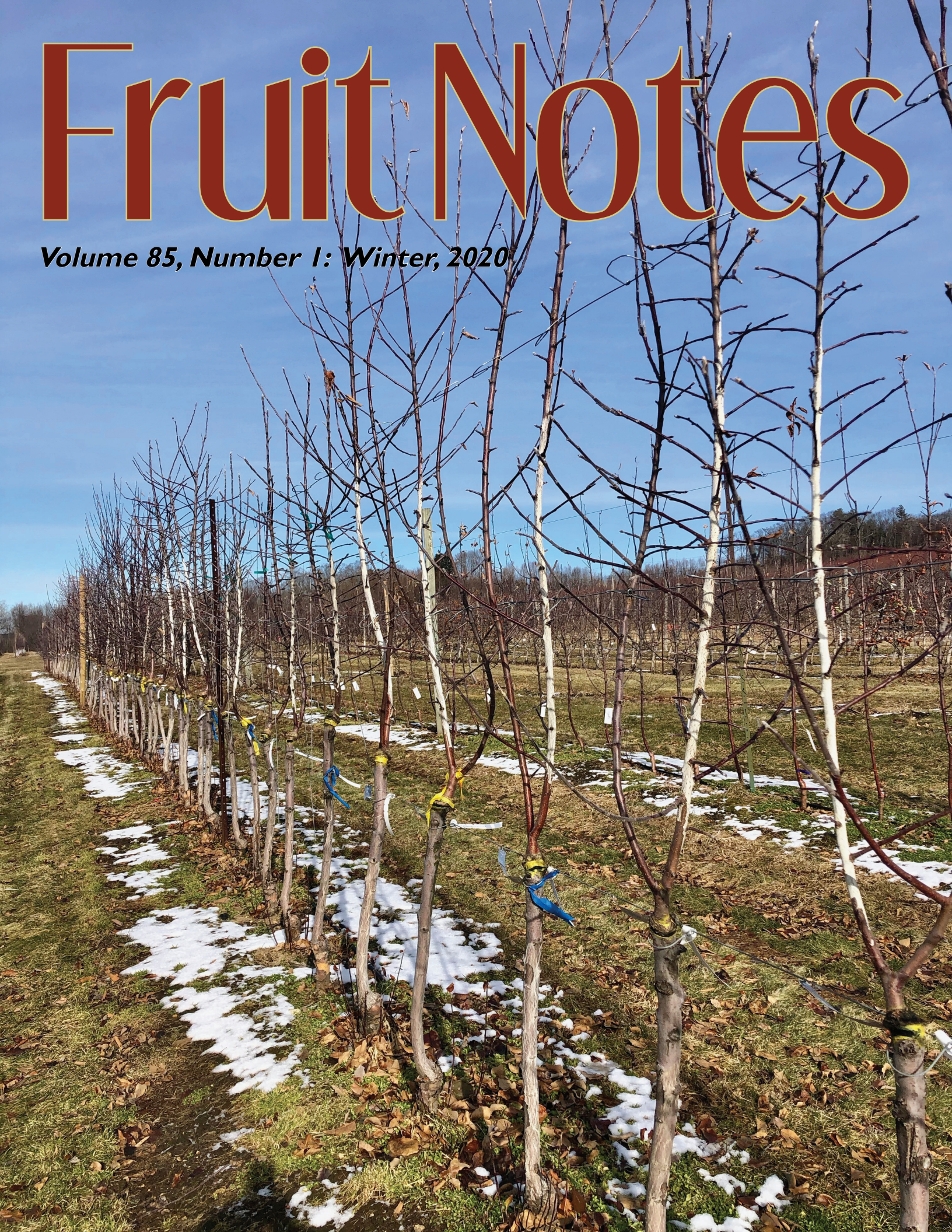
Fruit Notes

Volume 85, Number 1: Winter, 2020



Fruit Notes

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

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Cover: Cover: Bi-axis top-worked cider apple trees with branching treatments on January 7, 2020 after two growing seasons at the UMass Cold Spring Orchard Research & Education Center, Belchertown, MA. See article on page 22. Photo: Jon Clements.

Massachusetts Fruit IPM Report for 2019

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

Weather

Low winter temperature(s) recorded at the UMass Cold Spring Orchard was -6°F. on January 21, January 31, and February 1, 2019. January 31 through February 2 marked three nights of sub-zero temperatures between -5°F. and -6°F. While there was some consternation about stone fruit flower bud damage, in the end, with some exceptions, the stone fruit crop was very good in 2019. Continuing a recent trend, green tip on apple was about on time if a little early (April 12). However, a cool May (Figure 1) delayed apple bloom somewhat (May 12) and then we were in for a prolonged bloom period. Pollination weather and bee flight appeared to be so-so, however, a heavy crop was generally set (except where a heavy crop was observed in 2018, then for example, some Honeycrisp blocks were very light set). Again, continuing a recent trend, the summer was hot (mostly July, Figure 2), but with adequate precipitation season-long (Figure 3). The peach crop enjoyed this weather and was one of the best in terms of quantity and quality in years. August was not particularly hot, with some low temperatures in the 50's beginning early in the month. Apple red color benefitted. Unlike in recent years, September was also not hot, but it was dry. All which generally favored the harvest of a nice crop of apples.

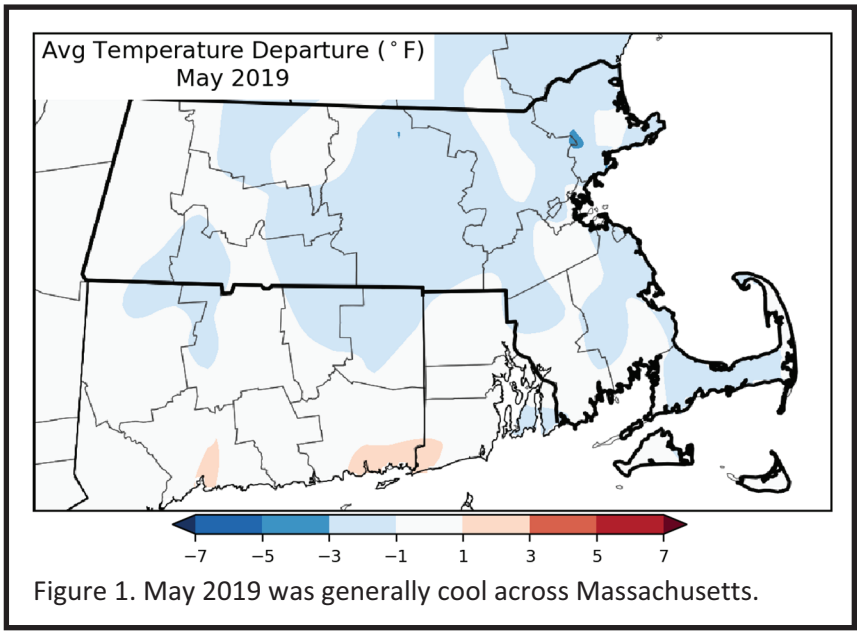

Figure 1. May 2019 was generally cool across Massachusetts.

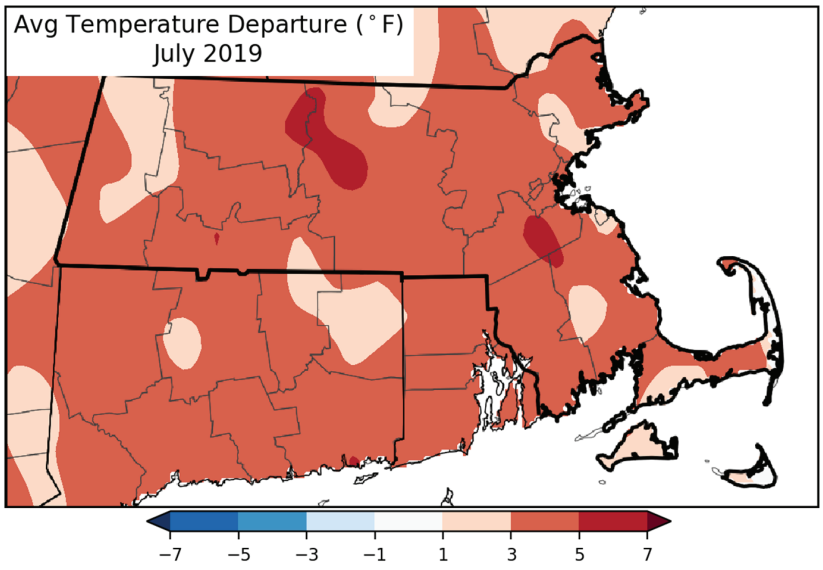

Figure 2. Air temperature prevailing during July 2019.

Diseases

The spring started off wet, making orchard access difficult. These conditions exacerbated last fall's rainy weather leading to a few,

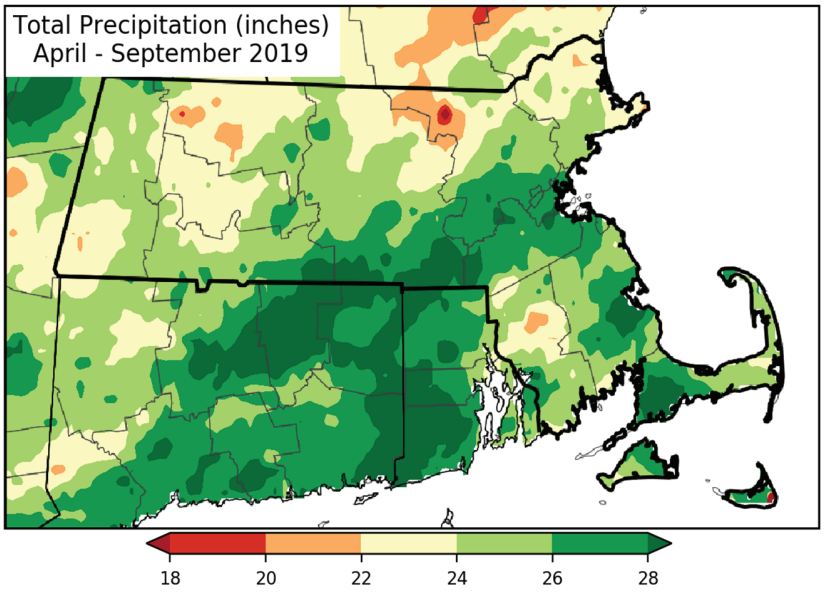

Figure 3. Rain was generally adequate during the 2019 growing season. However, not the same state-wide.

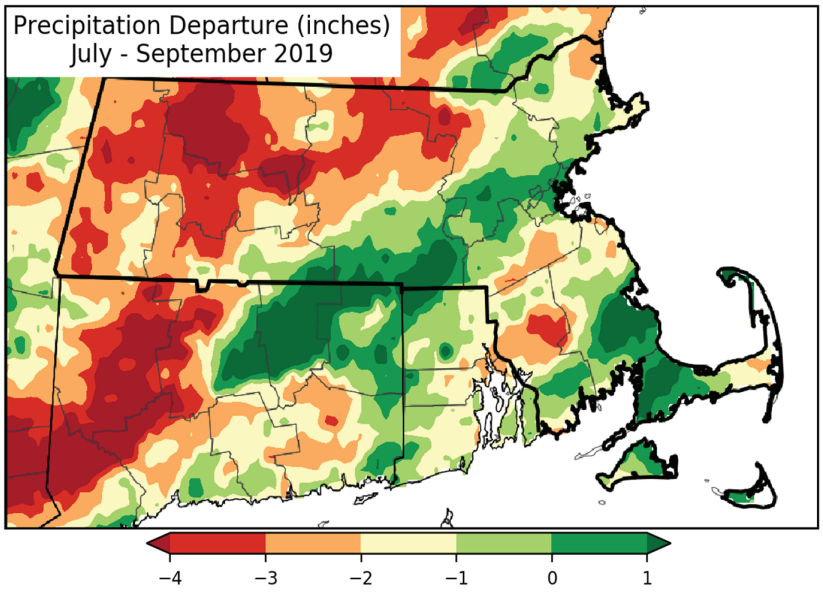

Figure 4. Summer precipitation during the summer of 2019 was normal to dry in most of the state.

isolated, **Phomopsis** outbreaks. While these may have looked bad (and caused a fair amount of panic), they did not seem to progress once pruned out.

Muddy orchard conditions also made early season disease management difficult, in general. Some **apple scab** cropped up, especially in blocks where inoculum has been historically high. While the better part of primary scab was fairly readily managed, enough infections were established to lead to some fruit damage. At the UMass Cold Spring Research Orchard, we had both RIMpro and NEWA running for Decision Support Systems. Between April 12 (GT) and June 10, RIMpro estimated 6, multi day, infection events with RIMs exceeding the 100 level. NEWA estimated 16 separate infection events over the same time frame.

As shown in Figure 5, only about 2% of the fruit sampled at harvest had scab lesions. Fly speck was a complete no show and sooty blotch barely present. Similarly, the fruit rots that were so prevalent last year did not appear this year. The precipitation during the summer was drier than normal to normal over the state (Figure 4) accounting for less summer disease pressure. Growers were prepared to spray fungicides for summer rots and diseases this year, given last year's problems.

Insects

In 2019, the most challenging insect pests in Massachusetts in several orchards seem to have been, in this order: codling moth and other Lepidoptera, plum curculio, stink bugs, and mites. The least damaging or almost non-existent pests were leafminers and European sawfly.

Brown marmorated stink bug (BMSB). In 2019, 12 BMSB monitoring sites were established in MA orchards, in cooperation with private consultants. Four of these sites were used to assess the potential of the ghost trap as a means of managing late season BMSB damage, especially in PYO blocks where insecticide residues are not permissible. Fruit in blocks adjacent to the ghost traps were evaluated to determine if the proximity of the traps to the blocks increased stink bug damage. After last year's big (big for Massachusetts, anyway) trap captures, we were all geared up for even higher numbers

Table 1. Summary of precipitation and scab infection events by date, recorded at the UMass Cold Spring Orchard (Belchertown, MA).

2019 Apple Scab Summary UMass Cold Spring Research Orchard				
Precipitation			Infection Event (date initiated)	
Date	# Days with Rain	Total Rainfall (inches[a])	RIMpro- RIM value[b]	NEWA Y/N
4-12	4	1.36	2 (4-15)	Y (4-12) (4-14)
4-18	7	2.03	1770 (4-20)	Y (4-19) (4-21) (4-24)
4-26	5	2.69	182 (4-26)	Y (4-26) (4-28)
5-2	6	0.61	2246 (5-3)	Y (5-2) (5-7)
5-12	3	1.14	1507 (5-10)	Y (5-12)
5-17	1	0.19	1 (5-17)	Y (5-17)[c]
5-23	4	0.75	1 (5-23)	Y (5-23)
5-28	1	0.44	857 (5-28)	Y (5-28)
6-2	2	0.30	0	N
6-10	7	1.62	133 (6-11)[d]	Y (6-10) (6-14) (6-16)

[a]Precipitation events with less than .10 inches of rain are not recorded here as they are not considered sufficient to trigger an infection event.
[b]RIM values less than 100 are not considered "significant" infection events, for practical management purposes. RIM values represented here are the total value for a combined infection event, not each day's discreet RIM value.
[c]NEWA estimated essentially all ascospores were released May 17.
[d]The final primary scab even estimated by RIMpro was 6-10 and exceeded the 100 RIM necessary to make it a "significant" infection event.

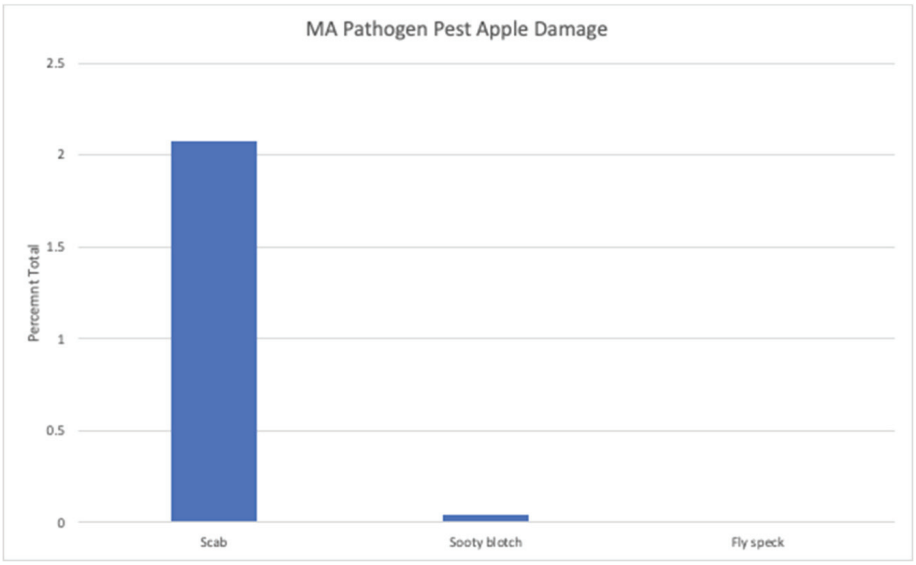

Figure 5. Percent fruit damage from the three most common fungal pathogens. A total of 2,650 apples were sampled from five orchards in Massachusetts.

this year. Not all that much actually showed up though. Neither ghost traps, nor pyramid traps caught anything like what we had expected. The cool weather for the first part of the summer might have slowed down stink bug development. While stink bug damage was documented in several apple blocks, whether or not that damage was from invasive or native stink bugs has yet to be determined.

Codling moth (CM). Reports indicate that for about 5-6 years, we've gone from CM being an occasional pest to posing a serious problem –particularly for the last 2 years. A couple of MA orchards reported injury by this pest.

Oriental fruit moth (OFM) still seems to hang mainly in peaches but occasionally in apples -- a couple of people that were using mating disruption in small stone fruit plots had significant activity from (presumably) mated females flying in and laying eggs.

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

PC adults seemed to come and go in a fairly 'normal' pattern, although the cold, wet spring got

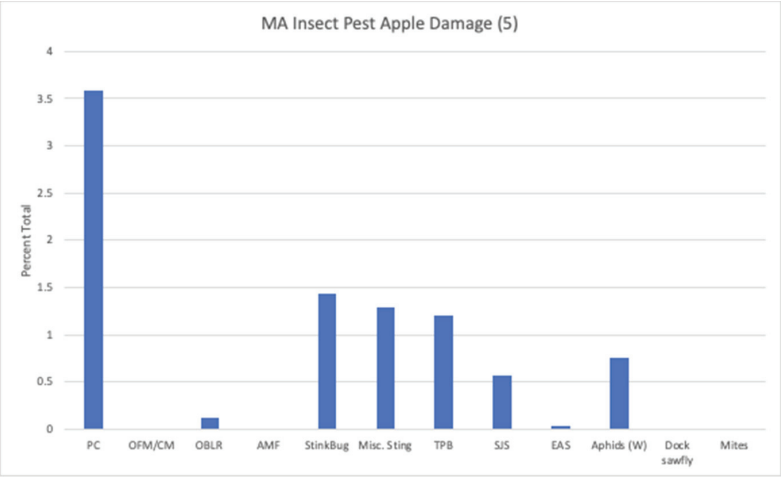

Figure 6. Percent fruit damage from the 13 most common insect pests of apple. A total of 2,650 apples were sampled at five orchards in Massachusetts.

them to a slow start. Such a weather pattern also resulted in an extended period of PC activity which, for the first time in several years, was difficult to monitor using odor-baited traps. Table 2 shows that 2019 had the lowest average air temperature for the month of May, when compared to the three preceding years. For example, in 2018 the average temperature during May was about 7 degrees higher, with more comparatively 'warm' days. It seems that the 2019 May weather was similar to 2017 in terms of temperature (both years were similarly cool), although in 2017 the amount of precipitation during May was nearly twice as much the amount received in 2019.

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

Apple maggot fly (AMF). AMF populations appeared and peaked later than usual. There was high variability in AMF pressure across orchard blocks, but in general populations were not high. The final insecticide in August usually seems to take care of late-appearing AMF. Preliminary research was initiated to determine whether perimeter-row sprays in association with semiochemicals would result in adequate levels of AMF protection. See Fruit Notes article reporting on the main 2019 findings of that research.

Tarnished plant bug (TPB). On April 14, 2019, the first TPB adults were captured in white sticky cards (two TPB adults in six traps) deployed at the UMass Cold Spring Orchard. It seems that TPB was well controlled in most orchards.

Oblique-banded Leaf Roller (OBLR). Current control strategies implemented by growers seem to be working well.

Mites were, generally speaking, not a big problem. When they cropped up, it was often in limited areas in some cases limited to single limbs. It is possible that such spotty presence may due to uneven coverage with oil since application conditions were so challenging.

Red-banded leaf rollers presence was documented in a couple of orchards, but fruit injury was not evident.

Wooly apple aphid continues to crop up in more places where it was not previously seen, both in old standard type trees as well as high density plantings.

Fruit injury at harvest. The level of fruit sampled at harvest showing insect damage (expressed as percentages) is presented in the Table below (from two MA orchards) - data are presented separately for perimeter rows and for block interior, and also in Fig. 6 (from five MA orchards).

Table 3 shows infestation data collected at harvest in two MA commercial orchards. Note the comparatively high percentage of fruit with PC scars in the perimeter of one block. Injury by AMF was confirmed via incubation of individual fruit sampled from trees, which were kept in individual containers with sand (pupation substrate) for 5 weeks. Fruits were dissected and a determination was made of whether injury was caused by AMF (presence of larvae / pupae) or by stink bugs (presence of feeding tube).

As shown in Figure 6, Oriental fruit moth (OFM) and codling moth (CM) (here, considered together as

Table 2. Air temperature and rainfall recorded during the month of May over a 4-year period (2016-2019) at the UMass Cold Spring Orchard (Belchertown, MA).

	Avg. temperature (May)	# of days with max. temp ≥ 70°F	# of days with max. temp ≥ 80°F	Total rainfall (inches)
2019	55.5	9	1	3.3
2018	62.0	20	9	1.6
2017	56.3	9	3	6.7
2016	59.0	16	6	2.5

internal lepidoptera), and plum curculio (PC) caused the greatest amount of damage while European apple sawfly (EAS) caused relatively minimal damage. Miscellaneous sting is considered any damage where the cause is indeterminable.

Horticulture

Chemical fruit thinning remains one of the most challenging AND most important spray(s) of the year. Some of my "adventures" in apple chemical thinning in 2019 follow.

The nibble fruit thinning approach as espoused by Dr. Duane Greene was advisable. This includes using NAA (Fruitone, PoMaxa), carbaryl (Sevin), and 6-BA (Maxcel, Exilis) at the appropriate timing (beginning at bloom and continuing through 10-12 mm fruitlet size) and during good weather (warm, partly cloudy, neither of which occurred together at a particularly good time).

Still, this approach generally resulted in inadequate thinning. Apple trees were rarely under considerable carbohydrate stress during most of the chemical thinning window (Fig. 7) for chemical thinners to be particularly effective. But, it (nibble approach) definitely did some thinning. Some might argue the results were acceptable. But I am tired of too many small, clustered-up apples, particularly when it comes to crop-load sensitive varieties like Honeycrisp wherein fruit quality (size, red color, and flavor) suffers.

Table 3. Level of perimeter-row and interior-row injury caused by insect pests recorded at harvest in two Massachusetts orchards.

Insect pest	MA orchard 1		MA orchard 2	
	Perimeter row	Interior	Perimeter row	Interior
PC	8%	0.45%	1.76%	0.63%
PC feeding or similar type of damage	0%	0	1.47%	2.5%
Late-season stink bug	0.33%	0	1.18%	0.63%
Early-season Hemiptera	1.67%	1.36%	2.35%	1.88%
AMF	0.33%	0	0.88%	0.63%
Rollers	0	0	0.29%	0
OFM	0	0	0.58%	0
CM	0	0	0	0
EAS	0.33%	0.45%	0.29%	0

The Pollen-tube-growth Model. New this year, I followed it (the PTGM, https://ptgm.newa.cornell.

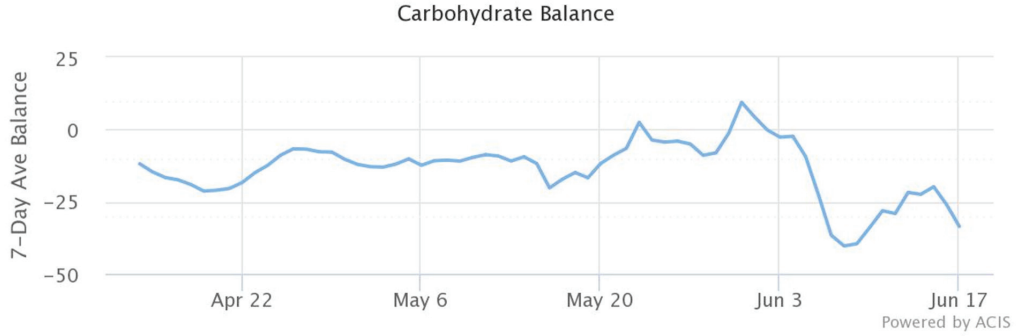

Figure 7. Carbohydrate balance at UMass Orchard. Note carbohydrate deficit was minimal during most of the chemical thinning window from app. May 15 through May 25.

fur application, all other trees received the standard UMass chemical thinner application(s), whatever that was. I won't bore you with all the details, you will have to wait for an upcoming jmcextman blog or *Fruit Notes* article, but suffice it to say, in the end, still too many apples at harvest. Too many.

edu/) closely, fully intending to apply lime sulfur to a block of Honeycrisp. Which I did. The result, it smoked the flower petals (see picture below) at a high rate! I was pleased. I was so pleased — and a bit scared! — that I did not follow-up with another application of lime sulfur, which is advised to get that last cohort of flowers, including lateral bloom, that was pollinated. Kind of a mistake, as although the lime sulfur spray at bloom definitely resulted in king fruit set only (mostly?), at the end there was still too many apples on these trees! Hand thinning followed in the summer. Note to self, don't be gun shy, follow the recommendation of the PTGM. Of course, if I do it again next year, and apply lime sulfur twice, I will probably strip the trees. (Would not be the first time, see below.) So, who out there is willing to give bloom thinning with caustic thinners a go in 2020?

Malusim app and the fruitlet growth rate model. I used the Malusim app (https://malusim.org/) in its first year of general release to help measure apple fruitlets and predict fruit set (using the fruitlet growth rate model.) Four varieties — Pazazz, Gala, Fuji, and Honeycrisp. Two sets of trees — five trees per variety, five (only) flower clusters per tree. Only 25 flower clusters per variety. Suppose to do 75. (Trying to see how little I can get away with, yup, I'm lazy, I'll admit it. The result, well, interesting. Seems like things were pretty much on track, with the exception of the lime sul-

Yes, you can, strip trees of apples that is. Using ethephon. And 6-BA. And Vydate. Yup, I did it, Golden Delicious, really sick of hand thinning in the past, so a tank mix of above did it. And fruits were about 1-inch diameter! Bottom two-thirds of trees, all apples fell off beginning about a week after application. Interestingly, top one-third of trees had a nicely thinned crop. Shows you where the spray hits and where spurs are weaker (more shaded). Also, there was a pretty good carbohydrate deficit around application. Good thing I don't make a living doing this.

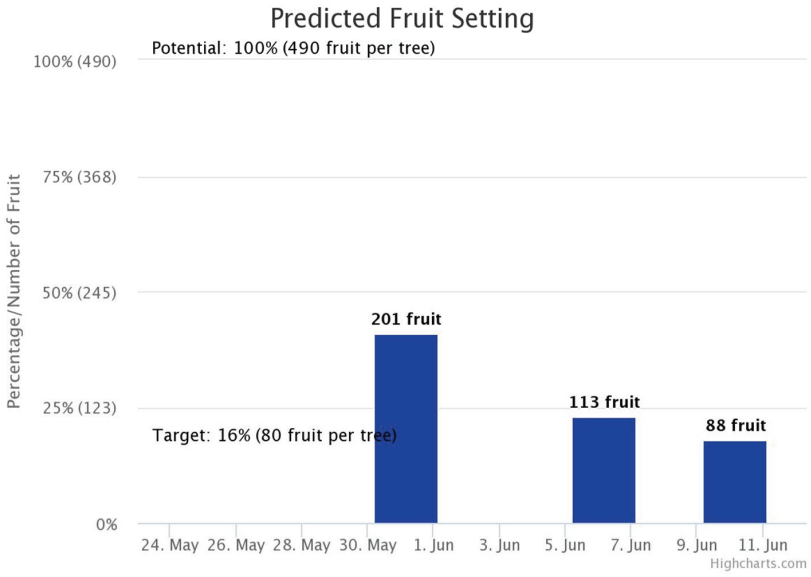

Figure 9. Malusim app output for Gala at the UMass Orchard. Although it appeared the target was being approached, in the end at harvest there were still too many apples on these trees to achieve optimum fruit sizes and profitability.

Figure 8. Honeycrisp flowers on May 17, 2019 after application of 4% lime-sulfur.

Multiple applications of ReTain, again using Duane Greene's recommendation, did a nice job of holding Honeycrisp on trees and they took on real nice color in October. (Wish I had taken a picture!) Anecdote from another PYO orchard confirms this approach. For more information: http://umassfruitnotes.com/v83n3/a1.pdf.

Small Fruit IPM

Winter Moth (WM). WM egg hatch occurred this year on or around April 10th in the Southeastern Counties of the state. Egg hatch was spread over a fairly long period of time due to cool temperatures, but populations were very low and little significant damage occurred. This is widely thought to be the result of Cyzenis albicans parasitoid releases from prior years. There was some evidence of WM migration to more westerly counties in the state in 2019 where they have not previously been thought to overwinter. Dr. Joe Elkinton is monitoring this migration and feels that it may be the result of hybridization with Bruce Spanworm rather than because of any climate change effects. There does not seem to be a reason to worry about this leading to WM outbreaks in either forest trees or fruit crops (blueberry or apple), but his lab is monitoring to verify that.

Gypsy Moth (GM). We have reported on this pest in past years when the drought in 2016 set off an outbreak of GM in 2017 and some residual pockets of high damage in 2018. The Small fruit crops that were most affected in those years were blueberries and grapes. In 2019 the state did not produce an aerial survey map of GM damage due, most likely, to low populations. There were some reports of light infestation on fruit farms but growers were aware of what to look for and control was easily accomplished.

Spotted Wing Drosophila (SWD). The UMass statewide monitoring network was not implemented in 2019. Instead, our efforts were focused on (1) field trials for monitoring and possibly mass trapping, (2) bait/lure evaluations, and (3) laboratory investigations of the feeding behavior and physiology of this invasive pest. Piñero et al (2019) reported on the high attractiveness of Concord grape juice, a low-cost and readily available material, to male and female SWD. When diluted at a ratio of 1 part of grape juice and three parts of water, diluted grape juice showed to be 3 times more attractive to male and female SWD than one commercial lure under field conditions. Grape juice diluted at the 1:3 ratio also attracted significantly fewer (about three times less) non-targets than the commercial lure, highlighting the greater selectivity of grape juice.

In 2019, we also compared the SWD-capture efficiency of traps baited with commercial lures against that of traps baited with diluted grape juice early in the season at five MA locations. Diluted grape juice was the only attractant that detected SWD during the month of May. During June, while commercial lures also attracted SWD, the numbers of SWD were greater in the diluted grape juice-baited traps. In addition, traps baited with diluted grape juice captured most (89%) of the females that were trapped over a 6-week period, highlighting the effectiveness of this inexpensive material for SWD monitoring. Cage studies revealed that nearly 90% of the SWD females that were released inside cages were killed by traps baited with diluted grape juice within a 24-hour period, whereas traps baited with commercial lures killed less than 50% of the females over a 24-hour period.

Spotted Lanternfly (SLF). No SLF reports in Massachusetts in 2019 (aside from 1 dead SLF found on imported ornamentals in Boston). On February 7th, 2019, and with support from the Massachusetts Department of Agricultural Resources, a Spotted Lanternfly Preparedness Conference was coordinated by UMass Extension. It was attended by over 240 people. We also did some grower outreach with educational materials and will continue these efforts in 2020.

Massachusetts IPM Berry Blasts/Healthy Fruit

Newsletter Small Fruit section. Fifteen issues of Massachusetts IPM Berry Blast (508 subscribers), were sent out during the 2019 growing season. These covered IPM recommendations for a wide range of pests and disease problems in berry crops. A condensed version of this information was also included in 16 issues of the Healthy Fruit newsletter (165 subscribers).

Special Projects

Northeast Cider Apple Project (NECAP). This 3-year project funded by NESARE is being led by the University of Vermont with collaborators from UMass and UMaine. At UMass, D. Cooley, J.C. Piñero, J. Clements, and E. Garofalo will evaluate at least five cider orchards throughout Massachusetts for insect and disease incidence on cider apples, and will also evaluate horticultural and fruit quality characteristics to develop fact sheets and recommendations for both established and new growers of cider apples. And video! https://www.youtube.com/channel/UCWrmWfBqbcK8FgjV-TuRT0Gw.

MyIPM app. This 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/

Publications

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Research/Extension grants received

Piñero, J.C., Wallingford, A., and collaborators. Multicultivar grafting: a novel low-cost, grower-friendly Attract-and-Kill approach to manage key apple pests in New England. NIFA Crop Protection and Pest Management program (9/1/19 – 8/31/2023). $324,246.

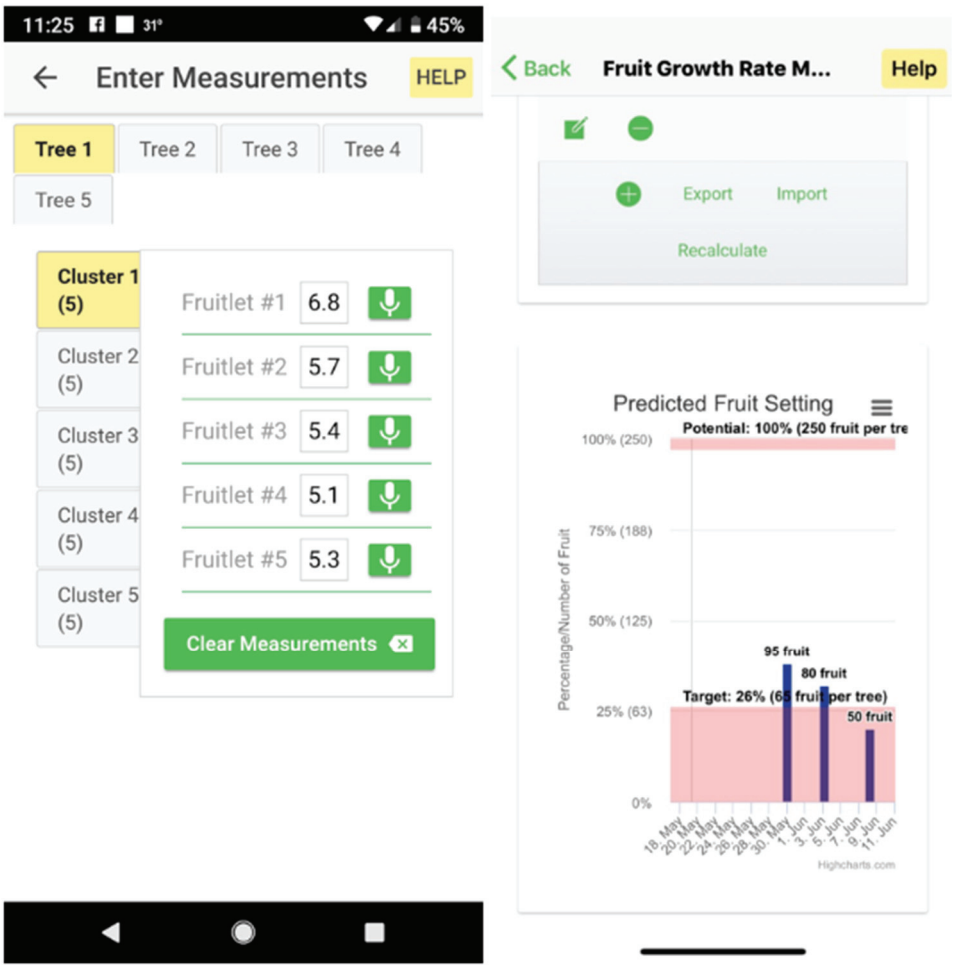
Malusim App and Precision Apple Thinning – Trials and Tribulations

Jon Clements
University of Massachusetts Amherst

Malusim is a web and smartphone app that includes the fruitlet growth rate model, apple carbohydrate model, and an irrigation model. In 2018, the app was in beta-test mode, but in 2019, was in public release and is available on the web (malusim.org) and in the Apple iOS and Google Play stores for smartphones. The Malusim app provides both keyboard and voice input (smartphone only) for entering fruitlet growth measurements and immediately charts predicted fruit set (percent or actual numbers of fruit) of the desired final apple crop load. It has the potential to be a very handy tool to simplify the predicting-fruit-set procedure; however, further refinement of the app is necessary to achieve full potential.

Basic use of the Malusim app includes creating a location (orchard block), providing location details such as a NEWA weather station (not necessary for the fruit-growth model), variety, tree spacing, emitter spacing, etc. Before measurements for the fruit-growth-rate model can be entered, number of trees/clusters/flower clusters per tree and target fruit per tree must be specified. Then, fruit growth measurements can be entered manually or by voice input or imported or exported.

The Malusim app was used for predicting fruit set on Honeycrisp, Gala, and Fuji apple trees using voice input in the field in 2018 and 2019 at the UMass Orchard in Belchertown, MA. Instead of using the



Malusim smartphone app screen shots for entering fruit growth rate and predicting fruit set.

recommended five trees and 15 clusters per tree, only five clusters per tree were measured on five trees. All were on M.9 or B.9 rootstocks, the objective being reducing the number of measurements made, and hence speeding up the process using the Malusim app and the predicting-fruit-set model. In general, the voice input worked OK, but one had to be methodical and continually check to make sure the app was recording the measurements correctly. Using voice input makes the predicting-fruit-set procedure a one-person job vs. a two-person job when measurements have to be entered manually. (Although this can still be done.) Having immediate results of the measurements to predict fruit set was very handy vs. having to go back to the office and entering the measurements manually in a spreadsheet before visualizing the outcome of measurements.

Overall, reducing the number of clusters measured probably introduced more error/variability in the results. In the end it seems like there were more apples on the tree than what was predicted. Seems, because in 2019, a bug in the app resulted in extraneous data being introduced which is still being sorted out, hence the importance of exporting and backing up your data frequently! Still, the app has a lot of potential and only the fruitlet-growth-rate model has been touched-upon here. It is hoped that resources can be further spent on developer de-bugging and improving the Malusim app going forward.

For more detail and further information, see predicting fruitset model (https://www.canr.msu.edu/uploads/files/PredictingFruitset1-21-14.pdf) and how to use the Malusim app (predicting fruit set): http://bit.ly/2WbWZ2n.

New England Cider Apple Project

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Jon Clements, Dan Cooley, Elizabeth Garofalo, and Jaime Piñero
University of Massachusetts

Renae Moran
University of Maine

In a recent survey of apple growers, one prominent Vermont apple grower stated, "*The cider apple market represents the first real increase in demand for New England Apples in a generation. While sales of our dessert fruit have been flat or declining, we see this market as essential to maintaining the competitiveness of our industry*."

Fermented cider production in New England experienced over 50% annual growth from 2009 to 2014 and sales of regional craft ciders made from specialty cider apples increased over 40% in 2017. That last figure is especially important, because cideries use two sources of apples for making their products: culled fruit of traditional dessert apple varieties (e.g. 'McIntosh', 'Empire', etc.); and specialty varieties grown specifically for their unique flavor and aroma contributions to the finished cider. The former of these apples make up the lion's share of fruit used for making cider in the U.S., and their production requires a wholesale dessert variety market that provides sufficient revenue so that growers can afford to sell culls at substantially lower prices. At regional educational meetings in 2014-2017, and in national surveys since 2014, apple growers stated that biennial bearing, variety adaptability, appropriate orchard training systems, and increased susceptibility to specific diseases, particularly fire blight, present significant limitations to increased expansion of cider apple production.

Specialty cider apple varieties, however, present greater value as cider apples than dessert varieties that are downgraded for cider use. Thus, cider varieties do indeed present opportunity for diversification of New England orchards without substantially changing production systems. Currently, the demand for cider apples exceeds supply, and apple varieties specifically selected for cider (e.g. 'Dabinett', 'Ashmead's Kernel', 'Franklin Cider Apple') offer high returns for growers. Cider apples also have lower infrastructure and management needs because lack of demand for blemish-free fruit creates an opportunity to grow them with fewer chemical inputs. In addition, postharvest cold storage, sorting, and packing are greatly reduced compared to dessert apples. However, production of cider apples is limited by unknown performance metrics for specialty cider apple varieties when grown in New England, unique pest management considerations including greater susceptibility to fire blight, and alternate bearing cycles that reduce yield. There is a dearth of objective, research-based information on cider variety performance across New England orchards. However, there are many growers whose expertise growing these fruit can be collected through citizen science to develop regional recommendations for cider apple production. In addition, new methods for managing crop load through use of plant growth regulators and/or canopy hedging could address biennial bearing issues that reduce cider variety productivity.

New England Cider Apple Project

In fall 2019, specialists from the Universities of Maine, Massachusetts, and Vermont initiated the New England Cider Apple Project (NECAP) with funding from the Northeast SARE Research and Education Program. This project includes research components that will yield valuable information for New England fruit growers":

Cider variety observations. In 2019, NECAP staff began collecting field observations of cider varieties in several orchard in Vermont and Massachusetts. Data is being collected on tree growth (vigor, habit); biennial bearing tendency, crop yield; juice quality; and incidence of disease and pest damage. Beginning in 2020, we will solicit growers for your observations and data,

if available, to build out profiles of popularly-grown cider apple varieties in the region.

Mechanical thinning research. Traditional European cider varieties do not respond as well to chemical thinners as most dessert varieties. In Maine, we will evaluate the effectiveness of a mechanical string thinner for effectiveness in early flower thinning, yield, and biennial bearing.

Return bloom: Plant growth regulators, and canopy hedging. The success of the highly biennial dessert variety 'Honeycrisp' has led to research on and recommendation for treatments to improve annual bearing tendency. The use of post-thinning plant growth regulators and trimming vegetative shoots through

New England Cider Apple Program
Grower Survey

The intent of this survey is to evaluate past and present cider apple production in New England and the surrounding region and to guide future research and outreach programming. Because apple cultivar and production system production figures are not collected in traditional agricultural census programs (i.e. NASS, USDA), it is critical to capture this information. Your support in completing this survey is appreciated. All data will be kept confidential and will not be linked back to any individual operation. Please visit http://go.uvm.edu/necapsurvey to complete this survey online. This survey complies with Institutional Review Board policies at the University of Vermont.
Questions regarding this survey may be directed to:

Terence Bradshaw, tbradsha@uvm.edu, (802)656-0972.

This survey is concerned primarily with *cider* apples that were intentionally grown for making cider, as opposed to cull dessert fruit cultivars, i.e., off-grade McIntosh, Cortland, etc. that were intended for fresh market sales but sold to cideries at marketing time due to reductions in fruit quality or similar factors.

1. Are you presently growing cider apples on your farm? Y / N
2. Are you considering growing or increasing plantings of cider apples on your farm? Y / N
3. Please list acres of **all** apples grown _____
4. Please list acres of **all** *cider* apples grown _____
   (if cider apples are easier counted in trees than acres, please do so and indicate that by circling below)
5. Please list cider apple cultivars and amount of each grown on your farm

Cultivar	Number of (trees or acres)	Cultivar	Number of (trees or acreas)
1.		8.	
2.		9.	
3.		10.	
4.		11.	
5.		12.	
6.		13.	
7.		14.	

6. On how many acres of cider apples are you using the following management practices:
   a. Reduced disease management inputs _____
   b. Reduced insect management inputs _____
   c. Hedging _____
   d. Fruit spur removal _____
   e. PGRs for return bloom _____

7. What is the overall value of cider apples sold from your farm:
   (*Please do not count cull fruit from dessert cultivars that were intended for the fresh market. If you only make your own cider, please cite the price for raw materials you would charge the cidery from the orchard*)
   a. Total $ _____
   b. $ per acre _____

New England Cider Apple Project December 2019 http://go.uvm.edu/necider

8. **Please rate** the following issues for your perception of their effect on difficulty in producing cider apples on your farm, where:
1 = not a problem at all, 2 = slight problem, 3 = neutral,
4 = manageable problem, 5 = major problem:
   a. Cultivar selection _____
   b. Canopy management- pruning _____
   c. Canopy management- training _____
   d. Biennial bearing _____
   e. Fire blight _____
   f. Other disease issues _____
   g. Insect management _____
   h. Pruning _____
   i. Sunburn _____
   j. Harvest labor _____
   k. Sourcing nursery trees _____
   l. Quality of nursery trees _____
   m. Cold hardiness _____
   n. Rootstock selection _____

9. **Please rate** your comfort with the following characteristics of cider apple management
1 = not comfortable at all, 2 = slightly comfortable, 3 = neutral,
4 = generally comfortable, 5 = very comfortable:
   a. Cultivar evaluation _____
   b. Canopy management – hedging _____
   c. Training systems; low vs high density _____
   d. Fire blight and other disease modelling and management _____
   e. Specific cider IPM programs _____
   f. Managing biennialism with plant growth regulators _____
   g. Harvest mechanization _____

10. How many applications of each of the following groups of pesticides were applied this year in your orchard:

	Cider blocks	Fresh fruit blocks
a. Herbicides	_____	_____
b. Fungicides	_____	_____
c. Bactericides (fire blight)	_____	_____
d. Insecticides	_____	_____
e. Plant growth regulators	_____	_____

Thank you for your participation in this survey. The New England Cider Apple Project is funded by Northeast SARE project LNE19-373, and is a collaboration of faculty and staff from the Universities of Vermont, Maine, and Massachusetts. Please forward any questions to the project director at Terence.Bradshaw@uvm.edu.

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hedging cam improve return bloom the following year independent of crop thinning. These treatments will be tested on commercially-important cider varieties to assess effects on yield, return bloom, and fruit quality.

Work completed to-date is preliminary, and thus we are not ready to make recommendations based on it. The intent of this session is to introduce the project to cider apple growers from across the region to invite participation in project activities, including collection of observations from your orchards. As this project unfolds, we will publish results on the NECAP website at http://go.uvm.edu/necider.

Funding for this project is provided by NESARE Grant LNE19-373.

DTN Smart Traps – Worth it or Not?

Jon Clements
University of Massachusetts Amherst

The DTN Agronomic Platform (DTN AP) is a comprehensive agronomic software tool that integrates precision ag technology into a single, easy-to-use interface (https://www.dtn.com/agriculture/agribusiness/dtn-agronomic-platform/). Optional components of the DTN AP are automated "Smart Traps" that upload pheromone-based trap catch pictures to their cloud-based AP. Smart Traps are essentially wing-type pheromone traps that capture a digital picture of the daily adult moth catch (codling moth, Oriental fruit moth, oblique banded leafroller typically in orchards), including species identification, eliminating insect catches that are not the target pest, and upload these pictures to the DTN AP cloud. Daily and cumulative catch totals, including the trap bottom picture are available after logging into the DTN AP. Data can be charted, exported, and alerts can be set when thresholds are exceeded.

Smart Traps were deployed in a commercial orchard in eastern Massachusetts in 2018 and at the UMass Orchard in Belchertown in 2019. As mentioned, three traps, one each for Oriental fruit moth, codling moth, and oblique banded leafroller were fully charged at the beginning of the season and placed head-height in the apple orchard block (Figure 1). Barring a few minor technical difficulties, traps were easy to deploy, obtained a cellular signal for data transmission to the cloud, and the battery lasted all season. With the exception of occasional trap bottom and pheromone replacement, the Smart Traps were virtually maintenance free. There was a learning curve to use the web interface "Dashboard" to use the DTN AP, but once figured out, monitoring and visualizing trap catch data, including pictures of the trap insert (and whatever was stuck to it!) was easy (Figure 2). Identifying the correct insect pest in the trap seemed to work just fine, including keeping track of new catches vs. previous catches. One advantage of the Smart Traps vs. manually checked pheromone traps is the setting of a biofix, which should prove to be more accurate because daily catch counts are made vs. weekly or bi-weekly, which is more typical of manual scouting. But it comes with a cost at $395 per year per trap, however, that includes the DTN AP which can be used for scouting with a smart phone. There is much value-added to their AP Dashboard and Smart Traps which might be particularly useful to researchers, crop consultants, and Extension advisors.

Figure 1. Smart Traps in an apple orchard block at the UMass Orchard with oblique banded leafroller pheromone catch.

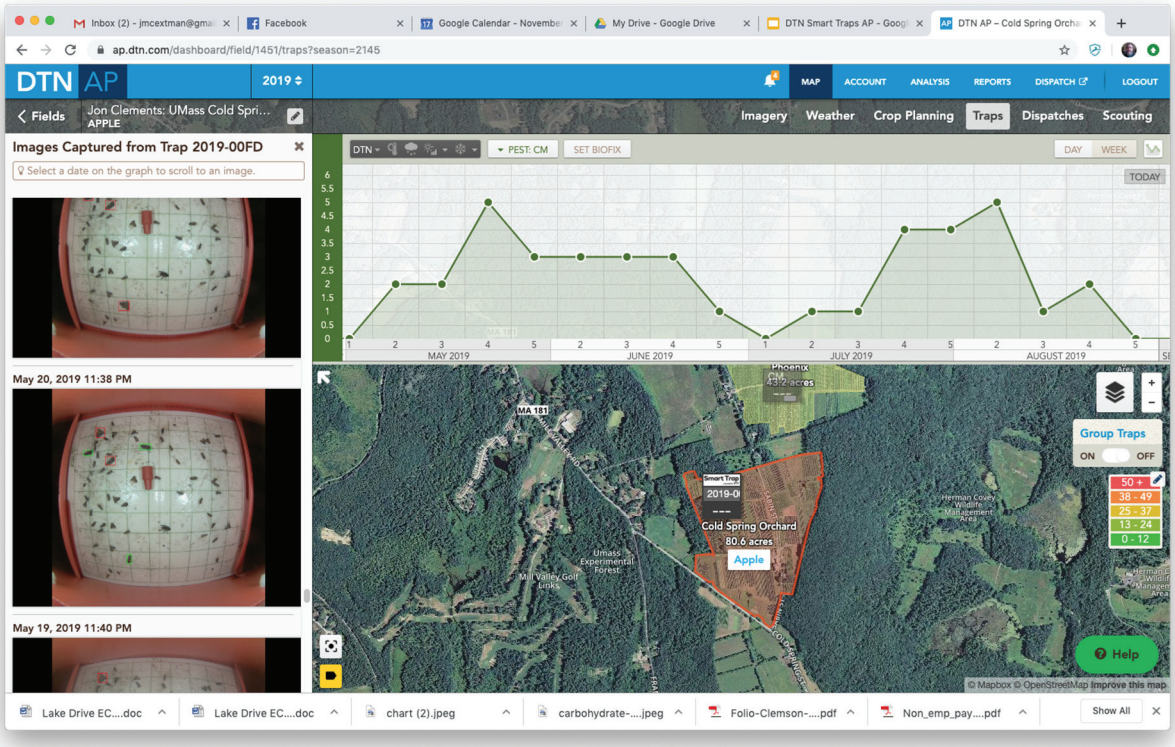

Figure 2. The DTN AP "Dashboard" charting trap catches, trap location, and pictures of trap catch for codling moth at the UMass Orchard.

Identifying Weed Management Priorities from the Ground Up: 2019 New England Vegetable & Fruit Conference Survey Results

Elizabeth Garofalo, Hilary Sandler, and Jaime C. Piñero
University of Massachusetts Amherst

Weed management begins with understanding what species are present as well as their life cycle. Confidence in weed identification is the first, critical step to successfully protecting crops form damage weeds do. Weeds can cause many different problems in a cropping system, making this diverse group of pests especially important to manage. Weeds act as alternate host plants to insect pests such as dock sawfly, stink bugs (Figure 1), borers, tarnished plant bug, aphids. Invasive insect pests like brown marmorated stink bug, spotted sing drosophila, and spotted lanternfly, often use weed hosts to feed their populations throughout the growing season only to jump the weed ship and feast on your crops when wild host carbohydrate stores are depleted. This usually occurs just in time for harvest, causing damage that, sometimes, may not manifest until your crops reach the consumer's table.

Sooty blotch and fly speck, rusts and other pathogens use weeds as either a waypoint between crop hosts, or, they may rely on these weedy hosts to complete a portion of their life cycle. Either way, pathogens can hop from weeds to your crops. Voles, rabbits and porcupines will all take shelter in the safety and bounty of a weedy patch. Once they have eaten what they like out of the weeds, fruit trees are often next on the menu. Weeds have evolved over time to be highly competitive organisms. Their seeds emerge sooner than most crops, they are more tolerant of adverse conditions and are quicker to snatch up valuable resources. If you are applying fertilizer to your crops while weeds are present and actively growing, you are in essence fertilizing your weed crop. The weeds will thank you for this service by setting seed and sending out new root shoots in order to provide you with even more weeds to enjoy. In addition to competition for resources, some weeds can harm crops by way of chemicals they release from

Figure 1. Left, pokeweed grown into apple tree, hosts native stink bug nymph. Bottom center, native stink bug nymph close up. Top center, native green stink bug adult. Right native green stink bug adult on pokeweed in apple.

Figure 3. *Tragopogon dubius,* commonly known as yellow salsify.

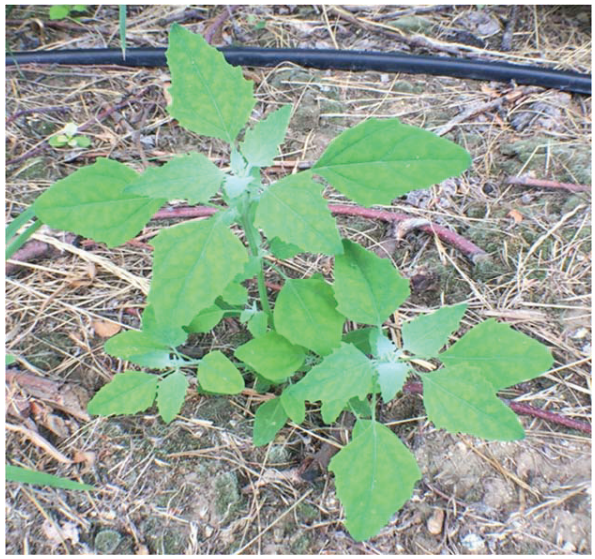

Figure 2. *Chenopodium album,* commonly known as lamb's quarters.

their roots. Black walnut, for example can kill apple trees if the two root systems are in close proximity to one another.

The damage weeds cause is almost as diverse as weed species populations. This makes proper identification of weeds present in crops all the more important. In order to determine how best to implement weed management Extension educational programming, a survey "pop quiz" was given to a group of growers who attended the 2019 New England Vegetable and Fruit Conference (NEVFC) in Manchester, NH. The purpose of this survey was to determine the level of grower's knowledge on weed species identification.

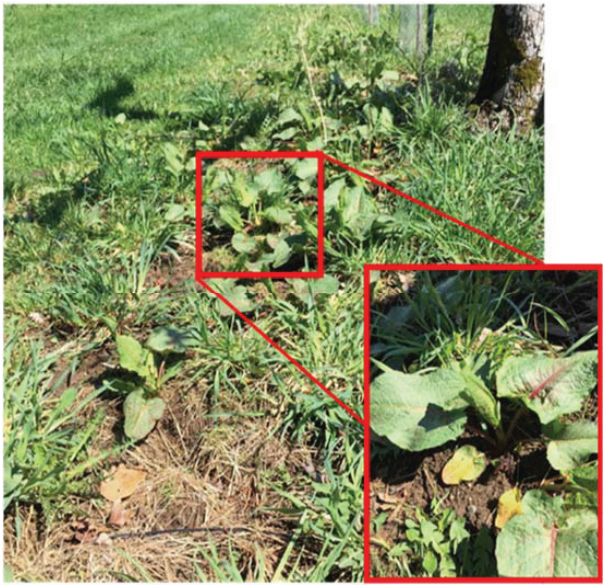

Figure 4. *Rumex obtusifolius,* commonly known as broadleaf dock.

Figure 5. *Cyperus esculentus,* commonly known as yellow nutsedge.

Materials & Methods

An instant-response survey was implemented at the weed management session (on 11 December 2019) of the NEVFC. This session was attended by approximately 80 growers. Each grower was provided with a handheld wireless transponder, commonly referred to as 'clicker technology'. Growers were asked what their

Figure 6. *Cerastium vulgatum,* commonly known as mouse-eared chickweed.

primary crop is: small fruit; tree fruit; vegetables or ornamentals, and to identify eight commonly occurring weeds.

Results & Discussion

The majority of participants, 61%, identified vegetables as their primary crop. The remainder of the participants identified themselves as small fruit growers; 23%, tree fruit; 12% and ornamental producers; 4%.

When growers were asked to identify eight commonly occurring weeds (see Figures 2-9), overall, the majority of the answers were correct. However, specific results were variable. 65% of participants correctly identified *Chenopodium album* (Figure 2, lamb's quarters) whereas 22% responded "I don't know" when asked to identify this weed. 19% of participants correctly identified *Tragopogon dubius* (Figure 3, yellow salsify), 23.5% of participants misidentified it as dandelion. This is an easy mistake to make as they are closely related. Dandelion seedlings, however, emerge earlier in the growing season than salsify. *Rumex obtusifolius* (Figure 4, broadleaf dock) was correctly identified by 64% of participants. 19% responded "I don't know" when asked to identify this weed. 82% of participants correctly identified *Cyperus esculentus* (Figure 5, yellow nutsedge) making it the most recognized weed in the pop quiz. 39% of participants correctly identified *Cerastium vulgatum* (Figure 6, mouse ear chickweed) while 35% responded "I don't know". 40% of respondents correctly identified *Celastrus orbiculatus* (Figure 7, oriental bittersweet).

Figure 7. *Celastrus orbiculatus,* commonly known as oriental bittersweet. Inset photo credit: Randy Prostak, UMass Extension Weed Specialist

Figure 8. *Solanum carolinense*, commonly known as horsenettle.

Figure 9. *Cuscuta spp.* commonly known as dodder shown on cranberry. Inset shows close up of dodder tendril wrapping around a cranberry stem.

5% of the responders chose "the actual devil", an answer that should be considered technically correct given the noxious nature of this invasive weed. 25% responded with "I don't know". *Solanum carolinense* (Figure 8, horsenettle) was correctly identified by 34 % of participants while another 30% identified it as night shade. While horsenettle is in the nightshade family, the use of this as an identifier can muddy the waters of communication. This is why scientific names are often used by educators and scientists when discussing weeds management. Finally, *Cuscuta spp.* (Figure 9, dodder) was successfully identified by only 13% of participants and was misidentified as bindweed by 23%. 39% of growers asked to identify this weed responded "I don't know". Dodder can be a serious pest in tomato, carrot, alfalfa, cranberry and ornamental production.

Conclusions

Proper weed identification is critical to effective and efficient weed management. Knowing what weed species are present in a cropping system is necessary for proper material selection and application timing. The three most recognized weeds in this pop quiz were lamb's quarters, broadleaf dock and yellow nutsedge. More than 50% of participants were able to accurately identify these weeds, especially important for weeds like yellow nutsedge which are difficult to manage.

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Increasing Branching of Cider Apple Trees

Jon Clements and Elizabeth Garofalo
University of Massachusetts Amherst

Personal observation has suggested some cider apple variety trees are particularly prone to producing blind wood. Blind wood is a result of last season's shoot growth failing to produce bud, or branch, breaks during the current growing season. These lengths of unproductive wood remain for the duration of the shoot's life (until it is pruned out or whatever). Several methods can be used on dormant 1-year old wood to prevent blind wood and promote branching. These include notching and use of plant growth regulators (specifically 6-benzyladenine, 6-BA). To promote branching on potential blind wood, ten cider apple varieties were treated with notching or 6-BA and compared to an untreated control in 2019 at the UMass Cold Spring Orchard in Belchertown, MA. Results show that a 6-BA application is particularly effective at increasing branching on 1-year old wood, however, results depend somewhat on cider apple variety.

Materials & Methods

In 2018, a previously planted apple variety evaluation block on M.9 rootstock at the UMass Cold Spring Research Orchard (CSO) in Belchertown, MA was top-work grafted to ten cider apple varieties using bark inlays. (See "Small Steps to a Big Future for Massachusetts Cider Apples" in the Spring 2019 issue of Fruit Notes for more details, http://umassfruitnotes.com/v84n2/a2.pdf). The cider apple varieties are: Foxwhelp, Ashmead's Kernel, Kingston Black, Ellis Bitter, Michelin, Redfield, Egremont Russet, St. Edmund's Russet, Medaille D'Or, and Cort Pendu Plat. The experimental design is a randomized block with four replications and three trees of each cider apple variety per experimental unit. Graft success was very good, and during the 2018 growing season two leaders were

Figure 1. Maxcel® in white paint applied to 1-year old Redfield cider apple variety on April 13, 2019 at UMass Orchard, Belchertown, MA.

Table 1. Mean number of branches produced by variety across three branching treatments.

Variety	Number of branches
Michelin	19.4 a
Egremont Russet	15.1 ab
Ellis Bitter	11.1 bc
Medaille D'Or	9.4 c
Cort Pendu Plat	8.9 c
Redfield	8.7 c
Kingston Black	8.3 c
Foxwhelp	7.9 c
Ashmead's Kernel	7.5 c
St. Edmund's Russet	6.4 c

Means not followed by the same letter are significantly different (Tukey's HSD $P = 0.05$).

selected such that each graft was grown into a double leader (bi-axis) tree. Leader/shoot growth was also very good, the leaders reaching heights ranging from two to four feet, but generally lacking any kind of branch breaks, i.e., they were mostly "whips."

In 2019, three branching treatments were applied to the leaders on 1-year-old wood: an untreated Control (UTC), notching (NOTCH), or Maxcel® (6-BA, Valent Biosciences LLC). Maxcel was applied using a mixture of 4 oz. 6-BA in 16 oz. white paint (app. 6,000 ppm). This is within the label rate range indicated to promote branching on dormant young wood. Within the experimental unit, leaders of each variety that were close to equal vigor were selected for each of the treatments. The 6-BA treatment was applied before bud break on 13-April (Figure 1) while the notching treatment was done just before bloom in early May. 6-BA in paint was applied to the leader in a two-to-three-foot stretch where branching was desired (but not to the top of the leader). Notching was done using a double-blade anvil-style pruner such that a notch was made just above the bud and also at the same time opposite the bud, and just notching the bark with a little twist. Not every bud was notched, but 6-8 notches were made to approximately the same length of wood as the 6-BA in paint treatment was applied. In mid-June the leaders were evaluated by counting the number of branches longer than 2.5 inches in the area where 6-BA and notching treatments were applied.

Figure 2. Typical branching achieved when 6-BA in white paint is applied before bud break to blind wood on most cider apple varieties.

Results & Discussion

For cider apple variety, across the three branching treatments, there was a significant difference between varieties in number of branches produced (Table 1). Michelin and Egremont produced the most branches, followed by Ellis Bitter, and then Medaille D'Or, Cort Pendu Plat, Redfield, Kingston Black, Foxwhelp, Ashmead's Kernel, and St. Edmund's Russet.

For branching treatment, across all ten varieties, the 6-BA treatment was very effective at producing

Table 2. Mean number of branches produced by treatment across three cider apple varieties.

Branching treatment	Number of branches
6-BA	14.9 a
NOTCH	8.9 b
UTC	7 b

Means not followed by the same letter are significantly different (Tukey's HSD $P = 0.05$).

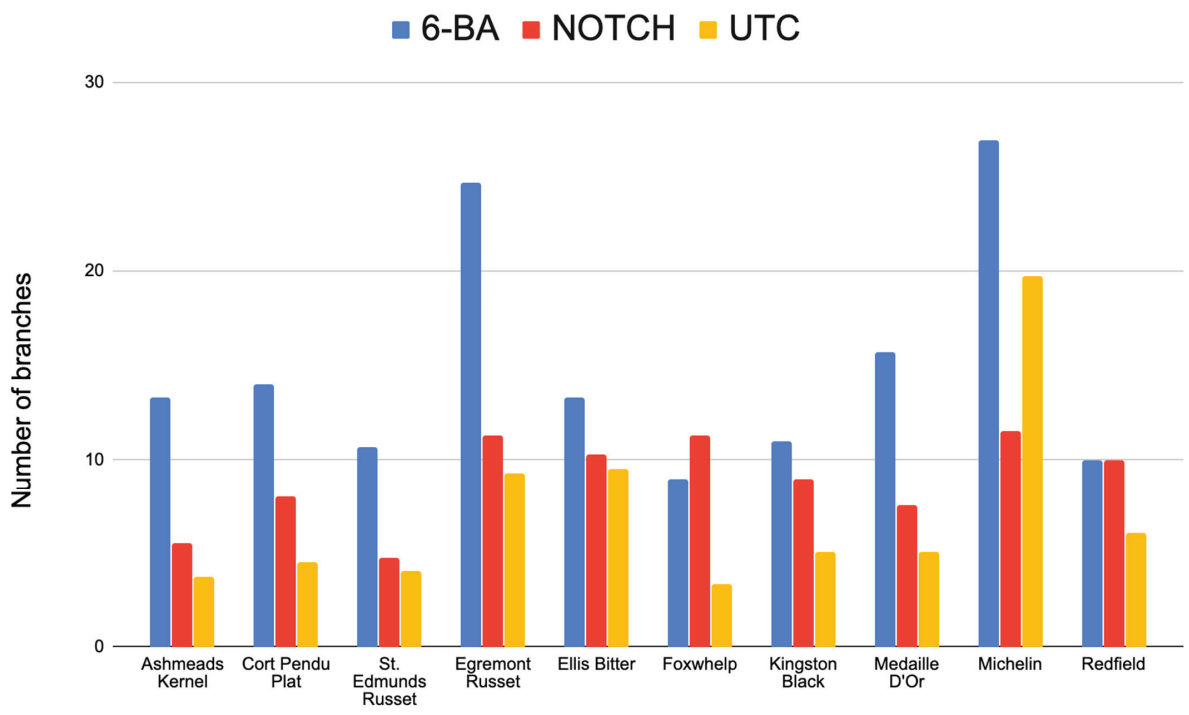
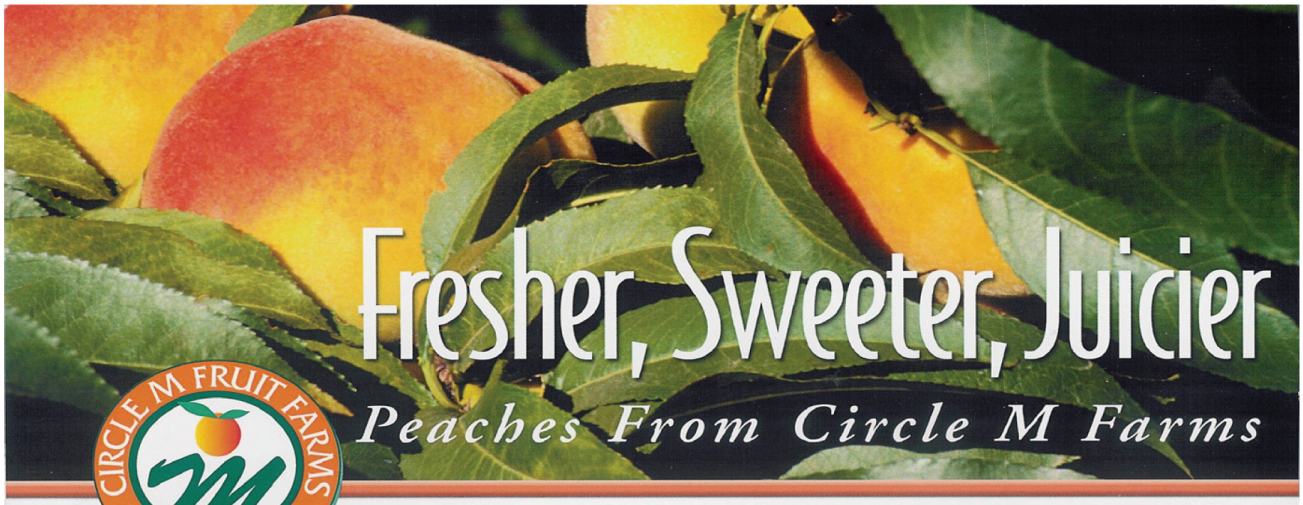


Figure 3. Number of branches produced by treatment depends on variety.

branches. (Table 2). The NOTCH treatment did not differ from the UTC.

A significant interaction of variety and treatment was also interesting (Figure 3). In other words, branching treatments were more or less successful, depending on which variety the treatments were applied. For example, only 6-BA (vs. NOTCH) was very effective at creating branches compared to the UTC when applied to Michelin. But on Foxwhelp, both NOTCH and 6-BA treatments increased branching over the UTC. And with Ellis Bitter, NOTCH and 6-BA application were rather ineffective at increasing branching. The other varieties varied in their response to the branching treatments. Still, as a trend, 6-BA was effective at producing branches across most varieties and is a recommended practice to improve branching on 1-year-old wood of most cider apple varieties where blind wood is expected to be a problem (Figure 2). Notching may also help make branches during bud break when the 6-BA treatment was not applied. Note that these treatments are likely most effective on top-worked trees or on 2nd-leaf trees (on 1-year old wood) with an established root system (vs. trees just planted this year) that have some "push" to them.

On a final note, it is assumed that increasing branching will subsequently result in a less "top-heavy" tree and greater flowering and fruiting. Remains to be seen, but we will follow flowering and fruiting during the 2020 growing season to see if these branching treatments make a difference.



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