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Introduction (J. Piñero)

***This issue of the March Message is dedicated to the memory of
Ronald J. Prokopy.***

It has been 15 years since the last publication of the Annual March Message. This publication is back because you asked for it, and we are happy to make it happen.

As in previous editions, the goal of this publication is to bring you a summary of IPM-related findings and situations that occurred in the preceding growing season, as well as new information, thoughts related to IPM, and some of our research plans for the upcoming season.

We have added a couple of new sections (e.g., Massachusetts Horticulture Overview, IPM around the country, and IPM around the world) in an attempt to be as comprehensive in our updates as possible. The information presented stems from work done at UMass and from colleagues located in other New England states and New York.

The Annual March Message, a collaborative effort, is brought to you by the UMass Extension Fruit program. We welcome your comments or suggestions for improving this publication.

Massachusetts Horticulture Overview

Label Change for Kudos® (D. Greene)

The Kudos® (Fine Americas) label has been changed to specifically allow this prohexadione-calcium formulation to be applied as early as the pink stage of flower development on apples. This has two very important implications. First, this early application will allow vegetative growth retardation to begin earlier in the season and thus making shoots less susceptible to infection by fire blight. It must be emphasized that Pro-Ca has no direct inhibitory activity on the fire blight organism, thus it does not provide any additional protection from blossom blight infection. The main advantage to this early timing is that shoot blight protection will begin much earlier than it would for applications made at petal fall or later, in most cases up to two weeks earlier. Follow up application of Pro-Ca must be made to maintain growth suppression and shoot blight protection. In blocks that are young where additional

growth is required to fill the canopy, a compromise will be necessary to allow adequate growth while achieving acceptable shoot blight suppression.

Second, the early application will allow growers to achieve much greater shoot growth inhibition, with the potential of gaining up to 25% more growth reduction for the season. This early application of Pro-Ca provides greater lateral shoot growth reduction which will lead to greater increase in light penetration into the trees. The best way to achieve added vegetative growth reduction in apple trees is to make the first Pro-ca application at pink rather than initially using higher rates of Pro-Ca at or after petal fall.

The early application of Kudos is limited to 6 oz./acre. Even though there may be a limited amount of leaf tissue exposed at this time, the 6 oz. rate is sufficient to achieve good growth control. It should be noted that it requires at least ten days following an application for Pro-ca to start to influence growth. Follow up applications will be necessary to maintain growth control.

Kudos®: Pink Application for Fire Blight Control (D. Greene)

A major impetus for amending the Kudos label to allow early application of Pro-Ca was to aid in the control of fire blight. The rationale for this amendment was to achieve early growth control of shoots, making the shoots less susceptible to invasion by fire blight during a period of heightened susceptibility. Again, Kudos does not directly influence, inhibit or kill the bacteria. The control is related to Kudos thickening the cell walls of the new shoots making them less susceptible to invasion by fire blight. While results from Kerik Cox in NY indicate that Pro-ca may make blossom pedicels resistant to the bacteria, limiting spread into shoots, control of blossom blight should still rely on streptomycin if models indicate treatment is needed. One to three standard streptomycin applications should be used, the number of applications depending on how long the high-risk weather lasts.

Following initial application of Pro-Ca, it is up to the individual grower to design a strategy for individual blocks. If the intent of the early application is for early fire blight control only, no additional Pro-Ca should be applied. This will allow some shoot fire blight control early but will offer the tree the opportunity to resume growth later in the season. If shoot blight control is desired further into the season then additional application(s) will be necessary. As the season progresses less Kudos/Apogee will be needed to achieve good growth control. The frequency of these applications will depend on vigor of the block, variety, rootstock, soil, rain or irrigation, and the weather.

Note: Only the Kudos formulation of Pro-Ca has the specific pink timing recommendation. The Apogee label says application beginning at 1-3 inches of shoot growth.

PGR mini-updates/minor uses (J. Clements)

Always look at the label before making application of any PGR's as there are further use directions and warnings on the label which may not be included here.

ReTain® (Valent USA) - For **increasing fruit set** of apple, cherry, European pear. APPLE: Apply one pouch of ReTain per acre, as a single application from pink stage to full bloom. Applications made prior to pink stage or after full bloom will significantly reduce efficacy of the treatment. Do not apply after petal fall. CHERRY: Apply one to two pouches of ReTain per acre during bloom. Retain may be applied as a single application of up to two pouches, or as sequential applications of one pouch per application. Applications between popcorn stage (balloon stage) to first bloom are more effective than earlier or later applications. Do not apply after petal fall. EUROPEAN PEAR: Apply one pouch of ReTain per acre, as a single application from white bud stage to full bloom. Applications made prior to white bud stage or after full bloom will significantly reduce efficacy of the treatment. Do not apply after petal fall. Can also be applied to European pear at 10 mm fruit size at a rate of one pouch of ReTain at 10 mm fruit size to increase fruit set.

Promalin® (Valent USA) and Perlan® (Fine Americas) to **increase fruit set** in APPLE following frost by stimulating the development of parthenocarpic fruit. Make a single application at a rate of 1-2 pints in 50-200 gallons of water per acre prior to or within 24 hours following a frost or freeze event, when the majority of the crop is between early bloom and full bloom. Do not apply to frozen foliage, blossoms or developing fruit, allow trees to completely thaw prior to application. Do not use a surfactant. Do not apply more than 2 times for this use.

Promalin® or Maxcel® (Valent USA) and Perlan® or Exilis 9.5SC (Fine Americas), latex paint application FOR INCREASING BRANCHING AND FEATHERING OF NON-BEARING APPLE, PEAR AND CHERRY TREES. Such an application improves tree structure by improving branch angles and increasing bud break and shoot growth in nursery stock and young trees. At the location where branching is desired, apply a uniform application in latex paint mix at a rate of 5,000-7,500 ppm (0.8-1.2 fl. oz./pint of latex paint). The latex paint mix should be applied using a brush or sponge to achieve thorough coverage of the bark surface. Application should only be made to one year old wood in the spring once terminal buds begin to swell but before shoots emerge. Applications made following shoot emergence may result in injury to the young shoots. DO NOT apply latex paint mix after bud break. Doing so may cause injury to shoot tips and reduce the effectiveness of the application for shoot growth. One-year pre-harvest interval. See [F-140 Branching Young Apple Trees with Plant Growth Regulators](#).

Harvista™ (AgroFresh) for **increasing fruit set** of CHERRY. Apply twice at 10% and again at 50% full bloom. Self-application can be done with your existing Harvista sprayer kit. Contact your AgroFresh representative = Andrew Barone, Account Manager, Eastern New York & New England, 570 854 3069, abarone@agrofresh.com.

ProGibb 4% (Valent USA) to increase PEACH fruit firmness and improve fruit quality in the season of application. Apply 16 to 32 oz. per acre as a single spray 1-4 weeks prior to the beginning of the harvest period. Use sufficient water to achieve complete coverage of fruits and foliage. This application has occasionally caused reduction in flower counts the year following the application, particularly if it is made during the months of May through July.

ProGibb 4% (Valent USA) to produce larger, brighter colored, firmer SWEET CHERRIES. Make 1-2 applications at a rate of 16 to 48 fluid oz. per acre when fruit is translucent green to straw colored. If making 2 applications, apply 1/3-1/2 of the total desired amount when the majority of the fruit is translucent green. Apply the remaining material 3-7 days later, when the majority of the fruit is straw colored. Color development and harvest date have occasionally been slightly delayed.

Inhibition of Flower Bud Formation with GA₇ (Arrange) (D. Greene)

Fine Americas Inc. is introducing this spring a formulation gibberellin (GA₇), Arrange, that is intended to specifically inhibit flower bud formation in apples. This product will provide to growers another option to help achieve regular cropping in apples. Currently we recommend applying a chemical thinner or a series of chemical thinners in a heavy blooming year. Rather than aggressively thin apple trees in the spring to reduce crop load and encourage good return bloom for the following year another approach is taken. Gibberellins (GAs) are a family of hormones that are produced very early by the seeds in apples and these diffuse from the seeds to the spur bud where they inhibit flower bud formation for the following year. By applying GA₇ shortly after bloom, flower bud formation will be reduced (not eliminated) for the following year. Normally, you are only afforded an opportunity to overcome biennial bearing once in every two years during the “on” year. Arrange will allow you to help regulate biennial bearing in both the “off” year by inhibiting excessive flower buds from forming and by thinning in the “on”. This is a very welcome addition to the tools growers have available now that should help them to even out bloom and cropping from year to year.

The registration of this product was delayed due to the government shutdown earlier this year. However, is expected to be available for use sometime this spring. It is recommended that this product should be applied between petal fall and 15 mm. My experience with the use of gibberellins on apples for the purpose of inhibiting flower bud formation has shown that the earlier applications are preferred and are more effective. The suggested use rate of this product is 1 gal formulated product/100 gal (100 ppm).

Bitter Pit -- it's the Calcium Stupid! (J. Clements)

Well, don't be offended, call me stupid too! Bitter pit incidence was a bit high in 2018. Resolve to do better. How? At the International Fruit Tree Association, Lailiang Cheng gave a talk -- “Control 'Honeycrisp' bitter pit: Use of rootstock and other strategies.” Of course Honeycrisp is kind of a poster child for this nutritional/physiological disorder, however, other large-fruited varieties like Cortland and Jonagold certainly (sometimes) exhibit their fair share of bitter pit. Foliar/fruit applications of calcium chloride -- because bitter pit is considered a low-calcium disorder -- are typically used, and often somewhat effective to reduce bitter pit incidence. See: [F-119R Foliar Calcium Sprays for Apples](#). Back to Cheng's talk, and his summary slide:

Take-home Messages

- Use tolerant rootstocks (B9, G. 214...)
- Ensure adequate Ca supply in soil (pH) and maintain root growth & Ca uptake (B, Zn, water, etc)
- Strictly control K to balance fruit Ca with K
- Control tree vigor (N supply, pruning etc)
- Adjust cropload to a medium level
- Do not over-irrigate
- Make foliar (fruit) Ca sprays
- Use Apogee (& ABA in the future)
- Harvest fruit at the right maturity

OK let me add my clarifications, aka 2-cents worth:

- **Use tolerant rootstocks** - Cheng is the lead investigator of a big, federally funded “Root2Fruit” research project. One of the major objectives (I believe) is looking at how efficient rootstocks are at nutrient uptake, including calcium. Their work has shown some of the Geneva rootstocks to be better at calcium uptake, however, I think the work is preliminary. Stay tuned. As to B.9, see my comments on tree vigor and you will see why (maybe).
- **Ensure adequate calcium supply in soil** - I’ve often maintained calcium management needs a holistic approach. If there is an opportunity to apply calcium to the soil, do it. If pH needs raising (should be 6 to 6.5), limestone. Gypsum, yes, maybe if pH does not need adjusting. But you need to use quite a bit (depending on tree age) and it’s not cheap. Worth doing to Honeycrisp if there is an herbicide strip and you can direct gypsum to root zone only. Did I mention you should be doing a soil test every 3 years? And if you need to apply nitrogen -- don’t overdo it with Honeycrisp! -- use calcium nitrate.
- **Strictly control K** - potassium and calcium compete in the root zone for uptake and K wins. Always. Yes, K is an important nutrient too, but please, do a leaf analysis to make sure you are not over-applying K on an annual basis. I know some of you do, rarely is K deficient in the leaf samples I look at. Try to keep it on the lower side of “adequate” for Honeycrisp. Magnesium, Mg, is also competitive with calcium, but it is often deficient so keep applying Mg, or start doing if you don’t.
- **Control tree vigor** - Yes! Maintain a calm tree. Avoid over-pruning and heading cuts which stimulate vigorous shoot growth. Shoots, although you need to have some, compete with apples for available calcium. And shoots win. Always!

- **Adjust crop load to medium level** - yes, larger fruit (reduced crop load) are more prone to developing bitter pit. Enough said, it's hard enough getting the "right" crop load as it is.
- **Do not over-irrigate** - Irrigate? Say what? But it's true, can wash calcium down out of the root zone and increase tree vigor. So don't over-irrigate. Sorry, I can't do much about the excessive rain.
- **Make foliar Ca sprays** - timing is important, calcium sprays should start shortly after petal fall when fruits are actively absorbing the sprays and you are providing competing shoots with calcium too. Calcium chloride is NOT a good choice at this timing as it can burn tender tissue -- use one of the formulated calcium products of your choice. DO NOT USE calcium nitrate unless you really, really need the foliar nitrogen. High nitrogen is implicated in more bitter pit development, so watch your nitrogen management closely.
- **Use prohexadione-calcium** - yes, Apogee or Kudos reduce shoot growth and thus perhaps competition for calcium. Preliminary work by Dan Donahue, Cornell's Eastern New York Commercial Horticulture Program, shows that Prohex-Ca applied at pink may be in particular effective at reducing bitter pit in Honeycrisp. Why? We don't know for sure, but see Duane Greene's article in this MM too for another good reason to apply Prohex-Ca at pink.
- **Harvest fruit at right maturity** - I believe, delaying harvest might result in more bitter pit during storage. Honeycrisp is a tough one, because it needs to be pre-conditioned at warmer than normal storage temperatures if soft-scald is an issue (which it often is) and should not be stored below 38 degrees F. BUT, colder storage temperature (and not pre-conditioning) would suppress bitter pit development. It's a tough balance, but overall I'd say harvest a little bit early if you are going to store Honeycrisp for more than a month or so. It's a ying-yang situation with Honeycrisp, which do I like least, bitter pit or soft scald?

If you want more, see my blog post [It's the calcium stupid!](#) I wasn't kidding... :-)

Massachusetts Pests Overview

Diseases (D. Cooley, E. Garofalo)

Stopping Diseases Before They Start – Orchard Sanitation

In a survey of IPM practices used by New England apple growers done in 2017, 37% of the growers who responded said they used urea or leaf chopping to get rid of disease inoculum in leaves in the orchard. What a shame it's so low. Every growers should be "cleaning up" leaves, because it's a cost effective way to prevent problems from starting. And it's not just apple scab. In the past two years, Marssonina leaf blotch (MLB) has shown up in several orchards in the region. The majority of initial inoculum for MLB comes from fallen leaves in the orchard.

To demonstrate how useful sanitation can be, think of using sanitation against these diseases this way. Suppose every leaf that has MLB in it can infect 10 leaves in the orchard in June. Then, three weeks later, each infected leaf can infect 10 more leaves. Three weeks after that, each infected leaf can infect 10 more leaves, and by the end of August, all the infected leaves have turned spotty yellow and fallen off. So, for each infected leaf on the ground in March, 1,000 leaves fall off at the end of August.

Now, suppose there are 1,000 infected leaves on an acre of ground in March. That means a million leaves will drop in August. You'd notice that. But let's say that with urea and flail chopping, 98% of those leaves are destroyed in late March, and cannot cause infections. In August, 20,000 leaves would drop, maybe enough to still see, but not a disaster.

Now, add some fungicide during the growing season that controls 95% of infections, and only 1,000 leaves dropping in the acre where you did sanitation. However, even with fungicide, 50,000 drop on an acre where you didn't use it. That's 50 times as much disease where you didn't "clean up", even with a very effective fungicide program.

But there are other benefits. With fewer spores produced, the chance that any will contact and infect a healthy leaf drops. This is especially important early in the growing season. An early-season infection can produce more "generations", more secondary infections, than later primary infections. The bottom line: getting rid of fallen leaves in an orchard reduces the risk of scab and MLB.

While the best time to use urea and to chop leaves is in the fall, the two sanitation treatments are still effective in spring. The weather is trickier, of course, as you need to wait until the ground has dried and firmed up. After that, the sooner the better. And while the combination of urea and chopping are better than either alone, doing one or the other is worthwhile. For urea, target the ground, with the bottom couple of nozzles on an airblast or a boom sprayer. Use feed grade urea, which is 46% N, and mix a 5% solution in water. (This is 44 lb. per 100 gal.)

Feed grade urea is more expensive but dissolves in water much easier than granular (fertilizer grade) urea.

For chopping, it's important get the leaves in the strips under trees, either by raking them or blowing them into the middles where they can be chopped. A flail mower can deal with brush and leaves at the same time if set low enough.

Unfortunately, urea isn't allowed in organic orchards – staying away from artificial nitrogen is central to the organic philosophy. However, compost spread in the orchard will promote leaf breakdown AND will contain microbes that promote organic matter decay. And chopping is certainly allowed.

Instead of urea, organic growers can apply dolomitic lime. In 1997, Bob Spotts and colleagues at the Hood River Station of Oregon State Univ. showed that applying 2.25 tons per acre of dolomitic lime containing 22.7% calcium and 11.8% magnesium in the fall reduced the apple scab spore load by 55 to 92%. This should go on dry, applied using a fertilizer spreader. This will, of course, raise the soil pH. A rule of thumb is that 1 ton per acre of lime raises pH 1 point. So, starting at a pH of 5.0, a 2.25 ton/A application will raise the pH to about 7.2, and the target pH for apples is around 6.0. How long it takes to do that depends on how fine the lime is. One hundred mesh lime will work very quickly, while 40 or 50 mesh lime will take several months. In addition, sulfur acidifies soils, so applying sulfur for scab would counter the lime at some level.

A more holistic approach for organic growers would be to manage lime according to soil test applications, and emphasize leaf chopping and compost. Apply lime if needed on leaves, preferably in the fall, then chop, then apply compost.

A Word About Weather and Climate

The climate is changing, which means that weather is changing. Unfortunately, the conditions for growing apples in Massachusetts do not seem to be getting better. The maps in Figure 1 below show the change in temperature and precipitation from the early season to the summer through harvest during the last growing season. Basically, it got much warmer and wetter in July through September than it was during April through June. This had a significant impact on diseases, which are talked about below.

Next to those maps there is a map of the eastern US, showing the Commonwealth of Massachusetts moving south. It's a powerful visualization of what's going on, thanks to climate change. The map comes from a 2007 report put together by the Union of Concerned Scientists, and tracks the predicted changes in average summer heat index—a measure of how hot it actually feels, given temperature and humidity. The starting point is the average heat index from 1961 to 1990. Then the yellow and red Massachusetts' represent changes according to a low carbon buildup scenario (yellow) or a high buildup scenario (red). In either scenario, we're already living in a heat index similar to the lower Hudson Valley and Connecticut of the 60's through 90's. In another 20 years, depending on carbon emissions, we'll be in either the middle of New Jersey or in northern Virginia. In 40 years we'll be in Maryland or North Carolina. Recent

predictions suggest that the high carbon emission scenario are most likely. Personally, in terms of apple diseases, I think we're already seeing hints of North Carolina!

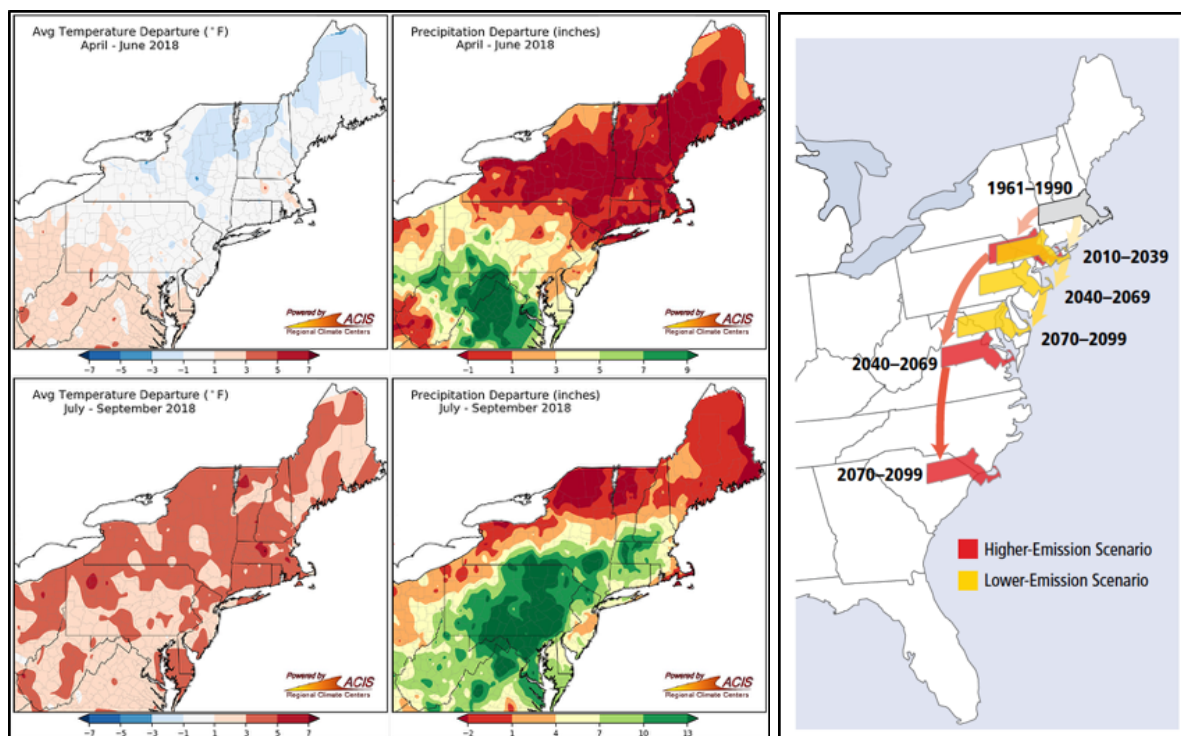


Figure 1. Maps on the left show the change in temperature and inches of rain during April-June 2018 (top maps) compared to July-September 2018 (bottom). The map on the right shows predicted change in the average summer heat index in MA with different carbon emission scenarios.

There's another aspect of changes in rainfall that's having an impact on diseases. Not only are we getting more rain total, but more of it is falling all at once, in heavy storms over one or two days. This is particularly severe in the Northeast. In Massachusetts, the number of rain events with 2 inches or more went from 2 per year over 1950-1995 to nearly 3 per year from 1996-2014. And as Figure 2 shows, it's not predicted to get any better. The number of days with 2 inches of rain or more is predicted to go up by a factor of 1.5 in 35 years. Heavy rain washes off fungicides and floods soils. Both of these things are bad for disease management.

Even if we get it together and radically address the causes of climate change over the next 10 years, the changes in weather that we're seeing are here to stay. It will continue to get warmer and wetter. We need to plan to deal with the problems that come with that kind of weather.

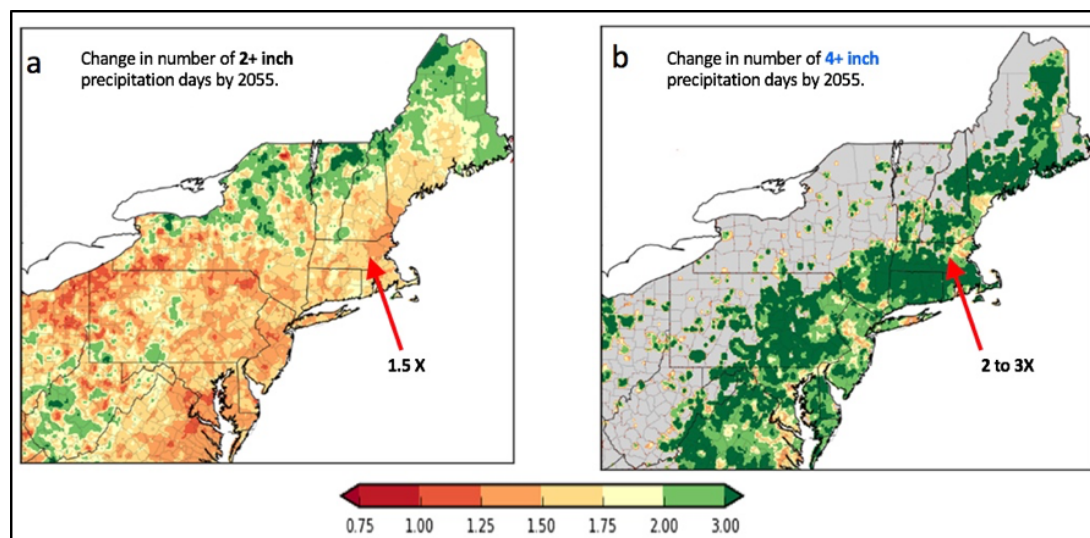


Figure 2. The change in the number of days with 2 or more inches of rain (left) or 4 or more inches of rain (right) by 2055.

Summer Fruit Rot Diseases, Leaf Spots and Related Problems

The transition from normal precipitation through mid-June to very wet weather in July and August generated much more fruit rot than usual in MA. In addition, the weather earlier in the year was cooler than normal, and later much warmer. Fruit rot and leaf spot fungi love wet, warm weather.

Honeycrisp was often infected, though other cultivars also had significant damage. The weather not only favored fungal infections, but also made it difficult to keep fungicide protection on fruit. Relatively warm temperatures, particularly at night, exacerbated problems. Sunscald cracks on some cultivars increased damage. Spotted wing drosophila were found around damaged fruit, but were not associated with initiating infections.

We identified at least two fruit rots, black rot (*Botryosphaeria obtusa*) and bitter rot (*Colletotrichum* sp.). A third rot, white rot (*Botryosphaeria dothidea*) wasn't identified definitively, but may have also been present. To add to the confusion, early symptoms of these rots may be confused with the physiological diseases associated with calcium deficiency, bitter pit and cork spot (see Jon Clements section on bitter pit management), and with stink bug damage. In general, black rot and bitter rot are treated the same way, with the same fungicides in cover sprays.



Figure 3. Photo upper left, Honeycrisp apples infected with rot fungi. Above, the apple on the left has stink bug damage, and the apple on the right has bitter pit. (Photo above by Tracy Leskey and Torri Hancock, USDA Fruit Lab, Kearneysville, WV).

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Black rot has long been a common but relatively insignificant problem in Massachusetts orchards. It damages trees in three ways, the fruit rot, a leaf spot commonly called frog-eye, and cankers in wood. The fungus *B. obtusa* is a weak pathogen, most commonly infecting wounds and stressed trees. It often follows fire blight infections, infecting woody tissue.

These infections produce spores that can infect leaves and fruit. Another source of spores are overwintered, infected small fruit, or mummies. Pruning out infected wood and mummies, and burning and burying them if possible, and at least chopping them, is an important part of managing black rot in fruit. Again, clean up.



Figure 4. Black rot. Black rot, both an early spot and a well-developed rot plus a mummified fruit (left), and a completely rotted fruit (right). (Photos by David Rosenberger, Cornell University, Hudson Valley Lab, NY).

Fruit infections begin as early as bloom, and can continue through the summer. While some young, infected fruit may be overrun by the fungus and become mummies, most early infections don't show up until later in the middle of the summer. The fungus will produce spores through the summer, and these can infect wounds and sunscald areas on fruit.

The most effective fungicides against black rot are captan and the QoI fungicides. Flint Extra and Sovran are straight QoIs. Among the premixed fungicides, Luna Sensation has trifloxystrobin, the active ingredient in Flint Extra, while Merivon and Pristine have pyraclostrobin. In warm, wet weather in blocks that have had black rot, it's important to keep fruit protected with a fungicide. When using a QoI fungicide, mix it with captan for resistance management.

Bitter rot is a relatively new problem to us in Massachusetts and New England, another "southern disease" that has moved north. In part this is because we are seeing warmer, wetter summers, and in part it's because Honeycrisp, Cripps Pink, Gala and other newer, popular apple cultivars are more susceptible to the disease than, say, McIntosh. The pathogen that predominates in New England, *Colletotrichum fioriniae*, is not the same fungus that causes bitter rot and Glomerella leaf spot in North Carolina and other southern states, *C. gloeosporioides*. I point this out because it may mean that the best approach to managing bitter rot here needs to be different from that in the South, though at present recommendations in both regions are similar.



Figure 5. Bitter rot. Smaller, early symptoms (left), larger rot with pink to orange spores (center), and cut fruit showing rot extending into the fruit in a “V” shape. Black rot does not have the colored spores or same type of internal rot. (Photos by Keith Yoder, Virginia Tech, Winchester, VA).

First, once again, clean up. The pathogen overwinters in wounded wood and old mummified or rotten fruit, so pruning and removing that source of infection is important. The optimum temperature for infections is 80°F to 90°F, when the humidity is over 80%. Historically, that would mean that infections on new fruitlets would be very unlikely, but the weather’s changing.

The fungicides recommended for bitter rot are captan and a QoI fungicide, such as Flint Extra or the premixes Luna Sensation, Merivon and Pristine. Because resistance development is an issue with bitter rot, the multi-site fungicide captan should be used with the QoI. It’s worth noting that another multi-site, ziram, has also been effective against bitter rot, though it is not used much in apples currently. If growers are bumping up against the season limit for captan, using ziram as a multi-site fungicide partner with a QoI is an option. Up to 77 days before harvest, mancozeb is also an option. Sara Villani from NC State has also found that adding a phosphorous acid fungicide such as ProPhyt, Phostrol or Agri-Phos will improve captan performance, though phosphorous acid alone is relatively weak against bitter rot.

Fungicides should be applied as frequently as 10 to 14 days if weather conditions, cultivars and recent problems with bitter rot combine to indicate high risk of infection. Where risk is lower, obviously the interval can be extended. And if, like last year, we have a deluge of 2 inches or more of rain, it may be necessary to go in to reapply before 10 days have passed. While not exactly the same, this is similar to the fungicide program used for black rot.

Leaf spots and blotches. We have seen Marssonina leaf blotch in Massachusetts for two years, though this past year it showed up in late August and early September, causing enough defoliation in some places to raise concern. Wet, warm summer weather appears to be increasing the severity of this new disease in MA. At the same time, other fungal diseases may be causing problems. The same fungi that cause black rot and bitter rot can also cause leaf spots. Frogeye leafspot, caused by the black rot pathogen, is a commonly seen but never serious foliar problem. Glomerella leaf spot caused by the bitter rot pathogen is common and can cause significant foliar damage in NC, has recently been seen in eastern NY. A physiological disease, necrotic leaf blotch, is also sometimes serious in NC, but only appears sporadically in

the Northeast, so far. It is associated with Golden Delicious and related cultivars and causes similar symptoms.



Figure 6. Marssonina leaf blotch on unsprayed Liberty. Defoliation and fruit drop in center and on the right. (Photos Liz Garofalo, UMass Amherst)

Of these problems, Marssonina leaf blotch (MLB) is potentially the most worrisome. It appears to be a new problem in many parts of the US and the world. It isn't clear why more Marssonina is becoming much more common, but it is probably related to a change in the fungus that causes the disease and the changes in weather we're seeing. It appears to be slowly building up from year to year, and spreading. This means that it is very important to use sanitation to get rid of as much overwintering inoculum as possible.

We don't have a good understanding of how to best use fungicides to manage MLB. In fact, there are no fungicides registered for MLB on apples in the US. In Europe, orchards using a standard fungicide program generally do not have MLB problems, but it can be severe and is increasing in organic orchards. The conventional fungicides used in Europe are captan and dithianon, a multi-site fungicide not available in the US (FRAC M9). These are applied on 10- to 20-day schedules, depending on whether the weather is wet or dry. Captan alone may not be as effective, since some orchards with MLB report that they maintained summer cover sprays with captan. However, a break in coverage due to heavy rain or other factors may be to blame.

QoI fungicides, applied before infections, could be effective. They can control the Marssonina fungus on roses. Applying one or two QoI applications during wet weather in summer, with captan applied at 10 to 20 days intervals (again, closer during wet weather) could be useful, and would overlap with fungicide programs used for fruit rots.



Figure 7. Frogeye leaf spot (black rot) left. Glomerella leaf spot early (center) and late (right) (*Photo left, Ontario Ministry of Agriculture, Food & Rural Affairs. Photos center and right, Sara Villani, NC State University.*)

Insects (J. Piñero, E. Garofalo, K. Leahy).

Coleoptera

Plum Curculio (PC). PC has been at fairly 'normal' levels in most locations for the past few years. Weather conditions at petal fall have a substantial impact on PC activity. Both 2017 and 2018 had a spell of warm weather shortly after petal fall, so that curculio immigration peaked quickly. There was little or no need for additional insecticides after the 'first cover' spray.

Research update: PC research conducted during 2018 aimed at (i) validating a Degree Day model for timing of PC emergence from overwintering sites using odor-baited traps, (ii) evaluating the attractiveness of plant-based compounds in an attempt to improve the attractiveness of the synergistic lure composed of benzaldehyde and grandisoic acid, the PC aggregation pheromone, (iii) validating the effectiveness of odor-baited trap trees as a management tool for PC in a reduced-spray scenario, and (iv) evaluating the efficacy of entomopathogenic (= insect-killing) nematodes (EPNs) at killing PC larvae in the soil.

(i) Degree Day model for PC. At the UMass Cold Spring Orchard, PCs became active on May 2nd 2018, at 220 DD (base 43°F), as determined by means of odor-baited Tangletrap-coated panel and black pyramid traps. McIntosh trees were at tight cluster stage. The onset of PC immigration closely matched the 5-year average (2000-2004) accumulation of **228 DD** (base 43°F) reported in a research article published by Piñero and Prokopy (2006). We will continue to monitor for PC spring emergence on a yearly basis.

(ii) Evaluation of plant volatiles. Results from trapping studies indicate that aromatic compounds such as methyl salicylate (wintergreen oil) may increase the response of PCs to odor-baited trap trees, which potentially could result in improved PC management. Additional research needs to be conducted for at least two more years to produce solid conclusions. In addition, one experiment compared the attractiveness of the benzaldehyde formulation that is

produced commercially by AgBio, Inc. (the same company that markets grandisoic acid) versus that of the benzaldehyde formulation that has been prepared in our lab at UMass. Results indicate that both lures are equally attractive, which is good news. Until now, we didn't have information about the performance of the benzaldehyde lure from AgBio.

(iii) Trap-tree research. Extensive field research conducted around 2001-2002 resulted in the identification of a synergistic two-component lure comprised of the plant volatile benzaldehyde (BEN) in association with grandisoic acid (GA), the synthetic PC pheromone. The identification of this strong attractant led to the development of an effective monitoring system for PC involving odor-baited trap trees. This approach calls for baiting perimeter-row trap trees with GA plus BEN as a practical approach to determining need and timing of insecticide applications against overwintered PCs.

More recently, odor-baited trap trees were evaluated for direct PC control. This new approach calls for baiting the branches of several perimeter-row trees, which results in aggregations of adult PCs on those trap trees, and then confining insecticide applications to those trees only. These specific insecticide-treated trap tree canopies function as an "attract-and-kill" trap crop for adult PCs. Recent research has evaluated the use of entomopathogenic (= insect-killing) nematodes (EPNs) to kill PC larvae in the soil. EPNs are very small, soft bodied, non-segmented roundworms that are parasites of insects and occur naturally in soil environments.

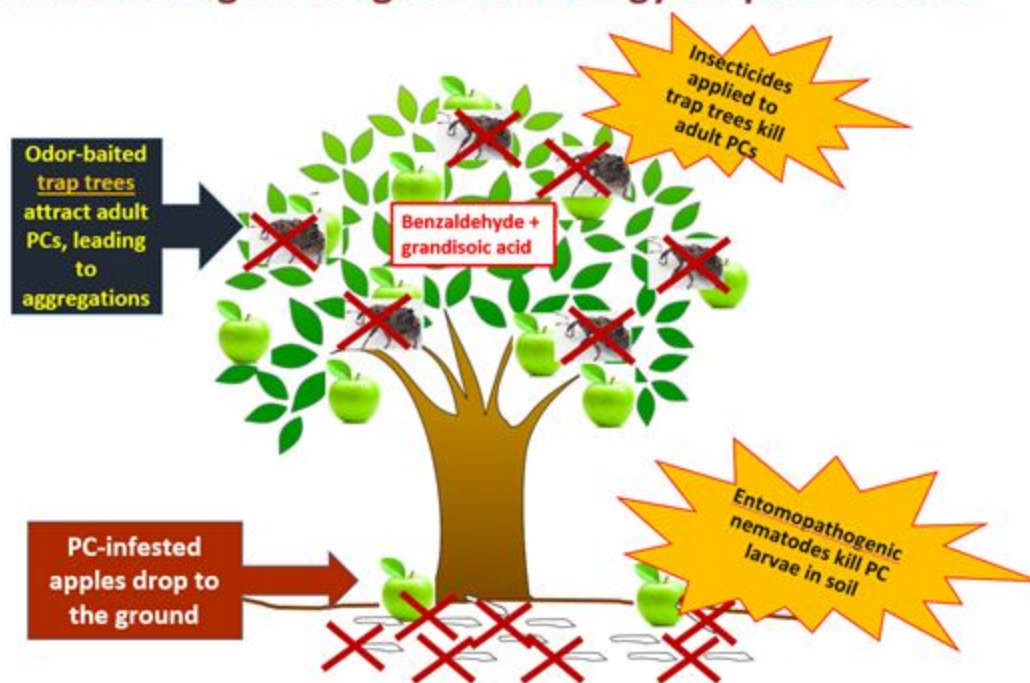
Results of a 2018 field study involving odor-baited trap trees to manage adult PCs after the full-block petal fall insecticide spray indicate that (1) About 10 times more injury by PC was found within trap trees (17.2% on average) in trap tree plots compared with unbaited 'control' trees (1.5% on average) in perimeter-row plots. The level of PC injury to fruit sampled from the plot interior was similar in trap tree plots and in plots subject to perimeter-row sprays. These results confirm previous findings indicating that PC can be controlled using odor-baited trap trees that received targeted applications of insecticide after the full-block spray applied by petal fall.

(iv) Evaluation of beneficial nematodes (EPNs). Studies were conducted at various farms to quantify the level to which the EPN *Steinernema riobrave* applied to the soil underneath the canopies of perimeter-row apple trees is effective at killing PC larvae. Results indicate that the application of *S. riobrave* led to a 5.5-fold decrease in the number of adult PCs emerging compared to the untreated check. Therefore, EPNs applied to the soil of those trees effectively kill PC larvae.

For a full description of studies (iii) and (iv) click [here](#). NOTE: subscription to Fruit Notes is required to access articles.

The main goal of the above studies project is to develop an integrated multi-stage management program for PC that minimizes use of insecticides. Combined findings indicate that both PC adults and larvae can be killed successfully using an "attract-and-kill" system combined with biological control using EPNs.

Multi life-stage management strategy for plum curculio



Multi-life stage strategy envisioned to control PC. Odor-baited trap trees attract PCs, which are killed by targeted applications of insecticides. PC larvae developing inside infested fruit are killed by applications of insect-killing nematodes applied to the soil.

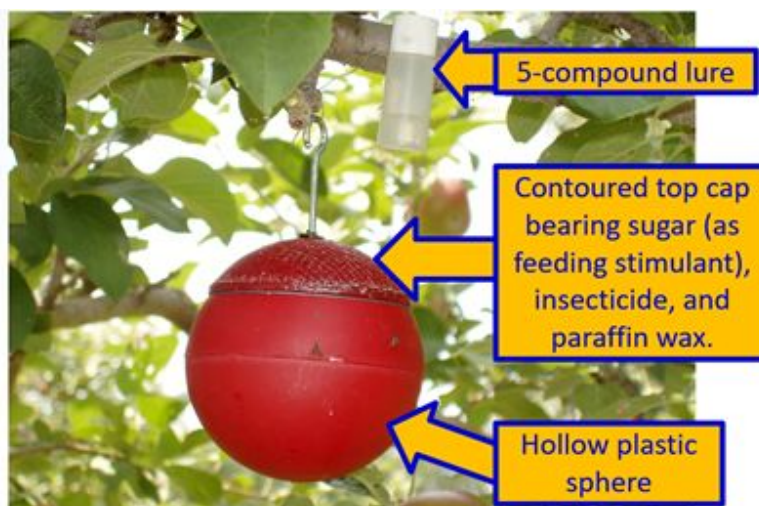
Diptera

Apple Maggot Fly (AMF). While AMF pressure was more variable, it seems to have been well controlled by minimal insecticide programs. Managing AMF without low-rate phosmet applications in summer can be a challenge.

Research update. This section presents an overview of the last AMF research (2003-2005) that was conducted in MA. AMF research will continue (2019-2021) with funding provided by the USDA, National Institute of Food and Agriculture for the project titled "*Developing a multi-life stage management strategy for apple maggot*". The goal of this project is to develop an IPM approach that combines the use of odor-enhanced bait stations with biological control involving EPNs for ecological management of the AMF.

In the 2004 issue of the Annual March Message (available [here](#)) mention was made to a multi-state (All New England states and New York) project led by RJP, which aimed at refining behavioral control of AMF using the latest design of attracticidal spheres (see picture to the right). Mention was also made to a new approach for assigning distances that employs an index incorporating the state of four environmental variables: the size of orchard trees, quality of

pruning, cultivar composition, and nature of bordering habitat. The greater the distance between spheres, the fewer spheres needed per block and the lower the cost of using spheres for AMF control.



The attracticidal sphere for AMF control consists of partially round red plastic sphere base topped with a 100 g contoured cap. The cap bears sugar (feeding stimulant), paraffin wax, and insecticide. Research is being conducted by T. Leskey and J. Pinero to refine this technology.

The index used for assigning distances between odor-baited spheres on each side of each targeted plot was created by first prescribing a value of 1 (highest AMF risk), 2, or 3 (lowest AMF risk) for each of tree size, quality of pruning, cultivar susceptibility, and bordering habitat for that side (Table 1A). Then, we used the sum of the four values to determine the distance between spheres (Table 1B). If the sum of the 4 values characterizing a perimeter were 4 (worst-case scenario) then spheres were placed 5 meters apart on perimeter trees. If the sum were 12 (best-case scenario), then the distance between perimeter spheres was 17 meters.

Table 1 (A) Values ascribed to states of four environmental variables, and (B) Index for assigning distances between odor-baited spheres on perimeter apple trees. Sum of values is derived from values assigned to the qualities of four environmental variables.

A					B	
Value	Tree size	Quality of pruning	Cultivar susceptibility	Bordering habitat	Sum of values	Distance between spheres (m)
1	Large	Poor	High	Woods	4	5
2	Medium	Fair	Moderate	Hedgerow	5	6.5
3	Small	Good	Low	Open*	6	8
*Also applies to bordering habitat consisting of grower-sprayed orchard trees.					7	9.5
					8	11
					9	12.5
					10	14
					11	15.5
					12	17

In 2004, field research was conducted 12 of orchard blocks located in MA. Each of the 12 orchard blocks was divided in 3 plots of ~1 acre each. Ranking system was used in combination with latest attracticidal sphere design. Three treatments were evaluated: (1) grower control, involving three insecticide sprays against AMF to entire plot (mid-Jul, early-Aug, mid-Aug), (2) 1st-level IPM involving insecticide applied to entire plot driven by accumulation of AM on unbaited monitoring traps placed in the plot interior (threshold: 8 AMF/4 traps), and (3) Odor-baited attracticidal spheres on perimeter trees of all 4 sides of plot for direct control.

The table below shows that, in the 2004 study, there were no significant differences in AMF captures by monitoring unbaited sticky spheres or in the level of fruit infested with AMF among plots, indicating that behavioral control of AMF was as effective as whole-plot insecticide sprays.

	Grower Control	1st-level IPM (threshold)	Attracticidal spheres
Mean no. AMF captured by 4 interior monitoring traps	2.7 ^a	3.1 ^a	3.5 ^a
% injury to fruit (harvest survey)	0.10 ^a	0.13 ^a	0.28 ^a

In 2005, field research aimed at comparing the level of AMF control achieved with odor-baited attracticidal spheres (latest design) against that of odor-baited sticky spheres versus grower

control (2-3 insecticide sprays). The ranking system was used again to determine distances among perimeter-row spheres.

Results from the 2005 study, shown in the table below, indicated that either behavioral control method was as effective as 2-3 full-plot insecticide sprays.

	Attracticidal spheres	Sticky spheres	Grower control
Mean no. AMF captured by 4 interior monitoring traps	14.3 ^a	13.1 ^a	13.7 ^a
% injury to fruit at harvest	0.13 ^a	0.17 ^a	0.13 ^a

Hymenoptera

European Apple Sawfly. Several growers experienced unsatisfactory control of EAS, mainly in 2017. In all cases, no pre-bloom insecticide had been applied, and only 'soft' materials were used at petal fall -- no organophosphates or carbamates. It appears that the newer, softer materials are effective on adults and possibly on eggs, but did not seem to have much effect on larvae that had already hatched. Growers who want to avoid using materials like phosmet and carbaryl after bloom, and have had trouble with sawfly recently, might be wise to cover pre-bloom with a material like Avaunt or a neonicotinoid.

Hemiptera

San Jose Scale. This insect pest has been a problem throughout the Northeast in recent years, for reasons that are unclear. Outbreaks seem to occur with no particular pattern, so that spot-treatments are no longer a good option in many cases. Oil and lots of it seems to be the best strategy in the spring; the 'kinder, gentler' scale products also seem to do well at the tight cluster to petal fall timing.

Tarnished Plant Bug (TPB). Populations of TPB were quite low in both years, gauging by both trap captures and observed populations in the fields. There were some reports of plant bug injury at harvest in a few locations in 2018, but this did not appear to be widespread.

Lepidoptera

Over the past several years New England growers have been seeing more problems with lepidopteran pests such as Oblique-banded leafroller, codling moth, and oriental fruit moth, primarily. Managing these pests requires special attention -- insecticide timing and material selections don't coordinate well with our usual management program. On the other hand,

we're lucky to have good control options, and good to excellent degree-day models for scouting and treatment.

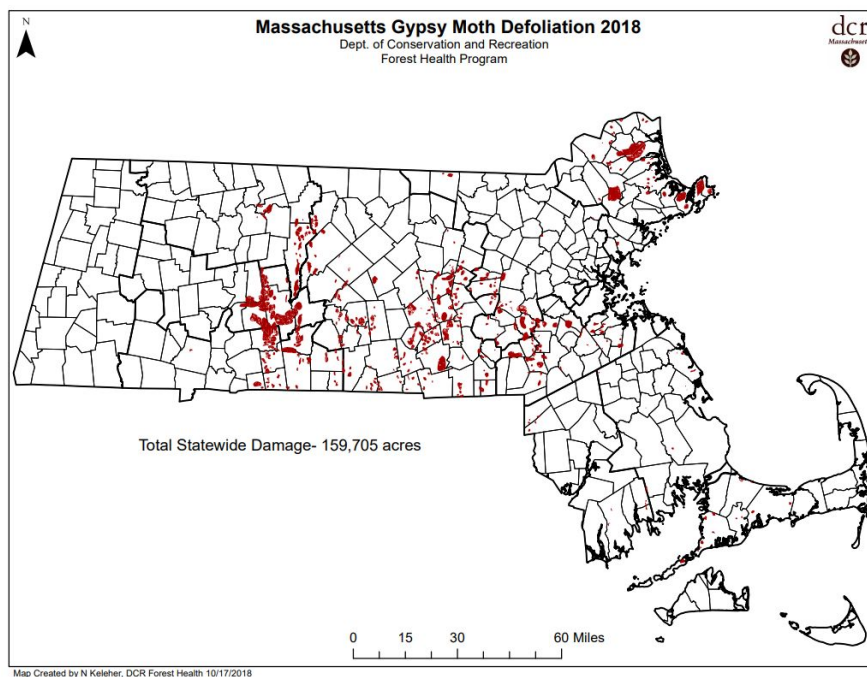
Oblique-banded leafroller (OBLR). OBLR has cropped up in more orchards than not, over the past ten year, for reasons that are unknown. These larvae are not affected by OP insecticides, but the good news is that materials like rynaxypyr (Altacor) and spinetoram (Delegate) do seem to provide good control, when used in conjunction with pheromone trapping and degree-day modeling (available on the NEWA site). Scouting of terminals and fruit clusters from late June through mid-July is helpful in assessing the need for treatment. Control has been satisfactory when using the right materials and timing, but this is a pest that doesn't seem likely to go away -- we continue to find larvae in low numbers in orchards where we've been actively controlling them for several years.

Codling Moth (CM). CM is looking like a tougher nut to crack. Degree-day models have been less useful here because of an extreme generational spread -- in 2018, first-generation larvae were still active in fruit when second-generation larvae were hatching, according to the degree-day model based on pheromone captures. Some growers and consultants reported seeing no distinct flight periods recorded by pheromone trapping, just a constant stream of new moths. This makes it very difficult to manage, period; and also difficult to change modes of action between generations (that is, using one material against the first generation, and another against the second). Mating disruption may turn out to be a useful tool in this situation, in conjunction with a finely-tuned insecticide program.

Oriental Fruit Moth (OFM). Some growers have had good success with such a program with OFM on peaches (they can also infest apples, but so far, they seem to prefer peaches and sometimes pears in this region) -- including an insecticide with good activity on OFM early, followed by deployment of mating disruption ties, and finishing with a late-season insecticide spray for bugs and OFM.

Winter Moth (WM). Biological control seems to be taking good effect in southeastern Massachusetts and in Rhode Island. We continue to monitor for activity moving inland.

Gypsy Moth (GM). In 2018, some parts of western Massachusetts had large numbers of caterpillars active in orchards that did not receive a pre-bloom spray. Below is an excerpt of the current situation and outlook for GM in 2019, as presented by the MA Department of Conservation and Recreation (DCR): *"The current outbreak began in 2015, with the population increasing through 2016 and leading to over 923,000 acres of defoliation in 2017. High caterpillar mortality in 2017 from the Entomophaga maimaiga fungus and the Nuclear Polyhedrosis Virus (NPV) led to reduced feeding pressure in 2018, which in turn caused a decreased impact, about 161,000 acres of defoliation statewide. However, there was very little caterpillar mortality in 2018 and we had high moth reproductive success. In many areas across the state, foresters have documented high densities of egg masses. We are expecting the outbreak to continue in 2019 with regionalized pockets of defoliation present in Essex, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, and Worcester Counties."* For more information, check the GM webpage at the [MA DCR](#).



Consider using DiPel® DF (*Bacillus thuringiensis*, subsp. *kurstaki*, strain ABTS-351 = Btk) to manage Lepidopteran pests that feed on foliage such as winter moth and gypsy moth. Fruit-feeding caterpillars (e.g., CM, OFM) and leafrollers may be less exposed to the Bt spores and may not be successfully controlled using DiPel --unless caterpillars are very young. Generally, leafroller population suppression with Bt products requires more than one application to achieve desired results.

DiPel DF is an effective biopesticide of bacterial origin. When Btk is ingested by a susceptible caterpillar, the highly alkaline environment of the caterpillar's gut triggers the Btk bacterium to release a crystalline protein called an "endotoxin" that poisons the insect's digestive system. The endotoxin acts by killing cells and dissolving holes in the lining of the insect's gut.

The DiPel label includes the Lepidoptera complex associated with tree fruit. To see the list of pests controlled by DiPel DF, click [here](#) to access the label.

Mites

Mites have been very spotty in their occurrence -- pre-bloom oil sprays seem to be doing a good job in most cases, assisted by spot-treatments where mites did build up. Growers should bear in mind that several of the newer miticides are very effective on eggs and nymphs, but may not have a visible effect on the adult mite population. If predators don't seem to be doing the job, a summer miticide may be needed before the population gets out of hand.

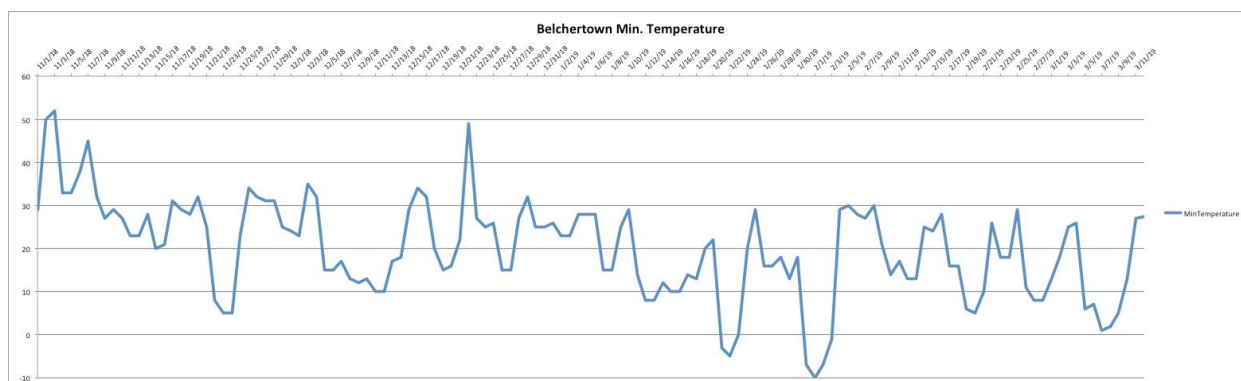
Invasive Pests Update (J. Piñero, E. Garofalo).

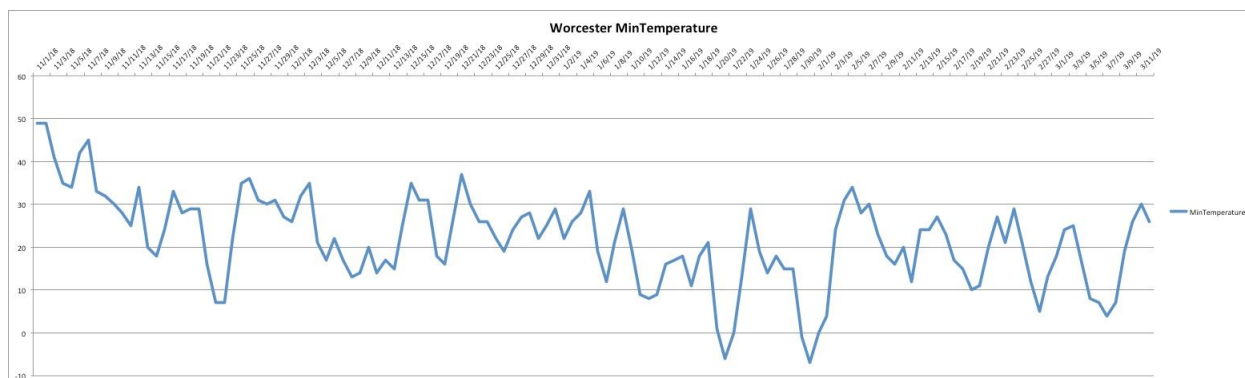
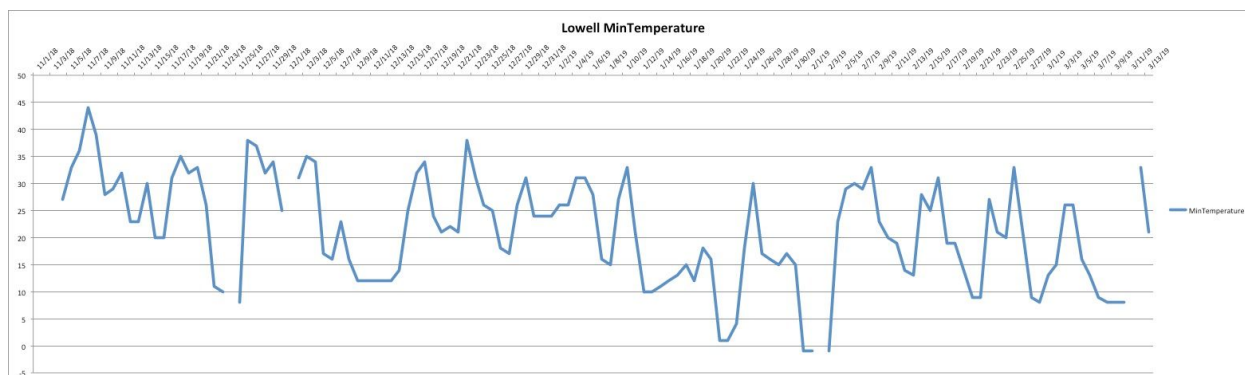
Brown Marmorated Stink Bug (BMSB), *Halyomorpha halys*.

BMSB has been a nuisance insect in Massachusetts for several years. Its penchant for overwintering in homes and other man-made structures has led to many phone calls from homeowners desperate to remove this odoriferous insect from their midst. More concerning for Extension and fruit growers, however, is the news from 2018 that, for the first time in MA, numbers of BMSB captured in pheromone-baited monitoring traps exceeded the threshold established for apple. It is important to note that this did not occur on a statewide level, but was relatively isolated to Worcester County, at sites near urban areas.

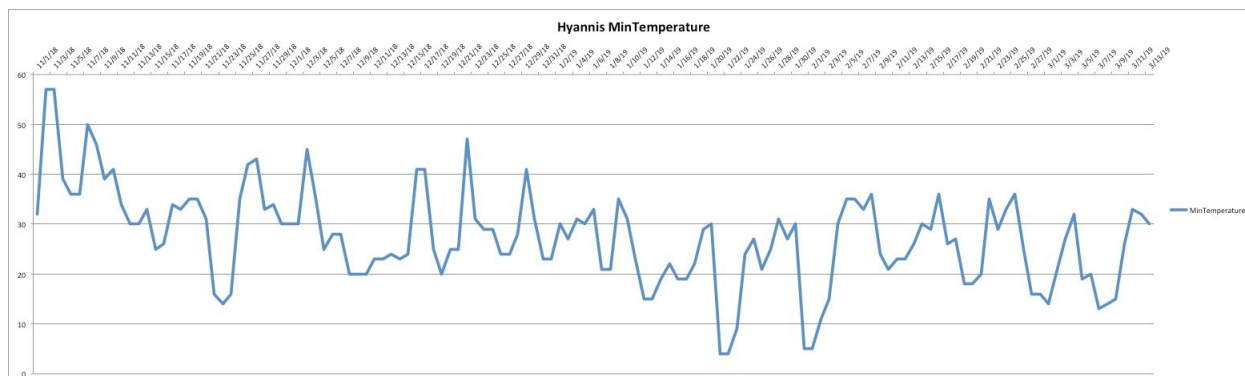
There are a few reasons the urban locations matters: (1) These tend to be heavily traveled areas, leading to increased potential for BMSB to immigrate from other areas beyond their natural flight patterns, and (2) Urban centers hold heat better than less populated areas, making them ideal overwinter sites for BMSB and other pests, whose populations might otherwise be affected by winter temperature extremes.

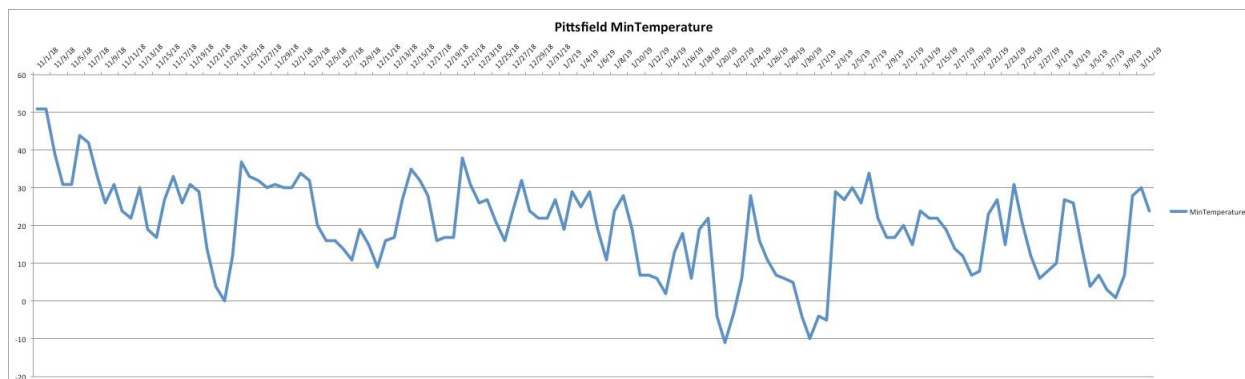
Speaking of temperature, we have been hearing about “polar vortices” drastically reducing overwintering BMSB populations. Is this true? Most likely not. While there was indeed a polar vortex, we did not experience extreme cold temperatures, contrary to what the local news might want you to believe. Here, hopefully, is some perspective on the idea that low temperatures might have significantly reduced BMSB populations. Looking at five locations (see figures below) across the state, we can see that the lowest temperatures reached did not drop below -11°F (Pittsfield, MA). Belchertown reached -10°F, Worcester -7°F, Lowell -1°F and Hyannis did not dip below freezing. Basically, if the pipes in your house didn’t freeze, neither did the BMSB overwintering in homes and other buildings.





Minimum temperatures recorded between November 1, 2018 and March 12, 2019 in Belchertown, Lowell, and Worcester, MA. The coldest temperature recorder at these three sites was -7°F at the Worcester observation site. The black line at 10°F represents the temperature at which BMSB mortality is reported to increase.





Minimum temperatures recorded between November 1, 2018 and March 12, 2019 in Hyannis and Pittsfield, MA. These sites represent geographical extremes for the state. The coldest temperature recorded for these two sites was -10°F at the Pittsfield observation location. The black line at 10°F represents the temperature at which BMSB mortality is reported to increase.

What's in store for 2019? While we clearly can't provide you with BMSB emergence dates and population levels for the coming year, we can tell you what your friendly, local Extension fruit team has planned for the season to help combat BMSB:

1. **Increased trapping locations.** We will concentrate our efforts at farms near the Worcester area, as this seems to be a "hot spot" for BMSB populations. We will also increase trap numbers across the state. As a reminder, insecticide applications to apple orchards are recommended when a **cumulative threshold of 10 BMSB/trap** is reached **OR** when one BMSB (nymph or adult) is observed per 100ft of tree row. After the spray, the threshold is reset and subsequent trap accumulations reaching 10 adults per trap will trigger successive management sprays as the season progresses.
2. **Attract-and-kill using ghost trap.** We will be assessing the efficacy of ghost traps to replace late-season insecticide applications, especially for PYO operations who are limited in the materials they can apply, bearing in mind many of the most effective materials available for BMSB have long PHIs. It will also be necessary to determine if using the ghost traps increases stink bug feeding damage nearby.

The Samurai Wasp and its Potential for Biological Control of BMSB.

The most promising biological control agent against BMSB is the samurai wasp, *Trissolcus japonicus*. These wasps (who lack stingers) seek and destroy 60–90% of BMSB eggs in Asia. Female wasps lay their eggs inside the BMSB eggs. The samurai wasp's offspring will develop inside the pest's egg, consuming the pest while they grow and emerging as an adult wasp.

This biological control agent has been considered for future release in the country in recent years. During a 2014 study of native natural enemies attacking BMSB, the samurai wasp was unexpectedly found in Maryland, and subsequently has been detected in twelve states (VA,

WV, MD, DE, NJ, NY, PA, OH, MI, OR, WA, and CA), the District of Columbia, and British Columbia.

Field surveys and extensive analyses are currently underway to track the establishment and biological control impact of the samurai wasp in the U.S. Results from field surveys also indicate that BMSB has been found being attacked as eggs (by parasitic wasps) and as adults (by tachinid flies). Below is a picture of a wasp emerging from a BMSB egg (photo: Chris Hedstrom, Oregon Department of Agriculture). For more information about the samurai wasp, click [here](#).



Spotted Wing Drosophila (SWD), *Drosophila suzukii*.

In 2018, two field research studies involving SWD were conducted in MA. The **first study** represented the second year of a multi-state project led by Dr. Tracy Leskey (USDA ARS, Kearneysville, WV) and research was conducted in 7 commercial berry farms in WV, MD, MA and NJ. The UMass team was composed of Dr. Jaime Pinero, Elizabeth Garofalo, Sonia Schloemann, and Arthur Tuttle, and was supported by Cameron Olanyk, Isabel Jacome, Natalie DiDomenico, and Lindsey Ware.

The MA experiment was conducted in a Polana raspberry block at Nourse Farms (Whately, MA). It aimed at assessing the effectiveness of red attracticidal



spheres (same sphere design used for apple maggot control, see picture on the right) deployed either, at the top or bottom of plants, to reduce SWD populations and fruit damage, compared to control plots. Spheres were deployed at a rate of 1 sphere every three meters in the upper third of the canopy, 1 sphere every three meters in the lower portion of the canopy, and no spheres as a control. Each plot was at least 1 acre in size. SWD fruit infestations rates were compared among treatments. Data from the 2018 study are currently being analyzed statistically. Results from the 2017 study showed that attracticidal spheres significantly reduced SWD infestation in raspberry fruit compared with control plants though it made no difference if spheres were deployed at the top or at the bottom of the plants.

The **second study** aimed at identifying inexpensive, more species-specific and readily available materials that could be used by fruit growers to attract and trap male and female SWD. While commercial lures are already available, SWD lures are based on fermentation materials that also attract a comparatively high number of non-target insects. Such high captures of unwanted insects hinder trap performance and increase sorting time. The study compared various dilutions of Concord grape juice in traps (depicted on the right), for attractiveness to SWD. Our results indicate that the response of SWD males and females to undiluted grape juice did not differ significantly from the response shown to various dilutions of grape juice. Traps baited with grape juice diluted to 1:3 ratio (one part of juice and 3 parts of water) captured, on average, 3 times more SWD and 3 times fewer non-targets than traps baited with the SWD Scentry® lure. On a per-trap basis, the cost of using diluted grape juice is \$ 0.08 whereas the cost of a single Scentry SWD lure is ca. \$ 8. Our combined findings indicate that diluted grape juice at 1:3 ratio is an effective and economically viable (diluted grape juice is 100 times cheaper than the commercial lure) attractant for SWD. For a full description of this study, click [here](#). NOTE: subscription to Fruit Notes is required to access articles.



SWD research outlook for 2019 (Pinero's lab):

1. **Early-season detection of SWD.** SWD captures in traps baited with commercial lures will be compared with captures in traps baited with Concord grape juice diluted at a 1:3 ratio. This will be done at various commercial farms.
2. **Perimeter trapping.** Comparison of SWD and non-target captures in traps baited with various attractants Concord grape juice diluted at a 1:3 ratio. The main goal of this study is to compare weekly captures to assess potential for mass trapping.

3. **Effects of grape juice fermentation.** At CSO and in two commercial orchards, we will compare SWD captures in traps baited with fresh diluted juice *versus* traps baited with 7-day-old diluted juice. This in order to assess whether fermented juice attracts more or less SWD (and non-targets) compared to fresh diluted juice.

European Cherry Fruit Fly (ECFF), *Rhagoletis cerasi*.

The ECFF is the most serious pest of cherries in Europe. Damage associated with this pest is caused by larval feeding in the fruit pulp, which can result in losses of up to 100% if left uncontrolled. The first record of this fly in North America took place in June 2016 in an urban park located in Mississauga, Ontario. It was first detected in the U.S. in New York in 2017. In North America, this pest can also reproduce in honeysuckle. The European Cherry Fruit Fly is a quarantine pest; its presence can restrict export markets for commercial fruit.

Spotted Lanternfly (SLF), *Lycorma delicatula*.

Native to Asia, the SLF has quickly spread since its initial detection in Pennsylvania in 2014. While this planthopper is not a strong flier, its U.S. range is expanding, mostly due to the movement of vehicles or objects to which females glue their inconspicuous egg masses. SLF nymphs and adults feeds on a wide range of fruit (e.g., apples, grapes, apricots, cherries, nectarines peaches), ornamental and woody trees, with tree-of-heaven being one of the preferred hosts. Keep an eye on this invasive pest. On February 21, 2019, MDAR announced that a single dead SLF specimen was reported and confirmed at a private residence in Boston. As a result, MDAR urged the public to check for signs of SLF in any potted plants that they may have received over the holiday season and to report any potential sightings of this pest on MDAR's [online reporting form](#) by taking photographs and collecting a specimen if possible. Residents should look for large, gray insects, about one inch long, with black spots and red underwings. For more information about SLF, click [here](#).

Pesticides Update (J. Piñero, D. Cooley, K. Leahy)

Inscalis insecticide is a foliar-applied active ingredient (IRAC MoA group 9D) that provides a unique mode of action for the control of aphids, whiteflies and other Hemipteran pests in specific specialty and row crops. According to BASF, the chemistry's formulation works by moving through the leaf (translaminar) to control pests that may be living on the underside of leaves. Inscalis insecticide causes insects to quickly stop feeding. In addition, the insecticide boasts a favorable environmental profile with low toxicity to beneficial insects, including pollinators. It provides 21-day residual control. Inscalis will power Versys, labeled for use on pome and stone fruit against aphids, and on some vegetables such as brassicas and leafy vegetables against multiple Hemipteran pests including aphids and whiteflies. The Versys label can be downloaded [here](#).

Chlorpyrifos is in the process of being withdrawn, though it may be quite some time before the process is complete. It is likely to be legal for use for another year or two, though adverse publicity and buyer wariness are likely to limit its use.

Exirel insecticide will now have language on the label suggesting that use be restricted to one generation of codling moth or obliquebanded leafroller. A monitoring program is under way for watching for any shift in susceptibility of moth populations to **Exirel** or **Altacor**.

Revysol is a sterol inhibitor (SI) which may have its own FRAC 3 subcategory, meaning that it works differently than other SI materials. They're hoping for a label in the 2nd quarter of 2019.

Trionic 4SC (triflumizole, UPI/UPL NA) FRAC 3

Apples & Pears-Powdery Mildew & Scab 8-16 fl oz/ac 14 day PHI

Cherries-Powdery Mildew 8-16 fl oz Blossom Blight & Fruit Rot 10-16 fl oz 1 day PHI

Oranil 6L (chlorothalonil, UPI/UPL NA) Frac M5

Apricot/Cherry/Nectarine/Peach/Plum/Prune 3.125-4.125 pt Leaf curl, Shothole,

Brown Rot Blossom Blight, Scab & Cherry Leaf Spot

Export shippers are running into occasional issues with materials that don't have a maximum residue limit for the country they're being shipped to. One example was that Israel has no MRL for Danitol, and turned away a load of apples that had detectable residue.

The Latest Version of the IRAC Mode of Action Classification Incorporating Bio-Insecticides is Now Available.

The Insecticide Resistance Action Committee (IRAC) is dedicated to prolonging the effectiveness of insecticides and acaricides by countering resistance problems. IRAC provides a coordinated industry response to prevent or delay the development of resistance in insect and mite pests. The IRAC Mode of Action (MoA) Classification Scheme is recognized globally as the authoritative reference for defining the MoA of commercial insecticides. This information provides growers, advisors, extension staff, consultants and crop protection professionals with a guide to the selection of acaricides or insecticides for use in an effective and sustainable acaricide or insecticide resistance management (IRM) strategy.

IRAC has just published the latest version of the MoA Classification, now incorporating bio-insecticides. In addition to presenting the MoA classification, this document outlines the background to, and purposes of, the classification list, and provides guidance on how it is used for Insecticide Resistance Management (IRM) purposes. IRAC has taken the step to systematically integrate non-chemical and biological products with insecticidal activity into the IRAC MoA Classification Scheme. This is one of the most significant updates to the scheme since its creation. Now included are bacterial agents, plant-derived extracts and unrefined plant oils,

fungus agents, non-specific mechanical disruptors, peptides and viral agents. Access the IRAC MoA Classification Scheme [here](#).

Decision Support System (DSS) Options for 2019 (J. Clements, E. Garofalo).

Massachusetts (and beyond) apple growers have a choice of three Decision Support Systems (DSS's) in 2019. **NEWA, Ag-Radar, and RIMpro**. These are websites that use site-specific environmental (weather) data to feed into apple pest and horticulture models that help make orchard management decisions based on this weather information. Most use degree-days (with various base temperatures), precipitation, relative humidity and leaf wetness, and (sometimes) user-entered tree phenology (bud stage) or insect trap captures to best inform and start the models. Note that both history and forecast model outputs are available, realizing that future model predictions are only as good as the weather forecast that goes into them. Hence, the following caveat applies - Decision Support Systems are intended as guides only. To quote the UMaine Ag-Radar introduction web page "The best decision tools are the experience and knowledge between your ears, supported by input from direct observations." We couldn't have said it better. A brief description of each DSS and how to get it for your site follows.

Network for Environment and Weather Applications (NEWA), is run out of Cornell University's New York State IPM Program and the Northeast Regional Climate Center (NRCC). The website is <http://newa.cornell.edu/>. Access to the website is free for anyone, however, despite the perception NEWA is free, it is not. UMass Extension, thanks to USDA grant funding, pays \$1,750 per year to have NEWA host our Rainwise weather station-based sites. (Not to mention a certain amount of staff time/maintenance/weather station depreciation, etc. dollars. Estimated to be about \$500 per year per station.) Currently, there are 43 NEWA sites in Massachusetts. 21 of these are on-farm weather stations (Rainwise or Onset) and 22 are airports (believe it or not). Anyone can look at the models from these sites by going to the NEWA website. Some of the more relevant orchard models include apple scab, fire blight, codling moth, plum curculio, apple maggot, and apple carbohydrate thinning. But be advised, the conditions may not be the same at your location if you are using an off-site station. Therefore, you are encouraged to purchase a weather station and get on NEWA if you really want to use it most confidently. In Massachusetts, contact NEWA state coordinator Jon Clements, jon.clements@umass.edu if you have questions or want to establish a NEWA site. Expect a major NEWA website update in the next year.

Ascospore Maturity Summary								
	Past	Past	Current	Ensuing 5 Days				
Date	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18
Ascospore Maturity	82%	85%	87%	90%	93%	95%	96%	97%
Daily Ascospore Discharge	0%	15%	0%	0%	21%	2%	0%	0%
Cumulative Ascospore Discharge	54%	70%	70%	70%	91%	93%	93%	93%
Ascospore Maturity Graphs								
Infection Events Summary								
	Past	Past	Current	Ensuing 5 Days				
Date	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18
Infection Events	No	Combined	Yes	No	Combined	Yes	No	No
Average Temp (F) for wet hours	-	47	46	-	62	53	-	-
Leaf Wetness (hours)	0	13	2	0	8	9	0	0
Hours ≥90% RH	3	11	11	10	16	11	12	2
Rain Amount	0.00	0.23	0.00	0.00	0.65	0.01	0.00	0.00
Download Time: 5/19/2018 17:00								

Apple scab infection events for one week in 2018 (Belchertown, MA) as modeled by NEWA.

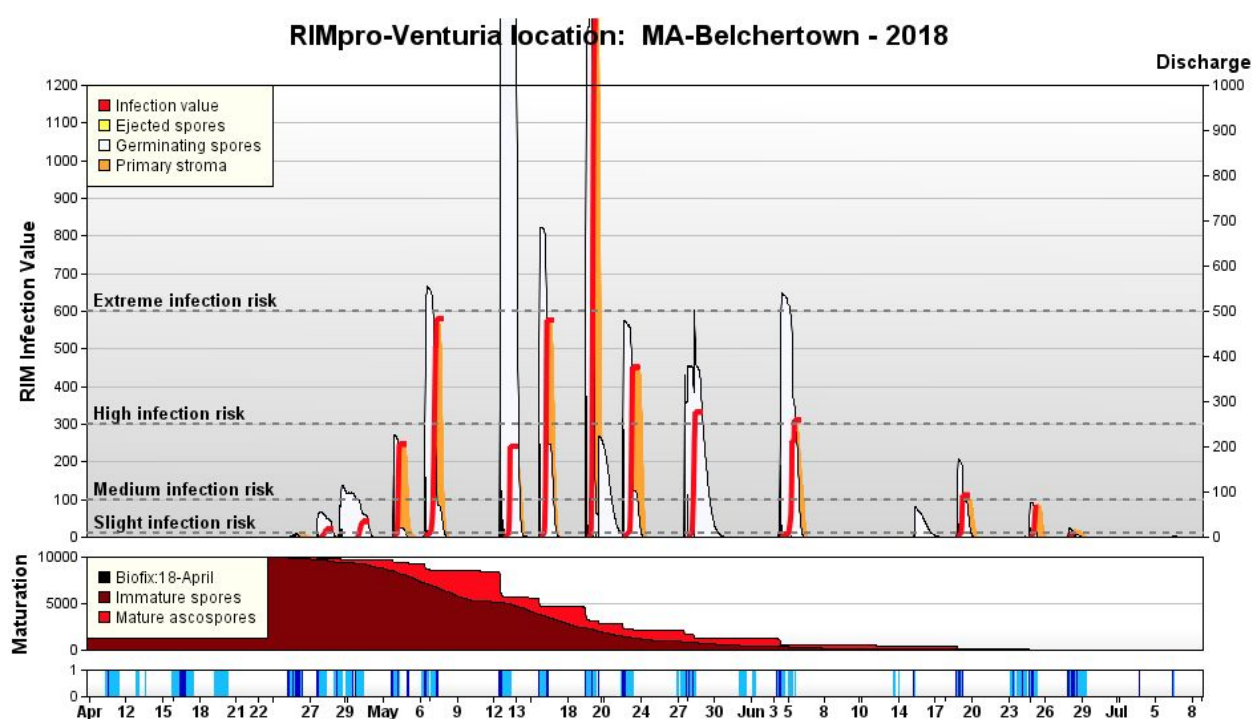
RIMpro is a cloud-based service that according to their website, <https://rimpro.eu/>:

“RIMpro...is an interactive Decision Support System (DSS) for pest and disease management in fruit and wine grape production. For many growers and consultants RIMpro is their essential tool for effective crop protection. Connect your weather station to the system in minutes. Get valuable real-time information to manage your crop protection in integrated, low-input or organic production systems. The RIMpro simulation models are carefully developed in cooperation with specialist, worldwide validated, and widely used. User-friendly interfaces show you what you need to know to make your decisions. RIMpro is no black-box. All biological processes in the models are explained and you can set all simulation parameters to your personal experience. RIMpro is constantly developed further based on user feedback, input of working groups and projects, and new insights in the biology of the pests and diseases involved.”

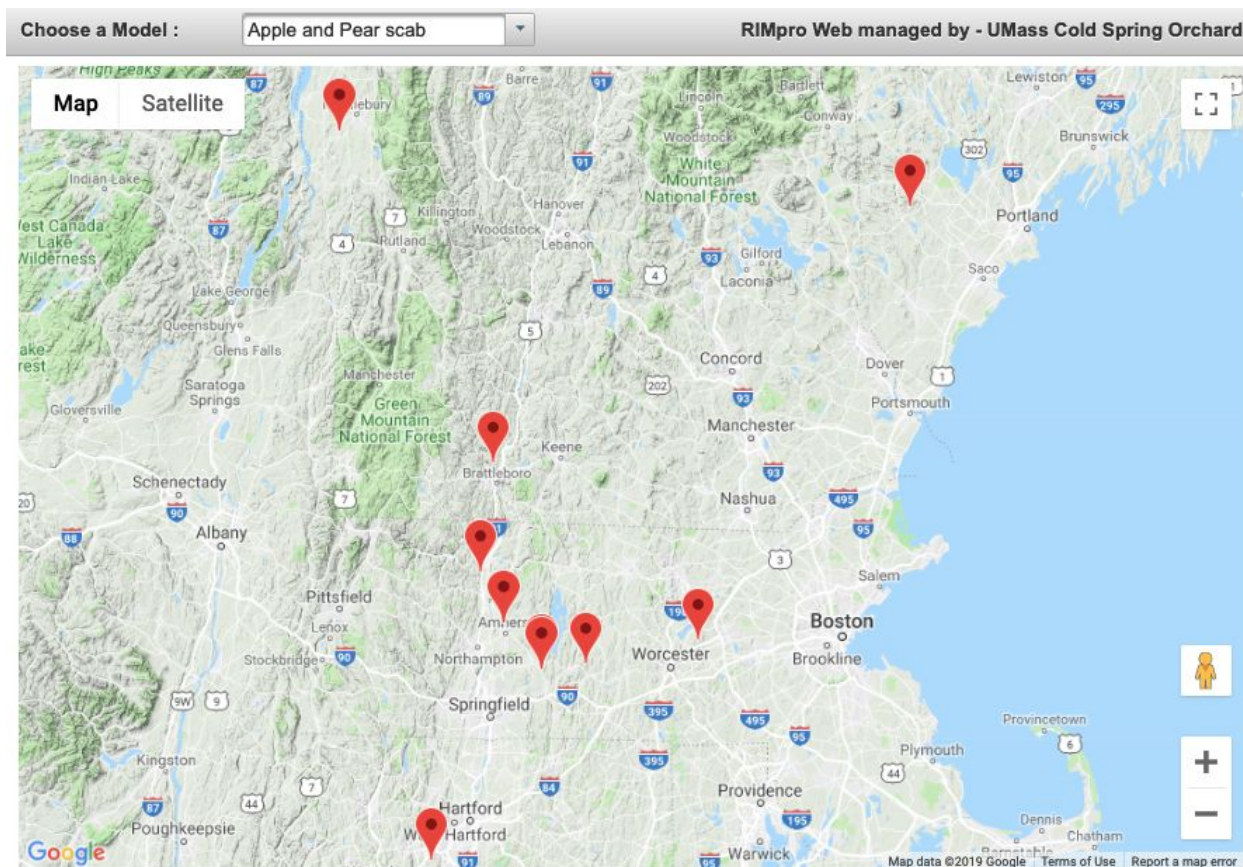
OK, sounds good, but not so fast. RIMpro is definitely not for everybody. For starters, it costs 220 Euros per year (about \$250 USD right now) plus, at least in our case, supplying it with weather data costs about 50 USD per year. There are two options for getting weather data to

RIMpro, using a NEWA site or using their virtual weather data source Meteoblue. RIMpro is arguably the “Cadillac” of DSS’s for apple growers, with extensive and detailed models for apple (and pear) scab, fire blight, codling moth, sooty blotch, fruit thinner, and some more esoteric ones like sawfly, mildew, and Marssonina. (Among others. It also has grape models.) Hence, not for everybody, you have to really be kind of into it.

But, for the past two seasons, the UMass Extension Fruit Team has hosted a RIMpro Advisory Service. That makes it much easier for you to get going with RIMpro, and we try to provide timely updates based on the most important RIMpro models. In 2018 there were eight orchards in Massachusetts, two in Vermont, one in Maine, and one in Connecticut who were participants of our UMass RIMpro Advisory Service. We plan on going at it again in 2019, the price will be \$300. Contact Liz Garofalo or Jon Clements for more information or to sign-up.

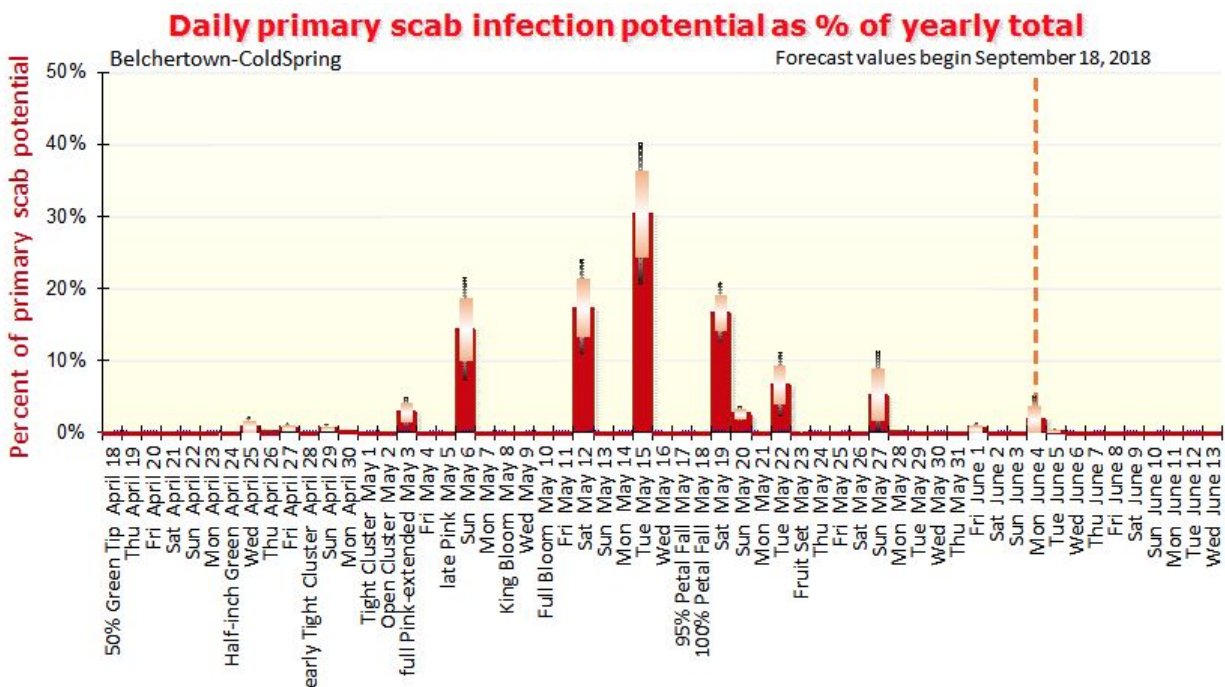


Apple scab infection events and severity for 2018 (Belchertown, MA) as modeled by RIMpro.



UMass 2019 RIMpro Advisory Service sites

Ag-Radar, created and curated by Glen Koehler at UMaine has been given a “weblift” and will be available through a for fee subscription (estimated launch date April 1, we will send out the notice when this becomes available to you). Ag-Radar will continue to offer the same services we have come to appreciate. These include (but are not limited to) the apple scab model, fireblight model, and one of *my* favorites, the honeybee activity model, designed to help you to avoid applying material at peak honey bee activity times. In addition to the suite of models already contained in Ag-Radar, there will be an expanded plum curculio model, a new sunburn model and more detailed frost warnings. To navigate to the site in your browser, use this link: <https://extension.umaine.edu>



[/ipm/apple/ag-radar-apple-sites](https://ipm.apple/ag-radar-apple-sites). Apple scab infection events and severity for 2018 (Belchertown, MA) as modeled by Ag-Radar.

IPM and other News Around the Country (J. Piñero)

APHIS Launches Webpage for Invasive Pests and Diseases

The U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) is launching a new "[Pests and Diseases](#)" webpage. The new page lists all pest and disease programs managed by APHIS as part of its mission to protect American agriculture and natural resources. On the new page, users can search by type (plant, animal), keyword (avian, fruit fly, cotton), or by the specific pest or disease (coconut rhinoceros beetle, brucellosis). You can also scroll through the page, which lists the pests and diseases alphabetically and includes a corresponding image.

APHIS created the webpage to make it easier for its customers to find critical information on pests and diseases of concern. With this tool, members of the public will have the information they need to report pests and diseases and together we can protect America's agriculture and natural resources. To visit the page, go to www.aphis.usda.gov/pests-and-diseases.



Reducing Cold Damage in Apple and Sweet Cherry (Washington State Univ.).

A WSU team led by Dr. Matthew D. Whiting conducted several trials aimed at evaluating the ability of Cellulose nanocrystals (CNC) treatments to improve bud hardiness i.e., reducing cold damage to reproductive buds or flowers. CNCs represent a new generation of renewable nano-biomaterials that provide excellent insulation. In a trial in a mature 'Scifresh' apple block the team compared two concentrations of CNC (1% and 2%) with untreated control. This trial was conducted on 18 April when trees were at about 20% full bloom (i.e., all king flowers in lower half of trees were open). Treatment with 2% CNC improved hardiness of 'Scifresh' apple flower buds, reducing pistil death at every temperature. The greatest improvement in flower hardiness was observed at 21.2 F, a temperature at which 80% pistil death was recorded for control, 90% for 1% CNC, and only 30% for 2% CNC. Based on their results, untreated trees would have complete crop loss at about 19 – 20 F, and trees treated with 2% CNC would have ca. 50% crop remaining, not losing the entire crop until ca. 16 F. Read entire article [here](#).

IPM Around the World (J. Piñero)

Halving pesticide use in apple orchards in Europe.

Researchers from INRA (France's National Institute for Agricultural Research) have reported on their long-term experimental work on apple orchards, which has resulted in reductions of pesticide use by up to 50% through a series of measures based on increased forecasting and observation of pests and diseases. INRA and its partners have been experimenting with three orchard systems using three different apple varieties since 2004.

INRA's broadly similar organic and 'eco' systems have seen them reduce the average number of annual treatments from 35 to 20 with the major difference between the systems being the fact that synthetic inputs can be used as a last resort in the latter. Crucially, these reductions have only been possible using varieties offering good resistance to pests and diseases such as Ariane, and Melrose. More information is available [here](#).

Boosting IPM in Europe.

Recent years have seen an increasing effort towards the development and adoption of sustainable crop protection strategies, especially in the European Union (EU). Several policy frameworks have been put in place including the EU framework Directive (128/EC/2009) on the sustainable use of pesticides. Consequently, all EU Member States developed National Action Plans to ensure the implementation of the general principles of Integrated Pest Management (IPM) by all professional pesticide users starting from January 1, 2014.

An article published by a group of researchers from 11 countries discusses practical issues hindering IPM adoption and the role of stakeholders to overcome such obstacles. The issues discussed are a summary based on the outcomes of workshops, conferences and annual meetings held within the frame of the European Research Area Network on Coordinated Integrated Pest Management (ERA-Net C-IPM; <http://c-ipm.org>) which intended to contribute via coordinated knowledge sharing and research efforts to overcome those impediments.

The article discusses that demonstration farms are one of these tools to show farmers that the IPM adoption can ensure yields and may lead to long-term benefits. In addition, all possible communication channels and media should be engaged in producing clear and simple messages for the general public. The need for producers to actively engage with the retail sector to extend the focus of consumers on IPM-based products is also discussed.

The full article is available upon request to Jaime Pinero.

Overview of Apple IPM implementation in Europe.

In Europe, even though most of the pest management strategies still rely on the use of synthetic pesticides, a wide array of innovative and environmentally friendly tools are now available as possible alternative to the pesticides within the modern apple production system. A review paper published in 2015 highlights how recent pest management strategies and tools have created an opening for research towards IPM improvement in apple orchards, including the use of biorational pesticides, semiochemicals, biological control, and forecasting models. In addition, new tree training systems and innovative spray equipment have been developed to improve treatment coverage, to mitigate pesticide drift, and to reduce chemical residues on fruits. The authors also highlighted that as a consequence of the raising consumer concerns about environmental impacts generated by the fruit production, 'Integrated Fruit Production'

certification over product standards, including process aspects, are frequently required by consumers and supermarket chains. To access the entire review article, click [here](#).

The European Union Bans Outdoor Use of Three (Five in France) Neonicotinoid Insecticides.

In April 2018, the European Union voted for a complete and permanent ban on all outdoor uses of the use of the three main neonicotinoids — imidacloprid, clothianidin and thiamethoxam — starting on December 19, 2018. And France became the first country in Europe to add thiacloprid and acetamiprid to the list. French farmers have said that the ban leaves them with no effective alternative for protecting some crops from pests. For more information, click [here](#).