocks starting about mid-July. Monitor your traps carefully, and be ready to apply preventive spray(s) as necessary. Options include: Imidan, Assail, Avaunt, Delegate, Exirel, certain premixes such as Endigo, Leverage, Besiege, and the pyrethroids.

Apple maggot stings without tunneling larvae. Photo: Harvey Reissig

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Internal Lepidoptera

We are now in the midst of the 2nd generation codling moth flight across the Eastern New York region. While we saw very little OFM activity during the 2nd generation timing, the 3rd flight of oriental fruit moth is due to start soon in the Hudson Valley. Recommended options include Altacor, Assail, Delegate, Verdepryn, Exirel, Besiege, and Minecto Pro. Pyrethroids and OPs may be less suitable because of locally resistant populations. This is also a suitable time for Cyd-X granulosis virus applications against codling moth, or Madex HP or ViroSoft CP4 against both OFM and codling moth.

European Corn Borer

This late season moth can be active until the middle of September, so larvae can be a threat, particularly to later varieties. Delegate is a good option for control, and 1-2 sprays of a B.t. product can also be a useful alternative.

Mites

Our warm temperatures are still capable of promoting flare-ups of mites. The 7.5 mites/leaf threshold (sampling chart on p. 79 in the Guidelines) would apply now that we have reached August. There are several good rescue materials available, if needed. Check the acaricide efficacy table on p. 68 of the Guidelines for ratings against TSSM vs ERM.

Woolly Apple Aphids

Colonies in the canopy are present and can always increase. It is probably too late for a Movento application to be effective, but Assail (plus a non-ionic surfactant), Admire Pro, Sivanto Prime or Beleaf could be of use. For fruit not intended for European markets, baby food, or any of the eco/sustainable fruit program buyers, Diazinon remains the best option on the market.

Wooly apple aphid colony. Photo: A. Agnello

San Jose Scale

This old-timer refuses to fade away, and together with white prunicola scale, represents an increasing challenge to fruit quality during the late summer. We've begun catching adults of the 2nd

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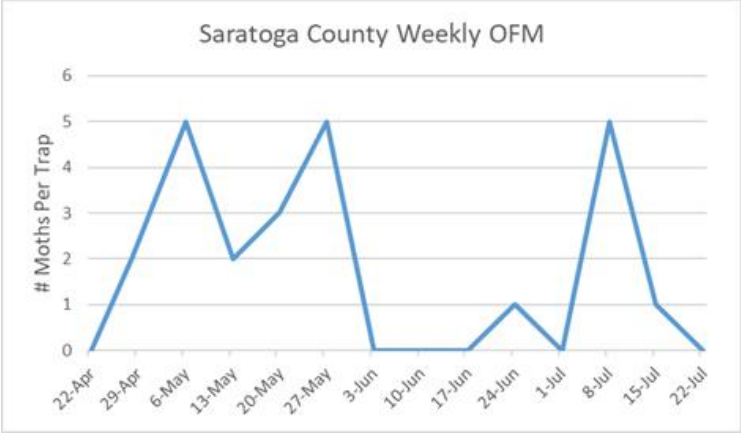
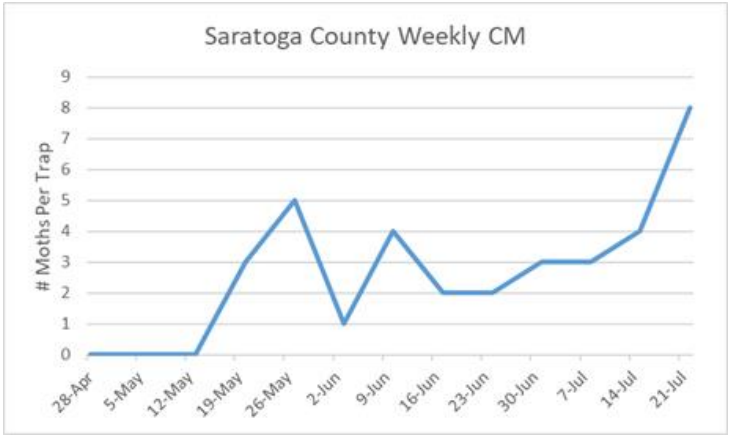
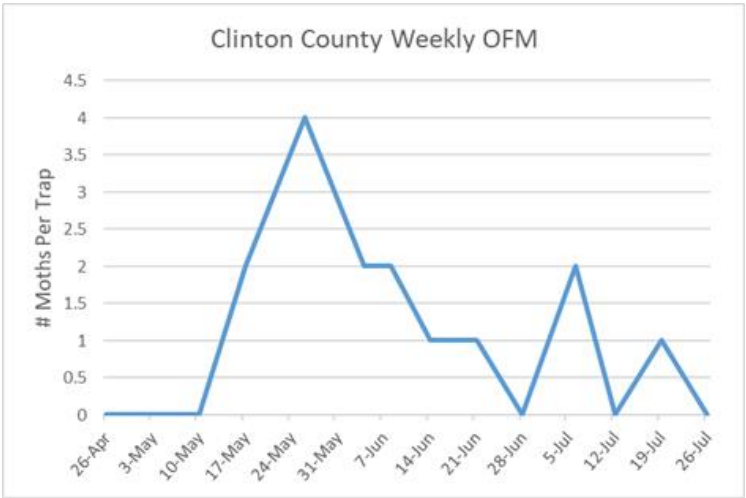
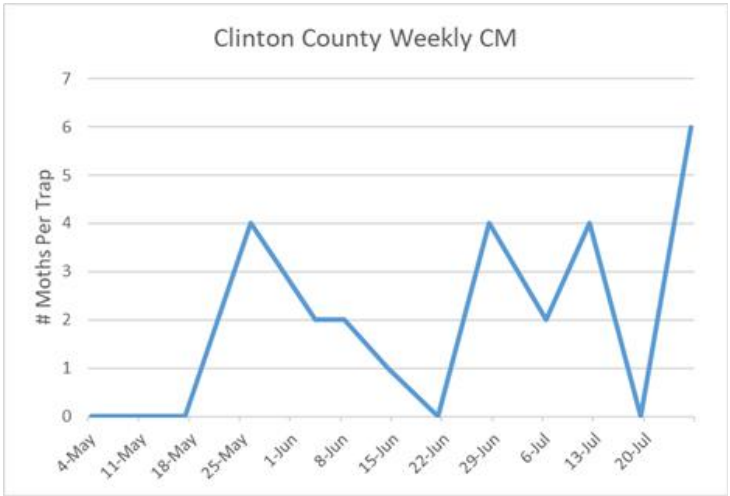
Weekly season long OFM and CM captures in our Saratoga and Clinton county trapping sites.









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generation SJS around July 19th in the Champlain Valley, the next batch of crawlers is expected 400 DD (base 50°F) from this adult emergence. Alternatively, monitor for fresh crawler emergence using black electrical tape tied around the limb of a tree with a known infestation. Esteem, Centaur, and Sivanto Prime are the go-to choices for problem blocks; for more moderate pressure situations, Assail, Admire Pro (as noted for WAA above), or Venerate are appropriate; the first two options will serve double duty if they're already being used for apple maggot and/or leafhoppers.

Japanese Beetle

This once invasive but now entrenched foliar feeder is having another abundant occurrence this season, and continues to cause noticeable damage to apples and stone fruits; heavy infestations can also result in damaged fruit. Check your trees again, and keep open the possibility of a(nother) application of an effective preventive/rescue spray. Options include Assail, Sevin, Endigo or Besiege (in apples) or Admire Pro, Assail, Sevin, Imidan, Endigo, Exirel, Leverage, Minecto Pro or Besiege (in cherries or peaches).

Brown Marmorated Stink Bug

At this point in the season, BMSB appears to be at very low levels. We are yet to catch them here in Northern New York, however a few nymphs have been found elsewhere around the state. We expect their numbers to increase, as they usually start entering the orchard in earnest in late July/early August.

Clear panel trap used for catching stink bugs. Photo: Steve Schoof, NCSU

Pyramid traps or clear panel sticky traps baited with a commercial lure can be an excellent monitoring tool and are effective at capturing BMSB adults and nymphs season-long, even when populations are low. In apples, research in New York, West Virginia, and Maryland has demonstrated that captures in these traps can be used to trigger a management action. When cumulative captures of adult BMSB in any trap within the orchard or at the orchard border reaches a threshold of 10, an effective insecticide is applied as two alternate-row-middle sprays with 7 days between. This strategy has been demonstrated to reduce the number of BMSB-targeted sprays while maintaining good control of injury. Research has demonstrated that BMSB injury to apples at harvest tends to be greatest in fruit from the upper canopy of trees in border rows next to woods, aiding injury scouting efforts during the season. It is recommended that scouting for BMSB injury to peaches and nectarines should include periodically inspecting sampled fruit for internal injury, since it may not be associated with injury on the fruit surface.

One of the most effective tools for use in managing BMSB is the active ingredient bifenthrin, which is available in a number of formulations. Bifenthrin has a 12-hr re-entry interval, a 14-day pre-harvest interval, and a 30-day re-application interval. **However, bifenthrin products are not currently labeled for BMSB in NYS. Section 18s for three products have been filed, however we are still awaiting EPA approval for 2021. We will send at an alert if/when the Section 18 has been approved for this season.**

Late season external stink bug feeding damage at harvest. Photo: Jim Engelsma

Looking for More Tree Fruit IPM Resources?

*For additional **apple IPM** information, we highly recommend reviewing the videos available at https://www.youtube.com/playlist?list=PLoNb8lODb49vifrm9Tla4GmAVhlIL0527*

*For **stone fruit IPM** information, visit our video playlist on Youtube at https://www.youtube.com/playlist? list=PLk2Q-bw9Aiu5NUJa7IwI_Obs1V5-RSUGb*

NY HERO Act Airborne Infectious Disease Prevention Plans are Due August 5th

Elizabeth Higgins, CCE ENYCHP

The New York legislature passed, and the governor signed, the New York HERO Act on May 5, 2021. This legislation requires ALL employers to adopt an airborne infections disease safety plan and requires employers with 10 or more employees to "permit employees to establish and administer a joint labor-management workplace safety committee." All types of private employers are included in the new requirements and "farmworkers" are specifically identified as included employees in the legal text. The HERO Act defines the worksite as "any physical space, including a vehicle, that has been designated as the location where work is performed." It goes on to include in the worksite definition "employer-provided housing and employer-provided transportation at, to or from the work site…"

The NY State Department of Labor (NYSDOL), in consultation with NYS Department of Health, is responsible for implementing the new law. They created model safety plans with ready-to-use templates for many industries including agriculture. Employers have the option of simply adopting NYSDOL's model standard or developing a plan of their own that meets or exceeds all of the law's requirements. The law requires the plans to specifically address the following items: employee health screenings, face coverings, personal protective equipment (PPE), workplace hand hygiene, cleaning and disinfecting of share equipment, social distancing, compliance with quarantine or isolation orders, engineering controls such as ventilation, designation of supervisors to enforce the plan, compliance with regulations, and the verbal review with employees of all related employer policies.

To get into compliance with the plan, farm employers can download the agriculture template developed by NYS DOL and NYS DOH and add information specific for your farm. The link to the template is provided below. There are 9 places in the template where you can add farm-specific information. Note that this template is in "fillable PDF" so you should be able to type right in the specially provided boxes and lines on the form.

The text of the HERO act says employers must provide their plans to employees, in writing, in English and in their native language. Further, it says the plan must be posted prominently in the workplace, included in the employee handbook if the employer has one, and made available upon request to contractors, employees, and government representatives. The HERO Act website states that "Employers are required to provide a copy of the adopted airborne infectious disease exposure prevention plan and post the same in a visible and prominent location within each worksite." Translations of the template are not available on the website at the time of this writing but the website does indicate that DOL does intend to provide a Spanish translation.

It's important to note that, while private employers are required to have a plan for their business by August 5, 2021, the plans are not currently required to be in effect. The plans will only be activated "when an airborne infectious disease is designated by the New York State Commissioner of Health as a highly contagious communicable disease that presents a serious risk of harm to the public health."

Resources

Agriculture Model Safety Plan Template NY Hero Act, Model Airborne Infectious Disease Exposure Prevention Plan

NYS HERO Act Website NY HERO Act | Department of Labor

Sampling Honeycrisp for Bitter Pit Prediction Using the EMR Model

Daniel J. Donahue and Michael Basedow, CCE ENYCHP

The (E)nvironment, (M)ineral, and (R)ootstock 'Honeycrisp' bitter pit (BP) prediction model was developed in Eastern New York, tested across NYS from 2016-2020, and is now ready for commercial implementation. The current (3rd generation) EMR model incorporates three parameters: Heat unit accumulation, the peel magnesium/calcium ratio at five weeks before first harvest, and rootstock. The 1st generation model was developed in 2019 and recently published in the journal ACTA Horticulturae. The model prediction results for 2016 through 2020 are to the right.

(E)nvironment, (M)ineral, and (R)ootstock BP Prediction Model (EMR) Performance in New York State Commercial Orchards 2016-2020

EMR 3rd Gen Bitter Pit Prediction Performance			
Category	Model Develop. Blocks 2016-18	Model Develop. Blocks 2016-20	Model Validation Blocks 2017-20
Bad Recommendation	6%	6%	13%
Missed Opportunity	21%	23%	24%
Acceptable Result	2%	4%	5%
Good Recommendation	71%	68%	58%
Total Block Observations	100	160	201

Our bitter pit tolerance threshold was set at 10% out of storage, less is acceptable, higher is not. However, practical decision-making is never that clear cut. Predicting a block will have 11% BP and concluding it is unacceptable for storage is too harsh a criteria. Depending on the size of a producer's crop and anticipated market conditions, the storage operator may "adjust" their BP tolerance to match current and projected marketing needs. Considering this, an

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evaluation system must be a little "fuzzy", which is to say not so precise, in order to accommodate flexibility. Looking at Table 1, starting from the leftmost column, results are grouped into four categories. A "Bad Recommendation" is when the model recommended the fruit for storage, but in reality came out of storage after 60 days with unacceptable levels of bitter pit, over 15%. This is the situation we want to avoid as the results are direct financial losses to the producer and marketer. A "Missed Opportunity" is a case where the model recommended against storage, but the fruit was actually ok, less than 15% BP, and would likely have been considered acceptable. It was a missed opportunity to perhaps generate higher dollar returns from better FOB's in the spring. An "Acceptable Result" is one where the model recommended storage, and the stored fruit expressed BP in the range of 10.1 – 15%. Not ideal, but acceptable in most cases. Finally, a "Good" recommendation is when a low BP (10% or less) block was successfully recommended for storage, or a "problem" block (greater than 15%) was not recommended for storage. The most important objective of any bitter pit prediction model is to reduce the risk of storing a high-BP block subsequently suffering those direct financial losses.

As we move to the right, the results change based on the dataset being evaluated, development vs. validation. The EMR model was developed on data collected from 6-tree groupings in 34 blocks located in Eastern New York. As we see in column 2 from the left, the best results were seen when the model is run on the dataset from which it was developed. This is to be expected, but it is not an acceptable validation of the model's real-world performance. To evaluate any prediction model's real-world performance, the model must be tested on a completely independent data set. The independent or "validation" dataset is represented in the rightmost column. When evaluated independently across NYS, we see that model performance was not quite as good, but still acceptable. This drop in model performance is to be expected. To paraphrase a common saying, no plan ever perfectly survives its first contact with reality.

There was an unexpected delay last fall in receiving the peel mineral analysis results for Western New York and the Champlain Valley. As a result, only Hudson Valley participants received a 2020 pre-harvest report like the that shown in Table 2:

Example of a Grower Block Report for 2020

Location	Actual % BP after 60 days storage	"Passive" Model Predicted % BP	"EMR" Model Predicted % BP
Thruway South			
2020 Model Development	TBD		38.4%
2019 Model Development	6.7%		4.4%
2018 Model Development	67.8%		67.4%
2017 Model Development	11.1%		6.3%
2016 Model Development	46.7%		24.4%

Comments: Historical BP varies from year to year, and the EMR model has done well in following the annual variation. EMR is predicting a poor BP year in 2020.

The block in this particular example "Thruway South" has been in the development side of the EMR program since 2016 so there was a long historical record. The grower received this report in late August, allowing sufficient time before harvest to factor the BP prediction into the harvest, storage, and marketing plan. Fruit from "Thruway South" was predicted to be a BP disaster out of storage (38.4%), and later validation results confirmed that the recommendation not to store was the correct one.

For the upcoming harvest season, 46 Hudson Valley blocks from 10 producers were sampled on July 30. Western New York blocks should be sampled early in the week of August 9th depending on their proximity to Lake Ontario, with Champlain Valley blocks sampled later that same week.

EMR model bitter pit prediction sampling recommendations of 2021

Given a commercially appropriate crop load, our research results indicate that rootstock choice followed by geographic region are the most critical factors when attempting to estimate bitter pit, followed by fruit mineral content and certain environmental parameters.

It's not necessary to sample and test the peel mineral content of all your 'Honeycrisp' blocks when trying to identify those suitable for storage. **To simplify, follow these decision rules:**

1. Only consider for longer-term storage blocks with "average" commercial crop loads, avoid lightly-set blocks (BP risk is too high) and poorly-thinned blocks (reduced bitter pit risk but low packout because color and flavor will likely be off).

2. B.9 'Honeycrisp' blocks have consistently demonstrated superior bitter pit performance across NYS. Therefore we are recommending that B.9 fruit be prioritized for longer-term storage and there is no need to spend time and money testing peel mineral content.

3. If you require more fruit to store than available B.9 blocks can provide, focus sampling and testing on your M.9 blocks. BP incidence can vary year to year in any given block so while historical records are useful, they are not necessarily good predictors of BP storage performance. Our data suggests that all M.9 clones offer similar BP performance.

4. We do not recommend the longer-term storage of M.26 and G.41 blocks as our research indicates that BP incidence is higher than other rootstock choices. We do not recommend the long-term storage of fruit from other G-series rootstocks until there is more data available on their BP performance.

5. If you are a commercial marketer and source 'Honeycrisp' from outside the Hudson Valley Region, we suggest prioritizing the acquisition of B.9 fruit from the Champlain Valley. Our research indicates that fruit from these regions have intrinsically less BP. If possible, ask your suppliers from other regions to test M.9 blocks you are interested in marketing, B.9 fruit should offer acceptable BP performance and not require testing.

6. Retail farm marketers should also consider storing only 'Honeycrisp' with a low BP risk. The cost of EMR evaluation is low, so

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it makes sense to be choosy about which blocks you store for winter sales, even if its only a small lot.

How to sample 'Honeycrisp' fruit for the EMR model this season in the Hudson Valley:

1. Pick 12 apples per block (up to 5 acres in size). Walk down a row middle picking one fruit from each of 12 trees, 6 trees on the right and 6 on the left, skipping a few trees in-between, selecting fruit of average size from the middle of the canopy (5-7' above ground). Since fruits are peeled using a Norpro spiral peeler, avoid irregular or otherwise damaged fruit. Do not sample Premier 'Honeycrisp' blocks.

2. Wash the fruit using tap water with the final rinse in distilled water (sourced in gallon jugs from the supermarket), use a towel to dry the fruit.

3. Peel each fruit using a Norpro Spiral Peeler just as if you were preparing to make an apple pie. The peel should be 0.8-1.0 mm thick and 4-5 mm wide. We are only interested in the peel from the calyx half of the apple, no need to peel the whole fruit. Wipe down the peeler with distilled water between samples to minimize cross-contamination.

4. Place the 12 calyx-end peels in a 1-quart sized Ziploc or similar bag labelled with your farm name, block designation, rootstock, and Sample Key Number supplied by Dan. Store in a cooler or refrigerator in preparation for shipment to the lab for analysis.

5. Call or email Dan for your Sample Key Numbers.

6. No charge this season for peel mineral analysis as we have funds available in our project implementation grant. Norpro spiral peelers are also available at no charge. Our experience is to allow 10-15 minutes to process each sample.

7. Call or email to let Dan know your plans, 518-322-7812 or djd13@cornell.edu , copy Mike at mrb254@cornell.edu

'Honeycrisp' in Albany, Saratoga and neighboring counties should be sampled on August 5-7, contact Dan for details on sample processing.

'Honeycrisp' in the Champlain Valley should be sampled later in the week of August 10th, contact Mike for details on sample processing. Dan is planning on visiting the CV that week to assist.

The EMR bitter pit prediction project is supported by funding from the New York Farm Viability Institute.

Upcoming Events

Champlain Valley Summer Field Afternoon

August 19, 2021 1:00pm—5:00pm

Chazy Orchards, Chazy, NY

Now that we are able to host field meetings again, we invite you to the Champlain Valley to view some of our current field trials, listen to talks and discuss your management concerns with many of the scientists from Cornell AgriTech, and to reconnect in person with other growers from around Eastern New York. DEC credits are available in categories 1A, 10, and 22.

Full schedule and registration here: https://enych.cce.cornell.edu/event_preregistration_new.php?id=1556

Hard Cider Summer Tour

August 25, 2021 9:30am

Join us for our Hard Cider Summer Tour, sponsored by the Cornell Hard Cider Program Work Team and the New York Cider Association. We will visit 3 different locations around the Capital Region and will finish the day with a hard cider tasting.

For more information and to register, visit: bit.ly/HardCiderTour2021

The Eastern New York Commercial Horticulture Program is a Cornell Cooperative Extension partnership between Cornell University and the CCE Associations in these seventeen counties: Albany, Clinton, Columbia, Dutchess, Essex, Fulton, Greene, Orange, Montgomery, Putnam, Rensselaer, Saratoga, Schenectady, Schoharie, Ulster, Warren & Washington.

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