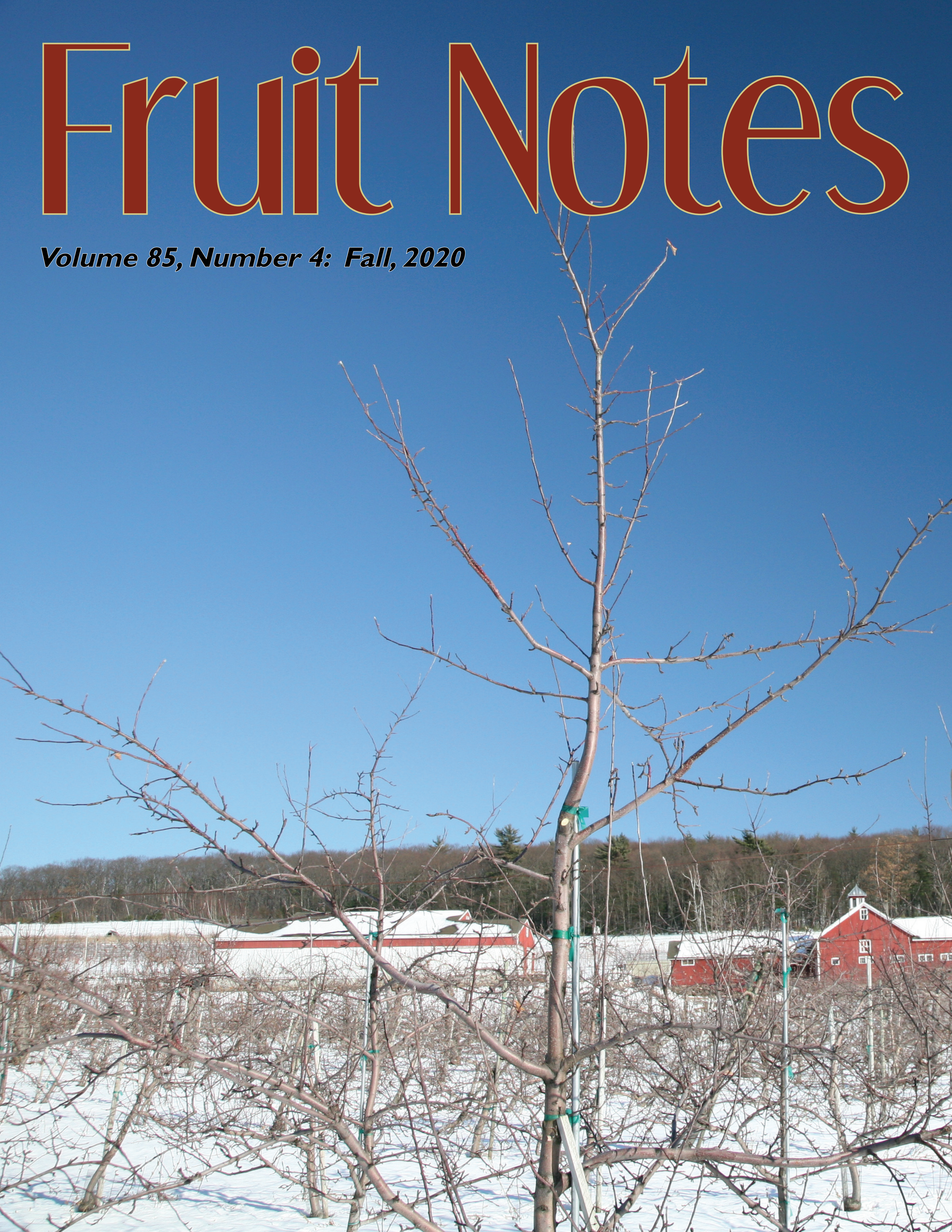
Fruit Notes

Volume 85, Number 4: Fall, 2020



Fruit Notes

Editors: Wesley R. Autio & Winfred P. Cowgill, Jr.

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Cover: UMass Cold Spring Orchard Research & Education Center Photo: Wes Autio.

Massachusetts Fruit IPM Report, 2020

Jaime Piñero, Daniel Cooley, Jon Clements, Sonia Schloemann, and Elizabeth Garofalo
University of Massachusetts

Weather

Other than some late fall 2019 cold and an early December snowstorm, the winter of 2019-20 was characterized by mild temperatures and lack of snow. The minimum (at the UMass Orchard, Belchertown, MA) was 2.4 degrees F. on 15-February, 2020. Given the lack of snow cover and some early March warmth, spring 2020 seemed on the brink of being "early," but April turned cold after early green tip arrived on 1-April. Mid-April temperatures flirted with bud damaging lows, and in fact it is suspected some site-specific bud injury occurred during this time. Full bloom was about 16-May, and it was extended with cool May weather. May and June were fairly dry which was great for controlling scab but initiated drought conditions in MA. July was hot, very hot overall, with a maximum temperature of 94.2 on 19-July.

A quick analysis of 20 years of weather station data from the UMass Orchard makes it pretty clear July has been getting warmer over the period from 2001-2020. (Fig. 1) At the UMass Orchard July and August had 3.90 and 4.77 inches of rain respectively during thunderstorms, which ameliorated our drought situation somewhat. However, many other orchards in MA were extremely dry and without irrigation fruit size suffered, and with irrigation, growers and water supplies were run ragged. Hailstorms were out there this summer, and several orchards had extensive hail damage. Crop insurance is an essential risk management strategy these days. Finally, the weather was generally sunny late summer into early fall, and peach and apple quality was very good as a result.

The fall harvest season in particular was weather-benevolent, and customer turnout at PYO orchards and farm stands could not have been much better on account

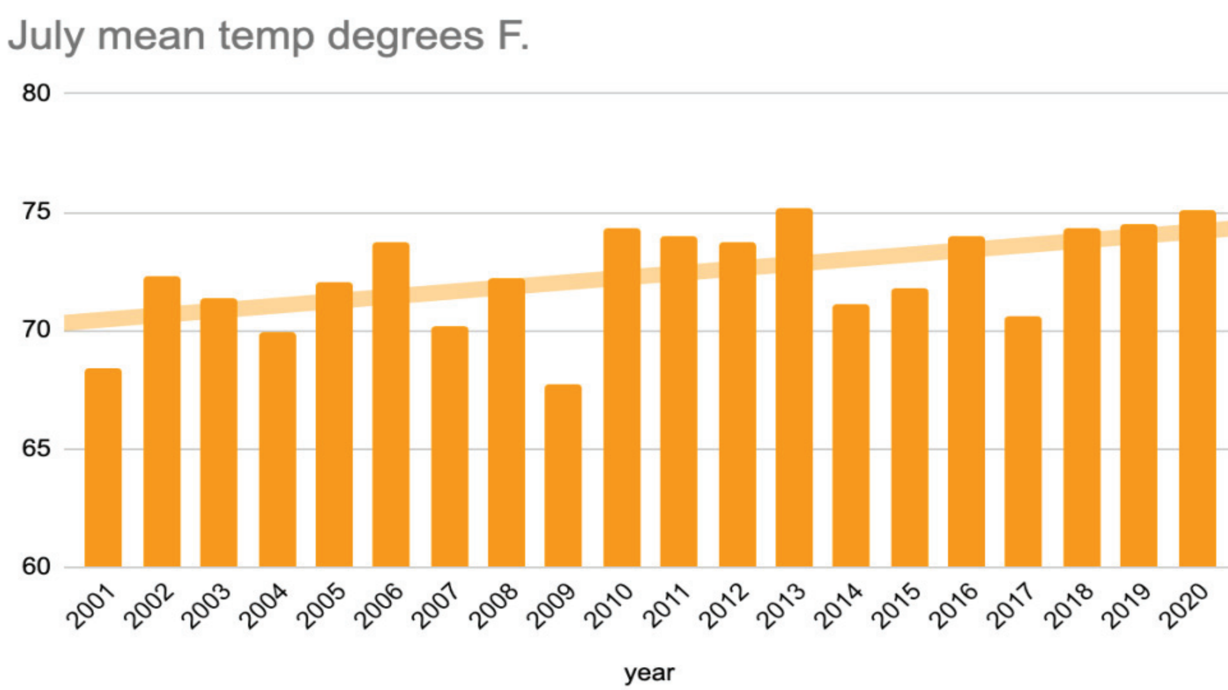

Figure 1. Mean July temperature 2001-2020 at the UMass Orchard Belchertown, MA. (https://orchardwatch.wordpress.com/2020/08/29/july-is-getting-hotter/

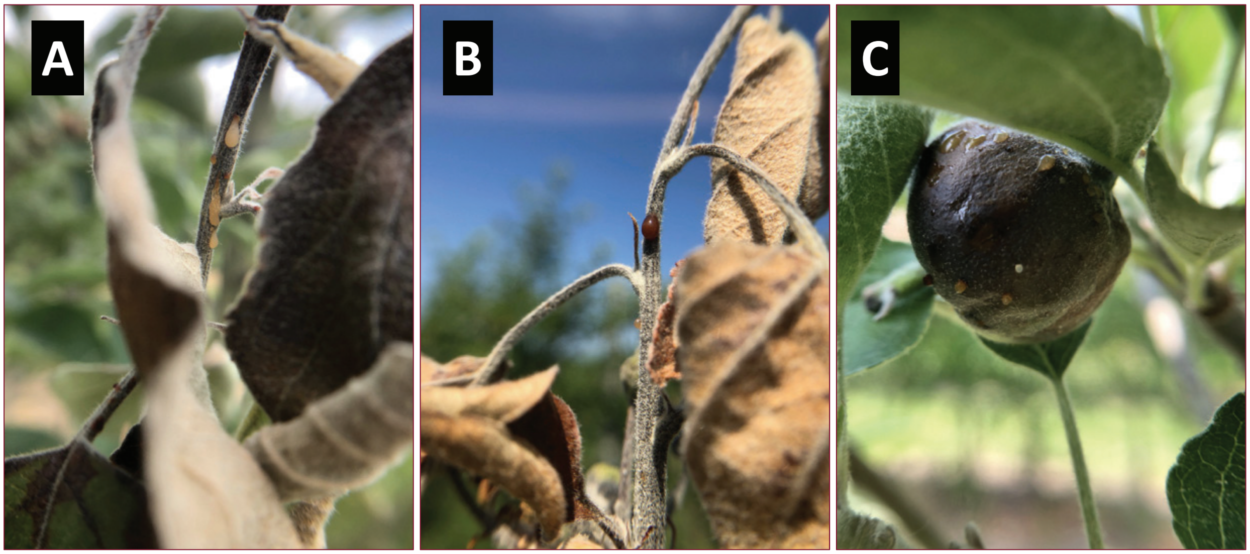

Figure 2. (A) Characteristic fireblight ooze on an infected apple shoot. This infection originated with a blossom infection resulting from late bloom time and. Streptomycin was applied to earlier blooming varieties but this late bloomer was missed, (B) advanced shoot blight with darker ooze droplets, (C) later in the season, fireblight persisted in the cider block and affected developing fruit as well as shoots.

of Covid-weary people wanting to get outside and enjoy a safe experience with their family. But growers had to adapt by adopting significant Covid-19 safety measures (at their expense) such as a customer reservation system, touchless payment, social distancing signage, requiring face masks, and hiring extra staff to manage the situation. Most growers will be extra glad to see the 2020 growing season come to a close, as whereas weather used to be the big worry item, they had an additional worry item with Covid-19 in 2020.

Diseases

Apple scab was largely a no-show as a result of the drought that eventually expanded to engulf the entire state. Final ascospores were observed in the petri plate assay and funnel trap on June 29, 2020. The cool temperatures heading into bloom led us to think we might slip through 2020 with no **fire blight**, but, sudden increases in temps throughout the region led to outbreaks in late blooming varieties. Suspect fire blight samples from five orchards throughout Massachusetts were submitted to Anna Wallis, PhD. student in Kerik Cox lab at Cornell University, for confirmation and streptomycin resistance testing. All were positive for fireblight and negative for resistance to streptomycin.

Sooty blotch (SB) and **flyspeck (FS)** became apparent in the harvest surveys in several blocks. For example, in two blocks located in a single MA orchard having cider apple cultivars, the incidence of SB and FS were 3.7 and 9.6%, respectively for block one, and 0% (SB) and 1.8% (FS) for the second block.

Marssonina leaf blotch continues to creep up in many orchards, cultivar and management practices significantly influence the severity of the disease. However, even in rigorously managed conventional orchards, the disease has been observed. The following photos (Figs. 3 and 4) all were taken in a low spray

Figure 3. Early Marssonina symptoms. On close inspection acervuli (tiny black fruiting fungal bodies) can be seen in the brown-purple spots. Photo taken in Amherst, MA October 9, 2020.

Figure 4. Enterprise (front of photo) versus GoldRush (behind) leaf drop.

organic orchard block (no fungicides this year).

Insects

In 2020, the two most damaging insect pests were **plum curculio (PC)** and **tarnished plant bug (TPB)**. Across 11 commercial orchards located in MA (7), NH (3), and ME (1), 10,560 fruits were inspected for insect injury at harvest. The average level of block-wide injury was 2.8% for PC and 2.6% for TPB. No PC research involving odor-baited trees was conducted this year. Therefore, the incidence of injury by PC being reported here occurred under standard grower management. As shown in Table 1 below, injury by internal Lepidoptera was very low. In 2019, low levels of fruit injury attributable to codling moth (CM), Oriental fruit moth (OFM) and obliquebanded leafrollers (OBLR) in Massachusetts were recorded: 0%, 0.15%, and 0.08%, respectively.

Plum curculio (PC). The timing of the petal fall insecticide spray is critical. There were at least 3 orchards where the petal fall spray was applied later than growers intended. This was likely due to the presence of mixed cultivars in those blocks or to rainy weather conditions that may have prevented them from entering the blocks to spray. In one block located in the UMass Cold Spring

Table 1. Insect incidence at harvest in 10,560 apples, sampled from 11 orchards located in MA (7), NH (3), and ME (1).

	PC	Stink bug	TPB	AMF	PC feeding or other damage	Rollers	OFM	CM	EAS	San Jose scale
PERIMETER	4.28	0.17	1.76	0.31	0.11	0.09	0.06	0.20	0.01	0.11
INTERIOR	1.27	0.45	3.52	0.54	0.11	0.06	0.03	0.26	0.31	0.00
Whole orchard block	**2.78**	**0.31**	**2.64**	**0.43**	**0.11**	**0.07**	**0.04**	**0.23**	**0.16**	**0.06**

Orchard that was used to compare the level of control achieved with Verdepryn (a.i. Cyclaniliprole) versus that of Avaunt (a.i. Indoxacarb), the insecticides were sprayed a couple of days after the optimal time. While both insecticides were equally effective at controlling PC, the timing of application led to higher levels of PC injury in those blocks, compared to other orchard blocks.

Monitoring for PC is key to successful management. A monitoring technique, based solely on observation of fresh PC injury on fruit from odor-baited trees, has proven effective and efficient 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.

Tarnished plant bug (TPB). Injury by this insect pest was recorded at each orchard where we conducted harvest surveys. This year, we initiated a project (led by UMass graduate student Ms. Prabina Regmi) aimed at evaluating plant volatiles for potential use in monitoring systems for TPB. *Findings will be presented in the next Fruit Notes issue.* Research will continue in 2021.

Apple maggot fly (AMF). In 2020, we conducted a study that started in 2019 in collaboration with the Univ. of New Hampshire and the Univ. of Maine. This investigation, led by a UMass graduate student (Ms. Dorna Saadat) evaluated the efficiency of 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. Two treatments were compared: (1) attract-and-kill and (2) grower control. The attract-and-kill block involved the use of lures deployed on the perimeter of the block plus red spheres as a monitoring tool. In these blocks, perimeter-row trees were sprayed with insecticide mixed with 3% sugar added to the tank mix. In the grower control blocks, two or three insecticides were applied to the entire block by the grower. *A full account of the results will be published in the next issue of Fruit Notes.*

Internal Lepidoptera. In 2020, we conducted a study aimed at assessing the efficacy of mating disruption using dual pheromone lure dispensers targeting obliquebanded leafroller (OBLR) and codling moth (CM). This work was led by a UMass graduate student, Mr. Ajay Giri. The mating disruption dispensers were deployed at a low rate (32 dispensers/acre). At harvest, we quantified the level of injury by CM and OBLR in the mating disruption and in the grower control blocks. The average level of fruit injury by CM recorded in the three mating disruption (MD) and the three grower control (GC) blocks was 0.02% and 0.03% respectively. Injury by OBLR was similarly low: 0.08% and 0.15% in MD and GC blocks, respectively. *More detailed results will be published in the next issue of Fruit Notes.*

Mites. Mites were not reported by growers as being a problem despite the lack of rain.

Brown Marmorated Stink Bug. Monitoring of BMSB was done in 10 commercial orchards starting in mid-August, 2020. Six of those locations had not been monitored for BMSB before. BMSB was detected at every single orchard that was monitored, indicating the presence of established populations state-wide. Ghost traps (insecticide-treated netting deployed in association with the BMSB pheromone lure) were deployed at selected orchards. In one orchard, two ghost traps killed 636 BMSB in 3 weeks. We can conclude that BMSB populations continue to be on the rise, and injury by this invasive pest was reported in at least 3 Massachusetts orchards.

San Jose scale was detected in only a couple of orchards, and the level of injury was low.

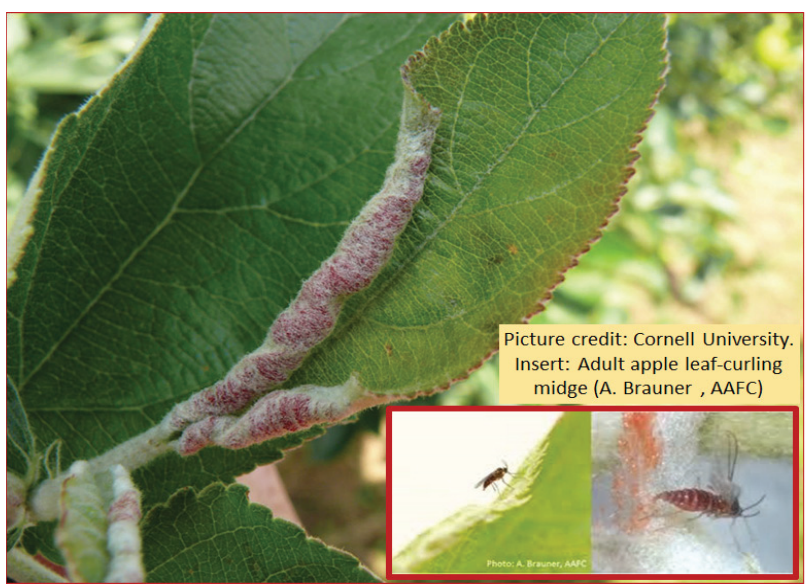

Figure 5. Injury by apple leaf midge and midge adults (insert).

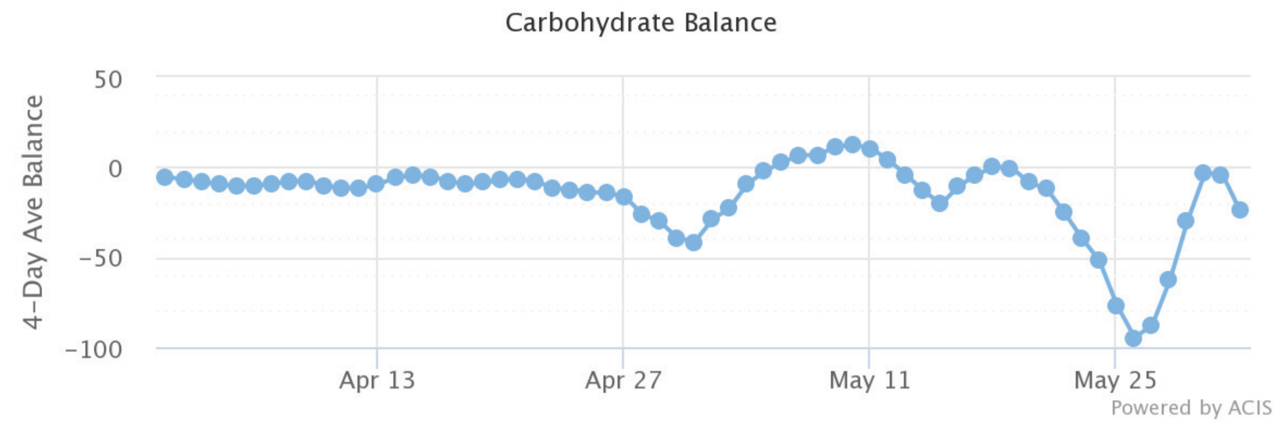

Figure 6. Carbohydrate balance at UMass Orchard culminating in a deficit of nearly 100 g/day on 26-May.

Injury by **European apple sawfly (EAS)** was recorded in a couple of orchards, at low levels.

Apple leaf curl midge. The apple leaf midge (also known as apple leaf curling midge and apple leaf gall midge) is an exotic foliar pest of apple trees. It was found in a few MA orchards. Minor injury potentially caused by this insect pest was suspected in one orchard.

Horticulture

Two things stand out in 2020. First, the weather, or should I say the carbohydrate deficit during the 10 mm apple fruitlet chemical thinning stage, and second, wind during Tropical Storm Isaias which wreaked havoc on some apple trees at the UMass Orchard.

2020 Thinning weather — suffice it to say a rather massive carbohydrate deficit on account of warm day and night temperatures and cloud cover made chemical thinning in 2020 rather dubious. More and more we encourage growers to thin aggressively using a "nibble" approach of multiple chemical thinning applications beginning at bloom. But still, the single best time to accomplish chemical thinning is when apple fruitlets are about 10 mm. This year, a large carbohydrate deficit occurred about this time, culminating in a 4-day average carbohydrate balance of -95 on 26-May. (Fig. 6) This is a huge deficit and could easily result in over-thinning if a chemical thinner was applied. The deficit was short-lived, but there was much hollering by growers who did apply a chemical thinner just prior to this deficit. After the fact a resounding "oh my goodness, I think I thinned all my fruit off!" was heard. We have not experienced this situation in several years. Some varieties did turn out light, however, later blooming apples had a nice crop. Mac type apples were generally good, but Honeycrisp turned out rather light across the board. Lesson learned? Pay attention to the carbohydrate deficit during that time period when apple fruitlets are about 10 mm, adjust your chemical thinning response (time, rate, combinations) accordingly, and direct 2/3 of the thinning spray in the tops of trees (always).

Wind and G.41 are a mismatch — Tropical storm Isaias blasted through the Hudson Valley of NY on 04-August with heavy rain there, but ALL we got at the UMass Orchard in Belchertown was WIND, with a recorded on-site gust of 50 mph. ALL was enough to break off many (100 or so, I did not count exactly, it was too depressing) young apple trees at the Orchard. The consistent factor was all the broken apple trees were on G.41 rootstock, they were snapped right off at the graft union. (Fig. 7) It appeared to me that this was a result of several factors: moderate-heavy crop loads, long branches, and a marginal support system with failure to fully keep the trees from twisting or moving too much from vertical along with what is commonly known as a weak graft union when mated with G.41 rootstock. Some varieties, but not all are known, may exacerbate the problem. Young trees are also more prone to breakage. Lesson learned? Apple trees planted on G.41 rootstock cannot be allowed to twist or rock in the wind, period. Keep branches short. Build a proper support system. Use extra fasteners (or wires) when attaching trees to wire. G.41 is a good rootstock because it is fire blight resistant, but it has this one fatal flaw that needs extra attention if planting an apple orchard on this rootstock. I have a YouTube video here if you

Figure 7. Apple tree on G.41 rootstock snapped right off at the graft union in high wind.

want to see the carnage up-front and personal: https://youtu.be/XLXvrBFY6H4.

Small Fruit IPM

Winter Moth (WM). Based on the success of biocontrols of Winter Moth in recent years and the resulting lower population levels, we did not directly monitor WM in 2020. Information on WM emergence predictions based on observations in RI and on Degree Day models were disseminated in the IPM Berry Blast and Healthy Fruit Newsletters early in the season.

Gypsy Moth (GM). Based on low levels of Gypsy Moth egg masses in the winter of 2019/2020, the UMass Fruit Extension team did not do any direct systematic monitoring of GM populations during the 2020 growing season. Information on damage potential in hot spots was disseminated in IPM Berry Blast and Healthy Fruit Newsletters as needed.

Spotted Wing Drosophila. In 2020, we continued to emphasize to implement the 1-2-3 IPM approach to spotted wing Drosophila (SWD) management. The three components are (1) monitoring, (2) cultural control methods, and (3) insecticide sprays. In 2020, we compared the performance of diluted Concord grape juice (1:3 juice: water) at capturing SWD against that of four commercial lures, at four MA locations. Diluted grape juice was used to monitor SWD for the entire season. The season-long pattern of SWD captured by diluted grape juice is presented in Fig. 8, below. *The results of this study are presented in the next article of this Fruit Notes issue.*

Massachusetts IPM Berry Blasts/Healthy Fruit Newsletter Small Fruit section. Nineteen issues of Massachusetts IPM Berry Blast (515 subscribers), were sent out during the 2020 growing season. These covered IPM recommendations for a wide range of pests and disease problems in berry crops. A con-

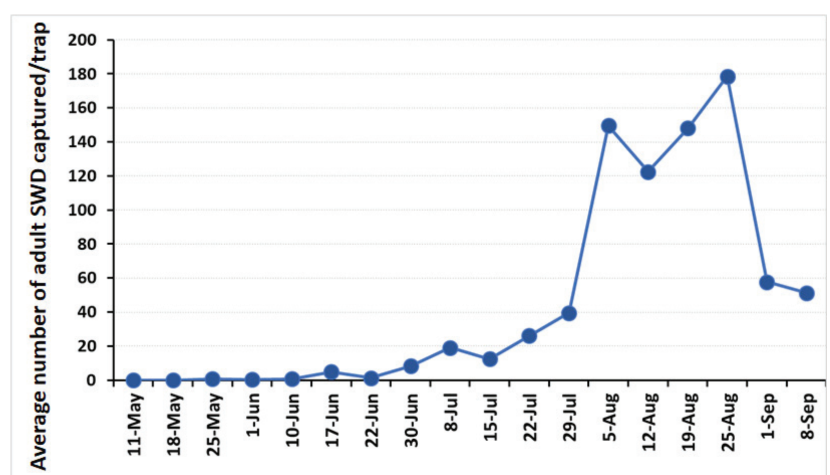

Figure 8. Season-long captures of adult spotted wing drosophila in traps baited with diluted concord grape juice (n= 4 orchards).

densed version of this information was also included in 20 issues of the Healthy Fruit newsletter (165 subscribers).

Special Projects

NEW Fruit IPM Fact Sheets and Videos! We have revamped the **Fruit IPM Fact Sheet series** (apple, blueberry, strawberry). If you are reading a PDF copy of this report, then the Fact Sheets are available (https://ag.umass.edu/fruit/fact-sheets). Otherwise, you can Google "UMass Fruit IPM Fact Sheets". Educational **videos** relating to fruit production and pest management are available (https://www.youtube.com/channel/UCKCU0_6fvuSPLtWvsmDhfwg/videos?view=0&sort=p&flow=grid) or Google "UMass Extension fruit program YouTube channel".

Northeast Cider Apple Project (NECAP) -- Beginning in Fall 2019, this 3-year Project funded by NESARE is led by University of Vermont with collaborators from UMass and UMaine. At UMass Cooley, Pinero, Clements, and Garofalo are evaluating at least five cider orchards throughout Massachusetts for insect and disease incidence on cider apples. We are also evaluating horticultural and fruit quality characteristics to develop fact sheets and recommendations for both established and new growers of cider apples (https://www.youtube.com/channel/UCWrmWfBqbcK8FgjVTuRT0Gw).

MyIPM app -- work continued by Cooley, Clements, and Garofalo on the MyIPM including adding pear insects, cherry insects, and updating apple and pear diseases. MyIPM is designed to provide mobile access to pest management information for many fruit crops with an emphasis on resistance management. For more information on the app: https://apps.bugwood.org/apps/myipmseries/

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pomonella (Diptera: Tephritidae) and interactions with entomopathogenic nematodes. Journal of Economic Entomology (in press).

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Research and Extension Grants

Supporting IPM on diverse Massachusetts farms through the integration of applied research and Extension. 09/01/2017 - 08/31/2021. USDA NIFA Award Number 2017-7006-27137. H. Sandler (PI) and J. Clements (Co-PI). $1,156,009.00.

Cooley, D. R. and J. M. Clements. Using Computer Vision to Improve Data Input for Precision Thinning Models in Apples. USDA/NIFA and NSF CPS: Medium: Collaborative Research. 6/1/2020 – 5/31/2023. $430,762. In collaboration with Carnegie Mellon University. Total Award both Institutions $1,100,000.

Precision crop load management of apples. USDA-NIFA-SCRI SREP 2020-51181-32197. 09/01/2017 - 08/31/2021. T. Robinson (PD), L. Chang (Co-PD), Cornell University., and J. Clements (Co-PI). $4,800,00 total award.

Piñero, J.C. Evaluation of a grower-friendly attract-and-kill strategy for apple maggot control in New England apple orchards. New England Tree Fruit Growers Research Committee 6/1/20 – 11/30/20) $2,600.

Multi-cultivar grafting: a new low-cost, grower-friendly Integrated Pest Management approach for key apple pests in Massachusetts. Massachusetts Society for Promoting Agriculture $21,964 (2020-2021).

Early-season Performance of Diluted Concord Grape Juice and Commercial Lures at Attracting Spotted Wing Drosophila and Effects of Juice Fermentation on Trap Captures

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Commercial synthetic food-based lures are available to monitor spotted wing drosophila (SWD). While effective, most commercial lures are based on fermentation materials and consequently they attract a comparatively high number of non-target insects. Captures of unwanted insects hinders trap performance and increases sorting time. For the past two years we have been evaluating the attractiveness of diluted Concord grape juice, a low-cost and readily available material, to male and female SWD. When diluted at a ratio of 1:3 (= 1 part of grape juice and three parts of water), diluted grape juice showed to be three times more attractive to males and females than one commercial lure under field conditions (see Piñero and Foley, 2018). In addition, grape juice diluted at the 1:3 ratio attracted significantly fewer (about three times less) non-targets than one commercial lure, highlighting a potential greater selectivity of diluted Concord grape juice.

Here, we assessed the efficacy of traps baited with diluted Concord grape juice at monitoring SWD early in the season when compared to four commercial lures. A secondary objective was to elucidate the effects of grape juice fermentation, as influenced by aging, on SWD captures in traps. For all experiments, we assessed the selectivity of the materials evaluated by relating captures of SWD to non-target insects.

Materials & Methods

Experiment 1: Early-season SWD monitoring using grape juice and commercial lures. Here, we quantified the ability of 1-quart traps baited with diluted grape juice at the 1:3 dilution ratio (thereafter referred to as 'DGJ') to detect the first adult SWD of the growing season, compared with 1-quart traps baited with commercial lures. Five olfactory treatments were evaluated (1) DGJ, (2) Scentry® lure, (3) AlphaScents® lure, (4) Trécé broad spectrum PEEL-PAK multi-component lure, and (5) Trécé high-selectivity 3-component lure. DGJ-baited traps received 6 oz. of this material whereas traps baited with commercial lures received 6 oz. of unscented soapy water as a drowning solution. On May 4, five traps (one trap of each treatment) were deployed at each of four locations: Deerfield (on cherry trees), Belchertown (cherry), Whately (raspberry), and Amherst (elderberry). Traps were deployed on May 4 and they were removed on July 8, 2020. Once a week, all traps were serviced and all captured insects were brought back to the laboratory, for identification. At each trap inspection session, DGJ was replaced. The commercial lures remained in place until traps were removed.

Experiment 2. Effects of DGJ fermentation. This field test was conducted during June and July, 2019, in a cherry block at the UMass Cold Spring Orchard. The objective of this evaluation was to quantify the response of male and female SWD to volatiles emitted by DGJ (1:3 ratio) that had been aged for either, 7 or 14 days, compared to fresh DGJ. The four treatments evaluated were (1) fresh DGJ, (2) 7-day old DGJ, (3) 14-days old

DGJ, and (4) water as control. DGJ was prepared in the laboratory using 1-gallon containers with a gauze secured with rubber bands to allow for air exchange. GJD was prepared three times a week, and aged inside a chamber at 77°F and 65-75% relative humidity. The baits were prepared following a schedule that allowed for simultaneous evaluations of aged materials. Each treatment was replicated 5 times (= 5 cherry trees). Twice a week, traps were serviced, and insects were collected and transported to the lab, for identification. At each inspection session, clean traps were re-baited with newly-prepared materials.

Results

Experiment 1: Early-season comparison of diluted grape juice and commercial lures. As shown in Table 1, traps baited with diluted grape juice (DGJ) and with Trécé lures captured the first adult SWD of the season. This occurred on May 25, 2020. On June 1, DGJ was the only treatment that attracted SWD to traps. On June 10, all treatments except for AlphaScents attracted SWD. Results from the June 17 trapping date showed that the Scentry lure attracted the highest number of SWD. The Trécé broad spectrum lure ranked second on this date. DGJ attracted the highest number of SWD on June 30 and on July 8 (Table 1).

The selectivity of each treatment is presented in Table 1 (see section 'Ratio (other drosophilids to SWD)'). DGJ was the most selective treatment (lower values

Table 1. Early-season captures (expressed as average number per trap) of spotted wing drosophila (SWD) and non-target insects (other insects belonging to the SWD family) in traps baited with diluted grape juice (DGJ) and four commercial lures at four Massachusetts locations. Boxes highlighted in orange indicate the date of first SWD captures in 2020.

Treatment	May 11	May 18	May 25	June 1	June 10	June 17	June 22	June 30	July 8
SWD									
DGJ	0	0	0.7	0.3	0.8	4.8	1.3	8.3	16.8
AlphaScents	0	0	0	0	0	4.3	2.8	2.3	2.8
Scentry	0	0	0	0	2.0	11.3	3	3.3	1.5
Trécé broad spectrum	0	0	0.7	0	0.5	8.3	1.3	3.0	1.5
Trécé selective	0	0	1.0	0	0.3	2.0	0.5	2.0	0.3
Other drosophilids									
DGJ	0	0.7	16.7	11	3.3	6.8	1.8	14.3	32.3
AlphaScents	14.3	39.7	4	6.5	18.8	58.3	23.3	8.0	13.0
Scentry	2	27	66	11.8	5	35.5	64.5	6.0	12.0
Trécé broad spectrum	55.7	88.3	76	14	54	106.8	10.5	10.3	22.0
Trécé selective	3	9.7	30.3	4	5.3	9.0	1.7	2.0	3.8
Ratio* (other drosophilids to SWD)									
DGJ	---	---	23.9	36.7	4.1	1.4	1.4	1.7	1.9
AlphaScents	---	---	---	---	---	13.6	8.3	3.5	4.6
Scentry	---	---	---	---	2.5	3.1	21.5	1.8	8.0
Trécé broad spectrum	---	---	108.6	---	108.0	12.9	8.1	3.4	14.7
Trécé selective	---	---	30.3	---	17.7	4.5	3.4	1.0	12.7

*=Numbers represent ratio of non-targets captured for each SWD captured; hence, a value of 1 would indicate one SWD captured for each non-target insect (= high selectivity). Conversely, high values indicate less selectivity for SWD. For each week, the most selective treatment (= the one with the lowest ratio) is highlighted in green.

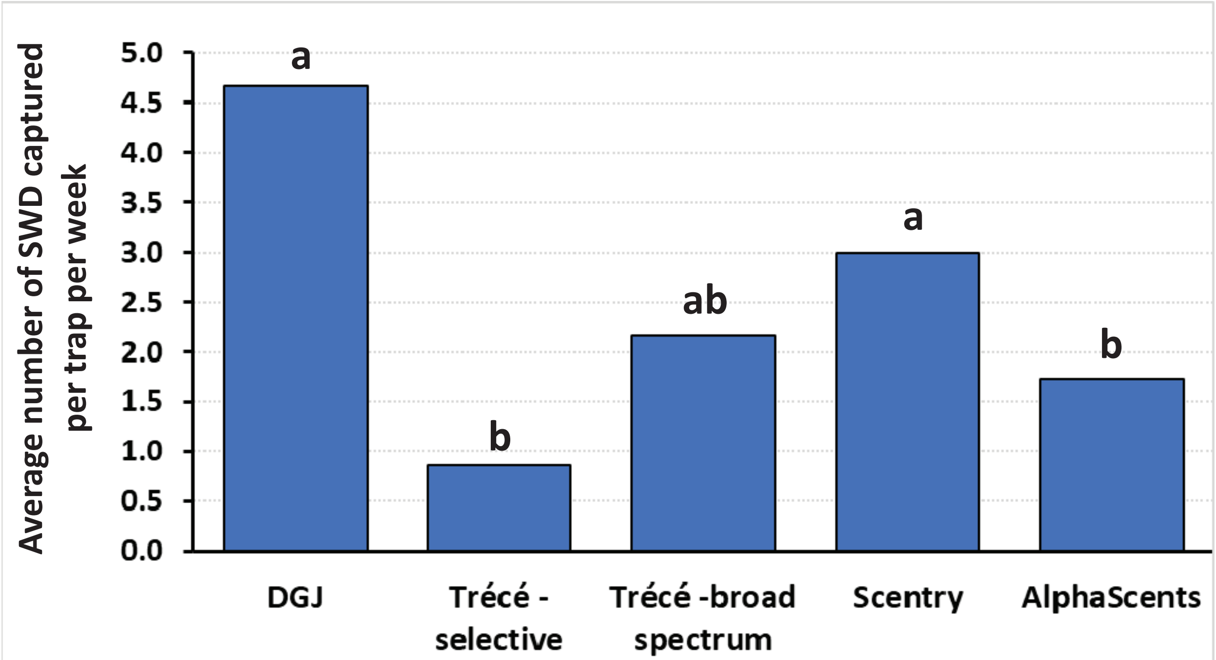

Figure 1. Early-season (11 May to 8 July, 2020) captures of male and female spotted wing drosophila (SWD) in traps baited with diluted grape juice (DGJ) and four commercial lures, in four Massachusetts locations. Bars superscribed by the same letter are not significantly different at odds of 19:1.

represent greater number of SWD captured relative to non-targets) in 5 out of the 6 dates for which such ratios were calculated. On June 1, the only treatment that attracted SWD was DGJ, therefore no comparisons of ratios could be made. The Scentry lure had the best selectivity on the Jun 10 trapping date.

Figure 1 shows that, across the entire trapping period (May 11 to July 8) DGJ was a very attractive material to adult SWD. More specifically, DGJ captured 5.5, 2.2, 1.6, and 2.7 times more SWD than did Trécé -selective, Trécé -broad spectrum, Scentry, and AlphaScents lures, respectively (Figure 1). It is important to note that DGJ was replaced every week whereas the commercial lures were not replaced throughout the study. The expected lure longevity is 4-6 weeks for the two Trécé lures and for the Scentry lure, and 8 weeks for the AlphaScents lure.

Experiment 2: Effect of grape juice fermentation on SWD attraction. Aging DGJ for 1 or 2 weeks did no influence captures of male SWD in traps. In contrast, twice as many females were captured when DGJ was fermented for 1 or 2 weeks compared to fresh DGJ (Figure 2A). No statistical difference in captures was noted between the two levels of fermentation. Captures of non-target insects followed the same pattern

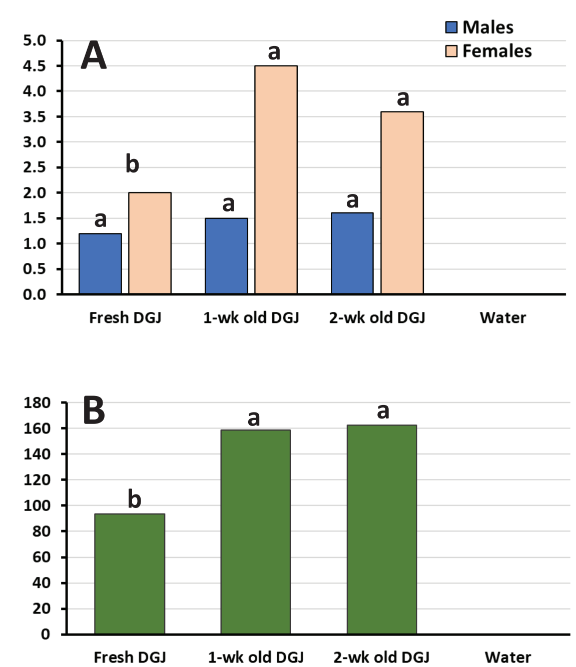

Figure 2. Captures (average number per trap) of **(A)** adult SWD (males and females combined) and **(B)** non-target insects (other insects belonging to the SWD family), according to treatment. This study was conducted at the UMass Cold Spring Orchard in 2019. For each SWD gender (top chart) and for non-targets (bottom chart), bars superscribed by the same letter are not significantly different at odds of 19:1.

described for female SWD. For instance, the number of other drosophilids was 70% and 74% greater when DGJ was fermented for 1 or 2 weeks, respectively, when compared to fresh DGJ (Figure 2B).

Conclusions

The results from the first study confirmed that DGJ is attractive to male and female SWD, it has high selectivity, and therefore this low-cost material can be used for monitoring SWD populations. Our fermentation study revealed that female captures can be increased if traps are left for up to two weeks in the field (we did not evaluate longer intervals). However, the fermentation process will also attract more non-target insects. Further research will be conducted to determine ways in which fermentation can be manipulated so as to attract fewer non-target insects without affecting SWD captures.

Acknowledgments

We thank Tim Nourse, and Tom and Ben Clark for allowing us to work on their orchards. We also thank Emily Begonis for assistance. Funding for this research was provided by the Massachusetts Department of Agricultural Resources Specialty Crops Block Grant with funds provided by the United States Department of Agriculture (USDA), Agricultural Marketing Service through agreement number AM180100XXXXG025. The views or findings presented here are the Grantee's and do not necessarily represent those of the State or the Missouri Department of Agriculture.

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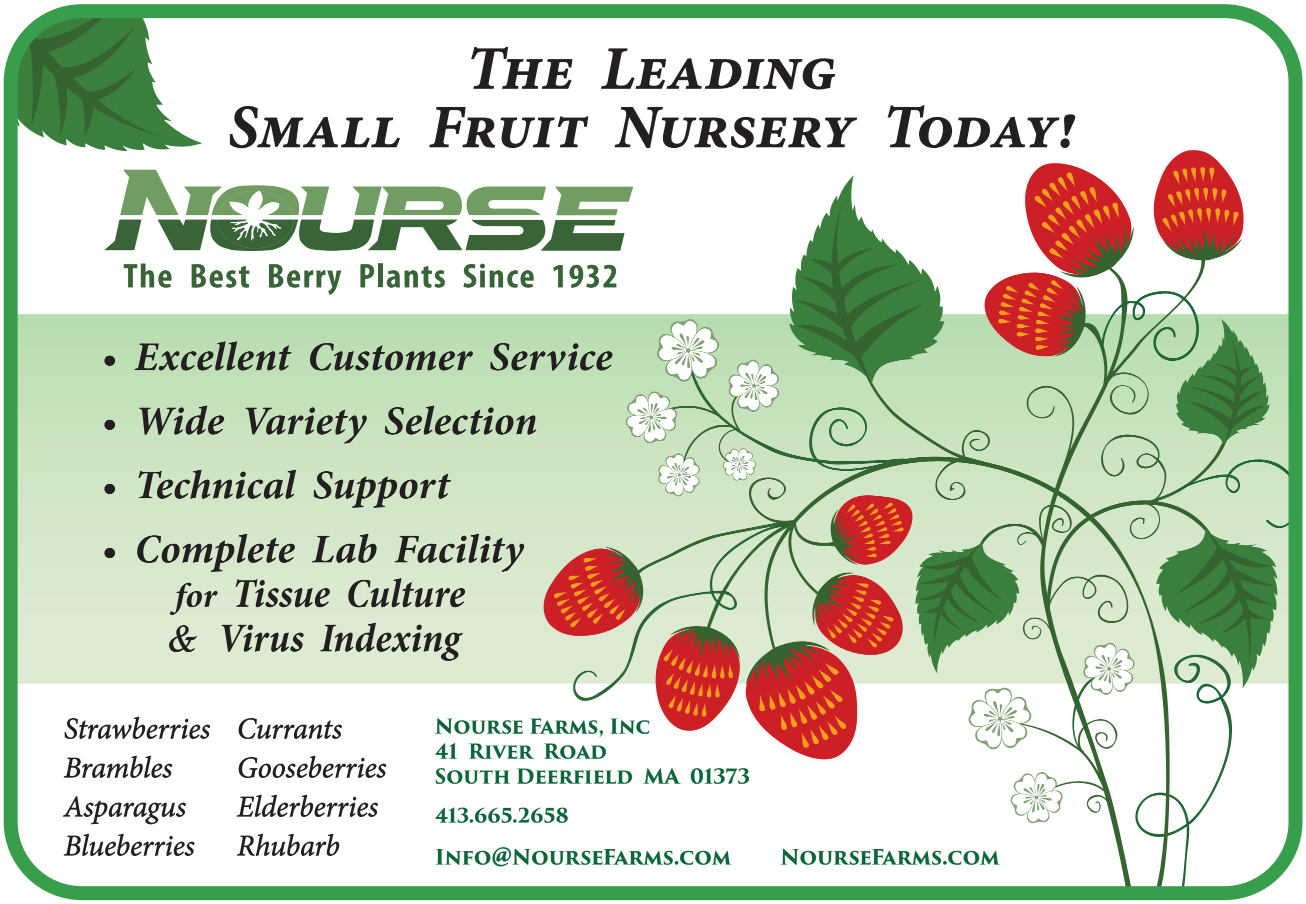
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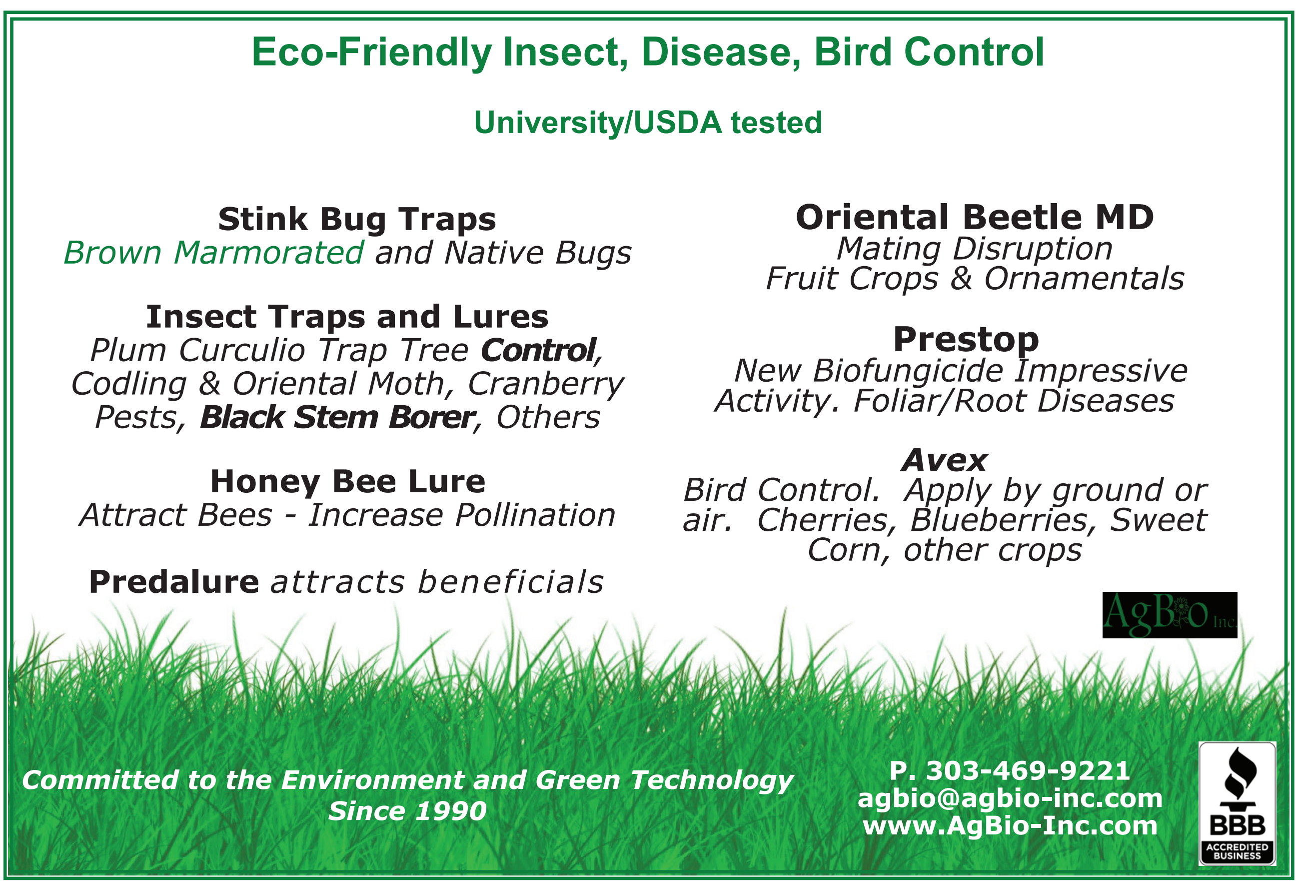
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Thwarting the Low-spray Plan: Marssonina Throws a Curve Ball

Elizabeth Garofalo and Daniel Cooley
University of Massachusetts

Marssonina coronaria, the fungal organism known to cause Marssonina leaf blotch (MLB) on apple, is an emerging disease in the Northeast. The pathogen was first documented in the United States in 1903 (Davis 1903). At the time, it was listed under a different name: *Ascochyta coronaria*, and has since undergone several changes in its taxonomic name before arriving at today's *M. coronaria*. Until recently, the disease has been considered minor in the US, compared to other diseases caused by fungi, notably apple scab, powdery mildew, rusts and fruit rots.

Over the last 20 years, *M. coronaria* has become a commercially significant pathogen in organic apple growing regions in Europe. It caused significant damage on 'sustainably grown' apples in northern Italy in 2002 and 2003 (Tamietti and Matta 2003). It now causes losses in southern Germany, southern Austria and Switzerland as well. (Persen et al. 2012; Wöhner and Emeriewen 2019). In China, India and other Asian countries, MLB has caused huge losses over the past 30 years, and is considered one of the most important diseases in apple production over that region (Verma and Sharma 2004; Lee et al. 2011; Dang et al. 2017).

M. coronaria has been observed in commercial orchards in the northeastern United States in recent years, and is becoming especially problematic in organic and low-spray orchards. It is also being seen in conventional orchards. Symptoms first begin as discreet dark brownish-purple spots. These spots develop acervuli, a fungal fruiting body that produces spores (Figure 1). These spots expand into yellowed chlorotic regions which then coalesce into a mottled yellow "blotch" of the leaf. If infections are severe enough, trees defoliate prematurely. Over a few years, this can lead to a decline in tree health, and cause a reduction in fruit production and quality. *M. coronaria* can also cause spots on fruit, decreasing value or even making them largely unmarketable. Fruit symptoms are less common than foliar symptoms.

Currently, there are no fungicides labeled in the United States for use in managing *M. coronaria.* Other regions that have been struggling with MLB in commercial orchards report that there are materials that are effective in preventing infection. For example, in India broad-spectrum protectant fungicides including mancozeb, ziram, dodine, chlorothalonil and thiophanate-methyl controlled MLB, but sterol inhibitors (DMIs) were not effective (Verma and Sharma 2003). Dang

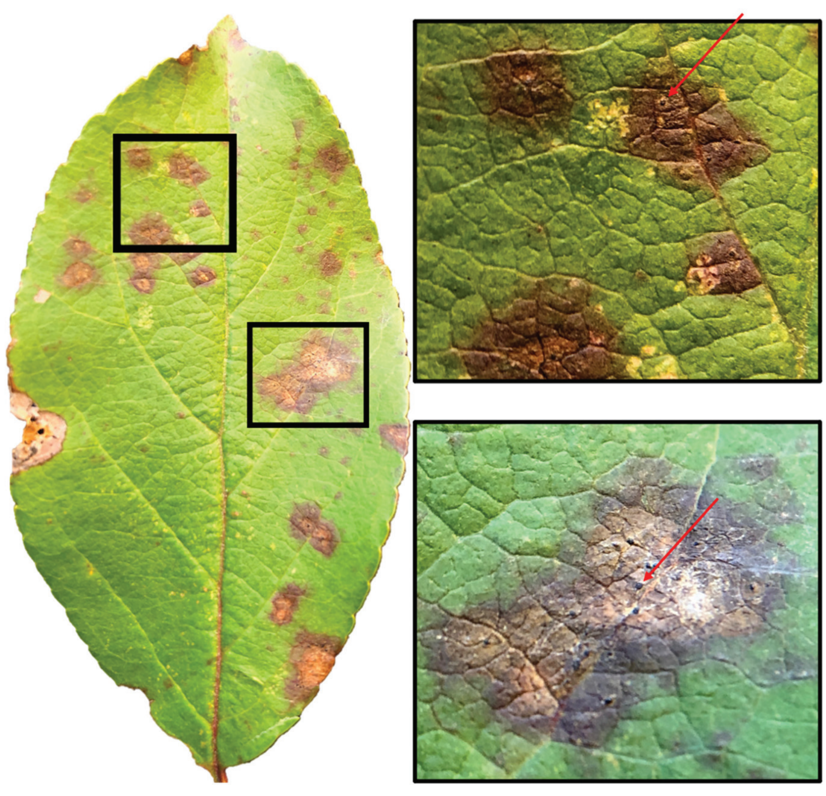

Figure 1. Leaf infected with Marssonina leaf blotch. Red arrows point to magnified acervuli, which are still difficult to see but are a good field diagnostic characteristic.

et. al. (2017) in China tested the strobilurin kresoxim-methyl (Sovran), DMI fungicides (tebuconazole = Tebuzole, myclobutanil = Rally, difenoconazole = one a.i. in Inspire Super, and two others not sold in the US), and Bordeaux mix. Sovran was effective, but performance of the DMIs and Bordeaux were erratic, with tank-mixes of different DMIs or with Bordeaux more effective. This work also recommended an early summer application of mancozeb in addition to DMI fungicides is effective in preventing disease in the field.

A trial looking at fungicide performance against apple fruit rots in Pennsylvania also proved useful in evaluating fungicide efficacy against MLB, and showed that several fungicides were very effective against the disease if applied from pink through the summer (K. Peter). Captan, mancozeb, Luna Sensation, Luna Tranquility and Merivon all provided excellent control. Topsin, Flint Extra, sulfur and the SDHI fungicides (Aprovia, Fontelis and others) gave good to excellent control. Again, these materials are not labeled specifically for use against MLB in the US. However, they may be used to manage other summer diseases such as sooty blotch/flyspeck, bitter rot and black rot. Mancozeb applications made early in the apple growing season targeting apple scab and rusts can also manage early season *M. coronaria* infections in conventional orchards. But mancozeb has a 77-day preharvest interval, so other fungicides or methods need to be used during the summer against MLB. For organic growers, the situation is difficult, as organically approved fungicides, except for sulfur, are not very effective against MLB (K. Peter, personal communication).

Figure 2. Enterprise (foreground) exhibits resistance to Marssonina compared to GoldRush (background).

Selecting disease resistant apple varieties might mitigate the impact of *M. coronaria*. Little is known about the relative susceptibility of apple cultivars to MLB, including the susceptibility of cultivars resistant to scab, and in some cases, other diseases. Commercially available cultivars selected for disease resistance were not screened for tolerance to MLB, as they were bred well before *M. coronaria* was observed on commercial apple trees in the U.S. Additionally, recent breeding has focused less on disease resistance and more on consumer sensory appeal (Peace et. al. 2019). In order to manage MLB, it is important to determine which cultivars currently on the market, or in the ground, are resistant to *M. coronaria.* In this article, two scab-resistant apple cultivars, GoldRush and Enterprise, grown under a low-spray, organic program are assessed for susceptibility to MLB during the 2020 season.

GoldRush is a commercially available scab resistant apple variety bred by the Purdue-Rutgers-Illinois (PRI) apple disease resistant breeding program (Janick 2006). In addition to field immunity to apple scab, GoldRush exhibits high resistance to powdery mildew and is moderately resistant to fireblight. It also stores extremely well, (Crosby et. al. 1994a). Goldrush develops optium flavor/sugars after 4-6 weeks in cold storage. It maintains its flavor and texture for 10-11 months. Quality can be inhanced for the longer storage times if treated with Smartfresh (personal communication, Win Cowgill, Professor Emeritus, Rutgers Univ.). Goldrush makes excellent hard cider as tested by Duane Green in his UMass hard cider apple trial. Is is utilized commercially for hard cider production both in NJ and PA cideries. It is also planted extensively in NJ, PA, and OH, as it has developed a retail sales and PYO following due to its hight desert quality. Goldrush ripens 3-3.5 weeks after Delicous and after Fuji but before Pink Lady. Because of its long maturity development and late harvest, there was concern by northern growers that it would not ripen in some years. Dr. Ian Merwin found that several nights of below 32F will trigger ripening, and it could be harested in good condition. Because of this, Goldrush can usually be harvested in Geneva, NY before it is ready for harvest in Norhtern

NJ. (personal communication, Ian Merwin, Professor Emeritus, Cornell Univ.). Generally, GoldRush is not prone to premature drop.

Enterprise is another commercially-available apple variety developed in the PRI program. This late maturing, approximately three weeks after 'Delicious', apple. Enterprise was extensively tested in greenhouse conditions and proved resistant to apple scab. It is also highly resistant to cedar apple rust and fireblight and moderately resistant to powdery mildew. This apple is reported to keep well, maintaining "excellent" quality up to six months in storage. Enterprise has a severe calcium disorder "Mystery Spot" that limits its commercial acceptance. (Tietjen et.al 1994, Tietjent et. al.1995). While Enterprise has excelent flavor and large size, it also has tough skin. These two issues limit it from being adopted as a retail apple cultivar (Cowgill et. al. 1994). Note that Enterprise is one of the parents of Washington States new club variety Cosmic Crisp tested as 'WA 38', the other parent being Honeycrisp. Of interest is that after 2 years of commerical production Cosmic Crisp is having a calcium disorder problem they coined 'green spot' (Courtney, 2018).

The original Enterprise seedling was planted out in 1982 at the Purdue University Horticultural Farm. The first GoldRush seedling was planted in 1973(Crosby et. al. 1994b). Both cultivars attribute their apple scab resistance to the V_f gene derived from *Malus floribunda* parentage.

Differences in the parentage of Enterprise and Goldrush suggest there may be differences in MLB susceptibility. Two varieties common in the parentage of these varieties have shown susceptibility to MLB, Golden Delicious and Rome Beauty (Li et al. 2012; K. Peter, personal communication, October 9, 2020). Golden Delicious is a direct parent of GoldRush. While Enterprise also has both Golden Delicious and Rome Beauty in its background, it is a direct result of a "sibling cross", where two plants grown from seed of the same fruit are bred together to create the new cultivar, in this case, Enterprise. Enterprise is three generations removed from Golden Delicious and four from Rome beauty. GoldRush has no generational separation from Golden Delicious though it is five generations removed from Rome Beauty, but with fewer intervening crosses than Enterprise. These sibling and other intervening crosses in the parentage of Enterprise as compared to GoldRush make it less directly descended from cultivars known to be susceptible to MLB, suggesting it may be less susceptible to MLB. It appears as though the gene deck is stacked against GoldRush when it comes to Marssonina.

In the comparison of MLB susceptibility of GoldRush and Enterprise, a rating scale of 0 to 9 was used to quantify disease severity, with 0 having "no visible lesions", and 9 showing "tree almost completely bare, only few leaves left on top or side branches" (Bohr et. al. 2018). Four trees were selected at random from each of six rows from each cultivar providing 24 trees as-

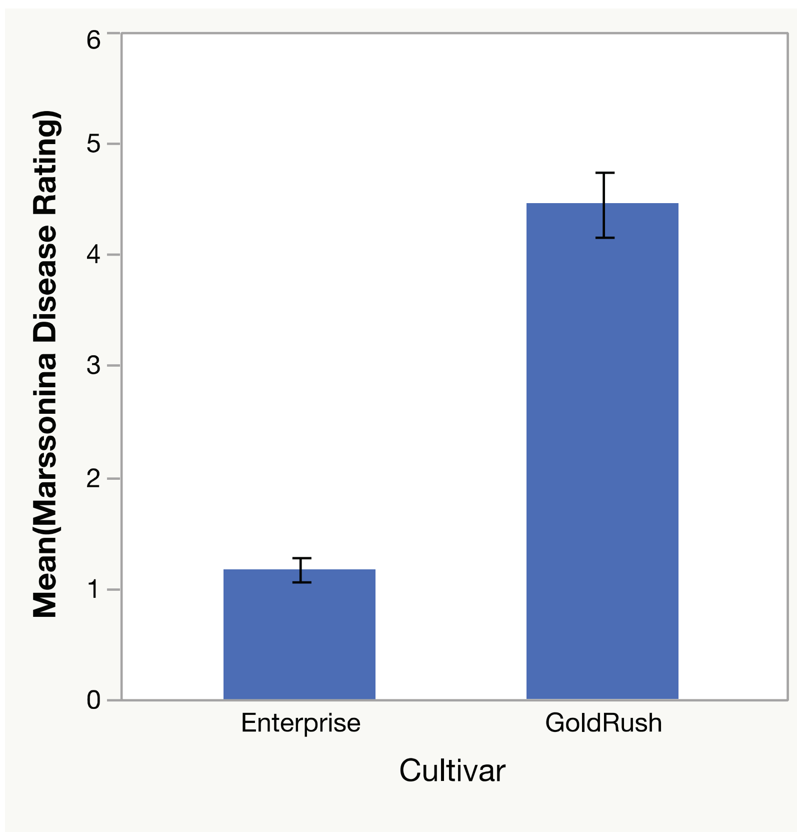

Figure 3. Each error bar is constructed using one standard error from the mean.

sessed per cultivar and a total of 48 trees assessed. All trees assessed had symptoms of MLB. The severity of MLB on GoldRush was significantly higher than that of Enterprise (Figure 1). MLB can also cause premature fruit drop in GoldRush, which appears to be more susceptible than Enterprise (Figure 2).

MLB apparently is becoming established in our region, and when traditional fungicide applications are stretched, or in the case of some low-spray or organic orchards, eliminated altogether, significant damage can occur. As MLB becomes more prevalent it is increasingly important to understand which varieties are more or less susceptible. Some evaluations of commercial cultivars in China (Li et al. 2012) show there are significant differences. Wöhner and Emeriewen (2019) identified differences in cultivar susceptibility drawing on several sources in their review of MLB. However, they rate Honeycrisp as resistant, while experience in the Northeast indicates it is quite susceptible. More research on resistance is needed. Unfortunately, it appears that available disease resistant varieties may not fare any better than many commercial varieties against MLB. Identifying which varieties are tolerant and which susceptible to the disease is a critical first step in managing this emerging disease.

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Northern New Jersey Report, As Presented at the NEIPM Conference on October 2020

Win Cowgill

Professor Emeritus Rutgers University, Win Enterprises International, LLC

Spring Weather

It was a tough spring for New Jersey growers. We started the season almost 3 weeks early with green-tip in Hunterdon County on March 16. While peaches were early as well, they have managed to move through bloom. Apples dragged along and were at tight cluster to early bloom on April 28 on many varieties depending on location and orchard exposure.

In North Jersey, nine freeze events occurred: 4/17, 4/18, 4/19 and 4/20, 4/22, 4/23, 5/8, 5/12, 5/13. Some apples were hurt in southern NJ. Cold events ranged from 32F down to 23F, but not every farm had all events. Bloom and post bloom damage occurred at most orchards, some severe some minimal, some lost whole crops, apples and or peaches. Damage depended on location, cultivar, stage of bloom, etc. Three types of damage was observed: ovary, stigma (where pollen germinates) and style, anther (pollen)- & filament. Some had all three areas injured. Overall, I gauged the apple crop at 60% of a normal crop in NJ.

Apple Thinning

Fruit set and thinning were a challenge this year with these cold events. I had several growers use Pro-

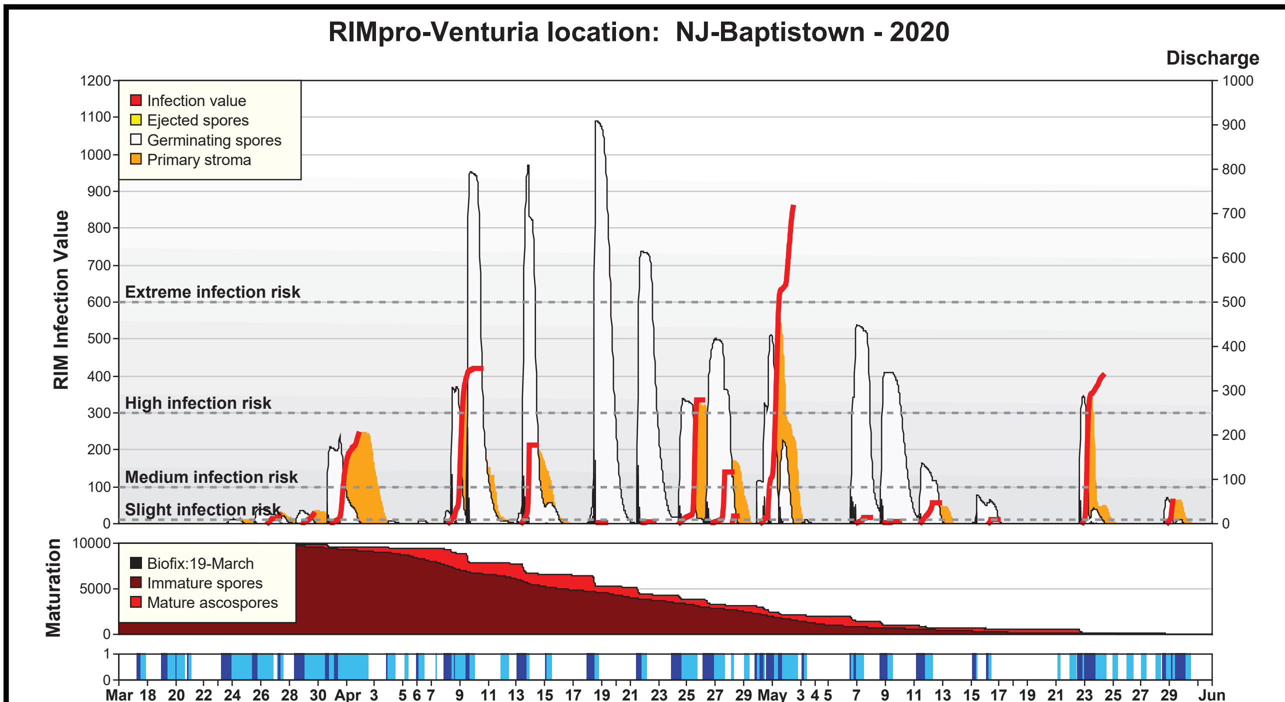

Figure 1. Rimpro Apple Scab (Ventura) Baptistown, NJ for 2020. Rimpro indicated a slight scab infections occurred on 3/28, 29, 30 with a medium infection on 3/31-4/1. A high infection risk on 4/9 followed by a medium infection risk event on 4/13. High infection risk on 4/26, medium 4/28 with an extreme risk infection event on 4/30-5/1. Slight infection risk events on 5/7, 9, 12, 16 with a high infection 5/23 and a last slight infection 5/29.

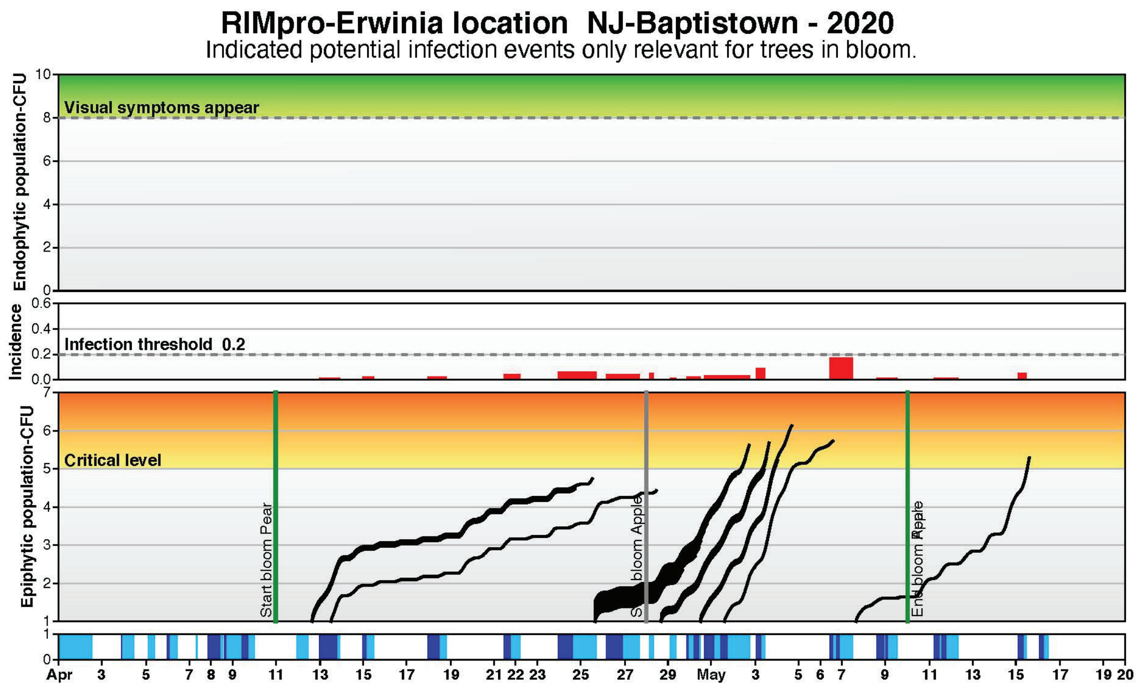

Figure 2. Rimpro Fireblight (Erwinia) Baptistown, NJ for 2020. Firblight infections reached critical levels on several dates according to Rimpro but none reached the infection threshold of 0.2. The Critical fireblight potential infection of May 16 did not reach the infection potential of 0.2 but on NEWA (see Figure 3) it reached 113 EIP which is the minimum for infection. Growers with open bloom should have sprayed on the May 15-17 with Strep.

malin or Perlan to help set apple fruit during several of the most severe events, with some success. We also enhanced typyness on many varieties, like Gala, with the Promalin treatment. A few growers on a few cultivars needed to bloom thin, but many held off. Where fruit set appeared strong, we thinned at petal fall and often applied a second 8-14 mm spray. Many growers with rapidly sizing fruit felt they needed to thin again at 14-18mm. The Cornell Carbohydrate Thinning Model showed a severe carbohydrate deficit during this time period. Even though we were we were conservative with this spray, some blocks thinning more than desired (overthinned), resulting in some reduced crop.

Diseases

Apple Scab and Fireblight were monitored with NEWA (http://newa.cornell.edu/) (Milford, NJ) and Rimpro (https://www.rimpro.eu/) at my location (Baptistown, NJ). Rimpro is a paid subscription service at your location using either your own weather station data or using virtual weather forecasting via Metro Blue. NJ maintains a set of weather stations in NJ through the Rutgers NJ weather network (https://www.njweather.org/), and NJEAES/Rutgers Coop. Extension pays Cornell Subscription fee. You also can have your own weather station and pay NEWA a subscription fee directly to Cornell for connection.

Fireblight was not a severe issue in Northern NJ in 2020. Several fireblight infection events occurred during bloom. Growers that used the program of applying low rates of Apogee beginning at pink, through first cover fared best with the least amount of infection. Note that I work with growers in 5 states. One grower in Orange County, NY had a severe fireblight outbreak in a newly planted block of mixed apple varieties. The Rrimpro and NEWA models showed close to 20 days of high susceptibility. Several streptomycin sprays did not control the infection, since they were not started soon enough, and not enough applications were made. It appears that fireblight may have come in on the susceptible M.9 Nic 29 rootstock from an out-of-state nursery. Tested by Cornell it was not a streptomycin-resistant strain. Late-blooming, newly-planted apple trees are always at risk for fireblight and must have the flowers removed before blooms open or be covered with streptomycin 24 hours before and after infections. A low-dose apogee program would also be helpful.

We are working on a new gibberellin formulation that will be used to treat trees in the production nursery to eliminate bloom of trees when they are planted in the orchard, this will be a big boon to apple growers. It looks very promising.

Brown Marmorated Stink Bug

We had several large populations of brown marmorated stink bugs (BMSB) in Northern NJ in late August through September that apple growers needed to treat. Rutgers has NOT been obtaining section 18's on key insecticides (Including Bifentrhrin) for the past 3 years, so options were limited for control. Fortunately, thanks to Peter Jentsch/Cornell, we had the use information and the newly labeled Venerate XC biological insecticide that works on BMSB, and other insects to keep them from feeding on fruit. Several growers were able to applied Venerate XC to several large Honeycrisp blocks with good control. From Peter Jenstch -Cornell Blog: http://blogs.cornell.edu/jentsch/2020/08/24/management-options-for-the-stink-bug-complex-on-pome-fruit-near-harvest-august-24th-2020/.

Fire Blight Risk Predictions for Milford

Orchard Blight History: Fire blight occurred in your neighborhood last year.

Select the fire blight history in your orchard block of interest and the tool will calculate risk. Toggle orchard blight history to recalculate risk.

First blossom open date: 4/19/2020 Click if bloom has not occurred

The first blossom open date above is estimated based on degree day accumulations. Enter the actual first blossom open date for your orchard block of interest and the tool will calculate the protection period during bloom more accurately.

Accumulated degree days (base 43°F) through 5/13/2020: 584 (0 days missing)

	Past	Past	Current	5-Day Forecast	Forecast Details			
Date	5/12	5/13	5/14	5/15	5/16	5/17	5/18	5/19
Cougarblight 4-Day DH	Low 0	Low 7	Low 37	Caution 298	High 462	High 473	High 454	Caution 196
Infection Potential EIP value	Low 0	Low 0	Moderate 3	High 74	Infection 113	Low 75	Low 37	Low 0
Wetness Events								
Rain Amount	0.00	0.00	0.02	0.29	Night 10% Day 10%	Night 35% Day 50%	Night 60% Day 50%	Night 49% Day 30%
Dew	No	No	No	Yes	Yes	No	No	No
Leaf Wetness (hours)	0	0	9	15	0	0	0	0
Hours >90% RH	0	0	0	0	0	0	0	0
RH max/min	70/28	81/25	85/38	84/51	87/47	80/58	84/68	84/59
Temp avg F	49	48	51	70	63	58	58	55

NA - data not available View Cougarblight Charts Download Time: 5/14/2020 9:00

Figure 3. NEWA Fireblight (Erwinia) Milford, NJ for 2020 (12 miles from Baptistown in Figure 2.) In this NEWA fireblight forecast for Milford we reached 113 EIP which is the minimum for infection (100EIP.) Growers with open bloom should have sprayed on the 15-17 with Strep based on this forecast.

Venerate XC is a novel approach. Keeping BMSB from feeding on the fruit is at the crux of our stink bug management program as we near harvest. Killing the insect as it moves into the orchard and onto the fruit is the traditional method of crop protection and proven to be very effective. Yet limitations, based on the material pre-harvest intervals constrain their use near harvest. There are no effective pyrethroids, neonicotinoids or pre-mixed insecticide tools that permit their use within the 7-day to harvest window with very few options available during the days prior to fruit harvest. The development of newer classes of insecticides that produce an anti-feeding response in the pest provides an additional mode of action for BMSB management. Both Corteva insecticide Closer 240 SC (classified as a Group 4C insecticide / neonicotinoid – 7 days to harvest) and Venerate XC (microbial-based insecticide with multiple modes of action and 0 days to harvest) have anti-feeding activity against BMSB. The 0 days to harvest of Venerate provides BMSB management up to the day of harvest under high risk conditions. Peter's complete study on Venerate Xc can be found in his 2017 report, https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/f/3191/files/2013/10/2017-Final-Report.8.14.18-pnm7v2.pdf.

The Venerate XC label requires a 4 hr. REI and has a 0 days PHI. In mixed blocks often requiring multiple picks, the use of Venerate XC has been shown to effectively reduce BMSB feeding injury to fruit 7 days prior to harvest. Although this insecticide provides no toxicity to the insect, it effectively reduced feeding over 7 days. A Technical Information Bulletin is available for the use of Venerate XC bio-insecticide brown marmorated stink bug on apple.

Fruit Notes

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