30th Annual March Message

To Massachusetts Tree Fruit Growers (2022)

UMass Extension

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Introduction

We are pleased to bring you the 30th edition of the March Message. During 2021, the Extension fruit team continued to adjust its programming largely for online delivery although we were able to conduct more research and farm visits than in 2020. We very much look forward to working with you during the 2022 fruit-growing season!

Publications, videos, and other IPM resources

Important educational resources produced by the UMass fruit team, by other Universities in New England, and by Cornell University are presented below.

- **UMass** IPM Fact Sheets

- **Healthy Fruit** is a timely newsletter that includes information on tree-fruit horticulture, pest management, and related topics. The primary reader is the commercial grower, but anyone growing fruit trees will benefit. Healthy Fruit is published weekly or biweekly from April through September and periodically throughout the rest of the year.

  The cost for a subscription to Healthy Fruit is $65 per year for the email version (available for purchase at the UMass Extension Bookstore or download the 2022 Fruit Publications Order Form and mail it in with your payment).
- **UMass IPM Fruit Loop Podcast.** Another way to get information presented in the Healthy Fruit Newsletter. Freely accessible HERE.
- **UMass Extension Fruit Team YouTube Channel**.
- **Fruit Notes** is distributed to growers and researchers in 35 states in the U.S. and 14 other countries. Most reports are from current research at the University of Massachusetts and other universities. Electronic versions are available for purchase at the UMass Extension Bookstore. or download the 2022 Fruit Publications Order Form and mail it in with your payment. 4 issues per year. Cost: $25 (electronic copy only).
  - New England Tree Fruit Management Guide. Available HERE
  - New England Small Fruit Management Guide. Available HERE
  - University of Vermont Extension - Tree Fruit production. Available HERE
  - University of Rhode Island IPM program. Available HERE

Plant growth regulator updates

Duane Greene and Jon Clements

ACCEDE

Accede (Valent Biosciences) is a new chemical thinner that has received full label clearance in Massachusetts, however, availability will likely be limited in 2022. The active ingredient of Accede is ACC, a naturally occurring compound that is found in all plants and is classified as a biochemical by the EPA. It is the last step in the biosynthetic pathway for ethylene production. ACC is converted to ethylene by the enzyme ACC oxidase. There is an ample amount of this enzyme in the plant to convert any ACC to ethylene. Therefore, the rate-limiting step in ethylene production is the amount of ACC available and this may now be supplied to the tree by spray application. Both ethephon and ACC application results in ethylene production although by different mechanisms. When ethephon is sprayed on a plant it is absorbed and moved to the cytoplasm where it is broken down by a chemical reaction caused by high pH in the cytoplasm. ACC is safer to use when applied at high temperatures because there appears to be no large spike in ethylene production because of elevated temperature as happens with ethephon.

One thinning characteristic that separates Accede from other thinners available today is that it appears to thin preferentially at the 16 to 20 mm. fruit size, a thinning window where other thinners are far less effective. Undoubtedly, this is the fruit size range where Accede should be used most frequently. Accede can thin at smaller fruit sizes, 7-12 mm., but it is not as effective then. The concentration range that ACC is to be used is 200 to 400 ppm, which equates to 23 to 46 fl. oz. of Accede per 100 gallons per acre. Accede may cause some phytotoxicity, as seen in leaf yellowing and leaf drop. The severity of this varies from year to year and some cultivars are more sensitive than others. Often no phytotoxicity is seen. When it occurs, leaf yellowing and drop is generally restricted to the smallest 1 to 3 leaves in a spur. These represent a very small percent of the total leaf area of a spur. Any effect on the tree should be minimal. Phytotoxicity is more pronounced when applied at the higher concentration and at the 7-12 mm fruit size. There appears to be no direct phytotoxic effect on fruit at harvest (russeting) that can be attributed to its application during the thinning season.

An Experimental Use Permit (EUP) allowed for Accede application in several Massachusetts orchards in 2021. Many varieties were treated at a rate ranging from 300 to 400 ppm. Some phytotoxicity was observed on Golden Delicious type apples (including Gala) and good additional thinning was observed on those varieties when applied at 20 mm. fruit size. McIntosh type apples generally thinned very little with Accede application in 2021 although ACC has thinned McIntosh successfully in previous experiments. Honeycrisp seemed somewhat intermediate in sensitivity to Accede. Note that all the orchards had one or more previous chemical thinner applications prior to the Accede. Blocks that needed further thinning at 15-20 mm. were selected for Accede application. Best results will likely be seen when Accede is applied during a period of modest carbohydrate deficit.

Accede also has full label clearance for thinning peaches in Massachusetts. This is the first compound registered to thin peaches in Massachusetts. The goal of Accede application is to thin peaches to reduce hand thinning, but not eliminate it. The suggested times of application are at pink and/or at petal fall. (Post-petal fall application is not allowed.) The suggested rates to use are 300 to 600 ppm, equivalent to 34.5 to 69 fl. oz. of Accede per 100 gallons per acre. The advantage of using Accede in addition to reduction in hand thinning is that it can increase fruit size. By the time hand thinning is usually started when fruit are about one inch, some reduction in fruit size has already occurred. Starting thinning nearer bloom reduces competition among fruit early, thus allowing the remaining fruit to grow larger. But keep in mind early thinning and larger fruit may result in earlier maturity and thus harvest date.

ARRANGE

Fine Americas Inc. received full label clearance for use on apples to inhibit flower bud formation. (In Massachusetts at least, not sure about the other New England states?) This is a new and unique tool to help moderate biennial bearing in apples. Traditionally, chemical thinners are used to reduce crop load in the “on” year thus leaving some spurs with no fruit encouraging these barren spurs to initiate flower buds for a crop the following year. Up until now we have not had a tool that we could use to help regulate flowering in the “off” year. The active ingredient in Arrange is Gibberellins (primarily GA7) which is a naturally occurring hormone produced by seeds in the developing fruit. GA7 diffuses from the developing fruit and inhibits flower bud formation in the bourse bud on that spur. The goal of Arrange application is to reduce flower bud formation on a tree in the “off” year by about 30%. Hence, expect less return bloom by about 30% in the “on” year. It appears to work best on less biennial varieties and on younger trees. Results on very biennial varieties, such as Fuji, have been variable. It appears to be more successful when used on younger trees. The timing of application of Arrange is generally from petal fall to about the 10 mm. fruit size stage. It may be applied in one spray of 100 ppm (128 fl. oz/100 gal/acre) or split and made in two to four applications of 25 to 50 ppm (32 to 64 fl. oz/100 gal/acre) as long as the total amount applied does not exceed 128 fl. oz/100 gal/acre per growing season. There appears to be no effect of Arrange on fruit quality the year of application. We have little direct experience with Arrange, but it’s worth trying if the bloom is light or “off” this year to reduce the amount of flowering next year when it’s “on.”

APOGEE/KUDOS

Pro-Ca to aid in the control of fire blight

Prohexadione-calcium (Pro-Ca) is the most important and effective plant growth regulator available to control vegetative growth in apples. Apogee (BASF) and kudos (Fine Americas) are the formulated Pro-Ca products available to us. In addition to the specific objective of growth control, Pro-Ca can be used to aid in the control of shoot fire blight. It does not have any direct inhibitory effect on the fire blight bacteria, however, it exerts its inhibitory effect by creating a physical impediment to invasion by the bacteria.

Pro-Ca slows shoot growth early thus thickening the cells in the new shoots making the shoot more impervious to the entrance of the fire blight bacteria. The inhibition of fire blight begins with the initiation of growth retardation 10 to 14 days after application. If Pro-Ca is applied at pink*, fire blight inhibition can be expected to be initiated at about petal fall. Dr. George Sundin at Michigan State University recommends the inclusion of 1 oz/acre Actigard™ with the Pro-Ca to improve fire blight control. His recommendation is to make the Pro-Ca application of 6 oz/100 gal. at the label-suggested timing of when shoots are 1.5 to 3 inches in length. Included in that the Pro-CA spray would be 1 oz/acre of Actigard™ which should be reapplied at 7-8 day intervals. This is necessary to maintain the Actigard™ induction. A total of 3-4 follow up applications of Actigard™ are recommended for shoot blight management. Note that Pro-Ca is NOT a substitute for applying streptomycin at bloom when fire blight infection risk is high! A complete fire blight management program is still necessary.

Pro-Ca Use on Young Trees

Once planted, the goal of fruit growers is to encourage rapid growth of young trees so that trees can fill their allotted space rapidly. But for the first 3 to 4 years after planting young trees are very susceptible to fire blight infection. Since trees are small, it takes very little time for the bacteria to move from the site of infection to the central leader of the tree. If this happens, it is quite likely that the tree will be killed. Therefore, using Pro-Ca to help control shoot blight will require a compromise between fire blight control and growth. A practical solution to this dilemma suggested by Dr. Sundin is to make an application at petal fall using 2 oz/100 gal of ProCa plus 1 oz/acre of Actigard™. The Actigard™ application should be repeated every 7-8 days until the danger of fire blight has passed. Because a low rate of Pro-Ca is used, the inhibitory effect should wear off relatively early, allowing the apple tree to resume growth for the remainder of the summer.

We have updated our Fact Sheet on Pro-Ca from which the above is excerpted. For more information, the updated fact sheet can be found here.

* Pink application of kudos is specifically indicated on the kudos label, however, use of Apogee at pink requires having the supplemental label for use at that timing in hand. Always follow the label directions when using Pro-Ca.

A review of thinning last year and thinning this spring

In general, there was a good return bloom last year. This created a thinning challenge since the weather was not particularly conducive to good and effective thinning. Bloom was quite cool and windy and marginal for good pollination. Still, the fruit set was good and there appeared to be a full complement of seeds in the fruit. Weather during the petal fall period was favorable for thinning. After petal fall and during early fruit development the weather was cool and the carbon balance remained positive, making thinning during this time a challenge. It was not until the fruit had grown to 19 to 20 mm. some favorable thinning weather returned (Fig. 1). Except for Accede, other thinners are less effective when used in the 20 mm. size range. At the end of June drop, many trees carried too many apples. Return bloom this year will reflect just how successful or unsuccessful growers were at thinning. For most of the summer there was adequate rain, so fruit did size well, even if some trees carried too many apples.

We have experienced a wide range of weather conditions which often deviate from normal. Since successful thinning is dependent on favorable weather following thinner application, we suggest that starting at bloom, take advantage of favorable weather, regardless of when it occurs. Over-thinning rarely occurs when thinners are applied at either bloom or petal fall or at both times. It is relatively safe to thin aggressively at these times. An NAA (Fruitone, PoMaxa, refine) application at 10 ppm (4 oz./100 gallons dilute TRV), once or twice during the bloom to petal fall period is highly recommended, especially to Honeycrisp where it gets the thinning process started early and (anecdotally) has shown to even out cropping from year to year.

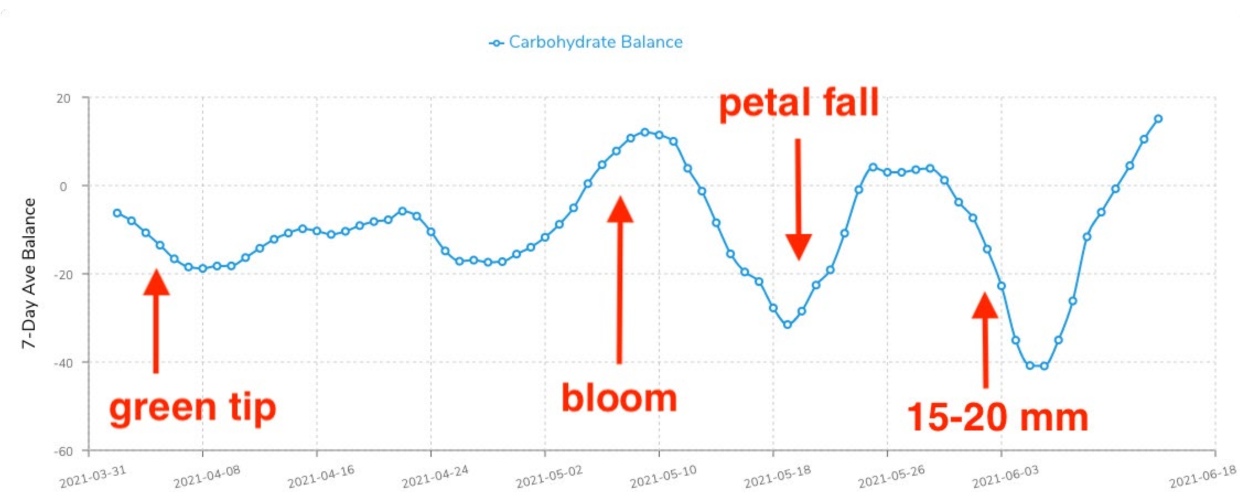


Fig. 1 - 2021 carbohydrate balance from NEWA at the UMass Orchard, Belchertown, MA

Massachusetts Pests Overview

Diseases (Elizabeth Garofalo)

Bitter Rot

Across MA, reports of bitter rot varied in severity but few orchards appear to have escaped infection entirely. The earliest report of symptoms (that I am aware of) came in on July 28, and included a photo of advanced lesion development, indicating the infection initiated even sooner than the date of the report. As one person noted "I have never seen bitter rot this early". In fact, none of us here in Massachusetts are accustomed to seeing or even having to think about bitter rot so early in the growing season. Bitter rot is thinking about us though. Let 2022 be the year we get bitter rot (BR), before it gets us.

The pathogen(s):

BR is caused by two different fungal species complexes: *Colletotrichum gloeosporioides* and *Colletotrichum acutatum*. In more southerly locations *C. gloeosporioides* has been well documented as the fungal complex that causes the disease bitter rot on apple fruit and glomerella leaf spot on apple foliage. In the north, however, it is commonly accepted that *C. acutatum* is the fungal complex responsible for causing bitter rot on apple fruit. There are currently 31 different species within the *Colletotrichum* genus that have been classified in the *C. acutatum* complex. Not all 31 of these fungi are known to cause disease in apple. The species *C. fioriniae,* one of the 31 fungi in the *C. acutatum* complex, is known to cause bitter rot on apple fruit in the Northeast. There have also been a number of studies showing *C. fioriniae* as one of the primary bitter rot pathogens in many European countries and New Zealand. This pathogen is a multi-host leaf endophyte and has been identified as a pathogen which can infect insects as well. As such, it has the potential to infect apple from sources outside of the orchard as well as within and can live on apple leaves without expressing symptoms. In essence, *C. fioriniae* can just kinda hang out in leaves not bothering anyone until the spores get dispersed to fruit where they can infect and cause disease under conducive environmental conditions.

Climatic conditions conducive to BR development:

The temperature optima differ between *C. gloeosporioides* and *C. acutatum* complexes. *C. gloeosporioides* likes it hot, at least relatively hotter than *C. acutatum.* The further south you go, temperatures are typically higher on average, relatively speaking, than we experience here in New England. We would expect to see pathogens that prefer those warmer conditions further south.

Research has shown, at 59˚F, using detached royal gala fruit, under lab conditions, lesions developed within seven days after spores were applied to the fruit. Additionally, wound inoculated fruit on the tree developed disease at a base of 59℉. This shows that, given the presence of an open wound, bitter rot can develop at temperatures as low as 59℉. There has to be some level of moisture present in the field to cause infection on sound fruit. It should be noted, however, BR *does not* require an open wound to cause infection. Further studies have shown that a minimum of twelve hours of leaf wetness is necessary to induce infection. So, we can estimate at this point that 59˚F + and about 12 hours of leaf wetness can lead to infection. Given the above research into the climatic conditions leading to bitter rot as a result of *C. fioriniae* infection, the following table shows three distinct potential infection events much earlier in the growing seasons than we historically expect them to occur.

2021 "Early Season" Bitter Rot Infection Dates- Belchertown, MA		
Date	**Temperature**	**Leaf Wetness (duration)**
5/26-5/27	61 F-71 F	13 hours
6/3-6/4	63 F-65 F	10 hours
6/8-6/9	69 F-71 F	17 hours

Note, this is not a complete list of possible bitter rot infection dates, just the first likely infection events of the season.

One challenge associated with these earlier than expected infection events is, at this time of the season, we are typically still thinking about scab, summer diseases in general, and BR specifically, are not yet on our minds. This means of course that the fungicides in use may not be the ones most effective against BR, throwing a wrench in protective covers which are imperative for BR management as there are no "kick back" solutions for this disease. A further nasty trick that bitter rot likes to play is "quiescent infection". Conditions may be present that lead to *infection*, however, if these conditions do not persist, disease- i.e., lesion- development may be delayed such that when symptoms do manifest, it is very difficult to pinpoint just when they were initiated. And, of course, as these lesions grow, they produce more spores, spreading to other fruits and neighboring trees.

Managing Bitter Rot

Sanitation within the orchard can help reduce inoculum, and thus infection potential. In blocks with a history of relatively high incidence of BR, especially in high value blocks like Honeycrisp, which is also highly susceptible to BR, mummies should be removed as best as possible during dormant pruning activities. Given the broad host range of the pathogen, however, this may not be an economical practice in blocks with relatively low historical incidence or cultivars with some resistance or tolerance to the pathogen.

Host Resistance is an important strategy in reducing BR incidence in your orchard. While replacing highly susceptible varieties with less susceptible and resistant varieties is clearly not practical, knowing which varieties are susceptible will help you prioritize which blocks to watch for bitter rot development and which to focus your protective spray applications on. The following table gives a list of cultivars and their relative susceptibility to BR.

Apple Cultivar	**Susceptibility Rating**	**Apple Cultivar**	**Susceptibility Rating**
Arkansas Black	HS	Ginger Gold	S
Fuji	HS	Honeycrisp*	S
Golden Delicious	HS	Jonagold	S
Granny Smith	HS	Jonathan	S
Idared	HS	Northern Spy	S
Nittany	HS	Stayman	S
NW Greening	HS	Delicious	MR
RI Greening	HS	Jerseymac	MR
Smokehouse	HS	Maiden Blush	MR
Yellow Newton	HS	Rome Beauty	MR
Braeburn	S	Winesap	MR
Gala	S	Yellow Transparent	MR
Grimes Golden	S	York Imperial	MR

Data compiled by K. S. Yoder and A. R. Biggs

HS = highly susceptible. *Control always needed where disease is prevalent. These cultivars should receive first priority when control is required.*

S = susceptible. *Control usually needed where disease is prevalent.*

MR = moderately resistant. *Specific control needed under high disease pressure.*
*Susceptibility reports vary with Honeycrisp, all agree, however, that it *is* susceptible and highly so under some conditions.

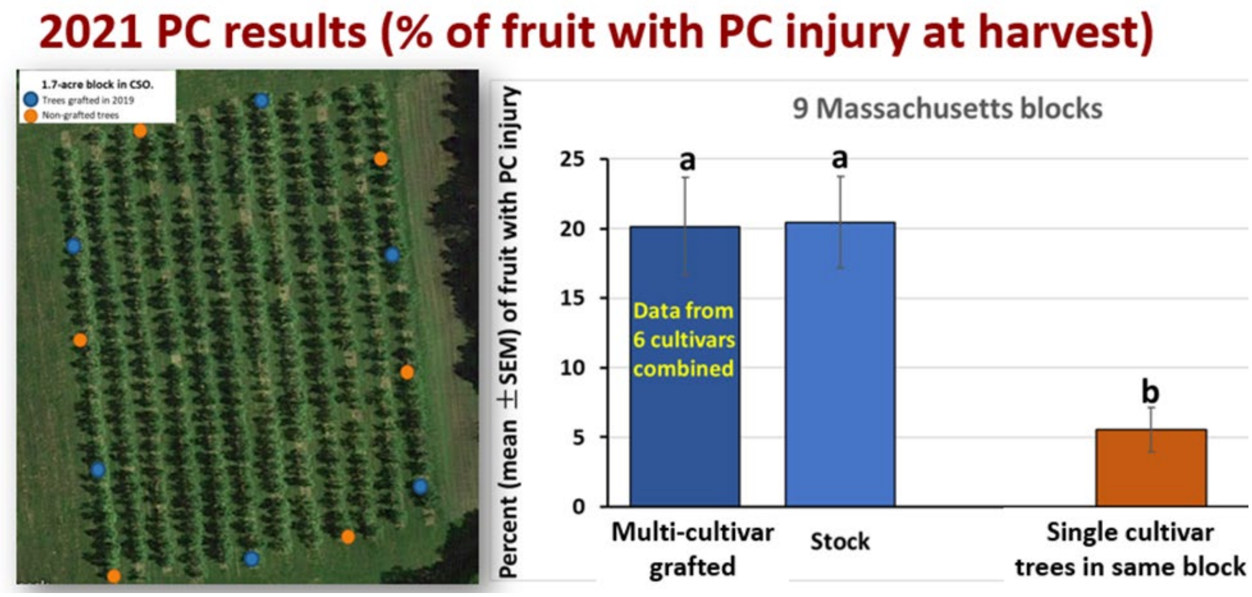
Fungicides listed as *highly effective* against the bitter rot pathogen include: (FRAC M3, 77 day PHI) Polyram, Manzate, Dithane, and other mancozeb formulations. (FRAC 7&11, not to exceed 4 applications per season) Merivon **OR** Luna Sensation **OR** Pristine. In blocks with a history of high incidence of bitter rot and or highly susceptible varieties, preventative fungicide applications should be made in advance of forecast rain events as early in the season as bloom time, if temperature and wetness duration requirements are met.

Fungicides listed as *moderately effective* include: (FRAC M4, maximum application rates vary by formulation, check the label) Captan, (FRAC 11, do not use in rotation with above mentioned, or any other, FRAC 7&11 materials) Flint and Sovran. Efficacy of these materials can be increased by adding prophyte. In low pressure blocks, or those with less susceptible cultivars, Captan + Prophyte in earlier season spray programs may be sufficient to prevent early infection where inoculum has not yet built up in the orchard. (FRAC F6) LifeGard is an organic material that can be used to increase plant host resistance to the pathogen. It is recommended this be used in conjunction with a fungicide application program as the organism *Bacillus mycoides* has no direct effect on the pathogen itself.

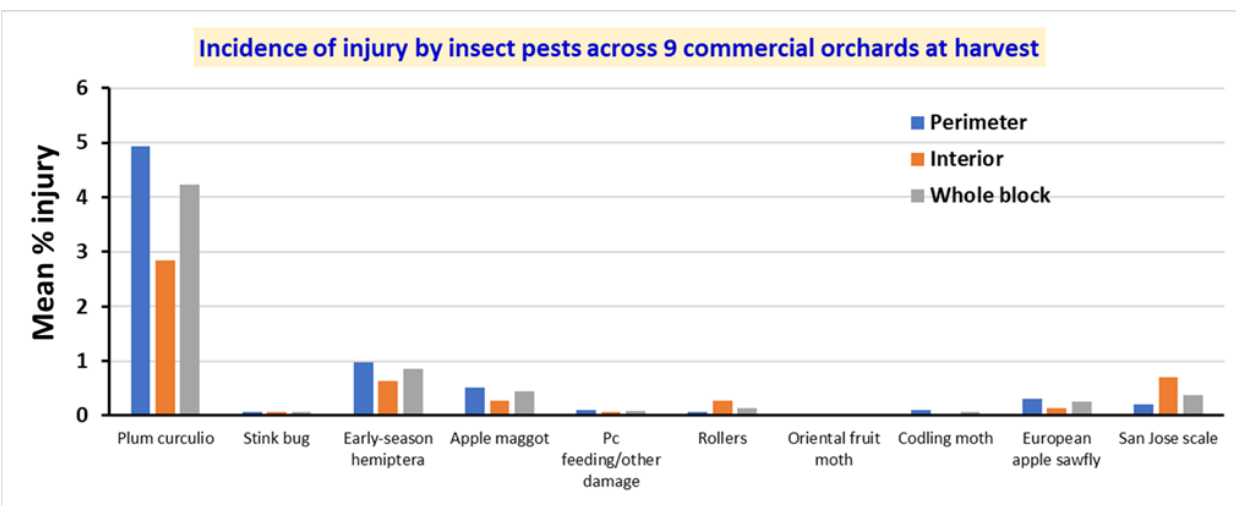
Insects (J. Piñero).

Grafting project update. In 2018, we initiated a long-term project aimed at assessing whether or not we can exploit natural sources of plant odor (provided by various cultivars that are very attractive to plum curculio [PC] and apple maggot fly [AMF]) to develop **permanent** monitoring and potentially killing sites (trap crops) for these two and other pests. The novel concept of multi-cultivar grafting for pest management is considered to be simple (i.e., grower-friendly) and inexpensive. If this new IPM approach proves to be effective, then permanent monitoring sites could be developed and farm inputs might be reduced in support of sustainable agriculture. Since 2019, over 100 trees in Massachusetts, New Hampshire, and Maine have been grafted in 14 commercial orchards. Each grafted tree received 6 cultivars (Yellow Transparent, Ginger Gold, Red Astrachan, Liberty, Wickson, and Dabinett) reported to be attractive to PC and AMF.

In 2021 we collected research data from 9 blocks in MA that have selected perimeter-row trees grafted with 6 different cultivars. The target pests in 2021 were PC and AMF because populations of tarnished plant bug and European sawfly were too low for us to get meaningful data. PC results were better than expected. The average level of fruit injury recorded on grafted branches (all six cultivars combined) was at least four times the level of injury recorded in trees that did not receive new grafting (referred to in the figure below as 'single cultivar trees in the same block'. Interestingly, stock fruit (i.e., fruit sampled from non-grafted branches in grafted trees) also received high levels of PC injury, indicating that fruit in the entire canopy of trees that receive multiple cultivars gets highly infested by PC. Results with AMF were also highly encouraging: more than twice as many AMF were captured in unbaited red sticky spheres deployed in multi-cultivar grafted trees than in similar spheres deployed in trees with single cultivar (i.e., original cultivar grown for market) in the same block. Results will be presented in more detail in a future article of *Fruit Notes.*



Levels of fruit injury by insect pests recorded at harvest. In 2021, most insect pests caused relatively low levels of fruit injury in commercial orchards. As shown in the figure below, the levels of fruit injury recorded at the harvest surveys were well below 1%. The only exception was the dreaded plum curculio (PC), which caused substantial damage in at least 3 orchards.



Coleoptera

Plum Curculio (PC). In 2021, two orchards experienced > 10% fruit injury (based on harvest survey results) in perimeter-row trees, and one orchard experienced 11.4% injury across the entire block. Across 9 commercial orchards, PC infestation levels averaged 4.9% in perimeter-row trees and 2.8% in interior trees. The average whole-block infestation levels by PC in 9 commercial orchards was 4.2%, which is an unacceptable level of injury.

In terms of performance of insecticides for PC control,, in 2021 we compared the effectiveness of the insecticides Verdepryn (active ingredient: Cyclaniliprole, IRAC group 28) and Avaunt (active ingredient: Indoxacarb, IRAC group 22) applied at petal fall at controlling PC in apple orchards in Massachusetts (the evaluation was conducted at the UMass Cold Spring Orchard) and Rhode Island, with very good results. For more detailed information, see article published in the 2021 summer issue of *Fruit Notes*.

A monitoring technique, based solely on observation of fresh PC injury on fruit from odor-baited trap trees, has proven effective at determining the need for and appropriate timing of perimeter-row insecticide sprays against PC after the whole-block petal fall spray. A Fact Sheet is available here.

Research update: In 2021 we focused on the grafting project. See partial results above.

Diptera

Apple Maggot Fly (AMF). Trap capture data using unbaited red sticky spheres deployed in commercial orchards in Massachusetts, New Hampshire and Maine indicate that 2021 AMF populations across Massachusetts were similar to those recorded in 2020. AMF numbers were much higher in 2019 than in 2020 and 2021.

Research update. In 2021, we continued with field-scale research aimed at developing an attract-and-kill strategy involving the use of attractive lures and insecticide sprays in combination with sugar added as phagostimulants, applied to perimeter-row trees.

Over a 3-year period and in multiple commercial orchards (6 in 2019, 11 in 2020, 9 in 2021) located in Massachusetts, New Hampshire, and Maine, we evaluated the level of AMF control achieved with lures deployed in perimeter-row trees in combination with insecticide sprays with 3% sugar (as a feeding stimulant) applied only to the perimeter. We expected the lures to bring AMF adults to perimeter-row trees (as evidenced by trap captures) where they could be killed by the insecticide sprays, before they could penetrate into interior trees. We also expected subsequent flies arriving to the baited tree canopies to be arrested and continue sensing sugar on the foliage and fruit, inducing flies to ingest insecticide residue. The effectiveness of this new IPM approach (termed attract-and-kill) was compared against that of grower-standard blocks that received full-block insecticide sprays. Results show that the level of whole-block injury caused by AMF was comparable in both types of blocks (attract-and-kill and grower standard) each year.

The table below summarizes infestation results for each year.

% fruit infestation at harvest

	Attract-and-kill		Grower standard	
	Perimeter-row	Interior-row	Perimeter-row	Interior-row
2019	0.79 a	0.18 a	0.66 a	0.35 a
2020	0.11	0	0	0
2021	1.06 a	0.86 a	0.52 a	0.28 a

Reductions in amounts of insecticide applied: 75% (in 2019) and 65% (in 2020).

Based on these results, we feel confident about recommending perimeter-row sprays targeting AMF provided that the insecticide is mixed with sugar and lures are used in the perimeter (every 30 yards or so) to bring AMF to those areas. This work was done in collaboration with Dr. Anna Wallingford and Jeremy Delisle (Univ. of New Hampshire) and Glen Koehler (Univ. of Maine Extension).

Hymenoptera

European Apple Sawfly. Injury by EAS was at very low levels (average of 0.25% across 9 orchards in MA, NH, and ME) in 2021.

Research update. In 2022, we will record EAS activity using baited and unbaited white sticky cards, and we will also document fruit injury as part of the 'grafting project'.

Hemiptera

San Jose Scale (SJS). SJS was detected in five orchards. While the amount of fruit injury caused by SJS can be considered low in 2021 (average incidence of injury was 0.37%), it was about 5 times the level of injury recorded in 2020 (0.06%). Thus, we recommend growers to increase monitoring efforts for this pest in 2022.

Tarnished Plant Bug (TPB). Very few TPB adults were captured in white sticky cards. The level of injury caused by TPB (or other early-season hemipterans) in 2021 was 0.85% on average, across 11 orchards.

Research update. In 2022, we will continue evaluating the attractiveness of selected plant volatiles to TPB. If populations are higher than in 2021, we will also record levels of fruit injury as part of the 'grafting project'.

Lepidoptera

Codling moth (CM), Oriental fruit moth (OFM) and obliquebanded leafrollers (OBLR). In 2021, low levels of fruit injury attributable to CM, OFM, and OBLR in 11 commercial orchards located in MA, NH, and ME were recorded: 0.07%, 0.02%, and 0.14%, respectively.

Research update. In 2021 we continued with trapping studies that aimed at determining whether plant volatiles can be used to kill female moths of various species (focus is on CM, OFM, and OBLR). The results show that, across the entire season, Megalure and TRE2267 (an experimental lure) were very attractive to OFM. Captures of CM were statistically similar in traps baited with CML2-P (the CM sez pheromone), Megalure and Megalure + TRE2265 (another experimental lure). The lure TRE2276 (a third experimental lure) was very attractive to OFM but was less attractive to CM in comparison to pheromone lure and Megalure. The addition of TRE2265 to Megalure did not improve the captures of female CM as their number's were similar in Megalure and Megalure + TRE2265, but it did increase female OFM captures.

Mites

Mites were not reported by growers as being a serious problem in 2021.

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

Brown Marmorated Stink Bug (BMSB).

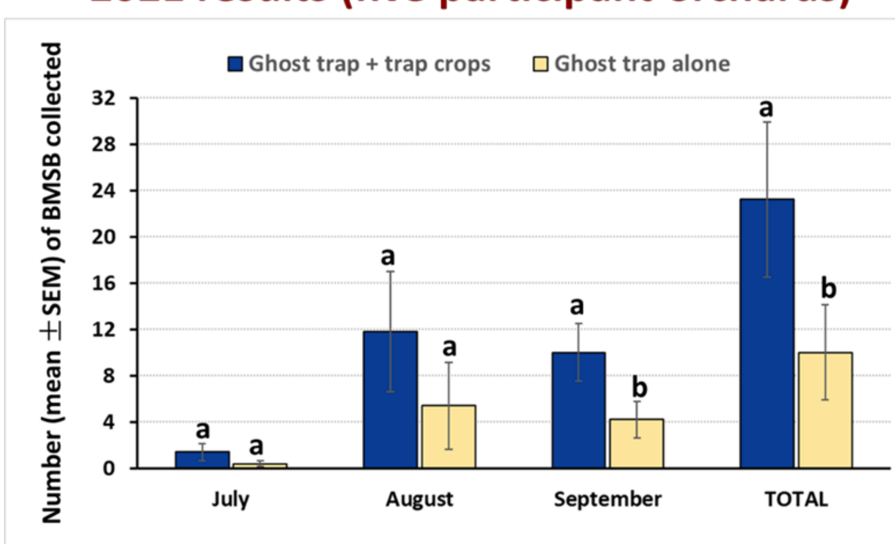
BMSB populations were very low in 2021, when compared to 2020 which was the year with highest BMSB populations ever recorded in hot spots in some areas of Massachusetts.

Research update. Does the presence of trap crop plants increase BMSB response to its synthetic pheromone? Previous studies have shown that sunflower, millet, buckwheat, and other plants can serve as trap crops. Trap crops are very attractive plants that can pull insect pests away from the cash crop, thereby decreasing pest densities, sometimes below action thresholds.

The diagram below shows the two plots that we evaluated at each farm. One plot was planted with dwarf sunflower and buckwheat and the second plot was a grassy or bare soil area. Both plots had a ghost trap with a red plastic device buried to collect the BMSB that were killed.

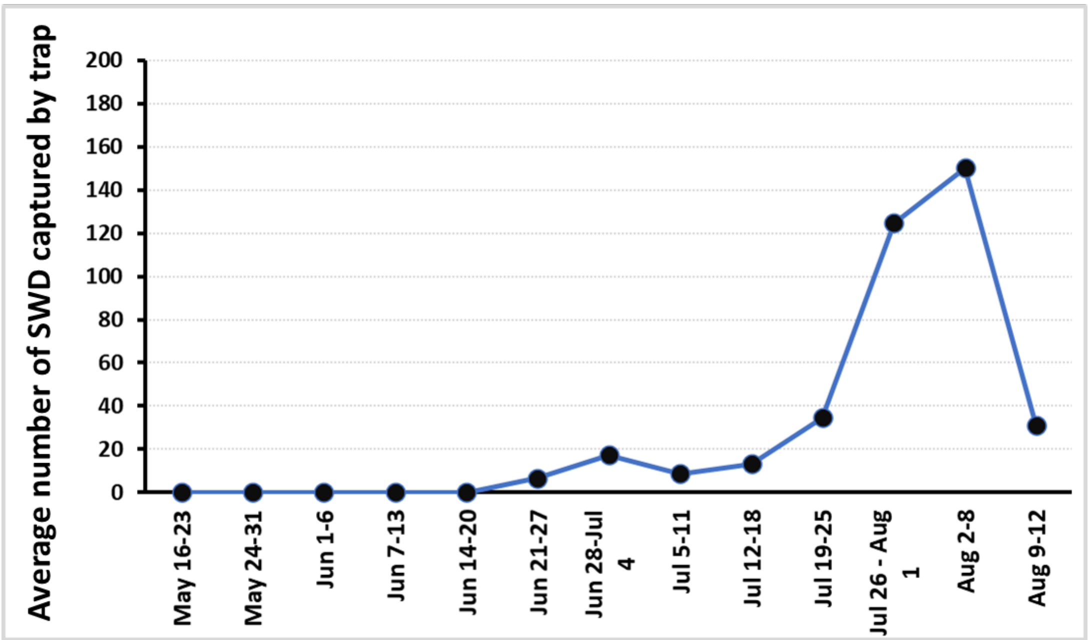
As shown in the figure below, during July and August there were numerical but not significant differences in the number of BMSB killed by the ghost trap in both types of plots. However, during September significantly more BMSB were collected from ghost traps in plots that had trap crop plants compared to plots where there were no trap crops. Overall, the effect of trap cropping was significant, meaning that growers that plant sunflower and buckwheat would be able to kill more BMSB in ghost traps when compared to the killing effect of ghost traps alone. This study will continue in 2022, we are hoping we can get more participant orchards.

2021 results (five participant orchards)



Spotted-wing drosophila (SWD).

In 2021, the first SWD flies were captured in MA on May 19th, which is similar to the first capture recorded in 2020 (May 25th). The chart below shows the seasonal pattern of SWD activity in 2021 across 5 MA orchards:



Research update. After four years of conducting research on SWD, we feel confident about recommending the use of diluted Concord grape juice (1 part of grape juice in 3 parts of water) for effective SWD monitoring. One unexpected result was that the addition of 2% table salt (this is just a sprinkle of salt for one trap) to diluted Concord grape juice prior to aging resulted in a fourfold increase in attractiveness to male and female SWD while reducing the number of non-target insects captured in traps. Therefore, diluted Concord grape juice is an effective bait that can be deployed in traps and, when 2% table salt is added, the resulting material outcompetes the performance of commercial lures and greatly reduces captures of non-target insects, thereby increasing bait selectivity.

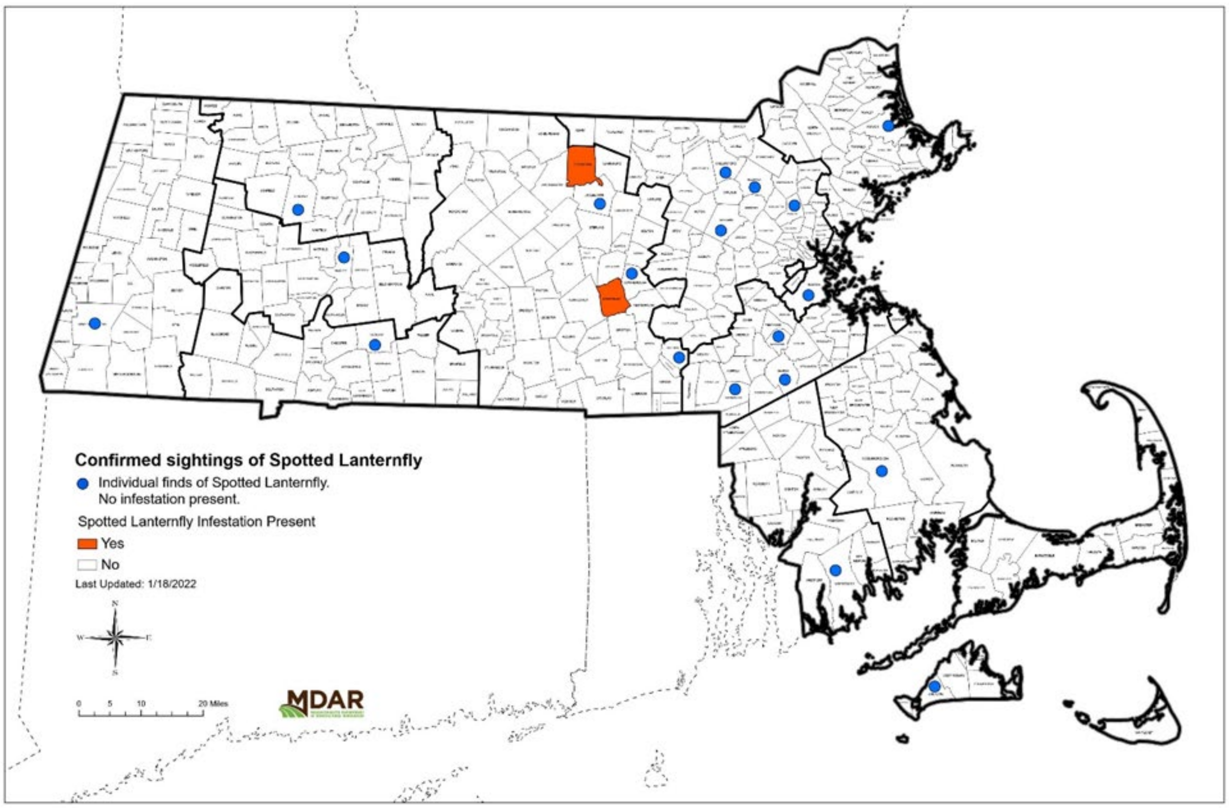
Status of the Samurai wasp, a parasitic wasp that attacks BMSB.

Peter Jentsch (now at PomaTech, Inc.) reports that the Samurai wasp seems to have become established in New York. This is based on captures of Samurai wasp in monitoring sticky cards in areas where it was previously re-distributed.

Research update. With support provided by a grant funded by the Massachusetts Department of Agricultural Resources, in 2022 the UMass Extension fruit team will establish a monitoring system for the Samurai wasp using sentinel BMSB eggs to determine whether this biological control agent is in Massachusetts.

Spotted Lanternfly (SLF)

PEST ALERT: The Spotted Lanternfly (SLF) Arrives in Massachusetts. The MA Department of Agricultural Resources (MDAR) announced on September 28th, 2021, that an established population of SLF was detected in Worcester County, MA. This finding was confirmed by state officials. For more information about SLF, click **HERE**



For more information about spotted lanternfly, visit:

UMass Extension's Fact Sheet: https://ag.umass.edu/landscape/fact-sheets/spotted-lanternfly
MDAR's Massachusetts Introduced Pests Outreach Blog: https://massnrc.org/pests/blog/
MDAR's Spotted Lanternfly Mini Poster:
https://massnrc.org/pests/linkeddocuments/SLFminiposter.pdf
Order Spotted Lanternfly Materials from MDAR: http://bit.ly/FPOMOrder
MDAR's Spotted Lanternfly Fact Sheet:
https://massnrc.org/pests/pestFAQsheets/spottedlanternfly.html
A Map of Known SLF Infestations in the US: https://nysipm.cornell.edu/environment/invasive-species-exotic-pests/spotted-lanternfly/

Pesticides Update (J. Piñero)

In 2022 there were very few pesticide updates for fruit crops. Here is what we got. If we receive more updates, they will made available via *Healthy Fruit.*

- **FROM SYNGENTA:**

  Miravis:

  - Removed Anthracnose/Colletotrichum and Leaf Rust/Tranzchelia
  - Changed REI to 12 hr
  - Stone fruit rate increased from 3.4 to 5.1 fl oz/A

  - For anyone who uses Gramoxone SL 3.0 – new closed system requirements on 2.5 gallon containers. Reminder of EPA required Paraquat training every three years.

- **FROM CERTIS:**

  Oso received OMRI listing in 2020. It's effective on Powdery, Sooty Blotch, Fly Speck and fruit rots.

NEWA 3.0 - What you need to know (J. Clements, Massachusetts State NEWA Coordinator*)

If you have not looked at NEWA (Network for Environment & Weather Applications, https://newa.cornell.edu/) since last year (or perhaps never?) you will notice a major change in the user interface now that NEWA 3.0 (as opposed to the 'old' NEWA or NEWA 2.0) is fully deployed. Here are some major enhancements and features you should know about to make NEWA more useful and user friendly. I call them my Top 10 NEWA Tips. Before I get to that though, a reminder NEWA is one decision support tool you can use and is not the final word. If in doubt, consult your crop consultant, agrichemical sales person, or UMass Extension for further advice. Now here is my Top 10 NEWA Tips:

1. *Sign In* is important to initially sign up and then subsequently Sign In for customization of your NEWA interface and make only the information you want — for example, just

your farm or orchard – appear in your Dashboard (see Dashboard below). Don't forget to save your username and password!

2. *Edit Profile* after signing up and login, go and Edit your Profile. There, you should enter some personal information; select your Favorite NEWA Station(s) – most likely your own farm or orchard, or the closest one nearby, you can add multiple stations even; add the Crop and IPM Tools of most interest to you; and there are Other Tools you can choose to add or not. The above will all now be available for quick access in your Dashboard (after you sign in).

3. *Dashboard* is where it all happens. There you will have quick access to: your favorite station(s); the current conditions; your weather forecast; and the Crop and IPM Tools you added in your Profile. A special note on the Crop and IPM Tools, if you click on the little arrow icon just to the left of the Tool, it should quickly give you an update on the current pest situation. Pretty cool and potentially very handy on your smartphone! I have not fully tested this feature, however, during the growing season.

4. *Apple scab* - Make sure you set your (McIntosh) Green Tip Date. (When you get there of course.) Note NEWA will attempt to estimate this based on degree-day accumulation, however, we have found it to consistently estimate an earlier than actual green tip date. Green tip date is used to start the ascospore maturity model. Note at the left of the window there is a Show/Hide menu, you may need to use that to select the apple scab model parameters of interest to you. Ascospore maturity, infection events summary, and infection events are a must 'Show. The Management Guide may be of interest for you to review, and if an action is to be taken, you can then consult the MyIPM app or Eco Fruit App for control options.

5. *Fire blight* is a fairly complicated model, with options. First you need to assess and choose your Orchard Blight History and First Blossom Date for the fire blight model to run. Then you will see a Results table that gives fire blight risk using both Cougar Blight and Epiphytic Infection Potential. EIP is basically Maryblyt, but NEWA can't call it that! Keep in mind that you must have a wetting event for a fire blight infection to actually occur, even if the risk of infection is elevated. Thus, there is a Wetness Events table to consult if you are unsure. As with apple scab, there is a Management Guide. There is also a Cougar Blight Risk Table visualizing the current and seasonal fire blight risk at a glance.

6. *Codling moth (CM)* - Compared to the disease models, the codling moth model is fairly simple. First you need to enter your first sustained catch of CM in your pheromone

traps. Assuming you are doing that? If not, NEWA will estimate that date. Then a results table will show you Accumulated Degree Days Base 50 F. from that first trap catch. You have to note in the Management Guide, the CM pest stage/status and pest management recommendation based on your current DD accumulation. Again, consult the MyIPM or Eco Fruit apps for control recommendations should the pest status/management indicate such action is necessary.

7. *Cornell apple carbohydrate thinning* is one of the most requested NEWA features. User input required includes green tip and bloom dates and percent flowering spurs. Then a Results Table will display Thinning Recommendations based on the current Carbohydrate Balance, for which there is also a graph. More info provides more information (obviously) such as "Improvements to the Cornell Apple Carbohydrate Thinning Model - Malusim." Note that all (most?) of the Crop and IPM Tools have a More Info text link (as well as Acknowledgements and References). AND, on all (most?) of the Model landing pages a WATCH TUTORIAL icon. These are extremely well done by NEWA and I recommend watching them at least once to get the most helpful information on how to use and interpret the Models.

8. *NEWA knowledge base* is accessible using the Help link in the menu at the top of each NEWA page. Clicking the Help link will take you to the NEWA Knowledge Base, allowing you to submit a request to the NEWA Help Desk. And, if you select the NEWA Help Desk link, you will be taken to a page where all the NEWA Knowledge Base videos are housed.

9. *NEWA weather tools* allow you to perform various weather queries like monthly summary by day, which I find most handy. Also there is a degree-day calculator with no fewer than 20 base temperature/DD calculation method choices!

10. *NEWA is mobile friendly,* although the experience on a smartphone is very condensed. It's very functional, especially when compared to the 'old' NEWA. You can even add a shortcut (iOS and Android) to your homescreen to launch NEWA with one click. Of course on a tablet – think sitting in your armchair recliner at home in the evening – this 'responsive-web design' NEWA is even more friendly!

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

Timing of Insect Growth Regulator Application for Control of Pear Psylla in Pears

Christopher McCullough, Louis Nottingham (Washington State University, Tree Fruit Research and Extension Center)

The purpose of this field study was to evaluate the application timing of insect growth regulators (IGRs) against pear psylla. This study took place at Washington State University's Sunrise Orchard in 2021. The 2-acre block of pear trees used were a mixture of 'Bartlett' and 'd'Anjou' varieties that were planted in 2007. These trees were maintained with standard commercial practices of pruning, irrigation, fertilization, weed, and disease management, but not treated with insecticides. On 12 May 2021, pear psylla adults were collected with aspirators from untreated pear trees at the Washington State University Tree Fruit Research and Extension Center. Five females and three males were enclosed in a 5-gal paint strainer bag that was secured around fresh shoot growth on the tree. Three insecticides (Senstar, Ultor, Esteem) were compared with a standard (Bexar), as well as an untreated check (water; Table 1). All treatments including the check were mixed with the nonionic surfactant, Regulaid. Treatments were replicated eight times to single trees using a handgun sprayer attached to an airblast sprayer (Pak-Blast, OVS McMinnville, OR) at standard rates (Table 1). Two application timings targeting different pear psylla stages were tested: (1) adults on 13 May and (2) eggs on 26 May. Adults were removed from all bags on 25 May. Old nymph (fourth and fifth instars) abundance was recorded from a random sample of seven leaves from inside the cages on 11 June. Next-generation adult abundance within the cages was recorded on 24 June by clipping the shoot, sealing the mesh-bag, freezing it, and then counting all PP adults.

Treatment/formulation	amt/100 gal[a]	Application dates and stage treated[b]	Old nymph abundance[c]	F1 adult abundance[c]
Untreated check	—	—	7.3b	7.4abc
Bexar 1.34L	798.2 ml	A	1.0a	2.4ab
Senstar 1.35SE	532.1 ml	A	7.4b	11.0bc
Ultor 1.25L	413.8 ml	A	10.6b	15.5c
Esteem 35WP	141.7 g	A	11.2b	11.7bc
Ultor 1.25L	413.8 ml	AB	7.2b	15.7c
Bexar 1.34L	798.2 ml	B	1.2a	1.8a
Senstar 1.35SE	532.1 ml	B	3.8ab	4.8abc
Ultor 1.25L	413.8 ml	B	4.8b	10.4bc
Esteem 35WP	141.7 g	B	6.1b	5.7abc
		P>F	<0.0001	<0.0001

Means within columns with the same letter are not significantly different ($P \leq 0.05$,

The authors concluded that none of the IGR insecticide treatments reduced pear psylla nymph or next-generation adult abundance relative to the control (Table 1). Bexar was the only insecticide that reduced the number of PP nymphs relative to the control at both application timings.

The full article is accessible here: https://doi.org/10.1093/amt/tsac026

Aphid Control on Blueberries, 2021

Cesar Rodriguez-Saona, Robert Holdcraft (Rutgers Philip E. Marucci Center for Blueberry and Cranberry Research and Extension)

This experiment tested the efficacy of seven insecticides for controlling aphids in highbush blueberry. The treatments and rates were: Azera (azadirachtin + pyrethrins) at 2.5 pt/acre, Apta (tolfenpyrad) at 27 fl oz/acre, Senstar (spirotetramat + pyriproxyfen) at 16 and 20 fl oz/acre, Movento 240SC (spirotetramat) at 8 fl oz/acre, Assail 30SG (acetamiprid) at 5.3 oz/acre, Sivanto 200SL (flupyradifurone) at 10.5 fl oz/acre, and an untreated control. Senstar and Movento treatments included the adjuvant Silwet at 0.25% v:v. The experiment was conducted in a blueberry field, cv. Bluecrop, located at the P.E. Marucci Blueberry/Cranberry Center in Chatsworth, NJ. Applications were made with an R&D CO_2 backpack sprayer, using 1-liter plastic bottles. The sprayer was calibrated to deliver 50 gal of volume per acre at 35 psi, using a single ConeJet TXVS 10 nozzle, yielding 156 ml (5.29 fl oz) per bush. Treatments were applied in the morning (5:00–6:00 h) of 6 Jun 2021.

In the morning of 3 Jun 2021, one young terminal (with ~5–6 leaves) was selected from each bush and enclosed using a cage, made of 6-liter (50 × 61 × 19 cm) Super-Aire fiber plant sleeves (A-ROO Company, Strongsville, OH). In the early evening of that date, each caged terminal received five aphid adults and 12 nymphs obtained prior to the experiment (on 29 May 2021) from a commercial blueberry farm in Hammonton, NJ. All cages were tightly closed to protect aphids from predators and parasitoids. After treatments were applied, the terminals were given 30–60 min to dry before the cages were closed. Terminals were left undisturbed for 5 d, and then they were removed from the bush and taken to the laboratory (at ~28°C and 16:8 [L:D] h photoperiod) for evaluation on 11 Jun 2021. In the laboratory, cages were opened, the terminals were examined under magnification and the number of live nymphs and live adult aphids was recorded. Percent control was calculated for each treatment as [1 – (number of live aphids on treated foliage/number of live aphids on control foliage)] × 100. Results are shown in Table 1.

Table 1.

Treatment	Rate/acre	*N*	Number of aphids (mean ± SE)			% Control[c]
			Adults[b]	Nymphs[b]	Total[b]	
Control	—	12	11.75 ± 1.35A	57.17 ± 8.01A	68.92 ± 9.15A	
Azera	2.5 pt	8	9.38 ± 1.38A	45.00 ± 9.43A	54.38 ± 10.53A	21.10
Apta	27 fl oz	8	3.13 ± 1.63B	13.25 ± 6.13B	16.38 ± 7.69B	76.24
Senstar[a]	16 fl oz	8	0.50 ± 0.27C	0.13 ± 0.13C	0.63 ± 0.26C	99.09
Senstar[a]	20 fl oz	8	2.00 ± 0.42C	0.38 ± 0.18C	2.38 ± 0.53B	96.55
Movento 240SC[a]	8 fl oz	8	4.38 ± 0.82AB	4.25 ± 1.00B	8.63 ± 1.72B	87.48
Assail 30SG	5.3 oz	8	0.00 ± 0.00D	0.00 ± 0.00C	0.00 ± 0.00D	100.00
Sivanto 200SL	10.5 fl oz	8	0.00 ± 0.00D	0.00 ± 0.00C	0.00 ± 0.00D	100.00

aTreatments included the adjuvant Silwet at 0.25% v:v.

bMeans within a column followed by different letters are significantly different (Fisher's LSD test, $P \leq 0.05$). Data were ln(x + 0.01)-transformed prior to analyses.

C% Control = [1 – (total number of aphids alive on treated foliage/total number of aphids alive on control foliage)] × 100.

The authors concluded that Senstar, Assail, and Sivanto reduced the number of aphids (nymphs and adults) by ≥90% (Table 1). Apta and Movento also significantly reduced the number of aphids by 75–90% compared to the control (Table 1). Azera was <30% effective at reducing the number of aphids, and this effect was not significantly different from the control (Table 1). No phytotoxicity symptoms were observed following any of the insecticide treatments.

IPM Around the World (J. Piñero)

Enhancing ecosystem services in apple orchards: Nest boxes increase pest control by insectivorous birds in Spain

Several studies have shown that increasing biodiversity in agricultural areas can result in improved ecosystem services (pollination, pest predation by biological control agents, etc.), helping to increase yield while reducing agricultural environmental impacts. A group of researchers in Spain conducted a field study aimed at determining whether by provisioning artificial nest boxes for insectivorous birds can reinforce pest biological control in apple orchards. The study was conducted in 24 cider-apple orchards over 3 years. The researchers compared the effect of insectivorous birds between orchards with and without nest boxes occupied by different bird species, through insectivory estimates based on attack on a sentinel pest and measurements of arthropod abundance in apple trees. We also identified preys that birds of different species captured to feed nestlings. The results were positive. Predation pressure on apple pests increased in orchards with nest boxes, as judged by the increased proportion of sentinel models attacked by birds (34.9% increase in 2018 and 41.1% in 2019), decreased biomass of tree-dwelling arthropods (−51.7%) and reduced probability of apple pest occurrence (from 57% to 40%), compared to orchards without nest boxes.

The authors concluded that nest boxes for insectivorous birds increased biological control of apple pests at a regional scale, identifying tit species as complementary predators of apple pests and herbivores. From the farmers' perspective, providing nest boxes in orchards may represent an efficient, easy to implement, cheap, and attractive measure of ecological intensification, compatible with other actions fostering biodiversity in croplands.

To access the full article, click HERE.

Organic Control Strategies for Use in IPM of Invertebrate Pests in Apple and Pear Orchards in Europe

Bethan Shaw, Csaba Nagy, and Michelle T. Fountain (NIAB EMR, UK and Research Centre for Fruit Growing, Budapest, Hungary)

This review article focuses on organic strategies for achieving effective pest control in apple and pear orchards, with specific emphasis on European invertebrate pests. The control strategies discussed can be adopted within IPM programs and, in some cases, substitute or complement synthetic pesticide-based pest control. This review focuses on cultural, physical, and biological controls including biopesticides which includes viruses, entomopathogenic nematodes and fungi.

To access the full article, click HERE.