28th Annual March Message

To Massachusetts Tree Fruit Growers (2020)

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Introduction (J. Piñero)

The UMass Extension Fruit Team is pleased to bring you the 2020 edition of the March Message. The March Message attempts to address a variety of topics of current concern to Massachusetts and other northeastern fruit growers. It also provides an overview of research that will take place over the growing season and discusses IPM issues within and outside the USA, which we consider to be relevant to growers. The March Message is not a formal publication, thereby allowing the authors to express opinions that might be withheld from formal publications.

We are pleased to announce that a new series of **IPM Fact Sheets** (focus on insects and diseases) have been developed by the UMass Extension Fruit program members. We will be adding to this list of fact sheets over time, so check back from time to time to see what's new.

Access the new IPM Fact Sheet series HERE

Massachusetts Horticulture Overview

The way I see it (Jon Clements)

What's on my mind as we approach an early spring? Climate Smart Farming (CFS) -- a couple pretty interesting on-line tools hosted by the Northeast Regional Climate Center. Apple Frost Risk Maps and Apple Stage/Freeze Damage Probability. Plenty of explanation on the respective websites, I do find the Apple Stage maps typically a bit more advanced than we actually see. (Anyone want to help with ground-truthing?) Take a look and let me know what you think? I hope we don't have to look at the Freeze Damage Probability one too much this spring! CASH and apps you need! Sounds good. Also, Duane Greene's PGR updates and a summary of the updated Cornell Apple Carbohydrate Model on NEWA. Good luck out there...

- CSF Apple Stage / Freeze Damage Probability
- Apple Frost Risk
- 4 Apps With Big Appeal for Fruit Growers

- CASH (Comprehensive Assessment of Soil Health) -- pretty self-explanatory, this service has been around for awhile, but I think we all need to consider soil health in orchards a little more seriously. Particularly when it comes to replanting, and compaction. I plan to submit a couple samples this year from the UMass Orchard. If anyone else has already done it, or is thinking about it, I'd love to see your results. I also plan on purchasing one of these, Spectrum's Soil Compaction Tester, so I may show up in your orchard with it someday!

Plant Growth Regulator (PGR) Updates (Duane Greene)

Inhibition of Flower Bud Formation with GA7

Fine Americas Inc. is introducing this spring a formulation gibberellin (GA7) which is intended to specifically inhibit flower bud formulation in apples. This product will provide to growers another vehicle 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 to reduce biennial bearing. Rather than aggressively thinning trees in the spring to reduce crop load and encourage good return bloom for the following year, another approach is available and may be taken. Gibberellins (GAs) are a family of hormones that are produced very early by the seeds in apples and these GAs 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-year cycle during the "on" year. This new growth regulator will allow you to help regulate biennial bearing in both the "off" year by inhibiting excessive flower buds from forming and by traditional chemical thinning in the "on" year in apple trees. This is a very welcome addition to the tool you have available now that should help you to even out bloom from year to year. On some biennial bearing varieties it is very difficult to break the biennial bearing cycle by thinning.

Regulation of crop by inhibiting flower bud formation is not a new concept in fruit production. The ProGibb label (gibberellic acid) allows this product to be used on young blueberry plants to inhibit flowering and fruiting thus allowing the young bushes to increase in size and fill their allotted space. Gibberellic acid is also used on non-bearing tart and sweet cherries to reduce flowering and fruiting to achieve faster growth and delay pollen-transmitted virus infection.

This was supposed to be registered for sale last year, however, there were significant delays in approval. As of March 2020 GA7 is now registered for commercial use as the product Arrange. There will be a limited supply of this product this spring. The label has not been made available as of now but we will update you when it appears. Application of Arrange will be from petal fall to 15 mm. My experience with the use of gibberellins on apples for the purpose of inhibiting flower bud formation has shown earlier applications are preferred and more effective. The suggested use rate of Arrange is one gallon formulated product/100 gallons water dilute TRV. A trial using Arrange to inhibit flower buds was done last spring on lightly cropping Fuji at the UMass Orchard. Results from this trial will be available later this spring.

New Chemical Thinners

Accede™ (1-aminocyclopropane-1-carboxylic acid, ACC)

ACC is a very interesting natural occurring compound. It is found in all plants. It is the last step in the biosynthetic pathway for ethylene production. ACC oxidase is the enzyme that converts ACC to ethylene. Ample amounts of ACC oxidase are present in a plant so that ACC is readily converted to ethylene when present. ACC is a water soluble compound that can be readily translocated within the plant.

Both Ethrel (ethephon) and ACC stimulate ethylene production although they do it in different ways. When Ethrel is sprayed on a plant it is absorbed and moves into the plant cytoplasm. The pH of the cytoplasm is close to 7.0 and at that pH ethephon is unstable and it breaks down to produce ethylene gas. ACC on the other hand is acted upon by ACC oxidase that is already present in cells. This results in ethylene production. Presumably, the ethylene produced by both compounds does stimulate some autocatalytic ethylene production by the plant.

ACC as the Accede™ formulation (Valent) has been tested as thinners in the orchard. One of the most exciting characteristics of Accede™ is that it is most effective as a thinner when applied at the 17-20 mm fruit size stage. This is unique among presently-used thinners and this is a slot in the thinning window of opportunity that is clearly deficient. Accede™ can thin in the traditional thinner time of thinner application, 8-14 mm but I believe that the major thinning slots that Accede™ will fill is at the larger fruit sizes where growers are running out of reliable thinners to use. The concentration range in which it will probably be used is 200 ppm to 400 ppm. Accede™ may cause some phytotoxicity. Generally, this is less severe when applied at the larger fruit sizes and when lower concentrations are used. Phytotoxicity may not be seen and whether it is observed or the severity of it is somewhat cultivar dependent.

I have used ACC since 2010 and it has thinned apples quite consistently. Now that this is a named product and on a pathway for development, perhaps there will be more widespread use which should be very useful in more clearly defining consistency and usefulness. Accede™ appears to have no direct effects on fruit quality.

Protone® (S-Abscisic Acid, ABA)

Protone® has been registered for enhancing red color on grapes on the west coast for several years. Valent is now releasing this ABA-containing formulation product for expanded use on the east coast. This label now allows the use of this product for thinning of apples and pears. It should be available this spring.

ABA is a naturally occurring compound that plays a critical role in regulation of several physiological processes in a plant, especially water relations. When a plant is under stress a plant produces abscisic acid in and this is a cue to the plant to close its stomata. If a plant is stressed or if it is sprayed with ABA stomata close, resulting in a significant reduction in photosynthesis. This in turn results in a carbon deficit in the plant. In the case with pome fruit, this happens for a long enough period during the time when developing fruit are competing for photosynthate (7-15 mm) fruit abscission will be initiated. Special attention should be paid to the weather conditions that occur especially the three days following application. If the weather is cloudy and or the temperatures are warm to hot, thinning will be favored because these conditions will increase the carbon deficit within the tree.

- **Apples.** Label recommendations for the use of Protone® on apples include using 1 to 2 applications from 5-12 mm fruit size at rates between 100 and 500 ppm in a 100 gal/acre application volume. Starting out I would recommend using mid- concentration rates at the 10-12 mm stage. Special attention should be paid to the cloud cover and the temperature since applying this during a carbon deficit may be necessary for adequate thinning activity. A good nonionic surfactant is recommended for use with this product. In the past we used Regulaid with ABA with good success. This may be used with MaxCel (not NAA) for added thinning. Protone® may cause some leaf yellowing and leaf abscission. The severity of this and the weather if phytotoxicity even occurs is somewhat cultivar dependent. It has been my observation that the addition of a small amount of 6-BA (MaxCel) may help reverse leaf yellowing and abscission.
- **Pears.** Protone® is cleared for use on pears for thinning. Pears are more sensitive to ABA than are apples. Everything being equal, a greater thinning response may be expected when used on pears. Some leaf abscission and leaf yellowing when used on pear can be seen. Based upon my experience on Bartlett pears, 6-BA (MaxCel) was unable to reverse this yellowing and leaf abscission effect when used in conjunction with Protone®.

Protone® has also been registered as a defoliant to stimulate leaf drop in the fall. It may be used on nursery trees or on trees in the orchard carrying green leaves into the fall. A good nonionic surfactant should be used with this and a rate between 500 and 750 ppm. Application on trees in the orchard is meant to speed leaf abscission and speed the development of dormancy. (May be particularly handy on non-cropping younger trees still actively growing later into the fall.)

Thinning this spring

At the time I am preparing this we have not seen weather conditions that would either weaken or damage flower buds for this spring. Since there may be a number of hurdles to go over, it would be premature to make any specific chemical thinning recommendations. However, we have experienced over the past few seasons erratic weather that has made thinning challenging. (Expect more of the same?) The most challenging time is near the traditional thing time, when fruitlets are 7 to 14 mm in diameter. This period of time is when fruit are most susceptible to chemical thinners. If weather is not favorable for thinning during this time, the chance of over- thinning or under-thinning is enhanced. Assuming that there are no weather disasters that severely damage flower buds on the trees I am going to recommend a very aggressive thinning program early, especially at bloom and petal fall. Although the word aggressive may concern you, in my estimation it may be the safest way to approach the coming thinning season. Details will follow as the season gets closer.

Improvements to MaluSim -- the Cornell Apple Carbohydrate Thinning Model (J. Clements)

In the most recent Fruit Quarterly (Vol. 28, No. 1, Spring 2020) Dr. Terence Robinson and co-authors introduce some improvements to the Cornell Apple Carbohydrate Thinning Model, also known as MaluSim. If you remember, MaluSim is a decision support tool to help make effective chemical thinning applications based on predicted thinning efficacy. Inputs to the model require temperature and sunlight which are derived from a NEWA weather station. Outputs include a daily Thinning Index and recommendation to increase or decrease chemical thinner rates. Many apple growers have indicated the MaluSim (Apple Carbohydrate Thinning) is one of the most widely used decision support tools on NEWA:

- Apple Carbohydrate Thinning v2019 on NEWA
- 2019 NEWA Impact Report for Massachusetts

The rationale behind Robinson making these changes/improvements to MaluSim are based on their annual study from 2000 to 2011 where experimental thinning treatments (using carbaryl, NAA, and 6-BA) were applied to apple trees in Geneva, NY and annual data on flower bud density and then cropping (yield, fruit size) was recorded. Weather data was input into MaluSim where a daily carbohydrate balance during the chemical thinning period was calculated and compared to the crop load at harvest. It turns out:

- The greatest effect on fruit set was timing of chemical thinning application, with the best thinning occurring at 200 to 250 degree days (Base 39 degrees F.) Note that king fruit diameter centered about 12 mm during this window. (I remember my MSU colleauge Phil Schwallier, who has done many chemical thinning trials over the years, saying he has consistently got the best results when chemical thinners were applied when fruitlet size was 10 to 12 mm.)

- Initial flower counts (bloom intensity) have to be taken into the equation too. When there are more flowers, more aggressive thinning is needed vs. having fewer flowers.

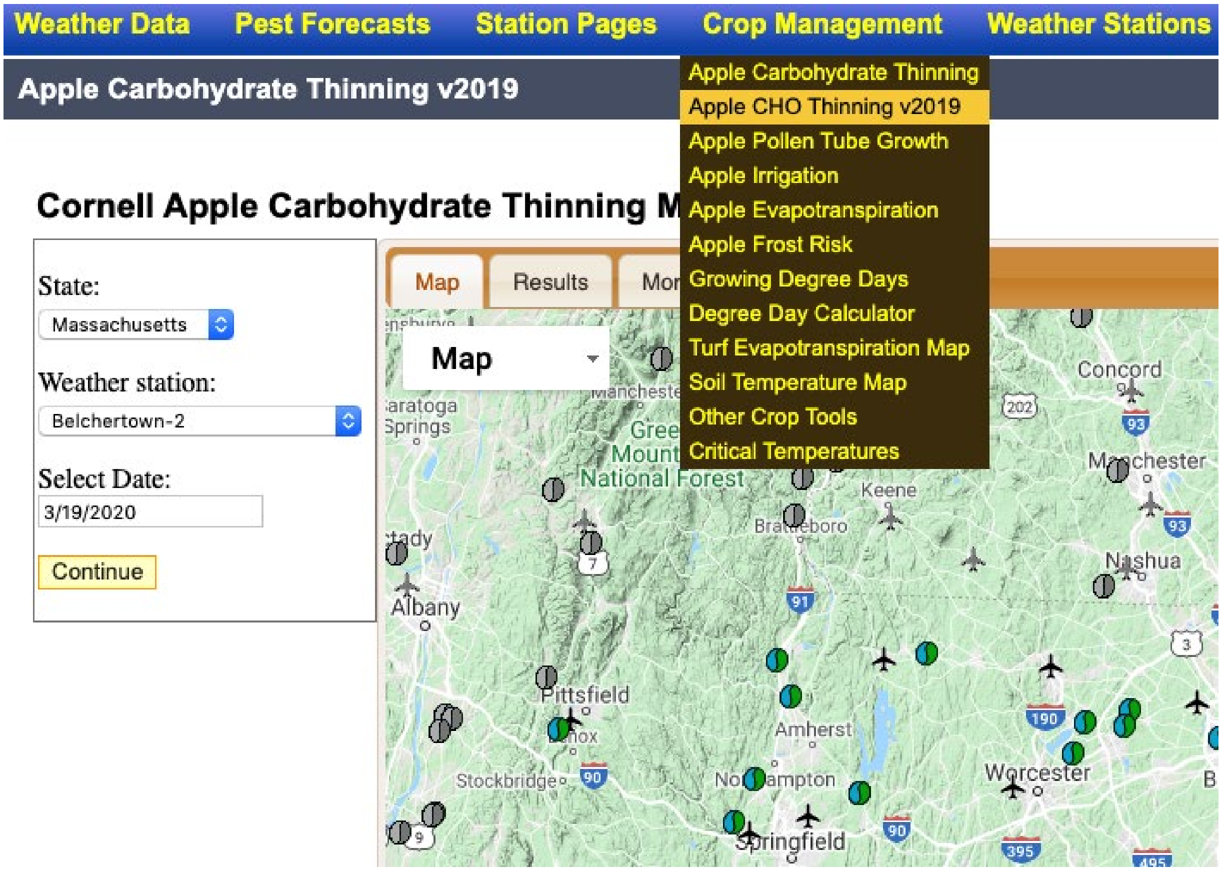
- Carbohydrate balance also had an effect on fruit set, but was much reduced (or non-existent) outside of this degree-day window of 200-250 DD's.

- And, the actual daily carbohydrate balance should be expanded to a longer period before and after the thinning application compared to the “old” MaluSim which used a 4 day running average to compute the daily carbohydrate balance.

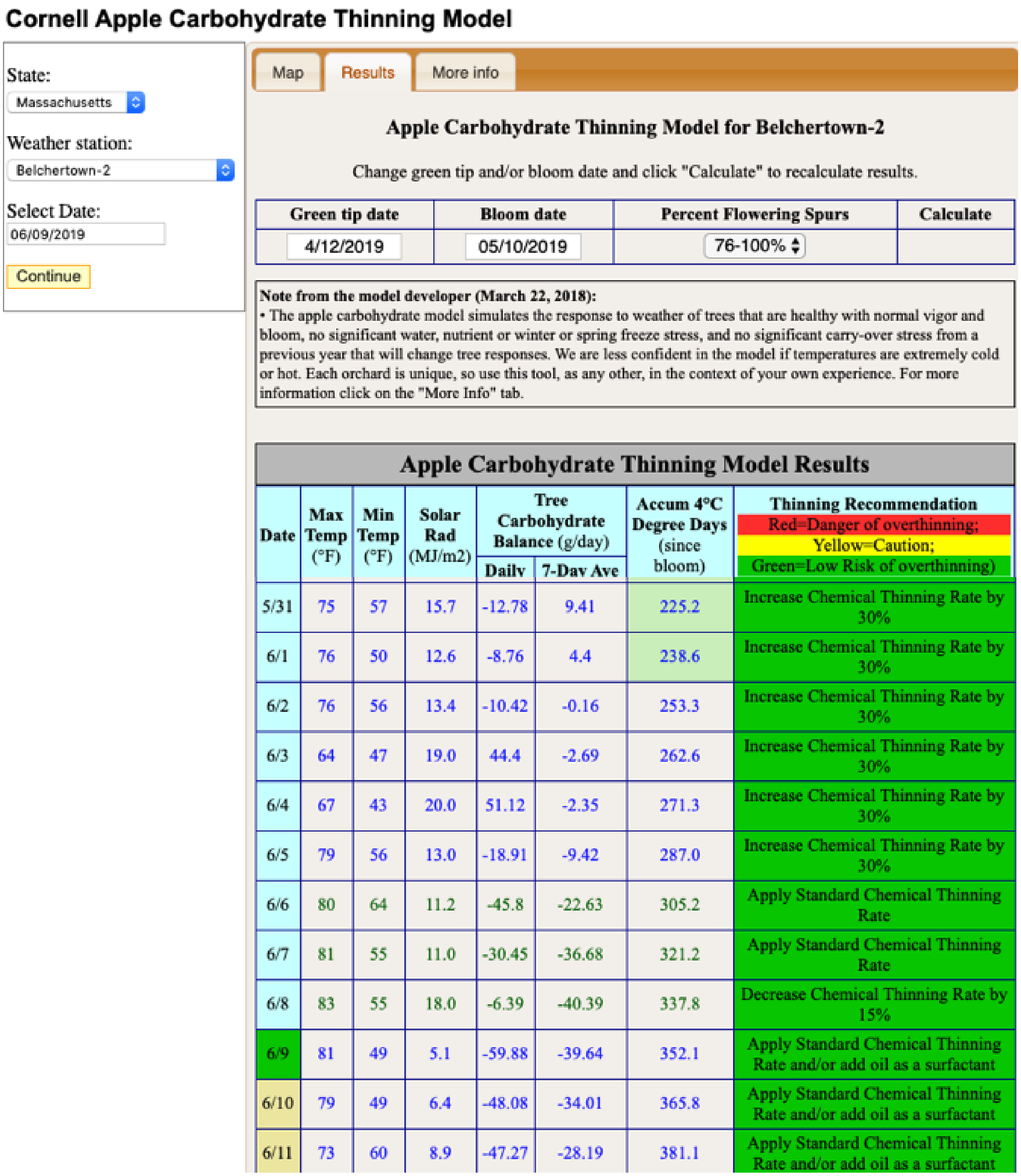
So, based on this research the new Cornell Apple Carbohydrate Model on NEWA (Apple Carbohydrate Thinning v2019) was modified as follows:

- Users must input % flowering spurs before running the model, with four choices: 76-100%, 51-75%,, 26-50%, or 0-25%. (Note the user must also input green tip and bloom dates.)
- Degree Days are automatically calculated, summed, and highlighted in the DD column when they are in the range of 200-250 DD’s (Base 39 degrees F.) from bloom.
- Calculation of the “Thinning Index” (daily carbohydrate balance) is expanded to seven days (two days before the day of thinning to four days after)
- And, thinning recommendation, taking into account % of spurs that are flowering, DD’s from bloom, and carbohydrate balance over seven days (all per above) will be color coded red=high risk of over-thinning, yellow=caution, possible over-thinning, green=expect good thinning, and blue=little or no thinning expected.

In 2019 the older Cornell Carbohydrate Thinning Model will be replaced by the new and improved Apple CHO Thinning v2019 MaluSim model and you are advised to use that. Note that CHO thinning is also available in the Malusim app available on both iOS and Android smartphones for mobile access to thinning recommendations.



Apple CHO Thinning v2019 web interface on NEWA



Cornell Apple Carbohydrate Thinning Model

State: Massachusetts

Weather station: Belchertown-2

Select Date: 06/09/2019

Continue

Map | Results | More info

Apple Carbohydrate Thinning Model for Belchertown-2

Change green tip and/or bloom date and click "Calculate" to recalculate results.

Green tip date	Bloom date	Percent Flowering Spurs	Calculate
4/12/2019	05/10/2019	76-100%	

Note from the model developer (March 22, 2018):
• The apple carbohydrate model simulates the response to weather of trees that are healthy with normal vigor and bloom, no significant water, nutrient or winter or spring freeze stress, and no significant carry-over stress from a previous year that will change tree responses. We are less confident in the model if temperatures are extremely cold or hot. Each orchard is unique, so use this tool, as any other, in the context of your own experience. For more information click on the "More Info" tab.

Apple Carbohydrate Thinning Model Results

Date	Max Temp (°F)	Min Temp (°F)	Solar Rad (MJ/m2)	Tree Carbohydrate Balance (g/day) Daily	Tree Carbohydrate Balance (g/day) 7-Day Ave	Accum 4°C Degree Days (since bloom)	Thinning Recommendation (Red=Danger of overthinning; Yellow=Caution; Green=Low Risk of overthinning)
5/31	75	57	15.7	-12.78	9.41	225.2	Increase Chemical Thinning Rate by 30%
6/1	76	50	12.6	-8.76	4.4	238.6	Increase Chemical Thinning Rate by 30%
6/2	76	56	13.4	-10.42	-0.16	253.3	Increase Chemical Thinning Rate by 30%
6/3	64	47	19.0	44.4	-2.69	262.6	Increase Chemical Thinning Rate by 30%
6/4	67	43	20.0	51.12	-2.35	271.3	Increase Chemical Thinning Rate by 30%
6/5	79	56	13.0	-18.91	-9.42	287.0	Increase Chemical Thinning Rate by 30%
6/6	80	64	11.2	-45.8	-22.63	305.2	Apply Standard Chemical Thinning Rate
6/7	81	55	11.0	-30.45	-36.68	321.2	Apply Standard Chemical Thinning Rate
6/8	83	55	18.0	-6.39	-40.39	337.8	Decrease Chemical Thinning Rate by 15%
6/9	81	49	5.1	-59.88	-39.64	352.1	Apply Standard Chemical Thinning Rate and/or add oil as a surfactant
6/10	79	49	6.4	-48.08	-34.01	365.8	Apply Standard Chemical Thinning Rate and/or add oil as a surfactant
6/11	73	60	8.9	-47.27	-28.19	381.1	Apply Standard Chemical Thinning Rate and/or add oil as a surfactant

Apple CHO Thinning v2019 web interface output example on NEWA

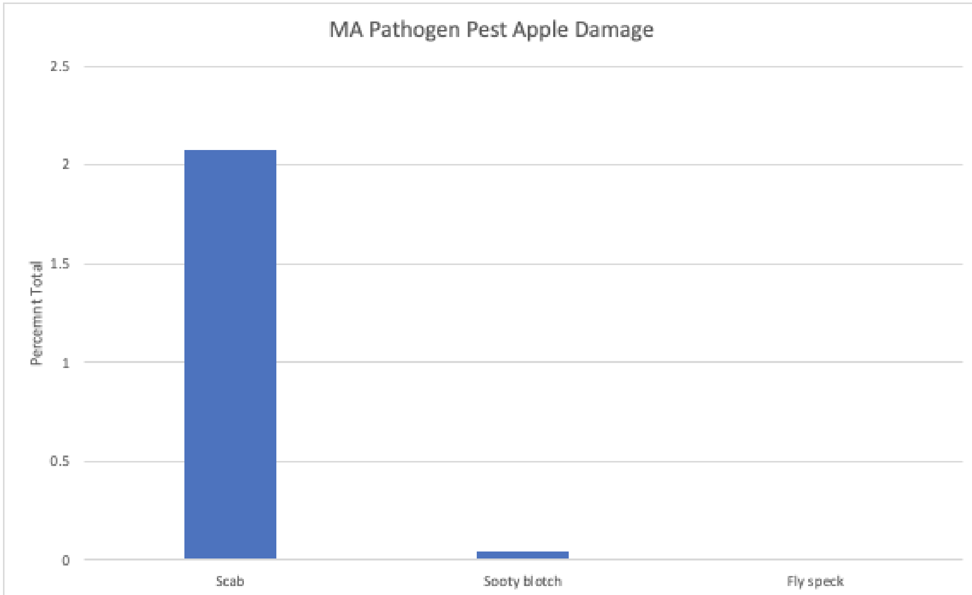
Massachusetts Pests Overview

Diseases (D. Cooley, E. Garofalo)

Apple scab. In 2019, apple scab appeared to be the most prevalent disease present at harvest. Bear in mind however, that of the 2,500+ apples sampled across the state, only 2% had scab on them. This will of course vary by site, so, if you had a troubling amount of scab on your fruit last year, it's not too late to get some sanitation accomplished this year! As of 3-19-2020 there have been no ascospores observed in our lab assays. This year we will continue to use the petri plate assay and the funnel trap to determine when spores first become available as well as to track their release and seasonal maturity.

Petri plate assay. Infected leaves are soaked in water and then placed suspended over two microscope slides which collect any spores released. Slides are then checked using a compound microscope to assess the number of spores present.

Infected leaves are soaked and placed on top of the funnel. This funnel is equipped with a fan, which draws air over the infected leaves, forcing any spore released onto a glass microscope slide. The slide is checked using a compound microscope to assess the number of spores present.



Percent fruit damage from the three most common fungal pathogens. A total of 2,650 apples were sampled from five orchards in Massachusetts.

Phomopsis popped up in a number of orchards last year. Affected tissue should have been removed and destroyed (where practical). While not a common disease for apple, under stress conditions such as we saw in the fall of 2018 and spring of 2019, it can become a problem, especially on trees already weakened or under other stress conditions. Adequate sanitation measures will greatly reduce the risk of this disease. Certain commonly used early season fungicides may be effective against phomopsis, but are not labeled for this disease on apple.

Newly formed phomopsis canker on apple twig.

Left: Blossom cluster infected by phomopsis. Right: Spore dispersal pattern showing as new infections on foliage below previously infected shoot. Note the flower cluster (lower right portion of photo) appears to be infected as well.

Blossom blast (*Pseudomonas syringae pv syringae*) is not often seen in apple. When cooler temperatures prevail around bloom, this disease can crop up. Given the timing and appearance of this disease it can be very vexing. It is easily mistaken for fireblight, although the characteristic "shepherd's crook" is not present nor does it progress as far into woody tissue, making blossom blast less damaging than fireblight. Like many other bacterial pathogens, populations of *Pseudomonas syringae pv syringae* inhabit plant surfaces. A delayed **dormant copper** application will reduce these populations. The last time blossom blast was confirmed in apple in Massachusetts was May 16, 2016. The disease was not widespread but found in a portion of a block on the lower end of a slope where cool air drained and pooled. Other trees in the orchard were not affected.


"Blossom blast" of apple, UMass diagnostic lab confirmed the presence of ***Pseudomonas** syringae pv syringae.*

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

Overall, the most challenging insect pests in several Massachusetts orchards in 2019 were codling moth and other Lepidoptera, plum curculio, stink bugs, and mites. The least damaging or almost non-existent pests were leafminers and European apple sawfly. Before providing an overview of pest-specific pressure in 2019, below we describe one long-term research project that involves multiple insect pests.

Project title: Multi-cultivar grafting: a novel low-cost, grower-friendly Attract-and-Kill approach to manage key apple pests in New England.

In late 2019, we received funding from USDA NIFA to conduct field-scale research aimed at developing permanent monitoring and attract-and-kill sites using selected perimeter-row apple trees grafted with six apple cultivars. The cultivars chosen are very attractive to plum curculio (PC) and apple maggot fly (AMF). We will also include tarnished plant bug (TPB), European apple sawfly (EAS), tortricid moths (codling moth, Oriental fruit moth, leafrollers), and stink bugs, in our evaluations. To fully assess the potential of using grafted trees as permanent killing sites for insect pests, this research will be conducted for multiple years (at least 6-8 years). This research will also allow for a comparative assessment of pest pressure and influence of habitat and weather factors across a region over time.

Rationale: Commercial pheromone and plant-based lures are available for monitoring and/or attract-and-kill of PC, AMF, BMSB, and a few other insect pest species. However, few growers are currently using lures largely due to their high cost, limited availability, and/or lack of information on when, where, and how to use them. For some pest species such as TPB and EAS, no effective lures have been developed yet.

If grafted trees prove to be effective 'trap crops', then growers could use grafted trees as permanent monitoring and killing sites, potentially reducing pesticide use.

Collaborators: Dr. Anna Wallingford, George Hamilton, Jeremy DeLisle (University of New Hampshire Extension), Duane Greene (UMass), Glen Koehler (University of Maine Cooperative Extension), Kathleen Leahy (Polaris Orchard IPM), and grower collaborators.

If you would like to be part of this research, please contact J. Piñero at jpinero@umass.edu. We would need to graft 3-4 trees per acre (our current grafted blocks range from 0.5 to 9 acres), and then wait for two years before start collecting data.

We can do the grafting for you!

No changes in pest management practices will be required.

In 2020, season-long monitoring of each of the pests listed above will be done using a variety of tools (white sticky cards, inspection of fruit for damage, red sticky spheres, etc.). Studies will be conducted in MA (9 blocks), NH (2 blocks), and ME (1 block). The main goal of the investigations is to compare the response and seasonal abundance of insect pests to apple trees that were grafted with 6 cultivars, against that of non-grafted trees. We will include control blocks for comparative purposes.

Results will be provided to growers via *Healthy Fruit*.

Coleoptera

Plum Curculio (PC). In 2019, we monitored the early-season PC activity using black pyramid traps baited with benzaldehyde (BEN) and grandisoic acid (GA), the PC aggregation pheromone. The first overwintered PCs (4 adults in 3 odor-baited traps) were captured on April 24th. These first captures took place at 214.1 DD (base 43F, accumulated since January 1st). This is very close to the 7-year average of **224 DD** (base 43F).

PC adults seemed to come and go in a fairly 'normal' pattern, although the cold, wet spring got them to a slow start. Such a weather pattern also resulted in an extended period of PC activity which, for the first time in several years, was difficult to monitor using odor-baited traps. This situation may have been due to a problem with the lures used, to less lure volatility (dispersion), and/or to less PC activity during cool days.

Overall, even though populations didn't seem to have been greater than usual, greater-than-expected damage took place in a couple of orchards that likely missed the timing or didn't have enough coverage due to rainy, cool weather that prevailed during the PC season.

Research update: In 2019, we conducted two main studies. The first study aimed at comparing the efficacy of the odor-baited trap tree approach with perimeter-row sprays to manage adult PC populations. Across six years (2013-2019), percent fruit injury on trap tree plots averaged 11.3% on odor-baited trees in trap tree plots and **1.4% on unbaited trees** in perimeter-row spray plots, highlighting the ability of trap trees to congregate PC injury. Mean percent injury on fruit sampled from interior trees in trap-tree plots did not differ significantly from that recorded on interior trees in perimeter-row sprays **(0.95 vs. 0.68%, respectively)**. One research article reporting the results of multiple years and multiple locations (orchard blocks were evaluated in MA, VT, and NH) is being prepared.

The second study compared the effectiveness of three commercial formulations of entomopathogenic nematodes (EPN) at killing PC larvae in the soil. The most effective EPN species was *S. riobrave* (sold as NemAttack™ - Sr by Arbico Organics), followed by S. *carpocapsae* (sold as NemAttack™ - Sc by Arbico Organics). These two EPNs caused the greatest suppression of plum curculios when compared to water control. The EPN *S. feltiae* (sold as NemAttack™ - Sf by Arbico Organics) was not effective. If you are interested in looking at this information in more detail, you can access the research poster HERE.

Diptera

Apple Maggot Fly (AMF). In 2019, AMF populations appeared and peaked later than usual. There was high variability in AMF pressure across orchard blocks, but in general populations were not high. The final insecticide in August usually seems to take care of late-appearing AMF.

Research update.

In 2019, we evaluated the level of AMF control achieved in commercial orchard blocks using an attract-and-kill strategy involving use of synthetic lures deployed in perimeter-row trees in combination with insecticide sprays with 3% sugar added to the tank mix. Sugar is a phagostimulant that readily induces feeding by adult fruit flies upon contact. We expected the lures to bring AMF adults to perimeter-row trees where they could be killed by the insecticide sprays, before they could penetrate into interior trees. Subsequent flies arriving to the baited tree canopies were expected to continue sensing sugar on the foliage and fruit, inducing flies to ingest insecticide residue.

This study was conducted in six commercial apple orchards (3 in Massachusetts, 2 in New Hampshire, and 1 in Maine). For each orchard, two treatments were evaluated (1) attract-and-kill and (2) grower control. The attract-and-kill block made use of 5-component lures (= 'attract' component) deployed every ~30 yards along the four perimeter rows. **The 'kill' component of this strategy consisted of insecticide sprays mixed with 3% sugar (3 lbs. per 100 gallons of water) applied during July and August**. The control block was treated by the grower most commonly with two or three insecticide sprays to control AMF. Results from this single-season study indicate that an attract-and-kill approach involving synthetic lures deployed on perimeter-row trees in association with perimeter-row sprays of insecticides containing 3% sugar was effective in controlling AMF, as determined by trap captures and infestation data, when compared to grower control blocks. For more information, check the article that will be published in the 2020 Spring Issue of Fruit Notes.

In 2020, we will validate the 2019 study, and will start new investigations involving (1) evaluation of insecticides to be used in the cap of CurveBalls (which include an insecticide, paraffin wax, and sugar as phagostimulant), (2) evaluations of entomopathogenic nematodes against AMF larvae and pupae, and (3) studies on the behavioral response of adult AMF to host plant tissue (leaves, fruit) stemming from six cultivars as part of the 'grafting' project. These investigations will be executed by Ms. Dorna Saadat, a Ph.D. student who will focus on AMF for her research project.

Hymenoptera

European Apple Sawfly. This insect has been decreasing in significance for quite a while. Trap captures were mostly below threshold and special insecticide applications were not needed in 2019.

Research update. The attractiveness of selected plant volatiles to adult EAS was evaluated in a couple of commercial orchards in 2019. Results are inconclusive, so we will conduct two more years of evaluations. In 2020 and 2021, one MS-level graduate student (Ms. Prabina Regmi) will conduct various evaluations of plant volatiles for attractiveness to EAS.

Hemiptera

San Jose Scale. San Jose scale was fairly well controlled in 2019, perhaps because of well-timed oil applications pre-bloom. It continues to be a pest of concern throughout the region, so growers should continue to monitor carefully, and try to get an oil application on around half-inch green to tight cluster. This is a bit early for mite control, but seems to work well on scale.

Tarnished Plant Bug (TPB). On April 14th, 2019, the first TPB adults were captured in white sticky cards (two TPB adults in six traps) deployed at the UMass Cold Spring Orchard. It seems that TPB was well controlled in most apple orchards, although it continues to cause problems in peaches. Ground cover management is a critical component, frequent mowing or herbicide applications seem to help a lot.

Research update. Selected plant volatiles will be screened for attractiveness to TPB. Traps and lures have already been deployed at CSO. This research is being executed by Ms. Prabina Regmi (MS-level graduate student) in 2020 and 2021.

Lepidoptera

Oblique-banded leafroller (OBLR). Some OBLR injury was observed in peaches in 2019, something that is apparently known. Generally, this insect has moved into most orchards in the area, but growers are doing a good job of controlling it.

Codling Moth (CM). Reports indicate that for about 5-6 years, we've gone from CM being an occasional pest to posing a serious problem –particularly for the last 2 years. A couple of MA orchards reported injury by this pest. Growers need to keep in mind that such control failures might be due to the occurrence of resistance to insecticides. Insecticide resistance trials at Penn State indicate a need to re-focus attention on strategies to slow down the development of insecticide resistance in CM.

Research conducted by Agriculture and Agri-Food Canada suggests OP resistance is present in some apple orchards in Ontario. To deter the development of pesticide resistance, always rotate chemistries between generations wherever possible. Use one chemistry for first-generation CM (e.g. insect growth regulators) and a different chemistry (e.g. neonicotinoids) for second generation. Do not rotate chemistries within a generation.

Reports indicate that in other regions of the country CM has been causing more damage in recent years. Drs. Elizabeth Beers (Washington State University) and Larry Gut (Michigan State University) indicated that with changing weather has come more variability in spring conditions that sometimes opens the window to a third generation, instead of only two. On balance, warming has added 400 degree days to the CM season. That's about half of a generation. Insecticide resistance could be a factor as well.

Research update. We are interested in evaluating plant volatiles that would attract female moths to traps in an attempt to improve monitoring and management tools for this and other tortricid pests. In 2019, evaluated the attractiveness of candidate non-pheromonal lures to male and female codling moth (CM), oriental fruit moth (OFM), and red-banded leafrollers (RBLR) in three commercial apple orchards in Massachusetts. Detailed findings are being reported in the Spring Issue of *Fruit Notes*. J. Piñero has selected a graduate student (Mr. Ajay Giri) that will conduct research (during 2020 and 2021) on the behavior, ecology, and management of CM, OFM, and leafrollers.

Oriental Fruit Moth (OFM). In 2019 there was relatively low activity in apples, but some orchards definitely have a population in peaches! In 2019 we evaluated a new formulation of mating disruption in one commercial apple orchard, with good results. However, for a couple of orchards (one of them in NH), mating disruption was useful but not sufficient for control -- it slowed down mating within the block, but mated females were able to penetrate into the block and laid eggs. A combination of mating disruption, monitoring, and well-timed insecticides will do a good job on OFM..

Research update. As indicated above, the results of research conducted in 2019 that aimed at evaluating the attractiveness of a non-pheromonal lure system targeting female noths will be published in the Spring Issue of *Fruit Notes*.

Mites

There were very few mite problems in 2019, as conditions were not favorable, and oil applications were mostly very effective in preventing mite buildup. There's a lot of interest in releasing *Typhlodromus pyri* mites into orchards in this area, if we can find a good source...

Invasive Pests Update (J. Piñero, S. Schloemann, T. Simisky).

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

A trap-based treatment threshold for BMSB. A threshold has been developed for BMSB using black pyramid traps baited with the synthetic BMSB pheromone lure. The recommendation is to count the number of BMSB in perimeter traps around a 10-acre or less orchard block, and when 10 BMSB (nymphs or adults) have been captured, that triggers a spray. After each insecticide application, the count goes back to zero.

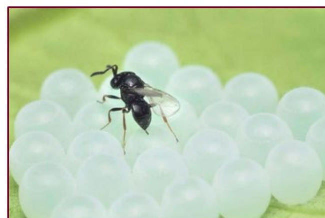
A simpler trap for monitoring BMSB. A new study conducted across 115 sites in 18 states in the U.S. shows a clear sticky-panel trap (12" x 12") baited with the aggregation pheromone of the BMSB to be a reliable tool for monitoring local populations of BMSB in various agricultural and environmental settings. This will help growers decide if and when management methods are necessary. In 2020, plans are underway to increase monitoring of BMSB at fruit orchards using pheromone-baited clear sticky traps. This work will be done in collaboration with Dr. Anna

Photo credit: Tracy Leskey (USDA ARS)

Wallingford (Univ. New Hampshire), Mary Concklin (UConn), and Heather Faubert (Univ. of Rhode Island).

Potential for biological control of BMSB. The samurai wasp, *Trissolcus japonicus*, is native to northeast Asia where BMSB comes from. Female wasps lay their eggs inside the eggs of stink bugs. Developing wasp larvae consume their host eggs before stink bugs can hatch. So far, the Samurai wasp has been found in 12 U.S. states.

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



Left: Female parasitoid samurai wasp laying eggs inside BMSB eggs.

Right: Female parasitoid samurai wasp emerging from a host egg.

Spotted wing drosophila continues to be a top priority of New England's berry industry. To provide the industry with the most up-to-date SWD information, Michigan State Extension and the Cherry Marketing Institute hosted the 2019 SWD Summit last November. **Videos of each presentation were recorded and made available in YouTube**. The topics covered are listed below (click each individual title to access the video):

- Influence of pruning on SWD populations in tart cherry
- Annual SWD population variability in Michigan
- Insecticide rainfastness for products used to control SWD
- Spotted wing drosophila insecticide efficacy and management programs
- Susceptibility of cherry cultivars to spotted wing drosophila
- Do SWD traps impact infestation?
- Influences of overwintering conditions and relative humidity on SWD populations
- Influences of overwintering conditions and seasonal relative humidity on SWD populations

Spotted Lanternfly (SLF), *Lycorma delicatula*.

The spotted lanternfly (SLF), a planthopper that has caused significant damage to vineyards in Pennsylvania, is spreading beyond that state. Already established in at least five states (Pennsylvania, Delaware, New Jersey, Virginia, and West Virginia) and detected but not established in others, it has proved effective at hitchhiking to new areas with the help of unintentional human-aided movement.

On February 21, 2019 the Massachusetts Department of Agricultural Resources (MDAR) urged Massachusetts residents to check plants for the spotted lanternfly. They announced the finding of a single dead spotted lanternfly adult at a private residence in Boston. As a result of this discovery, officials asked the public to check potted plants they purchase and report any suspicious insects. **There is currently no evidence that the spotted lanternfly has become established in Massachusetts.** For more information about this finding, please visit the following press release: https://www.mass.gov/news/state-agricultural-officials-urge-residents-to-check-plants-for-spotted-lanternfly .

Grape growers, other agricultural producers, and Green Industry professionals (landscapers, arborists, grounds managers, nurseries, etc.) across New England must be prepared. In the case of vineyards, SLF may spend most of its life cycle outside of the fruit crop, building up its population in the surrounding areas, and then may descend in "huge numbers" as adults to feed. In Pennsylvania, vineyards are reporting significant damage due to SLF feeding on grapevines, including increased susceptibility to winter injury, the failure of vines to set fruit, and in some cases, vine death. For more information about the impact of spotted lanternfly in vineyards in Pennsylvania, visit: https://extension.psu.edu/spotted-lanternfly-management-in-vineyards.

Like other leafhoppers, the lanternfly feeds on phloem tissue (plant sap), using piercing-sucking mouthparts. As the insects ingest large amounts of plant sap, they filter out needed nutrients (such as nitrogen and proteins) and excrete excess sugar and water. This sweet, sticky fluid the insects excrete is their excrement, or honeydew. Honeydew is attractive to ants, stinging insects such as wasps and bees, and other sugar-loving species. The attraction of stinging insects can be a nuisance, and a health concern for anyone with allergies to these insects. Honeydew also promotes the growth of sooty mold. Sooty mold fungi are not directly damaging to plants (they do not feed on the plant, but rather on the honeydew), however they can reduce the marketability of crops and PennState Extension reports that in some cases, sooty mold build-up may reduce plant photosynthesis which may result in plant dieback.

Adults are 1 inch long and ½ inch wide at rest. The forewing is gray with black spots of varying sizes and the wing tips have black spots outlined in gray. Hind wings have contrasting patches of red and black with a white band. The legs and head are black, and the abdomen is yellow with black bands. Early instar nymphs (immature stages; 1st, 2nd, and 3rd instar) are black with white spots. By the last immature stage, the 4th instar, they develop red patches in addition to the black color with white spots. This is the last immature stage before they mature into an adult. Both the immature insect and the adult are quite visually striking. Adults are especially so when they have been startled and expose the bright red coloration on the hind wings. When the adult is at rest, particularly on the trunk of the tree-of-heaven, their gray, spotted color may actually cause them to blend in with their surroundings. Freshly laid egg masses appear as if coated with a white substance. As they age, the egg masses look as if they are coated with gray mud, which eventually takes on a dry/cracked appearance. Very old egg masses may look like rows of 30-50 brown seed-like structures aligned vertically in columns.

This invasive insect prefers the tree-of-heaven (*Ailanthus altissima*; an invasive plant) over other plant species. It threatens grapes, hops, fruit trees, and ornamentals. Over 70 species of plants have been listed as potential hosts for the spotted lanternfly. The direct consequences of SLF feeding damage to host trees, including orchard crops and ornamentals, is not yet fully understood. Research is ongoing. In Pennsylvania, following particularly high levels of infestation, death of some tree-of-heaven and flagging on black walnut have been reported. Oozing from maple and oak that were heavily fed upon in 2018 was reported in PA, however the death of an ornamental tree has not yet been reported at this time. For more information about SLF in landscapes, visit: https://extension.psu.edu/spotted-lanternfly-management-for-landscape-professionals

Potentially at stake are New England's tree fruit, grape, hardwood, and nursery industries. In addition, this invasive insect pest can cause damage to high-value ornamentals in home landscapes and can affect quality of life for residents.

If you suspect you have found spotted lanternfly egg masses, nymphs, or adults in Massachusetts, please report finds here: https://massnrc.org/pests/slfreport.aspx

For more information about spotted lanternfly, visit: https://ag.umass.edu/landscape/fact-sheets/spotted-lanternfly

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

Fungicides

MIRAVIS®. New SDHI fungicide, active ingredient pydiflumetofen, in the same class (FRAC 7) as Aprovia, Fontelis and Sercadis, and several pre-mixes. Miravis is registered on all tree fruit. On apple it is registered for use against scab, powdery mildew, rusts, sooty blotch & flyspeck, and summer rot diseases. Trials indicate efficacy against scab and other apple diseases is equivalent to the other SDHI fungicides. It is used at 3.4 fl. oz./acre, with a limit of four applications per season.

EXCALIA. New SDHI fungicide (a.i. indiflin) that has been tested, but is **not registered**, though company representatives believe it will be during this growing season. It has good efficacy against scab equivalent to other SDHI fungicides.

CEVYA®. A new DMI fungicide (a.i. Mefentrifluconazole; FRAC 3). Like other DMI fungicides, Cevya is very effective against apple scab, powdery mildew and rusts, and is registered on other tree fruit diseases as well.

ORIUS® 20AQ; ORIUS® 3.6F. A new brand name for the DMI tebuconazole (FRAC 3), also marketed as Tebuzol for use on other crops. Orius is labelled for stone fruit, but NOT apples.

TRIONIC™4SC. Another rebranded DMI (triflumizole; FRAC 3) also marketed as Procure. Labelled for use on apples for scab, powdery mildew, and rusts.

TORINO. A new fungicide for use on apples, pears and cherry against powdery mildew. It is in FRAC U6, an unknown mode of action. Efficacy is good.

ECOSWING. A new botanical extract fungicide. Registered for use on apples. The only trial done with EcoSwing used it in combination with an experimental unregistered product. It is not known how well it will control diseases if used alone.

Insecticides and miticides

ENVIDOR© 2SC miticide. Bayer will not renew the registration of Envidor 2SC miticide. But you can continue to use this product. This seems not to be a regulatory problem. Rather, they're just not interested in carrying on with it. Active ingredient is Spirodiclofen (IRAC group 23= Tetronic and tetramic acid derivatives). In pome fruit, maximum ENVIDOR 2 SC MITICIDE allowed per crop season is 18.0 fluid ounces (0.28 lb a.i./Acre). Maximum number of applications per crop season: 1.

MAGISTER© miticide/fungicide. By Gowan. New foliar miticide that is active against spider mites (Tetranychidae), broad mites (Tarsonemidae), and other mites. Active ingredient: Fenazaquin (IRAC group 21A = quinazoline; FRAC group 39= quinazoline).

AVAUNT© eVo insecticide. FMC registered a new formulation of AVAUNT (eVo) for a couple of years and will finally produce it in the third quarter of 2020. AVAUNT eVo is a sucrose-based formulation that will mix readily (versus the clay based Avaunt). The solution will be more uniform so application is more uniform. There's some data from CA showing better wash off resistance. Check the label **HERE** for new crops, higher use rates in some crops, and some expanded pests round out the new label.

ENKOUNTER© insecticide. UPL (= Arysta + UPI) has Enkounter©, a mix of Assail (15%) and Intrepid (24%) for use sucking (e.g., aphids) and chewing insects (codling moth, leafrollers). The product has translaminar activity, which means that the materials penetrate leaf tissues and form a reservoir of active ingredient within the leaf. This provides residual activity against certain foliar-feeding insects.

TRANSFORM© insecticide. Corteva (= Dow + Dupont) has labeled Transform© for apples and stone fruit. Product active ingredient is sulfoxaflor (IRAC group 4 A= sulfoximines) for use against sucking and piercing insects. Sulfoxaflor is a systemic insecticide (it is not a neonicotinoid) which acts as an insect neurotoxin and is a member of a class of chemicals called sulfoximines which act on the central nervous system of insects. On pears, Transform™ can be used to suppress pear psylla. pear psylla. Transform© is the same material as Closer© but "*easier to formulate, and cheaper*" - we were told.

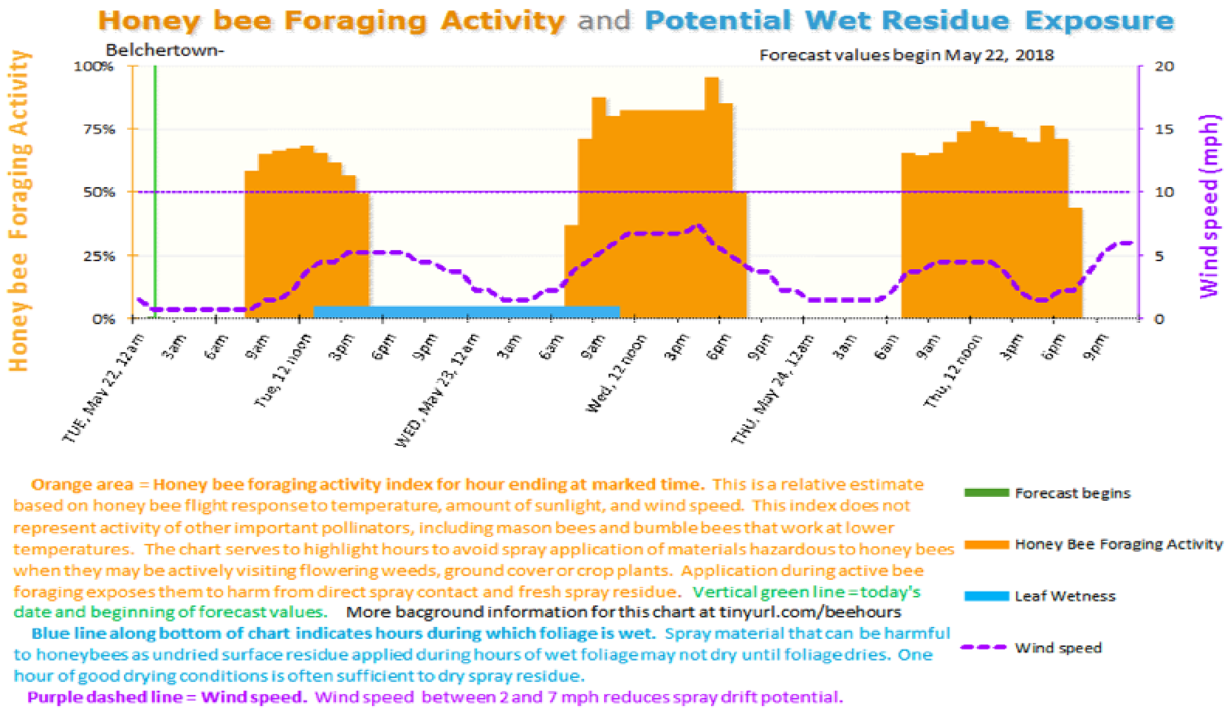
VERDEPRYN© 100SL insecticide. By Summit Agro USA, the active ingredient is cyclaniliprole (IRAC group 28= diamides). For pome fruits, the label includes a large list of insect pests including plum curculio, codling moth, European apple sawfly, leafhoppers, leafrollers).

VERSYS™ (Inscalis® Brand) insecticide. By BASF, for aphid control. Active ingredient is Afidopyropen (IRAC group 9D= Pyropenes).

Decision Support System (DSS) Options and Apps for 2020 (E. Garofalo)

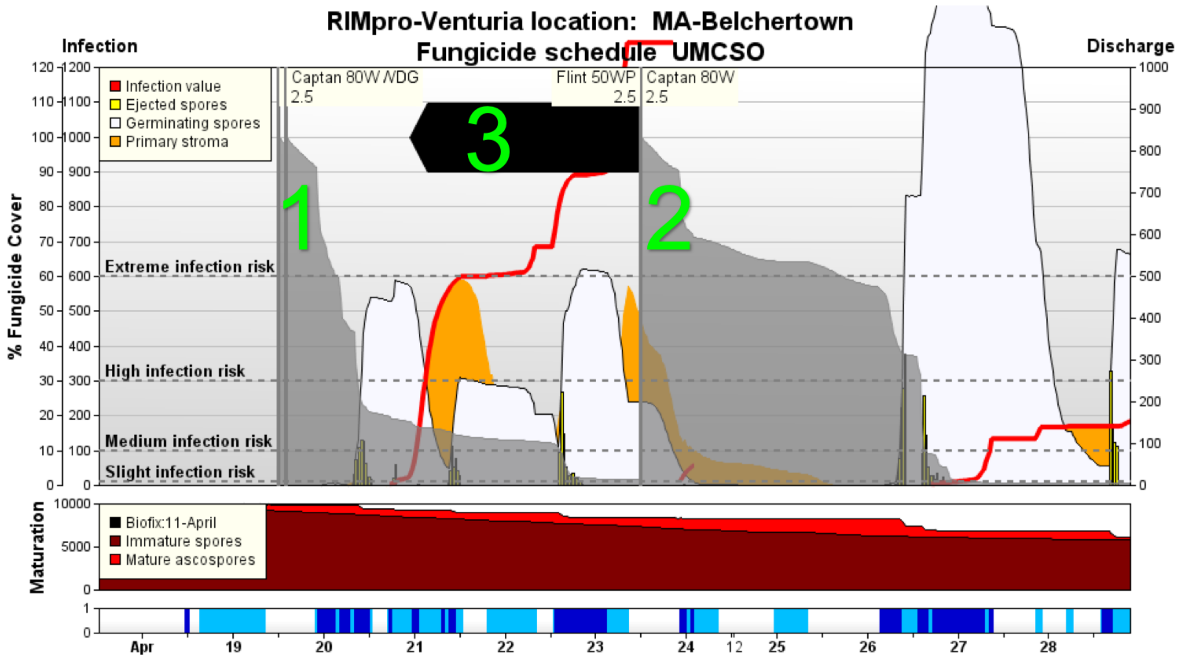
Decision Support Systems

Ag-Radar, created and maintained at the University of Maine is reported to be coming back on line for the 2020 growing season! Ag-Radar has a number of valuable features from a "honey bee foraging activity and potential wet residue exposure" model that shows the best times to make pesticide applications in order to avoid honey bee exposure to everyone's favorite, apple scab infection risk. Virtual, or gridded, weather data is required to run the models contained in Ag-Radar.



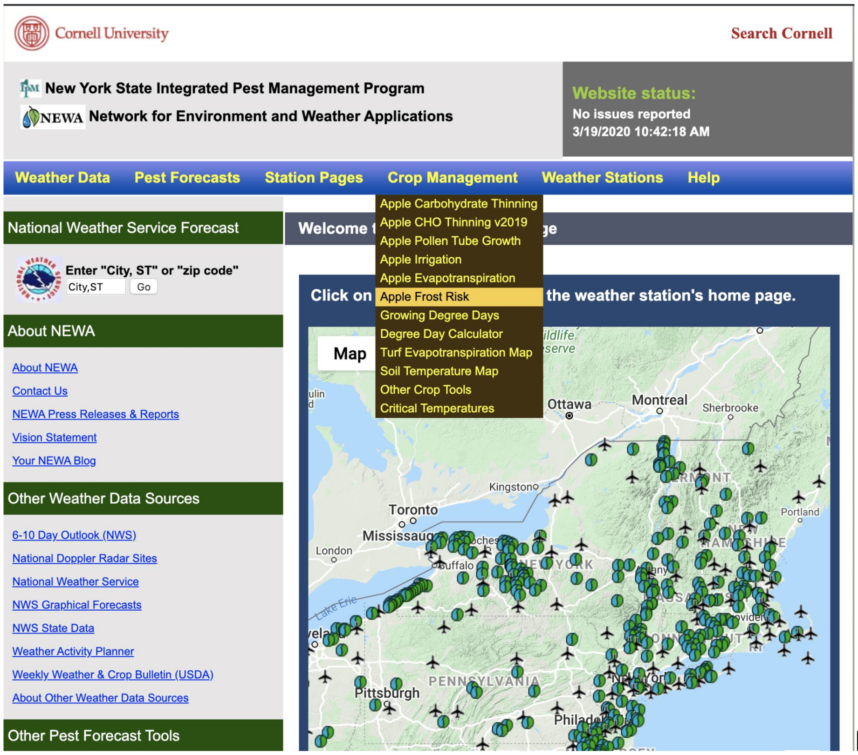
Honey bee foraging activity and potential wet residue exposure as represented in Ag-Radar. Orange bars show when honeybees are most likely to be out foraging. Dotted purple line indicates wind speed. Blue line shows the potential for leaf wetness and residue exposure.

RIMpro is a privately owned DSS created and maintained by Marc Trapman in the Netherlands. This DSS uses either physical weather stations or virtual weather data to run its models. In addition to apple scab and fire blight risk models (and a number of other insect and disease models), RIMpro also has an option for entering spray information which shows coverage and depletion of materials used.



Fungicide application coverage and depletion as represented in RIMpro. 1) shows a protective application (in this case Captan) in gray. Decreasing gray coverage of the spore ejection (small yellow bars) and Relative Infection Measure (RIM, climbing redline) indicates the protective activity of the Captan application was insufficient, requiring a curative material in the next spray. 2) A new fungicide application that included both Captan and Flint. The grey shows protection moving forward into the next forecast infection event. 3) The black arrow shows the curative reach of the Flint application. Based on this information, Flint's curative properties were sufficient to manage the previous infection event that the first Captan alone application did not fully cover.

NEWA. There are currently 28 working weather stations on the Massachusetts NEWA network, plus several airport stations. Each of these can be accessed to view weather information, pest forecasts and horticultural models. One model that may be of great interest right now is the Apple Frost Risk model. This can be accessed from the NEWA homepage and will link to the Northeast Regional Climate Center's Apple Frost Risks Map.



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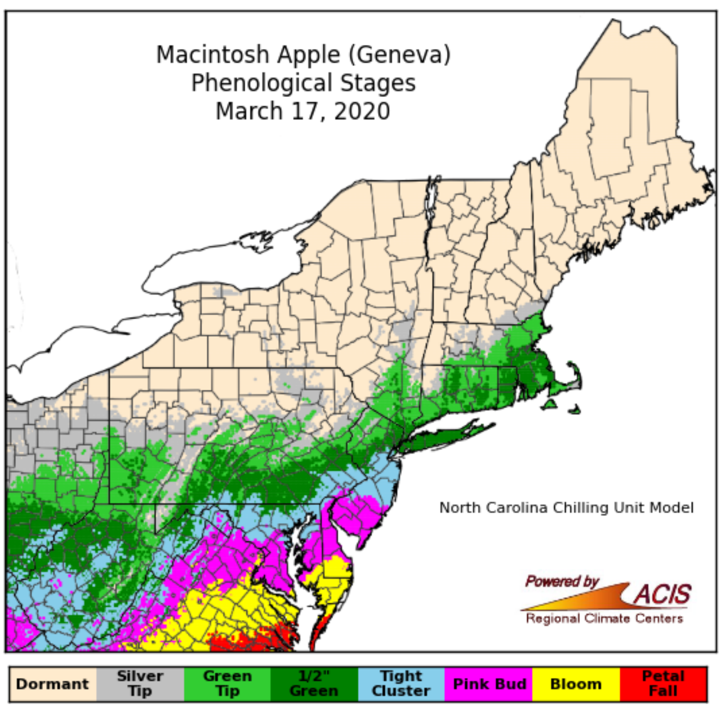
NEWA home page, the Apple Frost Risk link may be found in the "crop management section (highlighted in the above image). Selecting the Apple Frost Risk option will take you to the Northeast Climate Center's Apple Frost Risk page. There are many other useful tools here as well.

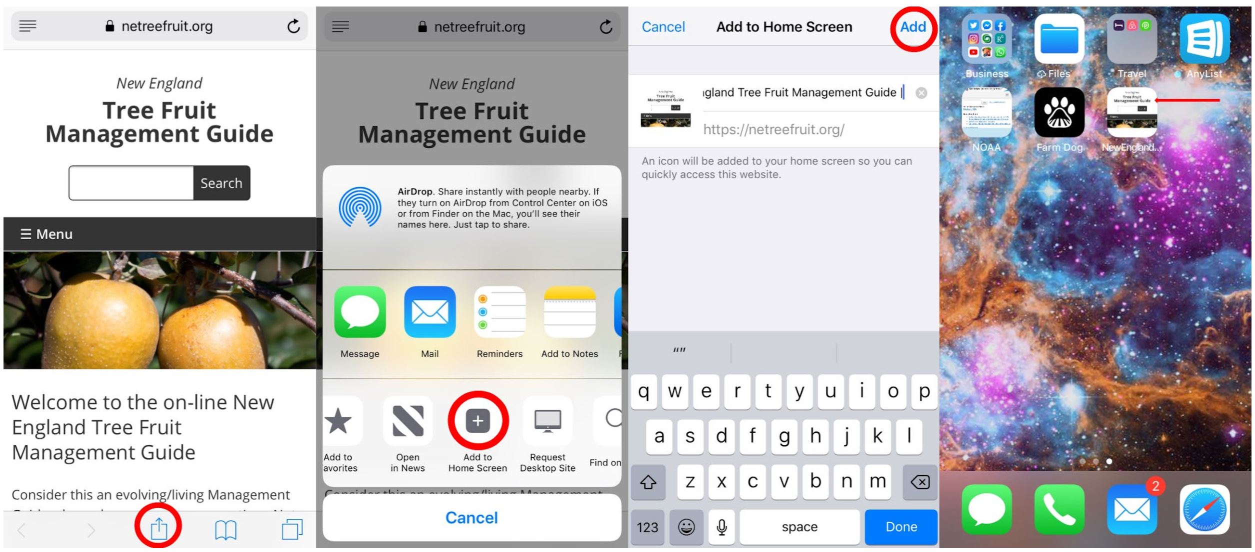


Northeast Climate Center's green tip model currently (as of March 19, 2020) estimates a significant portion of the state to already be at green tip.

Smartphone Apps

New England Tree Fruit Management Guide

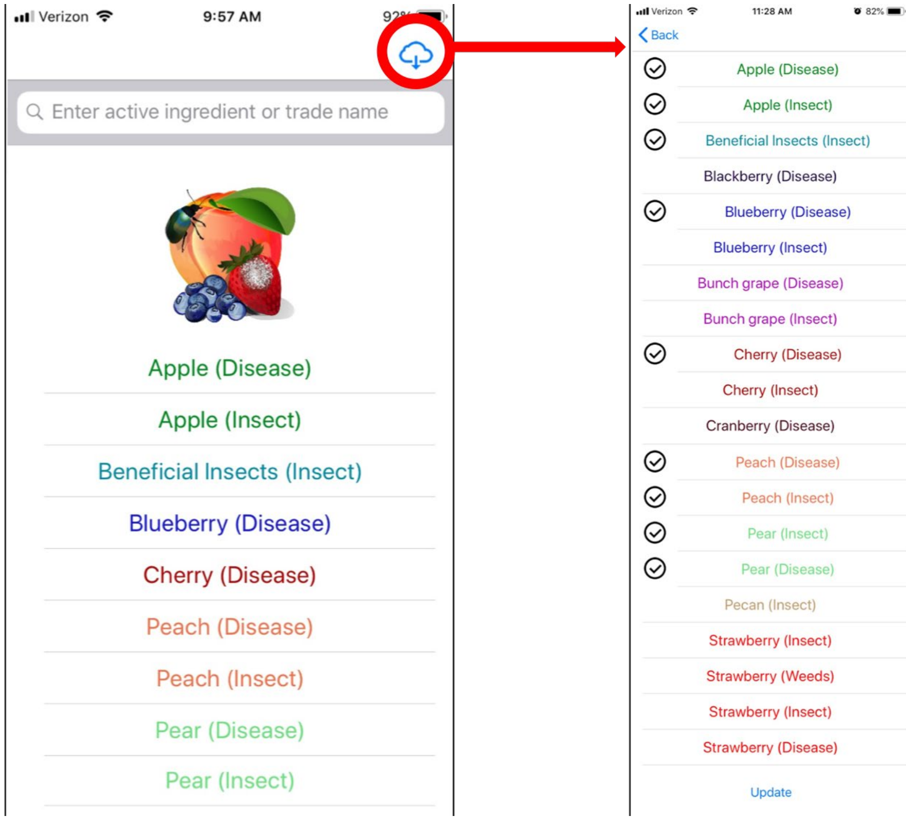
The New England Tree Fruit Management Guide is a "living" document that is updated in real time as new information becomes available. This makes it a more dynamic document of current, timely information than its printed counterpart. Updates made to the Guide online are automatically sent to your device. It is easy to add the NETFMG to your home screen for quick access; (iPhone) go to the web site, at the bottom of your screen, you will see an arrow icon pointing up, tap this, then, tap "add to home screen", you can choose to name the icon or leave it as is then tap "Add", the icon will automatically appear on your home screen, ready to go!



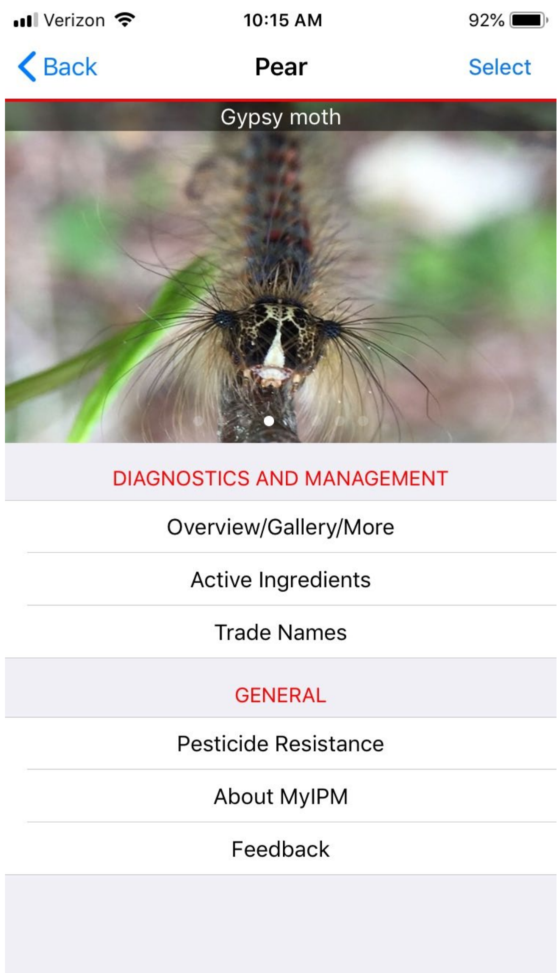
From far left: 1) home screen of mobile friendly New England Tree Fruit Management Guide, "upload" icon circled in red. 2) once "upload" icon has been tapped you will be given a number of options, select the square icon with the + symbol labeled "add to home screen". 3) tap "add in the upper right hand corner of the next screen, you may choose a name or go with the autoselected name provided. 4) a new icon for the guide is dropped onto your home screen. Now you have quick and easy access to the Guide on the go!

MyIPM

MyIPM is an extensive database of fruit crops and the various pests that afflict them. It contains valuable information to aid in identifying pests, beneficial insects as well as life cycle and management details. The app contains: *Apple*; disease and insect, *Beneficial Insects*, *Blackberry*; disease, *Blueberry*; insect and disease, *Bunch grape*; insect and disease, *Cherry*; insect and disease, *Cranberry*;disease, *Peach*; insect and disease, *Pear*; insect and disease, *Pecan*; insect, *Strawberry*; insect, weeds and disease. You do not need to load all these crop/pest combinations (Pecan, for example) onto your device. You may select which crop(s) and associated pests are of interests. Information is updated periodically and pushed to your device at which time you may choose to download the update or not.



MyIPM home screen (left) and crop/pest combination selection screen (right). Tapping the "cloud" icon, accesses the selection page from which you may choose the crop and pest combinations of interest to you.



MyIPM example pest screen where you can find photos and information for life cycle, damage, identification (overview/gallery/more) and materials for management.

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

A note on biopesticides

Given the increased growers' interest in biopesticides, I deemed necessary to provide an overview of what they are, and their use in fruit production.

What are biopesticides? As defined by the EPA, biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, viruses, and certain minerals. For example, canola oil and baking soda have pesticidal applications and are considered biopesticides. Plant growth regulators (PGRs), which exhibit no pesticidal activity but instead can promote, inhibit or modify the physiology of plants, are also regulated by the EPA as biopesticides.

Biopesticides, also known as "Ag. Biologicals", are used to control pests and prevent diseases on crops, with the vast majority falling into bioinsecticide and biofungicide sectors of use. Bionematicides are a small, but rapidly growing sector as a number of new microbial products have been launched recently, providing growers with safer alternatives to harsh conventional chemistry which have typically been used for nematode control.

There are three main types of biopesticides:

(1) Microbial. Products derived from various microscopic organisms. Microbial products may consist of the organisms themselves and/or the metabolites they produce. This category includes fungi (e.g., the fungus *Beauveria bassiana* controls some insect pests), bacteria (e.g., Dipel - *Bacillus thuringiensis*, commonly referred to as "Bt"), protozoa (e.g., the protozoan *Nosema locustae* is formulated as a bait to kill grasshoppers), viruses (e.g., Baculoviruses, a family of naturally-occurring viruses, most of which are so specific in their action that they infect and kill only one or a few species of Lepidoptera larvae such as codling moth, and yeasts (the yeast Candida oleophila Strain O has been developed into an effective biopesticide for the control of post-harvest fruit rots).

***Bacillus thuringiensis* MODE OF ACTION:** Within minutes after ingestion, the spores bind to the gut wall, become crystals, and the caterpillar stops feeding. Within hours, the gut wall breaks down and normal gut bacteria invade the body cavity.

Microbial biopesticides represent the largest product type in the biopesticide market, occupying ca. 70% of the total market.

(2) Biochemical. In general, biochemical biopesticides are characterized by a non-toxic mode of action that may affect the growth and development of a pest, its ability to reproduce, or pest ecology. They also may have an impact on the growth and development of treated plants including their post harvest physiology. There are several different subcategories of products, including Plant Growth Regulators (PGR), Insect Growth Regulators (IGR), Organic Acids, Plant Extracts, Insect Pheromones, and Minerals (e.g., Surround -kaolin clay).

(3) Plant-Incorporated Protectants. Pesticidal substances that plants produce (express) from genetic material that has been added to themplant. In other words: **Transgenic plants** that have been genetically engineered. For example, scientists have taken the gene for the Bt pesticidal protein , and introduced it into the plant's own genetic material. Then, the plant (instead of the bacterium) is able to manufacture the crystal toxin **proteins** that kill the insect pests.

Biopesticides are viewed favorably for IPM because of their safety profile for consumers, farmworkers and the environment. Some of the benefits provided by biopesticides are:

Labor and Harvest Flexibility: Most biopesticides have short worker Restricted Entry Intervals (REIs), allowing workers to safely return to the fields with minimum delay after treatment. In addition, biopesticides with short Pre-Harvest Intervals (PHIs) allow harvest and shipping schedules to be better maintained after required pesticide applications.

IPM Compatibility: Biopesticides are considered among the best low-risk and most highly effective tools for achieving crop protection in IPM systems. For example, biopesticides are compatible with biological control because they target specific pests without disrupting the beneficial components of an agroecosystem.

Resistance Management: Biopesticides typically have modes of action that are unique from synthetic pesticides and do not rely on a single target site for efficacy. They have long been used in combination with synthetic chemistries to provide the basis for excellent control programs that effectively manage resistance.

Environmental Safety: Overall, biopesticides have very limited toxicity to birds, fish, bees and other wildlife. They help to maintain beneficial insect populations, break down quickly in the environment, and may serve to reduce conventional pesticide applications through their effective use in resistance management programs.

Residue Management: Most biopesticides are exempt from residue limits on fresh and processed foods around the world. Whether used alone or in combination with reduced rates of traditional chemistries, biopesticide use reduces consumer exposure to regulated chemical residues

IR-4 Biopesticide and Organic Database for Integrated Pest Management

This database allows users to perform a targeted search by selecting specific crops, growing regions, and pests that relate to the user's particular need. Search results include registered active ingredients, trade names, labels, EPA registration numbers, suppliers, worker reentry and pre-harvest intervals for each query: http://ir4app.rutgers.edu/biopestPub/labelDb.aspx.

For example, when I searched for biopesticides labeled for Oriental Fruit Moth, on apple, in Massachusetts, the following information was produced:

The IR-4 Project

Need Request Form || Need Request || Funded Projects || Label Database Grant Funded

Biopesticides Label Database Search

Back | Download Report in Excel

Records counts: 15 Sort records by clicking on the header of the column.

Trade Name	Label (pdf)	EPA Registration Number	Company Name	Company Contact	Company Website
AzaGuard Botanical Insecticide/Nematicide		70299-17	BioSafe Systems	Vijay Choppakatla 8602908890 x221 vijayc@biosafesystems.com	http://www.biosafesystems.com/
Azera Insecticide		1021-1872	MGK	Steven Klaysmat 800-645-6466 steve.klaysmat@mgk.com	http://mgk.com/
CheckMate OFM Dispenser		56336-36	Suterra, LLC	(541) 388-3688	http://suterra.com/
CheckMate OFM-F		56336-24	Suterra, LLC	(541) 388-3688	http://suterra.com/
CheckMate OFM-SL+		56336-50	Suterra, LLC	(541) 388-3688	http://suterra.com/
CheckMate Puffer CM-OFM Pro		73479-14	Suterra, LLC	(541) 388-3688	http://suterra.com/
CheckMate Puffer OFM-O		73479-10	Suterra, LLC	(541) 388-3688	http://suterra.com/
Condor Wettable Powder		70051-80	Certis USA	Brett Highland 941-484-4523 bhighland@certisusa.com	http://certisusa.com/
Crymax Bioinsecticide		70051-86	Certis USA	Brett Highland 941-484-4523 bhighland@certisusa.com	http://certisusa.com/
Isomate-CM/OFM TT		53575-30	Pacific Biocontrol Corporation	Don Thomson dthomson@pacificbiocontrol.co	http://www.pacificbiocontrol.com/Pacific_Biocontrol_Corporation/Home.html
Isomate-M Rosso		53575-26	Pacific Biocontrol Corporation	Don Thomson dthomson@pacificbiocontrol.co	http://www.pacificbiocontrol.com/Pacific_Biocontrol_Corporation/Home.html
Isomate-OFM TT		53575-29	Pacific Biocontrol Corporation	Don Thomson dthomson@pacificbiocontrol.co	http://www.pacificbiocontrol.com/Pacific_Biocontrol_Corporation/Home.html
Javelin WG Biological Insecticide		70051-66	Certis USA	Brett Highland 941-484-4523 bhighland@certisusa.com	http://certisusa.com/
Lepinox WDG Bioinsecticide		70051-89	Certis USA	Brett Highland 941-484-4523 bhighland@certisusa.com	http://certisusa.com/
Sympatico		73049-502	Valent U.S.A. LLC	Jeff Smith 678-364-0258 jeffrey.smith@valent.com	http://www.valentbiosciences.com/

Additional information (not shown) includes PHI, REI, and efficacy data.

Some of the **barriers to adoption** that have been identified include their high selectivity, short shelf life, effective within narrow range of conditions, quick degradation with heat and UV light (for example, pyrethrins, the insecticidal molecules in pyrethrum, are rapidly decomposed by water, light, and mildly acidic or alkaline pH). Microbial insecticides are usually very susceptible to ultraviolet light and degrade quite rapidly when exposed to sunlight.

Most biological pesticides are allowed in organic crop production and are OMRI (Organic Materials Research Institute) listed. However, somewhere between 95-97% of biopesticides usage is in conventional cropping systems.

IPM Around the World (J. Piñero)

2020 apple and pear crop forecast for Europe and China

Apple production in the European Union is slated to drop nearly 25 percent to 11.5 million tons as the majority of Member States, especially Poland, experienced a combination of frost, drought, heat, and hail. This will mark the second time in 3 years that weather-induced losses will lower production more than 20 percent. With reduced output, exports are forecast down 200,000 tons to 975,000, the second lowest level since 2007/08. Imports are expected to remain nearly unchanged at 500,000 tons as a smaller share of domestic output goes towards processing and greater supplies are diverted to fresh consumption. The pear crop is predicted at 2 million tons, a decrease of 14 % compared to 2018. The overall low figure is mainly due to a decrease in estimation of Italian pears which caused the overall forecast to be the second lowest of the decade. The drop was mainly the result of low blossoming, influenced by the high crop, heat of last season and rain. Nevertheless, comparisons with previous years need to be handled with much caution, given last two years' exceptional variation.

China's apple production is forecast to rebound 8.0 million tons to 41.0 million, regaining all of last year's lost output from severe weather. Nearly all major growing provinces experienced favorable growing conditions throughout fruit development, and higher supplies are expected to boost exports up 230,000 tons to over 1.0 million. Though domestic supplies are higher, quality is reported as only fair, increasing import demand for higher quality apples to a record 100,000 tons.

Source: https://www.fruit-processing.com; https://apps.fas.usda.gov/psdonline/circulars/fruit.pdf

Monitoring resistance of codling moth field populations to new chemical insecticides in Spain

In Spain, researchers assessed the efficacy of new versus old insecticides against codling moth. In their bioassays, they used 10 different active ingredients on twenty field populations of codling moth. Very high resistance ratios were detected for methoxyfenozide and lambda-cyhalothrin, while 50% of the populations were resistant or tolerant to thiacloprid. Tebufenozide showed very good efficacy in all the field trials. Even though codling moth showed resistance to chlorpyrifos-ethyl because of its widespread use, in this trial it was effective against codling moth populations. All other insecticides (indoxacarb, spinosad, chlorantraniliprole, emamectin, and spinetoram) provided high efficacy. These results showed that resistant CM populations in Spain can be controlled using new reduced-risk insecticides

The full article is accessible here: https://www.mdpi.com/2075-4450/11/1/38/htm.

Impact of Exclusion Netting Row Covers on 'Honeycrisp' Apple Trees Grown under Northeastern North American Conditions: Effects on Photosynthesis and Fruit Quality.

Nets are commonly used as an anti-hail device in tree fruit production. Considering the various advantages they can provide to the grower (bird, insect, disease and mammal control and protection against hail, wind, frost and sunburn), they are also referred to as “multitask nets”. Researchers evaluated a complete exclusion system—in which the soil is also excluded—to grow ‘Honeycrisp’ apples for six years in southern Quebec, Canada. Abiotic conditions, as well as plant photosynthesis and fruit quality characteristics (color, firmness, size, sugar content, number of seeds, ripeness and skin integrity) and yield were estimated yearly and compared in netted (either with or without a rainproof top) and unnetted row units. Although annual variations were high and results showed little or no difference between netted and unnetted rows for all measured variables, with the following exceptions; color (increased red surface on fruits from unnetted rows some years), size (fruits from unnetted rows were smaller) and maturity (fruits from unnetted rows matured slightly faster). Fruits produced under nets had fewer microcracks at the surface than fruits produced without nets. Reduced cracking possibly helped decrease sooty blotch and flyspeck incidence and severity. These findings pave the way for using this exclusion system as an effective alternative, or addition, to IPM programs for orchards.

The full article is accessible here: https://www.mdpi.com/2075-4450/10/7/214.

Perennial flower strips for pest control in organic apple orchards - A pan-European study

In many crops, the intensive use of pesticides causes major problems both for the environment and for natural ecosystem services. Apple is Europe's most frequently produced orchard fruit, requiring high pesticide input to combat the most important apple insect pests, Rosy apple aphid, *Dysaphis plantaginea* and codling moth, *Cydia pomonella*. The researchers sought to control these pests by promoting natural enemies using sown perennial flower strips in the alleyways of organic apple orchards in seven European countries. Visual assessments over two years revealed a higher number of natural enemies on plant parts, and specifically in Rosy apple aphid colonies on trees, in flower strip plots than on trees in control plots with standard orchard vegetation. Trees in the flower strip plots recorded a slower rosy apple aphid population increase as compared with control plots, resulting in reduced fruit damage after the second fruit drop. Likewise, from 2016-2017, the number of pre-adult codling moths decreased more in the flower strip plots as compared to the control plots resulting in reduced fruit damage. The study shows on a wide continental scale that the implementation of perennial flower strips in the alleyways between apple tree rows boosts natural enemies and reduces key apple pests and the associated fruit damage. This supports the role of functional agrobiodiversity as a way to potentially reduce insecticide use in orchards and thus further promote conservation of agrobiodiversity. The authors also provide suggested plant composition for flower strips adapted to different European countries and recommendations for implementation and management in practice.

The full article can be accessed here.