Fruit Notes

Volume 84, Number 2: Spring, 2019

Fruit Notes

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

Fruit Notes (ISSN 0427-6906) is published four times per year by the Stockbridge School of Agriculture, University of Massachusetts Amherst. **The cost of a 1-year hard-copy subscription is $40 for U.S. and $50 for non-U.S. addresses. The cost of a 1-year electronic subscription is $20.** Each 1-year subscription begins January 1 and ends December 31. Some back issues are available for $10 each. Payments via check must be in United States currency and should be payable to the **University of Massachusetts Amherst**. Payments by credit card must be made through our website: *http://extension.umass.edu/fruitadvisor/*.

Correspondence should be sent to:

Fruit Notes
Stockbridge School of Agriculture
205 Paige Laboratory
University of Massachusetts Amherst
Amherst, MA 01003

Table of Contents

Massachusetts Fruit IPM Report for 2018
Jaime C. Piñero, Daniel Cooley, Jon Clements, Sonia Schloemann, and Elizabeth Garofalo 1

Small Steps to a Big Future for Massachusetts Cider Apples
Elizabeth Garofalo and Jon Clements 11

Update on the 2018 NC-140 Honeycrisp and Aztec Fuji Trials in New Jersey and Massachusetts
Megan Muehlbauer, Win Cowgill, Jon Clements, and Wesley Autio 15

Glomerella Leaf Blotch and Fruit Rot: New Apple Diseases in the Northeast
Win Cowgill 20

Cover: Foppema's Hilltop Orchard, Wilkinsonville, Massachusetts -- Twilight Meeting, May 10, 2018.
Photo credit: Jon Clements.

Massachusetts Fruit IPM Report for 2018

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

Weather

Low winter temperature recorded at the UMass Cold Spring Orchard was -10°F on January 7, 2018. There was some bud damage to sensitive peach varieties, but otherwise trees were nicely hardened off because of a late December 2017 to early January (very) cold stretch of weather. Apple green tip was about April 13, followed by a somewhat protracted full bloom period beginning before May 10 and continuing until at after May 15. Numerous new apple varieties make it increasingly difficult to pin down "full bloom" date. Otherwise, the growing season in Massachusetts and southern New England was more or less a tale of two seasons. The first part, from April through June, was nearly normal in terms of precipitation and temperature. In midsummer, temperatures increased, and rain fell, making a kind of southern summer from July on. This had an impact on diseases and physiological disorders.

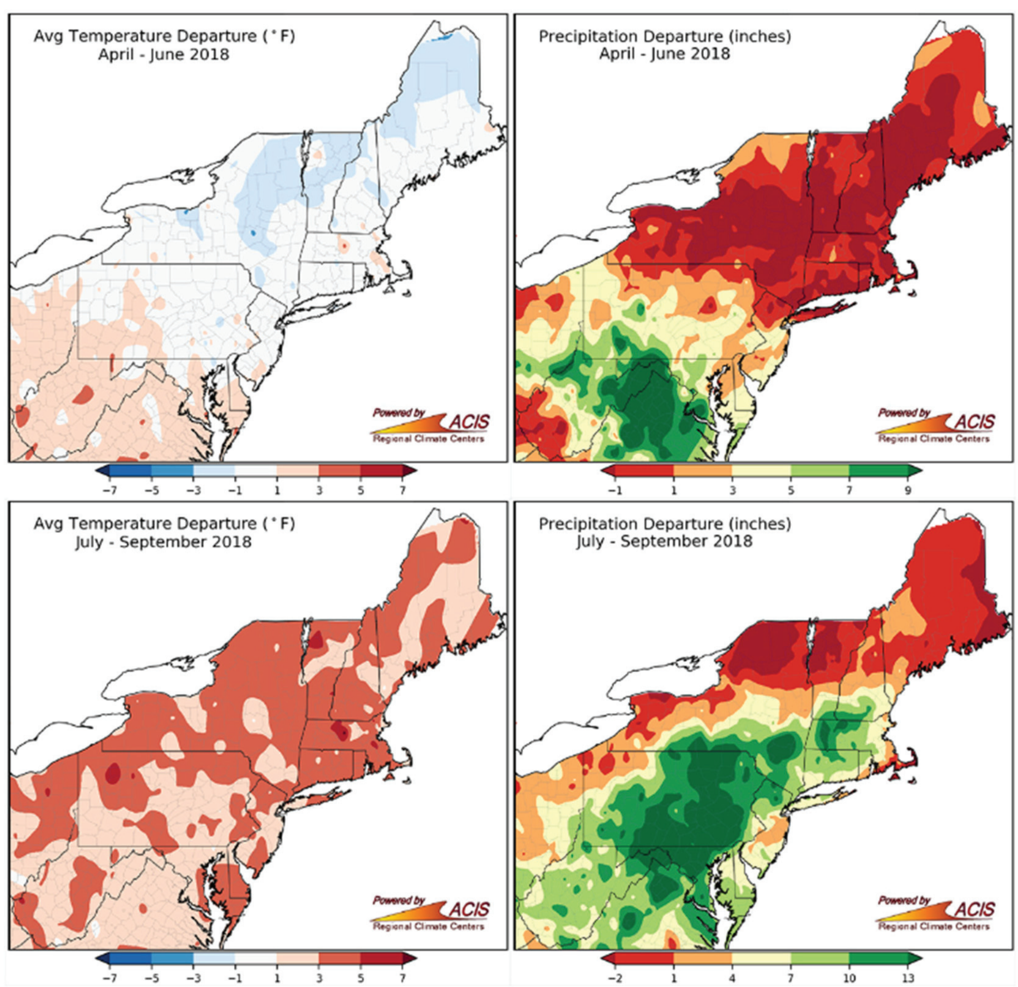


Figure 1. The 2018 growing season Northeast temperature and precipitation departure.

Diseases

<u>Apple scab</u> presented the normal management challenges this year. At the UMass Cold Spring Orchard (CSO), Ag-Radar recorded 13 infection periods, the first on April 25 and the last on June 4, with the most significant risk on May 6, May 12, May 15, and May 1. RIMpro patterns were

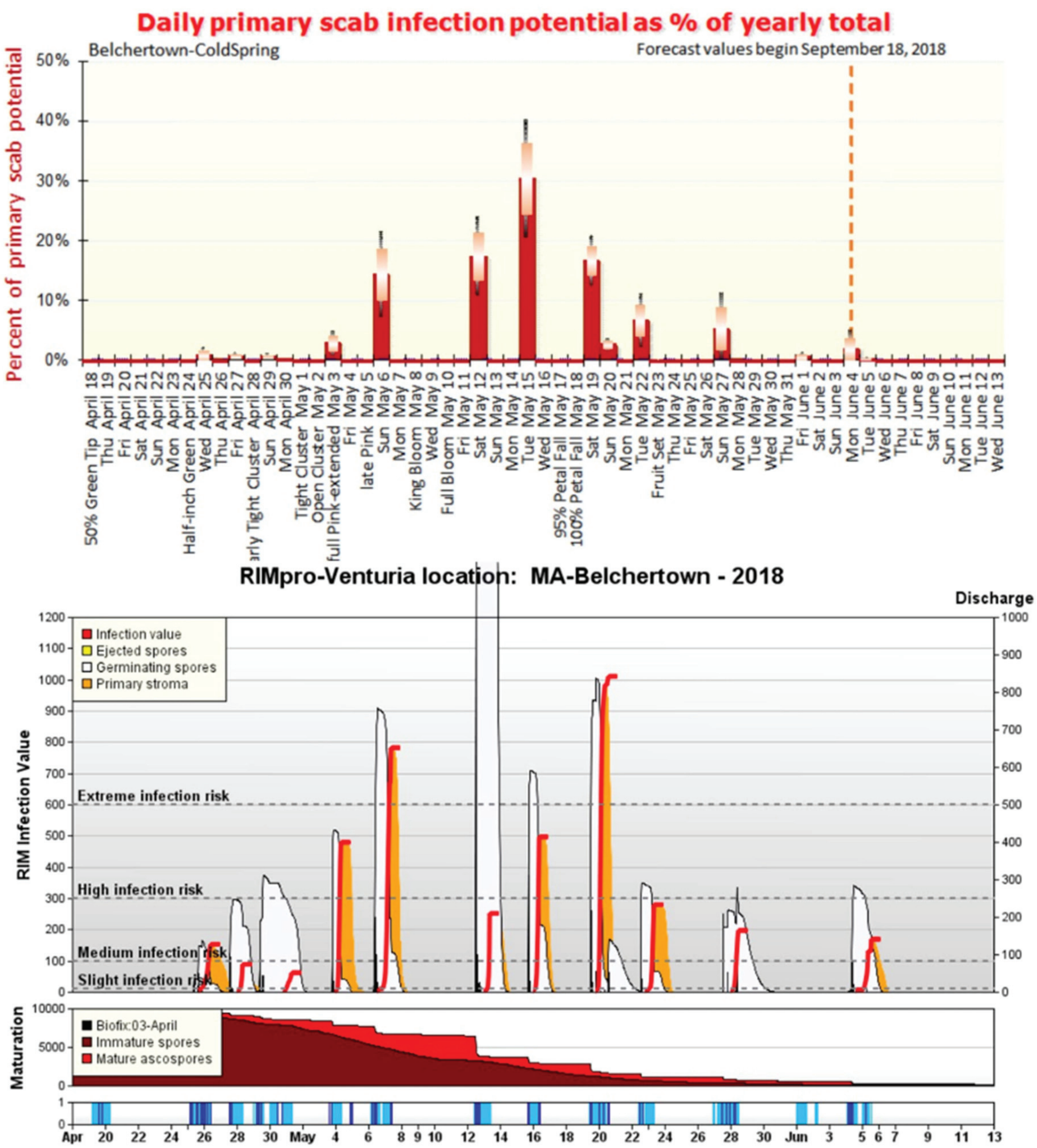


Figure 2. AgRadar (top) and RIMpro (bottom) primary apple scab infection periods, UMass Cold Spring Orchard, 2018.

very similar, with 11 infection periods, first on April 25 and the last on June 4, with the most significant risk on May 4, May 6, May 15, and May 19. Both systems recorded a slight chance of a primary infection on June 24. Early to mid-May was critical for scab fungicide sprays.

Fire Blight pressure was moderate this year, though models differed. At the UMass CSO, the AgRadar Cougarblight model had one infection (High Risk) May 16, the Maryblyt/Eastern FB model one infection May 21, and while RIMpro indicated three infections, May 8, May 15-16, and May 18-19. Inoculation on May 15 developed severe symptoms in two trials at CSO. Fire blight outbreaks in commercial orchards were not severe, as growers generally applied streptomycin at appropriate times, sometimes making more than one application, sometimes in combination with appropriately timed biological controls and/or prohexadione-calcium (Apogee, Kudos).

Summer rot diseases and related problems! The transition from normal precipitation through mid-June to very wet weather in July and August generated much more fruit rot than usual in MA. Honeycrisp was often infected, though other cultivars also had significant damage. The weather not only favored fungal infections but also made it difficult to keep fungicide protection on fruit. Relatively warm temperatures, particularly at night, exacerbated problems. Sunscald cracks on some cultivars increased damage. Spotted wing drosophila were found around damaged fruit, but were not associated with initiating infections.

We identified at least two fruit rots, black rot (*Bot-*

Figure 3. Typical fruit rot(s) on Honeycrisp and other apple varieties observed in 2018. Looks like bitter rot, but black rot also prevalent.

Figure 4. Marssonina leaf blotch on Morning Mist Fuji, September 26, 2018, UMass Cold Spring Orchard.

ryosphaeria obtusa) and bitter rot (*Colletotrichum sp*.). A third rot, white rot (*Botryosphaeria dothidea*) wasn't identified definitively, but may have also been present. To add to the confusion, early symptoms of these rots may be confused with the physiological diseases associated with calcium deficiency, bitter pit and cork spot, and with stink bug damage.

Marssonina leaf blotch (caused by *Marssonia coronaria*)showed up in late August and early September in MA, causing enough defoliation to raise some concern. Wet, warm summer weather appears to be increasing the severity of this new disease in MA. At the same time, other fungal diseases may be causing problems. Fungi in *Colletotrichum* sp. cause fruit rot, and some species can also cause leaf blotch. New *Colletotrichum* species may be moving into the region, as Glomerella leaf spot (yes, caused by *Colletotrichum*) has been found in eastern NY and is relatively common in NC. A physiological disease, necrotic leaf blotch is associated with Golden Delicious and related cultivars and causes

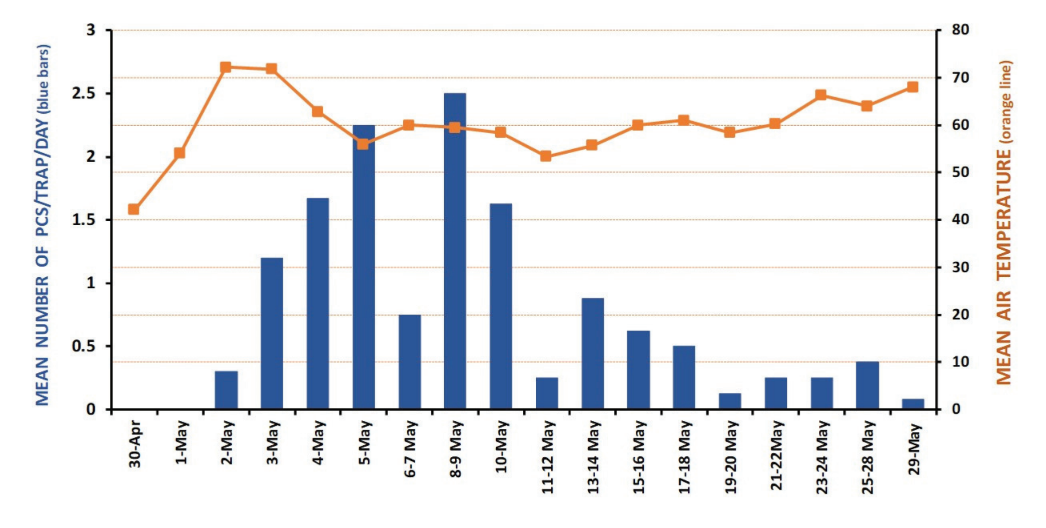


Figure 5. Temporal pattern of PC immigration into an unsprayed apple block, determined by odor-baited pyramid traps. The yellow rectangle shows the petal fall period for McIntosh trees at the UMass Cold Spring Orchard.

similar symptoms.

In general, climate change appears to be bringing diseases common in places like NC to MA. This will require significant rethinking of summer disease management practices.

Insects

Gypsy moth continued to give us trouble here and there in orchards. Some level of larval feeding damage was observed on apple. Females were observed laying eggs in forested orchard borders. On the up side, we were also able to ID (with the help of the Elkinton lab) an old natural enemy of gypsy moth eggs, the parasitic wasp *Ooencyrtus kuvanae.* More information on the gypsy moth situation can be found in the small fruit section that follows.

Plum curculio. In 2018, in one unsprayed apple block at the UMass CSO the first PC showed up at 220 DD (base 43°F), closely matching the 5-year (2000-2004) average DD accumulation of 228 DD. The immigration period was considered to be over soon after petal fall, when PC captures in odor-baited traps were quite low in despite of relatively warm air temperatures. About 88% of the total number of PCs were captured by the last day of petal fall.

Tarnished plant bug. Most fruit damage seen during pre-harvest surveys seemed to be the result of TPB feeding (unless you count rots, which are addressed in the disease section, oh man!). Early season damage was seen in flower buds too.

Brown Marmorated Stink Bug. The UMass Extension Fruit Program has been tracking the invasive Brown Marmorated Stink Bug (BMSB), *Halyomorpha halys*, since 2012. For the past six years, the number of BMSB captured in pheromone-baited traps had remained relatively low, until now. Trap-capture data for 2018 showed that this year BMSB populations were greater than any of the six previous years. Suspected feeding injury by stink bugs (allegedly BMSB) has been reported in a couple of orchards, however, the actual levels of damage have not been quantified yet. In late September, one grower deemed necessary the application of a perimeter row spray targeting BMSB as a result of trap captures exceeding threshold for the first time in MA. In an attempt to kill as many BMSB as possible, on 5-September one ghost trap was deployed at each of 5 orchard blocks. As of 12-October, the 5 ghost traps have killed 245 BMSB adults and nymphs.

Codling moth. Just a quick note that codling moth (CM) pheromone trap catches were very high in some orchards. Some orchards reported significant CM damage to apples in despite of control efforts. We don't know yet if we are experiencing a double flight peak for each generation, with the second peak being more OP-resistant.

Horticulture

Despite what appeared to be non-copious bloom in some cases, apple fruit set was quite copious. Ditto for peaches, however, it was quite variety-dependent in both tree fruits. Apple (and peach!) crop load management remains one of our most significant horticultural challenges.

Figure 6. Brown marmorated stink bug adults attracted and killed under 'ghost trap' in a commercial orchard (September 6, 2018).

Weed control! (Isn't that a pest management thing?). Copious precipitation resulted in rampant weed growth, both annual grasses and broadleaf weeds, and perennial weeds. Weed control often falls to the wayside, however, an integrated approach including timely application of both pre-emergent and contact herbicides to reduce the seed bank is required where an herbicide strip is desired. Especially important in new plantings on dwarf rootstocks! But be sure to follow herbicide label advisories on minimum tree age and avoid contact with bark when using contact herbicides.

The peach crop and harvest was pretty much as usual, however, wet weather set in and brown rot was its usual difficult stuff under wet conditions. Apple harvest was a bit of a slog, unseasonably warm late August into early September temperatures delayed red color development, and apples were very large. Quality was not the best, but everyone got through it and sales have been brisk. Buy Local! As already mentioned, some orchards had severe rot problems, most likely on account of slacking off on fungicide applications late in the summer, but also fostered by the high heat and humidity.

Small Fruit

Winter moth egg hatch occurred during the third week of April in 2018 at approximately 20–50 GDD Base 50˚F (177-243 GDD Base 40°F); approximately 1 week later than in 2017. Winter Moth flight in November 2017 was light suggesting lower WM populations. Blueberry growers reported very low levels of winter moth damage in 2018 marking 2 consecutive years of reduced pressure from this invasive pest. The accepted explanation is that the biological control agent, *Cyzenis albicans*, a tachinid fly, released by Dr. Joe Elkinton in 41 sites across Massachusetts, has become widely established and is having a measurable impact. We published 3 (of 13 total) Massachusetts IPM Berry Blasts (often in collaboration with Heather Faubert in RI) with information about winter moth to 456 recipients.

Gypsy moth populations were extremely high in several regions of Massachusetts in 2017 following the drought conditions in 2016 whereby the natural control agent *Entomophaga maimaiga* was suppressed by the dry conditions. Rain later in the summer of 2017 reactivated the *E. maimaiga* fungus and increased gypsy moth mortality later in the season thereby reducing egg laying and overwinter populations for 2018 (see images below). In 2018 GM populations were lower with only a few localized areas of outbreak. Timely insecticide applications (e.g., B.t.) to control this pest were only needed in some locations.

Spotted Wing Drosophila (SWD) – UMass Extension maintained a 10-trap network for monitoring the onset of SWD activity for 2018. Scentry traps and lures were used in most cases and traps were monitored on a weekly basis starting in mid-June. First capture coincided with sustained capture dates beginning at approximately June 25, 2018. This was similar to the timing in 2017 and again put some crops at risk that had not been considered vulnerable to SWD in the past; late ripening varieties of June bearing strawberries and sweet cherries. Grape growers again reported significantly high populations in vineyards during harvest indicating that late season sprays may be needed in this crop. Four issues of Massachusetts IPM Berry Blast (456 recipients) contained information on SWD pest status and management recommendations. Trap capture results from the 10-site network were reported on iPiPE.

A demonstration project showing how to build and manage an affordable, small scale exclusion netting system for protecting late ripening floricane raspberries from SWD was installed at the UMass Cold Spring Orchard at a cost of approximately $500. The system used PVC pipe as structural support, a combination of standard and pressure treated lumber, 80-gram exclusion netting. The tunnel was 100 ft in length with fifteen 3rd year black raspberry crowns of 3 varieties ('Niwot', 'Bristol' and 'Mac Black'. From this 75' row of plants we harvested 125 lbs. ($600-$650+ retail value) of fruit with no insecticide (or fungicide) sprays needed. This showed that the investment in exclusion netting can pay for itself in a short period of time. The only problem encountered was after harvest was complete there was an outbreak of aphids which dissipated after the exclusion netting was removed.

Special Projects/Research Publications

The UMass RIMpro Advisory Service was continued in 2018 with twelve orchards paying $250 each to join the Service. Members had access to a website with RIMpro model outputs including scab, fire blight, codling moth, and -- new this year -- a fruit thinning model. Most likely these growers will be on their own sign-up for RIMpro in 2019.

For a second and final year, a UMass team including Extension Educators, a graduate student, and two undergraduate students ran a pheromone trap network across Massachusetts orchards as part of the eIP and iPiPE Northeast Apple Crop Pest Program. Traps were checked weekly and pest incidence/counts were entered into the iPiPE portal. iPiPE is a collaborative effort between researchers, Extension specialists, and growers that utilizes near real-time data to provide pest status, education, and outreach on a national scale.

Figure 7. Exclusion netting being installed over black raspberries at UMass Cold Spring Orchard.

Led again and hosted by UMass, the New England Tree Fruit specialists team contributed to the online edition of the New England Tree Fruit Management Guide. Being 100% online at netreefruit.org, the Guide is continually updated and is the centerpiece of New England specialists' collaboration on tree fruit recommendations. The Guide was built with responsive web design, so it is very mobile friendly.

The Eco Apple App was updated; however, it was turned over to the IPM Institute for further updates. The App target audience is Eco Apple growers, the objective to make Eco Apple approved spray chemical information available by bud stage and pest. The app is free (thanks to some leftover Northeast SARE money) and can be used by any apple grower wishing to restrict their spray chemical use to Eco Apple approved chemicals. The app is available on both the Google Play and Apple App Stores.

MyIPM (another app!) was updated in cooperation with Clemson University and others. In particular, pear insects was added, and pear and apple diseases were updated. MyIPM is a helpful diagnostic app that provides both chemical and non-chemical management recommendations for insect and disease problems in multiple crops. (Apple, pear, peach, strawberry, blueberry, etc.) But the main goal is to provide chemical resistance management help, including fungicide and insecticide modes of action, with chemical spray rotation help. MyIPM is available on both the Google Play and Apple App Stores.

In collaboration with researchers at Cornell's Hudson Valley Lab (Acimovic), an Asian pear variety block at the UMass Orchard in Belchertown was dissected over time of fire blight cankers which were a result of purposeful inoculation in 2017. Canker samples were taken back to the Hudson Valley Lab and deep-frozen for later analysis, the objective being to look at overwinter ability of the bacteria. These trees were all cut down and removed by bloom in 2018.

Another collaboration with Cornell University was beta testing the Malusim app. Malusim is a web and mobile (iOS and Android) app that interfaces with the apple fruitlet growth rate model to help with precision thinning and similarly with the apple irrigation model to provide irrigation guidance (preventing both over- and under-watering). Malusim is linked to NEWA for real time weather information that are used in both the apple thinning and irrigation models. We expect Malusim to be released to all interested apple growers for the 2019 growing season. Get a sneak peek at malusim.org.

Funded by Northeast SARE in cooperation with Quan Zeng at the Connecticut Agricultural Experiment Station, a block of Jonagold apples at the UMass Orchard in Belchertown was treated with several alternatives to antibiotics, including Bloomtime Biological, Blossom Protect, Double Nickel, Cueva and Oxidate, as well as a streptomycin control. Trees were inoculated with *Erwinia amylovora* at 70% bloom. Resulting infection incidence in blossom clusters was very high, 97% for untreated controls. Streptomycin incidence was 39%, while incidence in treatments using the antibiotic alternatives ranged from 69% to 97%.

In another test, McIntosh on M.7 were treated with different rates and timings of copper-phosphite (BluLogic, 1% metallic copper, NutriAg Ltd.). Trees were inoculated with *Erwinia amylovora* at 70% bloom. Disease incidence in clusters on untreated control was 88%, compared with a streptomycin control at 68%. BluLogic incidence ran from 79% to 83%. Shoot blight incidence in the untreated trees was 48%, and 15% in the streptomycin treatment. BluLogic shoot blight incidence ranged from 21% to 38%. BluLogic moderately reduced scab incidence relative to untreated controls, and did not russet fruit. For more information, see www.getblulogic.com.

We participated in the weekly Northeast Regional Berry Call-in organized by Cornell University that brought together Extension and Industry and Growers from the Northeast (PA to Ontario) to discuss current observations and timely topics together. These calls are extremely useful for problem solving and general awareness of growing conditions and challenges. Calls started in mid-April and ran through July.

For a second year in a row, a UMass team composed of research and Extension faculties and staff, with student support, conducted research in an one acre block of 'Polana' raspberries to test efficacy and best placement of attracticidal spheres for management of spotted wing Drosophila. This was the last year of a multi-state SARE grant project directed by Tracy Leskey (Appalachian Fruit Research Station, USDA).

On-farm demonstrations of the effectiveness of odor-baited trap trees as an attract-and-kill strategy for PC adults, and entomopathogenic nematodes (EPN) as biological control agents against PC larvae in the soil were conducted in six commercial orchards (five in MA, one in NH) from May to August 2018. Data are being processed.

Figure 8. Emergence cages deployed underneath an odor-baited trap tree to monitor emergence of adult plum curculios as part of demonstrations of biological control using EPNs applied to the soil.

Research/Extension Grants Received

Clements, J. iPiPE Northeast Apple Crop Pest Program. iPiPE: Integrated Crop Pest Information Platform for Extension and Education. Pennsylvania State University/North Carolina State University/USDA AFRI Cooperative Agricultural Project.

Piñero, J.C., Leskey, T.C., Shapiro,-Ilan, D., Faubert, H., Concklin, M, and Hamilton, G. Project title: "Developing a multi life-stage management strategy for apple maggot, a persistent tree fruit pest in the Northeast, through the integration of attract-and-kill and biological control". Funding agency: NIFA Crop Protection and Pest Management program. The main goal of this 3-year project is to develop an integrated multi-stage management program for AMF involving attract-and-kill (against AMF adults) and use of entomopathogenic nematodes (against AMF larvae in the soil) that minimizes use of insecticides. Participant states: CT, MA, NH, RI.

Piñero, J.C., Schloemann, S., Simisky, T., Garofalo, E., and Clements, J. Project title: "Invasive Insect Pests Threatening Specialty Crops in Massachusetts: Research, Monitoring, Stakeholder Engagement and Education". Funding agency: MA Department of Agricultural Resources. Project objectives: (1) To develop and evaluate a grower-friendly mass trapping system to reduce populations of spotted wing drosophila, *Drosophila suzukii*, (2) to support existing monitoring systems for BMSB and SWD, and to initiate monitoring of spotted lanternfly, and (3) To engage and educate stakeholders through a multi-dimensional stakeholder engagement and education program involving a conference, workshops, field days, and dissemination of relevant information among stakeholders.

Small Steps to a Big Future for Massachusetts Cider Apples

Elizabeth Garofalo and Jon Clements
University of Massachusetts

In Massachusetts, our love affair with cider has a long and illustrious -- if sometimes notorious -- history that predates even John Chapman (AKA Johnny Appleseed). In recent decades, there has been a growing nationwide passion for the fermented beverage enjoyed by our forebears. Unfortunately, there is a dearth in production of desirable apples for traditional hard cider. (Referred to as just cider from here on, as it *should* be). This has led to a market flooded with a bevy of apple-based adult cider beverages possessing less than traditional qualities. There are some orchards in the Northeast that have been making positive headway in increasing traditional cider apple plantings. There remains, however, a chronic shortage of traditional cider apples (Fabien-Ouellet & Conner, 2017). This project aims to provide Massachusetts growers with information specific to Massachusetts cider apple varieties that contribute to a quality top-shelf cider.

Not all apple varieties are created equally. Some apples are far better suited for fresh eating and baking. The supermarket is filled with varieties we all know and love: McIntosh, Honeycrisp, Fuji, and Gala. These varieties do not possess the characteristics necessary to create the hallmark quality of a traditional cider we expect from Massachusetts cider makers. Many varieties prized for the fruit's cider qualities are European, with storied heritage, finicky growth habits and pest susceptibility. But, with craft cideries attempting to distinguish themselves from mass-produced sweet-tasting ciders often made from apple juice concentrate, there is an opportunity for local growers to find a new and exciting niche for their apples (Raboin, 2017).

Table 1. Eleven cultivars grafted onto older trees at the UMass Cold Spring Orchard in Belchertown, MA. Descriptions are general. Characteristics of each variety will be evaluated for MA production conditions.

Cultivar	Flavor Profile
Alkmene (aka Early Windsor)	Sweet-sharp
Ashmead's Kernel	Sweet-sharp
Court Pendu Plat	Sweet-tart
Egremont Russett	Sweet-sharp
Ellis Bitter	Bittersweet
Foxwhelp	Bittersharp
Kingston Black	Bittersharp
Medaille D'Or	Bittersweet
Michelin	Bittersweet
Redfield	Bittersweet
St. Edmund's Russet	Sweet

Table 2. Apple qualities considered when selecting which varieties to blend for fermentation.

Apple classifications[a]	Tannin[b]	Acid
Sweets	Low (<2 %w/v)	Low (<4.5 %w/v)
Sharps	Low	High (>4.5 %w/v)
Bittersweet	High (>2 %w/v)	Low
Bittersharp	High	High

[a] Merwin (2015).
[b] Weight by volume (w/v) is commonly expressed in g/L of tannins or total acidity.

Materials & Methods

Dormant scion wood was collected in Hawley, MA on April 6 and from Dummerston, VT on April 13, 2018 (Figure 1). For each cider variety, four to six budwood sticks approximately 1/4 inch in diameter and 12 to 16 inches long were selected. Care was taken to select wood with no obvious signs of disease or other damage. As each variety was collected, it was bundled using flagging tape labeled with cultivar name. The base of each bundle was then wrapped in moist paper towel and covered with plastic wrap to prevent desiccation and stored in

Figure 1. Peter Mitchell of Headwater Cider and Jon Clements tie off and label bud wood for later grafting (Good thing there was cider on hand, it was as cold as it looks that day!).

an uninsulated cellar to keep the wood cold enough to prevent bud break.

Existing trees at the UMass Cold Spring Orchard planted as a variety trial on M.9 rootstock in 2012 were selected for top working to the cider scions (Figure 2). These trees, on M.9 rootstock, were planted 3 feet apart and grown to a tall-spindle with 4-wire support. Just prior to grafting, the leader was cut-off just above several lower "nurse" limbs.

On May 4, 11, and 18, 2018, scion wood was grafted onto the topped trees using a bark-inlay. Three trees were grafted with each variety (the experimental unit) across 4 replications in a randomized (in)complete block design. (To be honest, the grafting was continued onto Rep 4 in an adjacent row of free standing trees on M.26 and G.210 rootstocks.) Grafting was done before, during, and after bloom, when the bark was readily "slipping." This is when the vascular system is actively growing and allows the bark to be gently moved away from the hardwood without damage. Each scion was cut down to two to three buds, the end whittled (with a utility knife!) to an angle on each side so that the vascular system of the new cultivar could be aligned with that of the interstem when slipped between the bark and hardwood. Grafts were wrapped with black electrical or masking tape (wicked technical, I know, but, it works!) and covered with Doc Farwell's grafting seal. And then we waited…

Figure 2. Jon Clements instructs undergraduates Cam Olanyk and Lyndsey Ware on the art and science of grafting at the UMass Cold Spring Orchard in Belchertown, MA, May 4.

Results

Successes and challenges. By-and-large, the grafts took well and grew vigorously during the 2018 growing season (Figure 3). Overall graft success was 77%. Time of grafting seemed significant, as graft take was 100% in the first two reps, which were grafted on May 4. Success rates declined as grafting date became later. Desic-

Figure 3. First round graft, scion budding out (circled) with nurse limbs surrounding graft, June 14.

Figure 4. Previously healthy graft lost to a windstorm. Tying up scion for support is a critical step in the success of the grafting process, July 24.

cation of the bud wood also played a role in decreased rate of success. That hot and musty, uninsulated cellar was not the best storage place as spring got underway in earnest. Later, there was a windstorm, never a friend of the orchardist. High winds swept through before all new scion growth could be attached to support wires causing some loss (Figure 4). It is interesting to note that once the grafts started growing, two leaders were selected and grown nearly vertical to what could be best described as a "bi-leader fruiting wall" where the leaders are spaced approximately 18 inches apart (Figure 5).

Pests. The biggest surprise in this arena was how few we actually saw. Potato leafhopper showed up in MA mid-June and immediately went to work causing damage to younger trees, and our grafts. Gypsy moth caterpillars also made a brief appearance. These were both readily managed to prevent loss, even if the foliage looked a little worse for wear from their feeding. Otherwise insect and disease issues were at a minimum, as you might expect from trees with no fruit.

Next Up

Next spring, we will collect more budwood to replace what was lost in 2018 to fill out all four replications in this planting. With any luck, by the end of 2019, we will have a complete block to observe bloom time, pest incidence and severity, growth habit and fruit quality characteristics. Already observed was lots of blind wood on these grafts, so a branching experiment on this 1-year old wood is already planned for Spring 2019. Stay tuned for more adventures in cider apple production!

Figure 5. Once scion had established and sent out new growth, the two most upright and healthy shoots were selected as leaders, the others removed.

Literature Cited

Fabien-Ouellet, N. & Conner, D.S. (2017). The Identity Crisis of Hard Cider. Journal of Food Research. Vol 7. No 2. 54-67

Raboin, M. (2017). Hard Cider in the North Central Region: Industry Survey Findings. http://www.cias.wisc.edu/wpcontent/uploads/2017/07/cideer-study071817web.pdf.

Merwin, I. (2015). Growing Apples for Craft Ciders. New York Fruit Quarterly. Vol. 23 No.1 5-9.

Update on the 2014 NC-140 Honeycrisp and Aztec Fuji Rootstock Trials in New Jersey and Massachusetts

Megan Muehlbauer and Win Cowgill
Rutgers University, New Jersey Agricultural Experiment Station

Jon M. Clements and Wesley R. Autio
University of Massachusetts

In 2014, as part of the NC-140 regional rootstock research project (nc140.org), three replicated rootstock trials were established in New Jersey and Massachusetts. One Honeycrisp and one Aztec Fuji trial were grown on a number of rootstocks at the Rutgers University, Snyder Research and Extension Farm in Pittstown, New Jersey. Further, a trial of Honeycrisp trees was grown on similar rootstocks at the University of Massachusetts Cold Spring Orchard Research and Education Center in Belchertown, MA.

The purpose of these trials is to compare standard (M.9 NAKBT337 and M.26 EMLA), and newly released Geneva (G.) rootstocks against four Vineland (V.) rootstocks from the Horticultural Experiment Station at Vineland, Ontario, Canada in 1958 (https://articles.extension.org/pages/60856/apple-rootstock-info:-v1). At the New Jersey site, Honeycrisp trees were planted at a 3-foot in-row spacing on M.26 EMLA, M.9 NAKBT337, B.10, G.11, G.30, G.41, G.202, G.214, G.935, G.969, V.1, V.5, V.6, and V.7 (Table 1). Aztec Fuji were planted (at 5-foot in-row spacing) on the same rootstocks except excluding B.10, G.41, and G.969 (Table 2). In Massachusetts Honeycrisp trees were planted (3-foot in-row spacing) on the same rootstocks as the New Jersey Honeycrisp plus G.890 and the excluding B.10 (Table 3). Ten replications of each

Table 1. Vigor and fruit yield in 2018 of Honeycrisp trees in the 2014 NC-140 Apple Rootstock Trial at the Rutgers University, Snyder Research and Extension Farm in Pittstown, NJ.

Rootstock	Trunk cross-sectional area (cm^2)	Number of fruit[1]	Fruit weight (g)[1]	Yield (kg)[1]	Cumulative yield (2015-18, kg)[1]	Yield efficiency (kg/cm^2)	Cumulative yield efficiency (2015-18 kg/cm^2 TCA)	Number of rootsuckers[1]
G.202	9.4 H	40	262	13.3	13.6	1.09 AB	1.84 AB	0
G.11	10.8 H	42	191	10.0	17.4	1.01 AB	2.35 A	0
B.10	12.1 GH	41	299	12.3	18.0	1.12 AB	1.71 AB	0
G.41	12.8 FGH	61	281	15.7	19.8	1.25 A	1.84 AB	0
G.214	14.3 FGH	76	236	17.7	23.5	1.24 A	1.70 AB	4
M.9 NAKBT337	14.8 FG	39	279	10.7	19.7	0.79 AB	1.78 AB	3
G.935	16.6 EFG	68	225	15.5	24.6	0.99 AB	1.61 ABC	4
M.26 EMLA	18.2 DEF	38	279	11.2	19.0	0.65 AB	1.19 BCD	3
G.969	21.5 CDE	68	278	18.3	22.4	0.88 AB	1.05 BCD	2
G.30	23.2 CD	59	248	15.6	24.9	0.74 AB	1.11 BCD	4
V.1	25.5 BC	53	251	13.3	20.2	0.53 AB	0.75 D	3
V.5	29.2 AB	57	296	15.9	23.6	0.57 AB	0.77 CD	2
V.7	29.5 AB	38	255	8.4	15.8	0.28 B	0.47 D	4
V.6	33.3 A	52	276	14.5	20.5	0.45 AB	0.62 D	4

Means within columns not followed by a common letter are significantly different at odds of 19 to 1.
[1] No significant differences across rootstocks

Table 2. Vigor and fruit yield in 2018 of Aztec Fuji trees in the 2014 NC-140 Apple Rootstock Trial at the Rutgers University, Snyder Research and Extension Farm in Pittstown, NJ.

Rootstock	Trunk cross-sectional area (cm^2)	Number of fruit[1]	Fruit weight (g)[1]	Yield (kg)[1]	Cumulative yield (2015-18, kg)[1]	Yield efficiency (kg/cm^2)	Cumulative yield efficiency (2015-18 kg/cm^2 TCA)	Number of rootsuckers[1]
G.11	20.2	123 AB	175	22.4	32.2 ABC	1.26	0.40 B	0 B
G.202	15.5	99 AB	203	17.7	30.1 ABC	1.16	0.80 AB	1 AB
G.214	16.0	125 AB	193	23.0	35.8 ABC	1.45	1.04 A	0 B
G.30	33.6	125 AB	194	24.0	45.9 A	0.77	0.48 AB	1 B
G.935	20.3	144 A	186	26.8	42.9 AB	1.33	0.73 AB	0 B
M.26 EMLA	25.9	121 AB	184	21.7	31.5 BC	0.88	0.52 AB	1 B
M.9 NAKBT337	18.9	152 A	167	25.7	32.4 ABC	1.40	0.33 B	5 A
V.1	31.6	80 B	235	17.4	32.3 ABC	0.57	0.37 B	3 AB
V.5	33.1	80 B	181	13.0	26.0 C	0.41	0.24 B	2 AB
V.6	38.3	104 AB	203	20.7	37.3 ABC	0.54	0.27 B	2 AB
V.7	39.3	99 AB	192	20.2	33.9 ABC	0.64	0.21 B	2 AB

Means within columns not followed by a common letter are significantly different at odds of 19 to 1.
[1] No significant differences across rootstocks

Table 3. Vigor and fruit yield in 2018 of Honeycrisp trees in the 2014 NC-140 Apple Rootstock Trial at the University of Massachusetts Cold Spring Orchard Research and Education Center in Belchertown, MA.

Rootstock	Trunk cross-sectional area (cm^2)	Number of fruit[1]	Fruit weight (g)[1]	Yield (kg)[1]	Cumulative yield (2015-18, kg)[1]	Yield efficiency (kg/cm^2)	Cumulative yield efficiency (2015-18 kg/cm^2 TCA)	Number of rootsuckers[1]
G.11	7.4 EF	49 BC	270 ABC	12.9 CD	19.5 CDEF	1.69 AB	3.11 ABCD	0 C
G.202	6.5 F	37 C	231 CDE	8.4 D	11.1 F	1.24 B	1.89 EF	0 C
G.30	16.2 C	82 AB	268 ABCD	21.5 AB	43.7 A	1.33 B	3.77 AB	5 AB
G.41	9.5 DEF	54 BC	246 BCDE	13.7 BCD	20.2 CDEF	1.39 B	2.57 BCDEF	1 C
G.214	11.2 D	72 BC	253 ABCDE	18.0 ABC	29.3 BC	1.59 AB	3.35 ABC	3 BC
G.890	21.1 A	84 AB	302 A	24.3 A	39.0 AB	1.16 B	2.33 CDEF	8 A
G.935	9.6 DEF	65 BC	230 CDE	15.1 BCD	22.8 CDE	1.54 AB	2.79 BCDEF	1 C
G.969	12.1 D	121 A	219 DE	24.6 A	40.7 A	2.04 A	4.13 A	1 C
M.26 EMLA	10.2 DE	46 BC	244 BCDE	11.4 CD	18.6 DEF	1.11 B	2.36 CDEF	1 C
M.9 NAKBT337	6.9 F	53 BC	216 E	11.4 CD	17.8 EF	1.63 AB	3.00 ABCDE	1 C
V.1	12.5 D	64 BC	236 BCDE	15.1 BCD	26.0 CDE	1.21 B	2.65 BCDEF	1 C
V.5	17.1 BC	82 AB	274 ABC	22.0 AB	27.8 CDE	1.30 B	1.82 EF	0 C
V.6	19.5 AB	78 BC	283 AB	21.6 AB	29.3 BCD	1.11 B	1.73 F	0 C
V.7	16.8 BC	72 BC	270 ABCDE	19.8 ABC	25.8 CDE	1.20 B	1.82 DEF	0 C

Means within columns not followed by a common letter are significantly different at odds of 19 to 1.

rootstock was planted in each trial. Data collected in 2018, included trunk size, yield, fruit weight, rootstock suckering, tree height, and canopy spread.

Results on vigor and yield of Honeycrisp trees grown in New Jersey are shown in Table 1 and Figure 1. Data showed that the statistically smallest trunk sizes were of trees on B.10, G.11, G.202, G.214, and G.41, while the largest were on V.5, V.6, and V.7. Average fruit per tree, fruit weight, 2018 yield, cumulative yield, and root suckering were shown to be similar across rootstocks. Average yield efficiency was statistically similar across all rootstocks with the exception of V.7, which was significantly lower. The comparison of cumulative yield efficiency showed B.10, G.11, G.202, G.214, G.41, G.935, and M.9 NAKBT337 had the largest efficiency while all of the remaining rootstocks were statistically similar to each other albeit lower than the aforementioned rootstocks.

In the Massachusetts Honeycrisp Trial (Table 3, Figure 1), the smallest trunk cross sectional area was found in rootstocks G.11, G.202, G.41, G.935, and M.9 NAKBT337, the largest trunk cross sectional area was

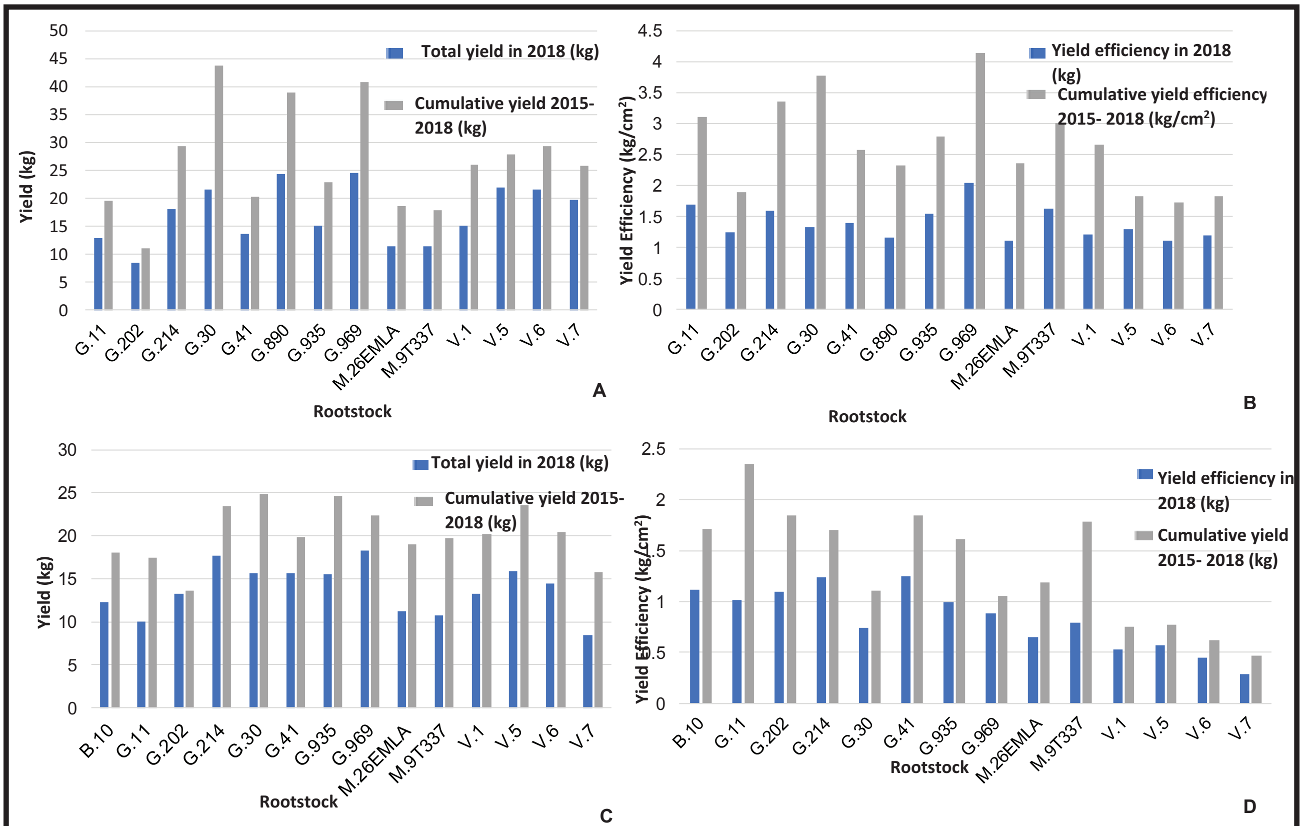


Figure 1. Averages of total yield (2018), cumulative yield (2015-18), yield efficiency (2018), and cumulative yield efficiency (2015-18) of all of the rootstocks grafted under Honeycrisp scion. Graphs A and B depict the yield and yield efficiencies across all rootstocks at the University of Massachusetts Cold Spring Orchard Research and Education Center in Belchertown, MA and graphs C and D depict the yields and yield efficiencies across all rootstocks at the Rutgers University, Snyder Research and Extension Farm, Pittstown, New Jersey.

G.890 (21.1 cm^2). The average number of fruit per tree was greatest in G.30, G.890, G.969, and V.5, all of which were significantly greater than the remaining rootstocks. Average fruit weights varied from 216 to 302 grams, and the rootstocks were statistically split into two groupings. Average yields in 2018 were also statistically split into a higher and lower group. The highest cumulative yields were collected from G.30, G.890, and G.969, while the lowest yields were collected from G.11, G.202, G.41, M.26 EMLA, and M.9 NAKBT337. Average yield efficiencies in 2018 were statistically similar across all rootstocks, while cumulative yield efficiencies were greater in G.11, G.30, G.214, G.969, G.202, G.41, G.890, G.935 and M.9 NAKBT337 and lower in all the remaining rootstocks. Root sucker production was statistically greater in G.30 and G.890 and G.30 had more root suckers than all other rootstocks with the exception of G.214, which did not differ from G.30 in root sucker number.

Interestingly, the data for the Aztec Fuji trial in New Jersey showed no statistical differentiation of any of the data points collected across the rootstocks. (Table 3, Figure 2). This result could be explained by the significant variability in the individual data points within each rootstock this growing season. In comparing the Honeycrisp trials in New Jersey to that of Massachusetts a number of points were made. The trunk cross sectional areas were largest in V.6 at both sites, in addition to V.6 in New Jersey V.5 and V.7 were also statistically larger, and in MA, G.890 was included in the highest range of trunk cross sectional areas. The average number of fruit per tree was equal in New Jersey; however, the Massachusetts site showed G.30, G.890 and G.969 as having larger numbers of fruit. Fruit weight was also shown to be statistically similar at each of the sites, with minor differentiation in Massachusetts.

The average yields for 2018 and cumulative yields (2014-2018) were statistically similar across all rootstocks in the New Jersey trial and fell into two groupings in the Massachusetts trial. Similarly average yield efficiencies were statistically analogous across all

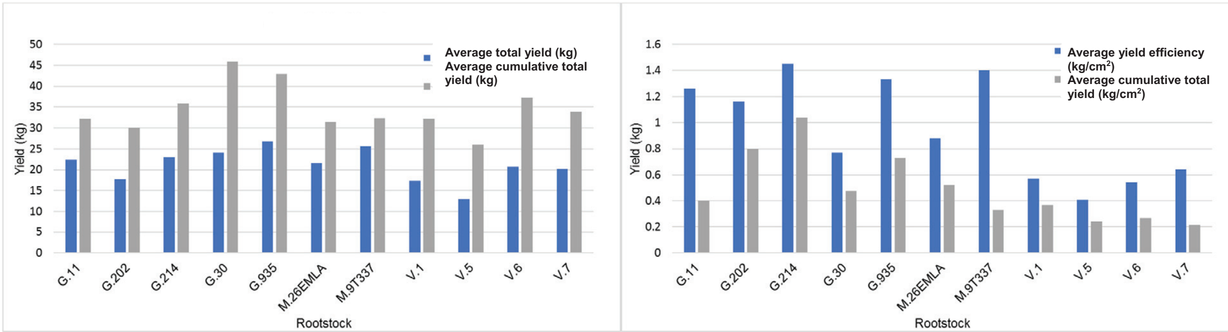


Figure 2. Yield (2018), cumulative yield (2015-18), yield efficiency (2018), and cumulative yield efficiency (2015-18) of all of the rootstocks grafted under Aztec Fuji scion at the Rutgers University, Snyder Research and Extension Farm, Pittstown, New Jersey.

rootstocks at both sites, however the highest cumulative yield efficiencies showed differences between sites, where the highest efficiencies in New Jersey were in B.10, G.11, G.202, G.214, G.41, G.935, and M.9 NAKBT337 and the highest efficiencies in Massachusetts were G.11, G.30, G.214, G.969, and M.9 NAKBT337.

Based on the data thus far, Honeycrisp trees in this study show the most promising results on G.11, G.214, and G.41 rootstocks. In contrast, Aztec Fuji trees in this study show the most efficient yields on G.214 rootstocks. Further data will be needed to determine further rootstock recommendations for growers.

Through the NC-140 regional project, these 2014 plantings were established at plots around the country and will be maintained for 10 years. In 2019, the 5th growing season of these trials, a half-term project report will be complied and published. Ongoing unpublished results for these trials located throughout the county can found at http://www.nc140.org.

Glomerella Leaf Blotch and Fruit Rot: New Apple Diseases in the Northeast

Win Cowgill
Professor Emeritus Rutgers, Win Enterprises International, LLC

Glomerella leaf Blotch (Photo 1), was first identified in North Carolina and then in Virginia. Since then, it has been seen in New York and Pennsylvania, and it was observed in northern New Jersey in 2019. This disease can also become a fruit rot, Glomerella Fruit Rot (Bitter Rot), caused by the sexual stage of the fungus. The disease has been observed primarily in cultivars that have Golden Delicious parentage, including Gala, Pink Lady (Cripps Pink), Jonagold and of course, Golden Delicious. Symptoms have also been observed on Granny Smith. In New Jersey it was observed on Cripps Pink (see Photos 2, 3, and 4).

Photo 1. Glomerella leaf Blotch on Golden Delicious in New York. Photo courtesy of Dr. Dave Rosenberger.

Glomerella Leaf Blotch was first identified in North Carolina, and has become a serious problem there. Since it has been found in Virginia, New York, Pennsylvania, and now in northern New Jersey in 2019 in Hunterdon County. In North Carolina, Glomerella leaf spot and fruit rot have been predominantly caused by *Colletotrichum fructicola*, a member of the *Colletotrichum gloeosporiodes* species complex.

Sources of Inoculum

Research regarding the sources of inoculum for Glomerella leaf spot and fruit rot is currently being conducted at NC State University. The main source of primary inoculum for the disease appears to be infected leaves overwintering on the orchard floor. Ascospores are released from perithecia sometime around bloom to petal fall. Other sources of Glomerella leaf spot and fruit rot inoculum that are currently being investigated include wood, cankers, crevices, buds, mummified fruit, and other plant hosts.

Environmental Conditions

Hot and humid conditions favor infection by the *Colletotrichum* fungi causing Glomerella leaf spot and fruit rot and disease development. Infection by conidia occurs between 59°F and 95°F, with an optimal tem-


Photo 2. Glomerella Leaf Blotch starting to show on Cripps Pink in October in northwestern New Jersey. Win Cowgill photo.

Photo 3. Glomerella Leaf Blotch almost defoliates Cripps Pink in mid-October in northwestern New Jersey. Win Cowgill photo.

perature of 82°F. A minimum 2.76 hours of leaf wetness is required for infection to occur.

Inoculum Reduction

Reducing inoculum for Glomerella leaf blotch and fruit rot are the same as used for scab inoculum reduction. There will be a benefit, particularly for the susceptible cultivars noted above. Since Honeycrisp is very susceptible to bitter rot, it would be very appropriate to use at least one of the leaf inoculum reduction treatments. See photos 5 and 6. In general, we recommend reducing apple leaf litter and the inoculum it contains. It is a relatively inexpensive and reliable method that decreases the risk of apple scab and Glomerella leaf blotch and fruit rot.

Shredding all leaves on the orchard floor in November or April reduces the number of spores. If the strip under trees cannot be reached with shredding equipment, then flail chopping the remaining area between trees will still reduce spores. Small leaf pieces break down quicker, and are more readily consumed by earthworms. If shredding is done in April, it will flip leaves, and leaf pieces, over. Flail chopping flips probably about half the leaves or pieces over, and spores formed in those pieces of leaves cannot release into the air.

Urea sprays directed to the leaves on the ground will reduce spores. Use feed grade urea, which is 46% N, and mix a 5% solution in water. (This is 44 lb. per 100 gal.) Feed grade urea is more expensive but dissolves in water much easier than granular (fertilizer grade) urea. Thus, feed grade is recommended, though the cost is higher – app. $25/acre vs. half that price for granular urea. The nitrogen content of both is the same, so granular urea can be used, but with more effort. Spray the ground surface at a rate of 100 gal. per acre. You can use an air-blast sprayer with only the lower nozzle(s) turned on, but it's best to use a boom-type herbicide or field crop-type sprayer. Make applications approximately two to four weeks before bud break, with a longer interval being more effective. Consider that this supplies approximately 20 lbs. actual nitrogen per acre, so you will need to adjust your N fertilizer application

Photo 4. Glomerella Leaf Blotch in Cripps Pink in October in northwestern New Jersey spreads from the originally infected tree nearby trees down the row.

Photo 5. Bitter Rot on fruit. Jon Clements photo.

Photo 6. Bitter Rot on fruit. Jon Clements photo.

rates later in the season. Shredding and urea treatments can be combined, for even greater spore reductions.

Fungicide Applications

Infection by conidia of *Colletotrichum fructicola* causing Glomerella leaf blotch and fruit rot (GLS/GFR) occurs in a temperature range of 59F to 95F and requires a relative humidity near 100%. If a standard apple scab program with a protectant fungicide (i.e. mancozeb) is being applied through bloom, programs for GLS/GFR should be initiated around the petal fall growth stage.

Dr. Sarah Villani, NC State Fruit Pathologist did an extensive fungicide trial for Glomerella in 2017. See the full results results at: https://apples.ces.ncsu.edu/2018/04/preparing-for-glomerella-leaf-spot-and-fruit-rot-in-2018/ The following points were taken from Dr. Villani's recommendations:

- Apply a full rate of a FRAC 11 containing fungicide (e.g. Flint or Merivon) plus mancozeb (1/2 rate) at petal fall and first cover.
- Flint does not have as high of level of efficacy as Merivon when used as a curative fungicide. Thus, for resistance management and for any kick-back activity, consider a fungicide containing pyraclostrobin (Merivon or Pristine) over a fungicide containing trifloxystrobin (Flint or Luna Sensation), particularly if the weather has been warm and humid, or there has been a lot of precipitation.
- Tighten up spray intervals from petal fall through second cover. Maintaining fungicide residues on the foliage and developing fruit is important for GLS/GFR control.
- For summer covers applications, consider rotating Ziram 76DF (3 lb) + ProPhyt (4 pt) with Captan 80WDG (3.75 lb) + ProPhyt (4 pt).
- Fungicides from FRAC Groups 3 (S.I.'s) Group 7 (SDHI's) and Group 1 (Tmethyl) have shown moderate to no activity against *Colletotrichum fructicola* in the NC State research orchard. However, against flyspeck and sooty blotch, they are good, so you may want to consider incorporating them as tank mixture of the protectant fungicide + ProPhyt.
- Do not extend beyond a 10-day spray interval from petal fall through harvest on cultivars susceptible to GLS.
- Manage weeds under the canopy to reduce alternate hosts/secondary inoculum, and humidity.

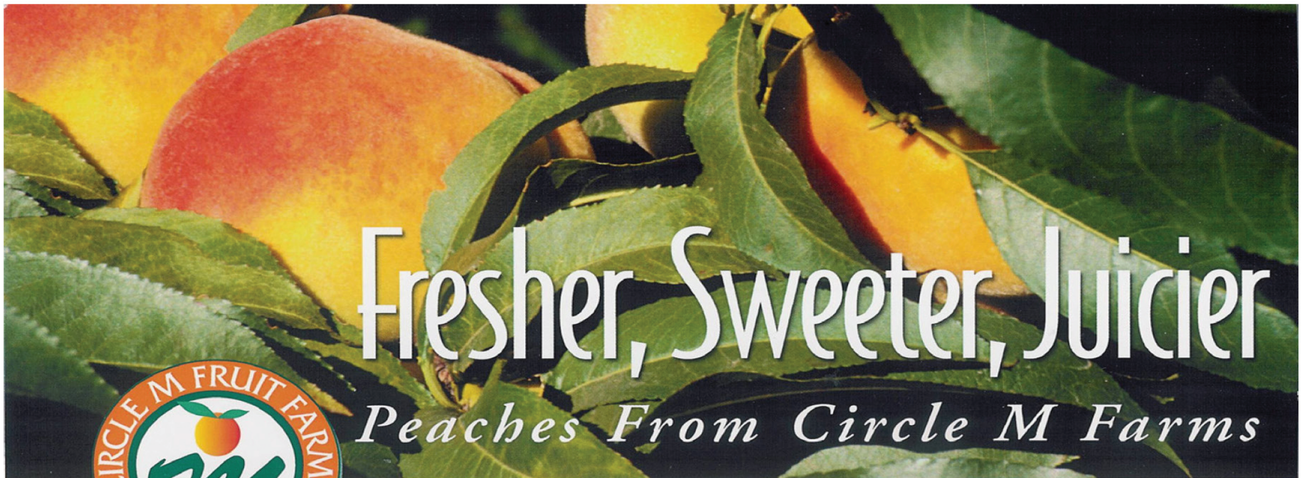
In Summary, begin sprays at petal fall for the GLS/GFR control program. Always use a protectant fungicide in combination with a systemic fungicide (best protectants = Captan, Mancozeb, and Ziram; best systemics = pyraclostrobin (Merivon or Pristine) and phorsphoric acid. Start with Mancozeb at 3lbs./ + ProPhyt or Merivon or Pristine. At 77 Days (phi for

Mancozeb), switch to Captan plus a pyraclostrobin (Merivon or Pristine).

Phosphorus acid products are used worldwide to prevent certain diseases of grapes and apples. These include ProPhyt, Rampart, Agri-Phos, Aliette, and Phostrol. They work as fungicides by interrupting the metabolic processes of the fungus. Phosphorous acid (H_3PO_3) is also known as phosphite or phosphonate and is not the same thing as phosphoric acid (H_3PO_4) or phosphate, which is a source of phosphorus fertilizer. Check the label to make sure your phosphorous acid product is labeled on apple.

Check the pH of the spray solution, especially when using alkaline well water. While most fungicides are stable over a range of pH values, some fungicides, like captan, mancozeb, can degrade under alkaline conditions. For instance, the half-life of captan is 32 hours at pH 5, eight hours at pH 7, and 10 minutes at pH 8. The half-life of mancozeb is 32 hours at pH 5, 17 hours at pH 7, and 34 hours at pH 9 (insecticides in general are more sensitive to pH than fungicides). The pH can be adjusted with an acidifying/buffering agent. Avoid letting the spray sit overnight in the spray tank. Fungicides should, whenever possible, be mixed and sprayed as soon after mixing as possible.

Phosphorous acid also effectively lowered the pH of the spray solution. The pH of the well water was 7.07. Additions of ProPhyt reduced the pH to 6.14 at 0.375 percent, 6.04 at 0.625 percent.



Fresher, Sweeter, Juicier

Peaches From Circle M Farms

CIRCLE M FRUIT FARMS

Exceptional quality and flavor at attractive prices
Brought to you from the 4th generation family farm of Santo John Maccherone

- PLU Stickers Available Upon Request
- Low in Calories
- Nutritious and Delicious
- Exceptional Flavor

SANTO SAYS...

"Peaches from Circle M Farms just plain taste better. Their size and color are what your customers want, and their flavor is the icing on the cake.

That's because our orchards are tended with care and attention, and their fruit is left on the tree to ripen naturally until they reach their optimum sweetess. Then they are picked by hand, taste-tested by me to ensure quality, and packed gently into 25 lb. volume boxes for shipping. Single layer cartons are available upon request.

Circle M's 30 varieties of peaches and nectarines are known for their sweetness and their luscious color. They look as good as they taste.

Discriminating customers appreciate our white flesh peaches because of their lower acid levels and supremely sweet taste.

Add it all up: Peaches from Circle M Farms are fresher and sweeter, picked by hand when their time has come, and packed with care for a longer shelf life.

Yellow, white and donut peaches and yellow and white nectarines are available early July to late September."

Call us at 856 856 207-4542 or 609 381-6465. Fax your order to 856 878-0404

JERSEY FRESH
FROM THE GARDEN STATE™

Made from fresh New Jersey Peaches

"Peach Cider Drink, Peach Salsa, Peach Preserves"

Santo John Maccherone
circlemfarmsllc@gmail.com

Circle M Farms
88 Sandy Ridge Road
Salem, N.J. 08079

Fruit Notes
University of Massachusetts Amherst
Stockbridge School of Agriculture
205 Paige Laboratory
Amherst, MA 01003-9286