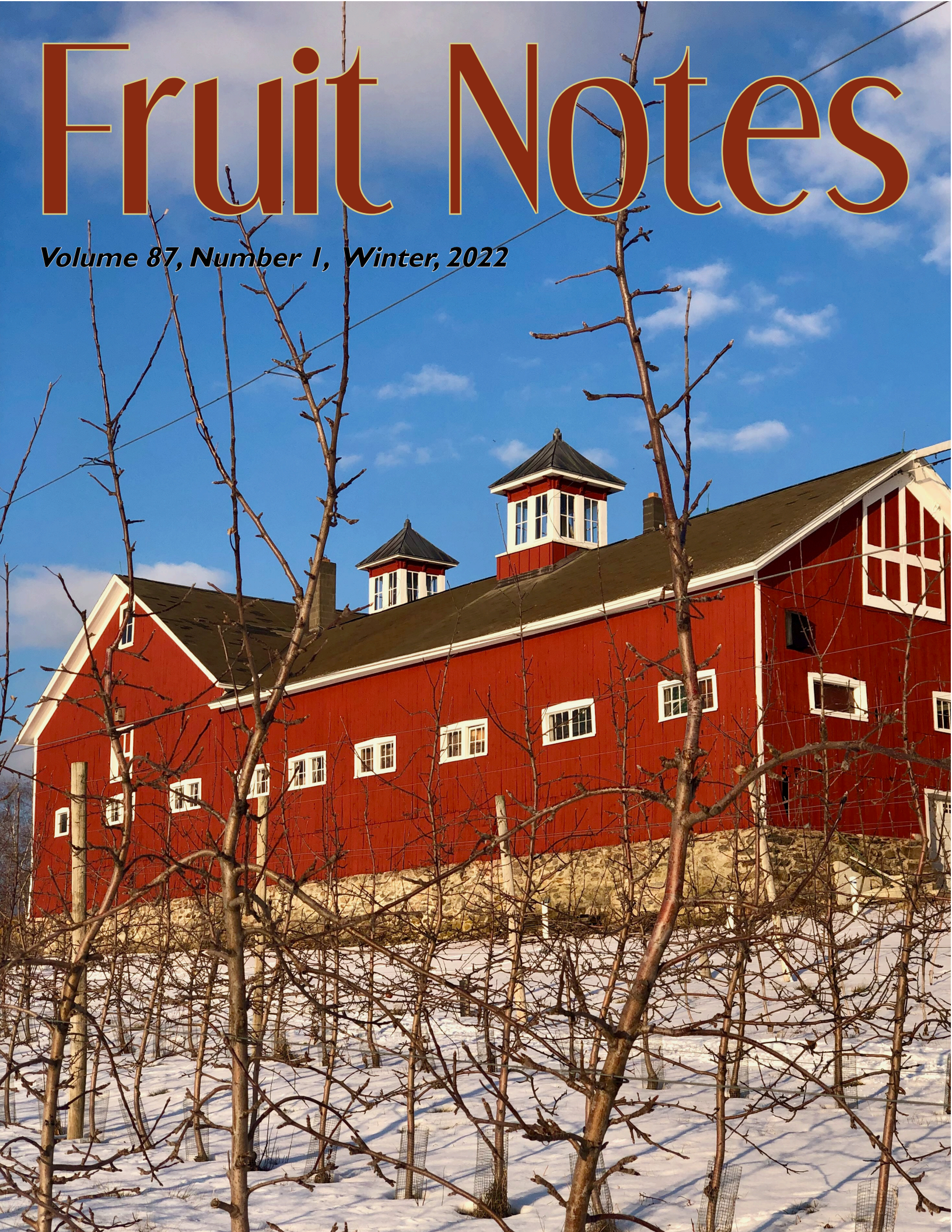
Fruit Notes

Volume 87, Number 1, Winter, 2022



Fruit Notes

Editors: Jaime C. Piñero & Winfred P. Cowgill, Jr.

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Cover: University of Massachusetts Cold Spring Orchard Research and Education Center (photo credit: Jon Clements).

Thanks to the generous sponsors of the UMass Fruit Program:

Massachusetts Fruit IPM Report, 2021

Jaime C. Piñero, Duane Greene, Daniel Cooley
Stockbridge School of Agriculture, University of Massachusetts

Elizabeth Garofalo, Jon Clements
University of Massachusetts Extension

Weather

Minimum winter temperature was 1 degree F. on January 1. No winter injury to fruit buds observed or reported. Snowfall was limited. Some late winter/early Spring warmth pushed an early green tip, about 31 March. But then a relatively cold April -- including a mid-April snowstorm, when apples were at an early tight cluster, that dumped nearly a foot of snow at the higher elevations of the UMass Orchard in Belchertown -- made for a slog until apple bloom circa 10 May. A low temperature of 28 degrees F. on 22 April flirted with bud damage (Figure 1) but nothing really came of it. Apple bloom was generally heavy, although Honeycrisp blocks (among a few others) seemed a little less profuse. Peach bloom was also robust.

Summer was wet, wet, wet. And warm to hot and humid overall, other than for a dry spell in early-mid June when irrigation was necessary. July we had nearly 11 inches of rain, August dried out a bit at 4 inches of precipitation. September ticked back up at almost 7 inches of rain. Needless to say, summer disease pressure, particularly bitter rot, was high and some blocks/orchards suffered serious crop loss to bitter rot in apples, Honeycrisp seeming particularly susceptible to the bitter rot outbreak. A summer high temperature of 94 degrees was recorded on 29 June, but little sunburn injury was noted. In summary: June, hot and dry; July, wet; August, muggy. Interestingly, despite all the rain in July, the peach crop was really nice with not a lot of brown rot cropping up. The summer wetness transgressed into Fall as noted with 7 inches of rain in September. September was also unseasonably warm and red apple color was slow to develop. ReTain applications seemed to work very well in preventing pre-harvest drop, as drop accelerated in Macs and Honeycrisp in late September that were not treated with ReTain. PYO orchards had good crowds to pick all the apples as generally good weekend weather extended through Columbus Day.

Figure 1. An April 16 snowstorm at the UMass Cold Spring Orchard dumped nearly a foot of snow, these poor Gala flower buds pulled through OK though.

NEWA 3.0 has officially gone online as of 1-October. When you visit newa.cornell.edu you will be served a whole new interface which frankly may be disconcerting at first if you are already familiar with the "old" NEWA. Most users should set up an account and use the

Dashboard to access Weather, Crop, and IPM Tools for their closest NEWA weather station location. As of the end of 2020 there were 52 active NEWA stations in Massachusetts including four new stations. For some training videos on how to best use NEWA 3.0 visit the NEWA Help Desk.

Diseases

Abnormally dry weather began the week of 9 March, according to the U.S. National Drought Monitor. Conditions worsened through April. By the week of 27 April, 92% of the state was experiencing abnormally dry to moderate drought conditions. By the end of June, most of the state was seeing rainfall again, except the Cape and Islands which remained under abnormally dry to moderate drought conditions through the summer.

Apple scab was largely a no-show as a result of the drought during primary infection season that eventually expanded to engulf the entire state. Decision support systems (RIMpro & NEWA) estimated five primary infection events. Final ascospores were observed in the home lab on 1 June.

RIMpro estimated one **Fireblight** blossom infection on 14 May, suggesting symptoms would be visible 27 May. It was approximately a month later, however, when reports of shoot blight (Figure 2) began to come in. In some locations the infections were extreme with trees exhibiting 30% or more blighted shoots and limbs. Blossom infections were seen in several newly planted blocks where blossom removal was not (or not completely) accomplished.

Bitter rot reports varied this year in their severity. Not many orchards seem to have gotten away with no bitter rot. First symptoms (Figure 3) observed in Belchertown on Honeycrisp on 9 August. At this point, the lesions were large enough to exhibit characteristic salmon colored sporulating concentric rings.

Powdery mildew was the surprise "star" this year. The dry humid weather in spring and early summer made for excellent infection conditions for this pathogen. Peach blocks that were near infected apple trees also developed rusty spot.

Insects

The Spotted Lanternfly Arrives in Massachusetts. The MA Department of Agricultural Resources (MDAR) announced on 28 September, 2021, that an established population of the invasive spotted lanternfly (*Lycorma delicatula*) was detected in Worcester County, MA. This finding was confirmed by state officials.

Figure 2. Fireblight infections in older limbs leading to death of this season's shoot growth.

Figure 3. Characteristic salmon colored sporulating concentric rings of bitter rot on developing Honeycrisp.

Insect pest activity in 2021. In 2021, multiple growers and entomologists noticed less than normal insect activity, including pollinators. Examples of insect pests that were in very low population densities in almost every cooperating orchard in Massachusetts and New Hampshire include tarnished plant bug (TPB) and European apple sawfly (EAS). However, one insect pest that was abundant and caused some damage in several orchards was rosy apple aphid. More detailed information about the level of damage caused in commercial apple orchards in Massachusetts was reported in *Fruit Notes*.

Plum curculio. As shown in Figure 4, the levels of injury by most insects recorded at the harvest surveys were well below 1%. The only exception was the dreaded **plum curculio (PC),** which caused substantial damage in at least 3 orchards. Two orchards experienced > 10% fruit injury in perimeter-row trees, and one orchard experienced 11.4% injury across the entire block. Across 9 commercial orchards, PC infestation levels averaged 4.9% in perimeter-row trees and 2.8% in interior trees. The average whole-block infestation levels by PC in 9 commercial orchards was 4.2%.

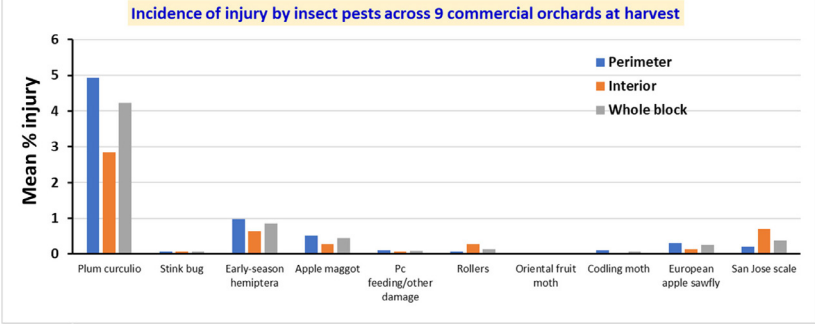

Figure 4. Average level of fruit showing insect pest injury at harvest according to sampling location in 9 commercial apple orchards in Massachusetts.

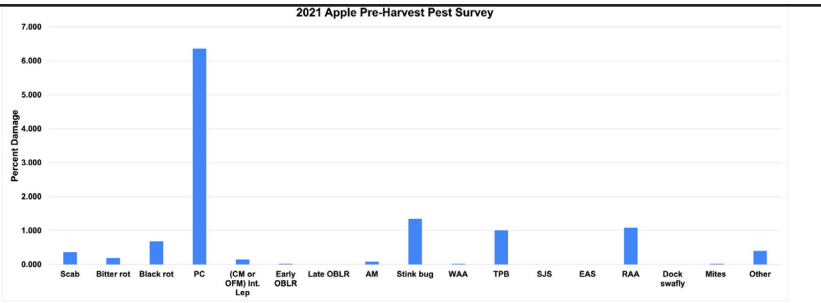

Figure 5. Average level of fruit showing insect pest injury at harvest in 11 commercial apple orchards in Massachusetts.

Additional pre-harvest surveys were carried out at 11 orchards in MA in the late summer of 2021. A total of 4,670 apples were (non-destructively) assessed for damage caused by 16 different insect and pathogen pests. Figure 5 shows the results from all sites evaluated.

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

Apple maggot fly (AMF). Excellent levels of control were achieved in 2021 in the monitored orchards. Three orchards had zero whale-block infestation by AMF, three orchards had < 0.40% infestation, two orchards had <0.80% and one orchard had 1.4% infestation across the entire block. These results correspond to blocks under standard AMF management. Across all nine orchards, the average level of AMF injury in the perimeter, block interior, and whole-block injury was 0.52%, 0.28% and 0.43%, respectively.

Internal Lepidoptera. In 2021, the levels of fruit injury by Oriental fruit moth (0.02%), codling moth (0.07%), and obliquebanded leafroller (0.14%) were very low in all nine monitored blocks.

Mites. Mites were not reported by growers as being a problem, except for some hot spots in a couple of orchards.

Brown Marmorated Stink Bug. In 2021, populations of BMSB in Massachusetts were at least 7 times lower than those recorded in 2020. For instance, in 2020 1,274 BMSB were killed by either clear sticky traps or ghost traps in 10 Massachusetts orchards (average of 127 BMSB/orchard) whereas in 2021 234 BMSB were recorded in 13 MA orchards (average of 18 BMSB/orchard). Not sure why that was the case.

San Jose scale (SJS). In 2021, infestations by SJS were recorded in 5 out of 9 cooperating orchards. Injury levels were 0.20% in three orchards, 0.42% in one orchard, and 2.3% in one orchard, the highest level recorded in a single location in two years. Two of those orchards were the same that reported injury in 2020, and three orchards had new infestations.

Injury by **European apple sawfly (EAS)** was non-existent in four orchards, very low (0.20 - 0.42%) in four orchards, and 1.25% in one orchard.

Spotted-wing drosophila (SWD). In 2021, the first SWD was captured on May 19th. This date is close to the 21 May date of first captures recorded in 2019, and some days apart from the 25 May date recorded in 2020. The peak of SWD captures in 2021 took place a couple of weeks earlier than in 2020, as shown in Figure 6.

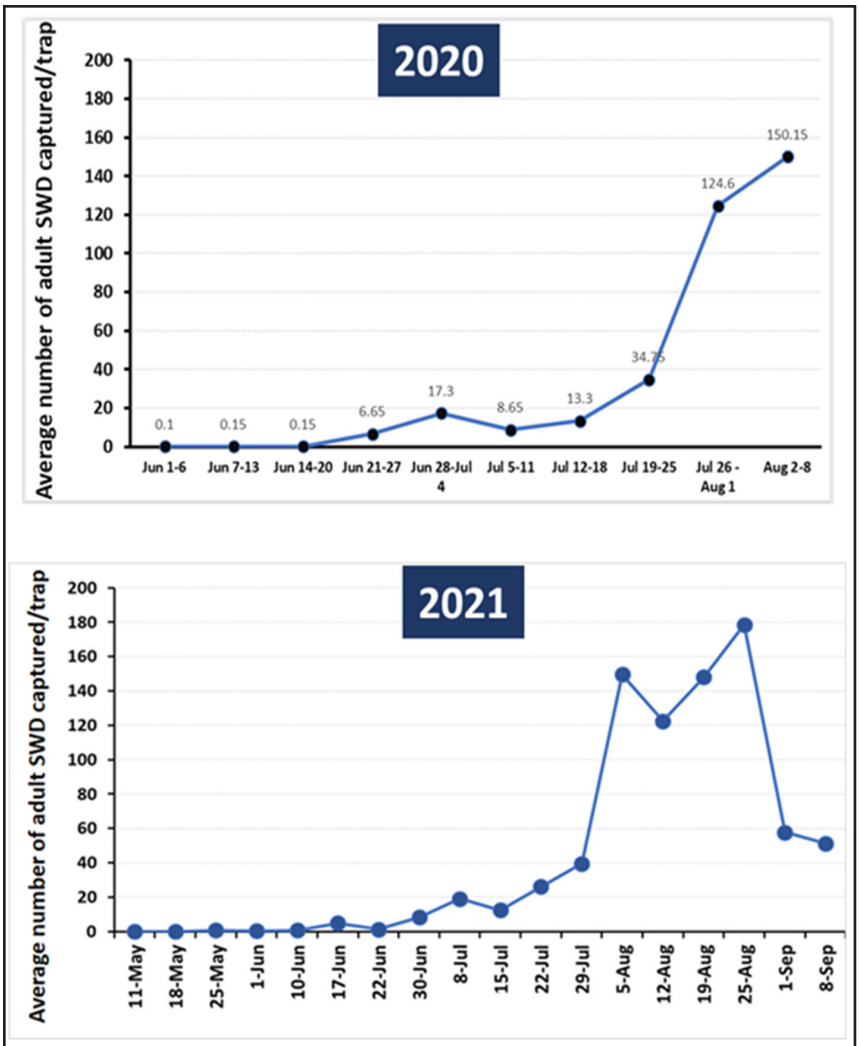

Figure 6. Seasonal captures of adult spotted-wing drosophila (males and females combined) in traps baited with fresh diluted Concord grape juice. Trap-capture data collected in five Massachusetts locations.

Pear Psylla remains a difficult pest for many growers to manage. One MA grower in particular has achieved success in managing psylla through implementation of an oil based program. A dormant application is used to suppress emerging overwintered adults and summer oil applications are made when scouting indicates a need and temperatures are favorable for oil use. This has enabled the grower to reduce their reliance on more traditional psylla management materials while producing a clean crop. Many growers remain hesitant to adopt this strategy in their psylla management programs.

Horticulture

As usual, **chemical thinning** of apples was nail crunching. At petal fall there was a significant carbohydrate deficit, and petal fall thinners were largely considered to be quite effective, although they did not do the job fully. Chemical thinners applied circa the 10 mm fruitlet stage faced a near zero carbohydrate deficit (Figure 7) and thus ideal application weather and higher rates of chemical thinners were necessary. Most growers thought they did an adequate job thinning, however, by mid-summer as fruit was sizing up there were often too many apples on the trees requiring hand thinning some blocks. All the rain in late summer swelled apple size so the crop looked particularly large pre-harvest. Quality was generally good as long as timely summer-long fungicides were applied to control rots.

An **Experimental Use Permit for Accede** (Valent Biosciences) allowed half a dozen growers to apply Accede on up to an acre of apples in each or their orchards. Accede stimulates ethylene production and can promote fruit drop (thinning) up to about the 20 mm fruitlet size, which is often considered to be the "rescue" thinning window when all else (previous chemical thinner applications) has failed and additional thinning is needed. Results were mixed, however. Gala and other Golden

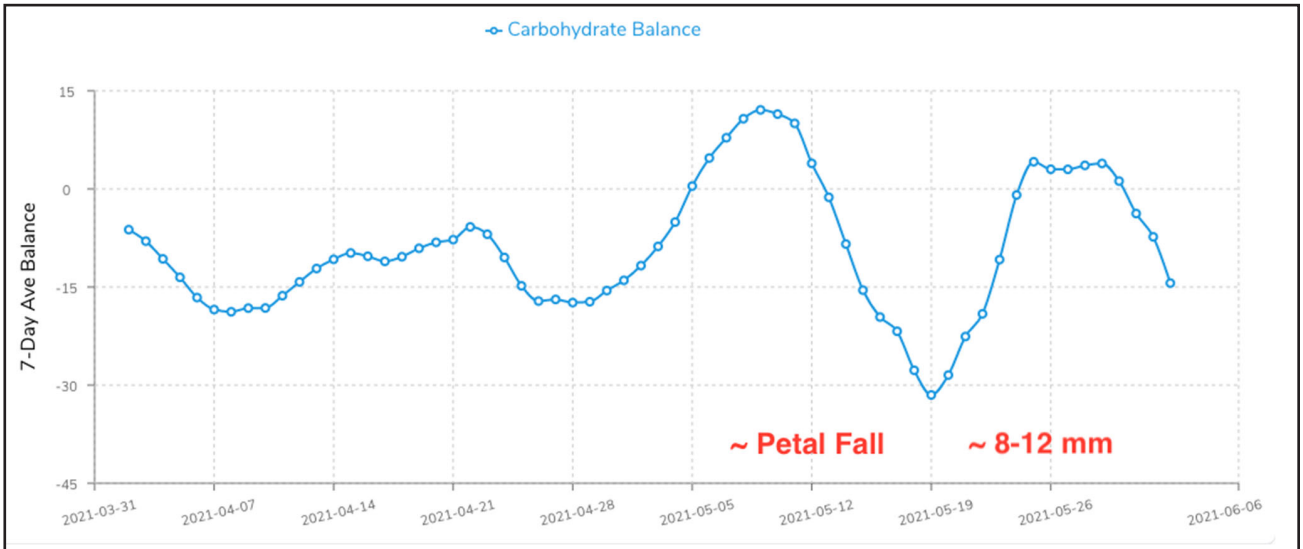

Figure 7. 2021 carbohydrate balance at UMass Orchard, Belchertown, MA (NEWA Apple Carbohydrate Thinning).

Delicious type apples seem more sensitive to Accede than McIntosh types. We still have much to learn about timing, rate, and variety sensitivity, however Accede will be available to all in 2022 for both apple and peach (you read that right) thinning.

All signs point to a bad year for **bitter pit** (Figure 8), worst on susceptible varieties like Honeycrisp, Cortland, and Macoun. Are you seeing it? Although somewhat block-specific, at the UMass Orchard the Honeycrisp in our 2014 NC-140 trial showed a lot of bitter pit at harvest which is only likely to get worse in storage. Other Honeycrisp blocks were not so bad. I submitted fruit and peel samples from G.11 and G.41 rootstocks to Cornell for both SAP analysis (Lailiang Cheng and Terence Robinson) and EMR (Environment, Minerals, Rootstock) prediction (Dan Donahue) and the former came back in the red zone (not good) based on the K/Ca ratio, while the latter predicted that 20-30% of the apples would develop bitter pit in storage. Ugh. I believe there was already close to 10% bitter pit in these Honeycrisp (across all rootstocks) at harvest. (Well, maybe not that bad, but there was way too much.) I saw bitter pit symptoms start to develop in late July, and I wonder, given the bitter rot outbreak also seen in these trees, if bitter rot invades developing bitter pit "lesions?" Just a thought. Basic factors that affect susceptibility to developing bitter pit in apples include: variety (Honeycrisp is the poster child); rootstock (not going there); weather (too much rain or too little rain affecting calcium dilution and uptake, note it was dry late May to early June during the fruit formation period when calcium demand is high); young trees with large apples (large apples in general are more likely to develop bitter pit); light crop (large apples, lots of shoot growth); high nitrogen (underlooked as a promoter of bitter pit, particularly in Honeycrisp); too much potassium fertilization; lack of sufficient calcium sprays; and excessive shoot growth. Reducing bitter pit? There is

Figure 8. Honeycrisp bitter pit? Start of bitter rot? Lenticel breakdown?

no silver bullet, it has to be a complete program. Yet it can still be a challenge in some years depending on a lot of interacting factors as above. But I think I will take a dry year over a wet year for starters.

Special Projects/Research/Publications

Northeast Cider Apple Project (NECAP) -- Beginning in Fall 2019, this 3-year Project funded by NESARE is led by University of Vermont with collaborators from UMass and UMaine. At UMass Cooley, Piñero, Clements, and Garofalo are evaluating cider blocks in Massachusetts for insect and disease incidence on cider apples. We are also evaluating horticultural and fruit quality characteristics to develop fact sheets and recommendations for both established and new growers of cider apples. And **VIDEO**!

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

Clements, J., D. Cooley, and E. Garofalo. A comparison of four on-site weather stations and one virtual weather service as data sources in 2020 for the apple scab infection period model at the UMass Cold Spring Orchard in Belchertown, MA. (Research/demonstration).

Clements, J., D. Cooley, and P. O'Connor. A comparison of using the 'Ferri' version of the fruitlet growth rate model and the Malusim app to predict fruit set in 2020 of Gala, Honeycrisp, Empire and Pazazz apples at the UMass Cold Spring Orchard in Belchertown, MA. (Research/demonstration).

Clements, J. and J. Piñero. Blending technology and IPM: Onset Hobo RX300 weather station and NEWA, DTN Smart Traps, and "attract and kill" trap of brown marmorated stink bugs. A case study in a Berkshire's Massachusetts orchard. (Research/demonstration).

Clements, J., D. Cooley, P. O'Connor, and L. Ware. OrchardWatch: remote sensing of weather conditions across multiple locations in a single orchard, does it make a difference? (Research/demonstration).

Publications

Clements, J. and W. Cowgill. 2021. Precision Cropload Management of Honeycrisp: Flower Bud Identification and Precision Pruning. Fruit Notes. Vol. 86, No. 1, Winter 2021. http://umassfruitnotes.com/v86n1/a3.pdf

Clements, J. 2021. Double-notching Whip Apple Trees at Bud Break Is Effective at Promoting Branching. Fruit Notes. Vol. 86, No. 3, Summer 2021. http://www.umassfruitnotes.com/v86n3/a1.pdf

Clements, J. and W. Cowgill. 2021. Painless and Efficient Maturity Testing. Fruit Notes. Vol. 86, No. 3. http://www.umassfruitnotes.com/v86n3/a5.pdf

Wakil, W., Usman, M., Gulzar, S., Piñero, J.C., Wu, S., Toews, M.D., and Shapiro-Ilan, D.I. 2021. Combined application of entomopathogenic nematodes and fungi against fruit flies, *Bactrocera zonata* and *B. dorsalis* (Diptera: Tephritidae). Pest Management Science (accepted for publication).

Usman, M., Wakil, W., Gulzar, S., Piñero, J.C., Wu, S., Toews, M.D., and Shapiro-Ilan, D. 2021. Evaluation of locally isolated entomopathogenic fungi against multiple life stages of *Bactrocera zonata* and *Bactrocera dorsalis* (Diptera: Tephritidae): Laboratory and field study. Microorganisms, 9, 1791. https://doi.org/10.3390/microorganisms9081791s.

Piñero, J.C., Souder, S.K., Cha, D.H., Collignon, R.M., and Vargas, R.I. 2021. Age-dependent response of female melon fly, *Bactrocera* (*Zeugodacus*) *cucurbitae*, to induced volatiles emitted from preferred and less-preferred host fruits. Journal of Asian-Pacific Entomology 24: 759-763. https://doi.org/10.1016/j.aspen.2021.06.011.

Bolton, L.G., Piñero, J.C., and Barrett, B.A. 2021. Olfactory cues from host- and non-host plant odor Influence the behavioral responses of adult *Drosophila suzukii* (Diptera: Drosophilidae) to visual cues. Environmental Entomology 50: 571-579 https://doi.org/10.1093/ee/nvab004.

Wen, X.J. Yang, K.L. Piñero, J.C., and Wen, J.B. 2021. Contrasting behavioral and physiological responses of *Eucryptorrhynchus scrobiculatus* and *E. brandti* (Coleoptera: Curculionidae) to volatiles emitted by various types of tissue from the tree of heaven, *Ailanthus altissima*. Insects 12(1), 68; https://doi.org/10.3390/insects12010068.

Piñero, J.C., Stoffolano Jr., J.G., Chiu, K., Colletti,

K., Dixon, Z., Salemme, V., Crnjar, R. and Solla, G. 2021. Effects of chitosan and erythritol on labellar taste neuron activity, proboscis extension reflex, daily food intake, and mortality of male and female spotted winged Drosophila, *Drosophila suzukii*. Journal of Insect Physiology 131(3):104240 https://doi.org/10.1016/j.jinsphys.2021.104240.

Piñero, J.C., Regmi, P., Saadat, D., Giri, A., Kassoy, J., McIntire, S., and Faubert, H. 2021. Effectiveness of the insecticides Verdepryn and Avaunt at controlling plum curculio in apple orchards in Massachusetts and Rhode Island. Fruit Notes 86: 5-7.

Giri, A. and Piñero, J.C. 2021. Evaluation of CIDETRAK ® CMDA + LR DUAL MESO™ as a Mating Disruption Tool for the Management of Codling Moth and Obliquebanded Leafroller in Apple Orchards. Fruit Notes 86: 7-10.

Piñero, J.C., Regmi, P., Saadat, D., Giri, A., Leskey, T.C., and Shapiro-Ilan, D. 2021. Evaluation of Entomopathogenic Nematodes Against Plum Curculio: Effects of Nematode Species, Application Rates, and Persistence in the Soil. Fruit Notes 86: 1-4.

Saadat, D. and Piñero, J.C. 2021. Evaluation of a Grower-friendly Attract-and-kill Strategy for Apple Maggot Control in New England Apple Orchards: Research Results for Year Two. Fruit Notes 86: 1-4.

Giri, A., and Piñero, J.C. 2021. Evaluation of Novel Kairomone-based Lures for Attracting Male and Female Tortricid Moths in Apple Orchards. Fruit Notes 86: 18-20.

Regmi, P. and Piñero, J.C.. 2021. Response of Tarnished Plant Bug to Synthetic Aromatic Plant Volatiles. Fruit Notes 86: 29-31.

Ware, L., Garofalo, E., Petit, E., and Piñero, J.C. 2021. Does the Red Color Enhance Spotted Wing Drosophila Response to Traps Baited with Diluted Concord Grape Juice? Fruit Notes 86: 15-16.

Piñero, J.C., Giri, A., Saadat, D., and Regmi, P. 2021. Does the Presence of Trap-crop Plants Enhance the Response of the Invasive Brown Marmorated Stink Bug to Its Synthetic Pheromone? Fruit Notes 86: 5-7.

Piñero, J.C., Regmi, P., and Saadat, D. 2021. Evaluating the Efficacy of Multi-cultivar Grafted Apple Trees as Perennial Trap Crops for Multiple Pests: Research Results Year One. Fruit Notes 86: 11-14.

Trade magazine articles

Good Fruit Grower - July 21st, 2021|Apples, Crop management, Insects and mites, July 2021 Issue, Matt Milkovich, Pest Management: An alluring six-headed hydra (https://www.goodfruit.com/an-alluring-six-headed-hydra).
Good fruit grower article trap crops – SWD – 3.24.21 hhttps://www.goodfruit.com/mass-traps-making-fatal-attractions

Research/Extension grants received

Integrating development, implementation and awareness of effective strategies and technologies to promote Specialty Crop IPM in Massachusetts. 09/01/2021 - 08/31/2024. USDA NIFA Award Number 2021-70006-35388. H. Sandler (PI), S. Scheufele, J. Piñero (Co-PIs). $817,708.

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

Clements, J. Precision Cropload Management for Apples. 09/01/2020-08/31-2024. CORNELL 92884-20621 PRIME USDA. $20,000.

Clements, J. 2021. Suppression of apple scab and fire blight. Agro-K Corporation. $12,000.

Clements, J. 2021. ACCEDE Experimental Use Permit in Massachusetts, Valent USA, LLC. $5,000.

Clements, J. 2021. Apple variety evaluation. Midwest Apple Improvement Association. $2,800.

Piñero, J.C. (PI), Akotsen-Mensah, C. (co-PI). Evaluation of a grower-friendly attract-and-kill IPM system for the Brown Marmorated Stink Bug. Northeastern IPM Center. 6/1/21 – 5/31/22. $59,713.

Piñero, J.C. (PD), Garofalo, E, Simisky, T. (co-PIs). Massachusetts Department of Agricultural Resources – Specialty Crops Block Program. Project title: "*Protecting Massachusetts specialty crops from two invasive pests through monitoring, research, and outreach*". 9.1.21 – 8.31.23. $58,928.

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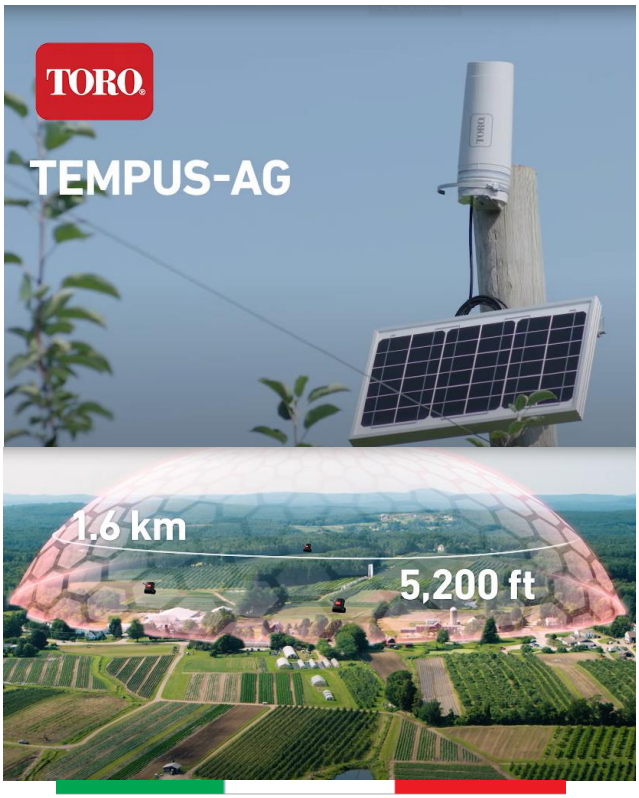

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RubyRush™ – New Apple Cultivar Release from Rutgers University and Adams County Nursery

Jon Clements[1], Win Cowgill[2], Megan Muehlbauer[3]

[1]University of Massachusetts
[2]Professor Emeritus, Rutgers University, Win Enterprises International, LLC.
[3]Rutgers New Jersey Agricultural Experiment Station, Rutgers University

RubyRush (NJ150 Cv.) tested as DW18-206 is a new scab-resistant apple variety recently introduced by Adams County Nursery (ACN).

From their 2020 ACN catalog "A new release from the apple breeding program at Rutgers University/New Jersey Agricultural Experiment Station (NJAES). This selection is a GoldRush x Enterprise cross selected for its scab-resistant traits. Both GoldRush x Enterprise are from the famous Purdue, Rutgers, Univ. of Illinois (PRI) apple disease resistant breeding program, https://www.hort.purdue.edu/newcrop/pri/default.html RubyRush™ exhibits excellent resistance to fire blight and cedar apple rust. The fruit is juicy and aromatic with a desirable crisp texture. The tree is vigorous and should be thinned to avoid biennial bearing. Trees available spring 2022. (Currently out of stock.)"

RubyRush was evaluated as DW18-206 in cooperation with Rutgers University and ACN at two locations in Massachusetts (Tougas Family Farm in Northboro, MA, and UMass Cold Spring Orchard in Belchertown) and one location in New Jersey (Rutgers Snyder Research and Extension Farm, Pittstown, NJ) beginning in 2011. A total of 24 lab and field observations for DW18-206 were entered into our apple testers database(s) http://appletesters.net, beginning in 2014 and ending in

Table 1. RubyRush fruit characteristic values.

Fruit Characteristic	Starch Index	Soluble Solids (%)	Firmness (lb.)	Fruit Weight (g)	Diameter (in)	Red Color (%)
Average Value	4.8	13	16.4	277	3.4	75

Table 2. RubyRush tree habit characteristics.

Tree Characteristic	Tree Vigor	Crop Load	Tree Habit	Branching	Pre-Harvest Drop
Average Observation	Precocious	Medium	Upright	Medium	None

2021. Below are some of our observation summaries for RubyRush. Note that the range of observations can be a result of tree age, crop load, harvest timing, and individual preference.

RubyRush Observations

- Dates harvested: ranged from 23 September to 18 October. In Northern NJ the best harvest date is around October 1, in Massachusetts October 5 is closer to optimal harvest date.
- Tree vigor: medium-strong (very)
- Branching: medium-strong
- Tree habit: upright-spreading
- Biennial bearing: none noted
- Crop load: medium-heavy
- Maturity period: middle-late
- Pre-harvest drop: none-nil-few
- Fruit ground color: green-light green-yellow
- Fruit over-color: 65-90%
- Color pattern: solid-blush
- Lenticels: somewhat conspicuous
- Fruit symmetry: elliptical-globose
- Russet coverage: <5%
- Russet region: minimal stem, some net on side
- Russet texture: fine
- Cracking: absent
- Fruit size: medium large
- Fruit diameter: 3.25 to 3.65 inches
- Fruit weight: 240 to 340 grams
- Fruit firmness: 18-21 lbs.
- Soluble solids (Brix): 11.4 to 14.5
- Flesh browning: none to faint
- Starch Index (SI): 3-8
- Flesh color: green-white-cream-yellow
- Flesh texture: soft-fine-medium-crisp-melting
- Flavor: tart-sweet-fruity
- Skin thickness: somewhat thick
- Skin greasiness: dry to slightly greasy
- Eating quality: good when harvested at optimum
- Attractiveness: very good
- Overall quality: good-very good

Summary

RubyRush trees are vigorous and upright growing (Figure 1), but eventually spreading with crop load, especially on more dwarfing rootstocks. Cropping can be heavy with biennial bearing if not adequately thinned. Harvest period is early late season, no sooner than October 1, with a two-week picking window and little drop. RubyRush fruit are large and very attractive with a bright pink-red solid color blush covering 75% of the surface. Background color will change from green to green-yellow with maturity. Flesh is fine-medium textured and quite firm with a tart-sweet flavor. Water-core can be an issue in some years. Eating quality is generally good, maybe very good, but does not have the 'snap" of a Honeycrisp or GoldRush.

Figure 1. RubyRush tree on M.7 rootstock at the UMass Cold Spring Orchard, 16 October 2018. Note high tree vigor.

Our overall feeling about RubyRush is it will not compete with Honeycrisp for consumer preference as to eating quality, however, for U-pick it is very attractive and large-fruited. It should not be stored for long term sales.

Organic production note

As a scab-and disease resistant apple it is one of the best we have observed for quality. Having cedar apple rust and fire blight resistance as well it may be very desirable for organic production. RubyRush does blend the attributes of Enterprise (thick skin, large size, red skin)

and GoldRush (sweeter flavor, firmness) quite nicely. We'd describe it as a red-blush Enterprise but sweeter.

One interesting note is that Enterprise in one of the parents of CosmicCrisp (WA 38) apple crossed with HoneyCrisp.

ACNursery Catalog 2021-2022
https://www.acnursery.com/

'GoldRush' Apple (Co-op 38)
HortScience 29(7):827-828. 1994.
https://www.hort.purdue.edu/newcrop/pri/coop38-3.html
PRI 2750-6 = (Co-op 17 (PRI 1689-100) x Golden Delicious) (Crosby et al. 1993) Introduced as 'GoldRush' (Crosby et al. 1994) U.S. Plant Patent No. 9,392.

(Enterprise Apple' (Co-op 30)
https://www.hort.purdue.edu/newcrop/pri/coop30.html
(PRI 2693-1 = PRI 1661-2 x PRI 1661-1) (Korban et al. 1990) Introduced as 'Enterprise' in 1993; U.S. Plant Patent No. 9,193

Figure 2. RubyRush apple at UMass Cold Spring Orchard, 30 September 2021.

Figure 3. RubyRush - UMass Cold Spring Orchard.

Figure 4. RubyRush - Rutgers Sndyer Research and Extension Farm.

Can Entomopathogenic Nematodes Applied Against Plum Curculio Larvae Survive the Winter in New England?

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David Shapiro-Ilan
USDA ARS Fruit and Tree Nut Research Laboratory

Entomopathogenic nematodes (EPNs) are small round worms that lack color, body segments, and appendages. This type of tiny worm lives in the soil and causes disease to the soil-dwelling stages of many species of arthropods; hence its name 'entomopathogenic' (= insect-killing). EPNs are highly effective against many pests, are non-toxic to humans and other mammals, have been shown to have reduced impact on beneficial insects and are typically organically certified. In New England apple orchards, EPNs have been evaluated in the field since 2013. Nearly all studies conducted in New England (for two examples, see Fruit Notes articles in the winter 2019 and summer 2020 issues), have shown good to excellent performance. Some EPN species have been shown to be able to overwinter in New England's weather. If this can be confirmed for Massachusetts, this would act as a method of pest control that allows growers to apply EPNs fewer times, saving them time and financial resources.

The purpose of this study was to determine to what extent the EPNs *Steinernema carpocapsae* strain All (SC) and *Steinernema riobrave* 355 strain (SR) that were applied to the soil in July 2020 at two locations in the UMass Cold Spring Orchard in Belchertown, Massachusetts, survived through the winter.

Materials & Methods

2020 Field Research: *Steinernema carpocapsae* (SC) strain All and *Steinernema riobrave* (SR) strain 355 were applied to the soil at two locations in UMass Amherst's Cold Spring Orchard (Belchertown, Massachusetts). The first location was X-block where EPNs were applied by hand on 16 July, 2020. A total of 7 different treatments, each replicated 4 times, were evaluated. In all, there were 24 areas with EPN applications and 4 control sites. The treatments were: SR and SC applied singly at low application rate, SR and SC applied singly at high application rate, SR and SC combined at low application rate, SR and SC combined at high application rate, and a control where water but no EPNs were applied.

The second location was Rock Mountain where a single EPN species (*S. riobrave* 355 strain) was applied on 17 July, 2020. One billion EPNs (donated by BASF) were applied using a tractor-mounted sprayer with the nozzle removed. The entire perimeter and 2 inner rows were sprayed with EPNs. For a 1-minute video showing the application of EPNs, click HERE.

On 25 May, 2021, 10 months after the original EPN application, soil samples were collected from the same sites where the EPNs had been applied. In X-block, soil was gathered from the same 28 spots that received particular combinations of EPN species and application rates in 2020. In Rock Mountain, 16 samples were taken from the perimeter and from 2 rows in (both areas received EPNs), and 6 samples were taken from the center of the block, were no EPNs were applied. Each soil sample was placed inside a 500 ml plastic container

and was taken back to a lab at UMass Amherst.

Lab Work: From May 5,2021 through June 23, 2021, the lab work started. We placed 20 wax moth larvae on top of each soil sample (Figure 1A). Wax moth larvae were used because this insect is highly susceptible to EPNs. The larval mortality was checked at 24, 48, and 72 hours. On June 4, 2021 White traps (Figure 1B) were set up to test Koch's Postulates which is a way of confirming that the wax moth larvae had indeed died from EPNs and that the EPNs could effectively reinfect and kill subsequent hosts.

The White traps involved a small petri dish with a piece of filter paper draped over it inside a larger Petri dish. Then, 20 mL of water was added to the larger Petri dish. From each sample a black (symptoms of cadavers either not infected by EPNs or initially infected by EPNs but then taken over by something else) and tan cadaver (symptoms characteristic of SC and SR infections) was chosen to be placed in a White trap (Figure 1B). Twelve days later the water was collected from each Petri dish and placed on the centrifuge for 10 seconds (to help concentrate any EPNs). Two mL of this water was poured onto a piece of filter paper and 20 new, live wax moth larvae were added. On June 21, 2021, up to 5 black larvae were dissected to check for the presence of nematodes. If EPNs were found, then that cadaver was placed in a Petri dish on top of a damp piece of filter paper. Then, 15 new, live wax moth larvae were added (Figure 1C). This was done to see if the EPN's would continue to re-infect and kill wax moth larvae. EPN presence was identified through dissection in the lab on June 23, 2021(Figure 1D).

Figure 1 (A): Twenty wax moth larvae placed on top of each soil sample, **(B)** White trap set up for wax moth larvae suspected to be infected with EPNs (left: tan larva; right: black larva), **(C)** Reinfection of wax moth larvae from the cadaver that was found to have EPNs upon dissection, **(D)** EPNs in a plum curculio larva, as seen under stereomicroscope.

Results

X-Block: The results from the X-block location show that the species *Steinernema carpocapsae* in a high concentration exerted the highest level of mortality (60.9%) of wax moth larvae when compared to the control (20.0%), followed by *S. riobrave* low (34.1%) and high (39.4%) and *S. carpocapsae* low (20.3%) (Figure 2). These results resemble those recorded in the field study with plum curculio, conducted in July 2020. The high mortality rate in the *Steinernema carpocapsae* at high application

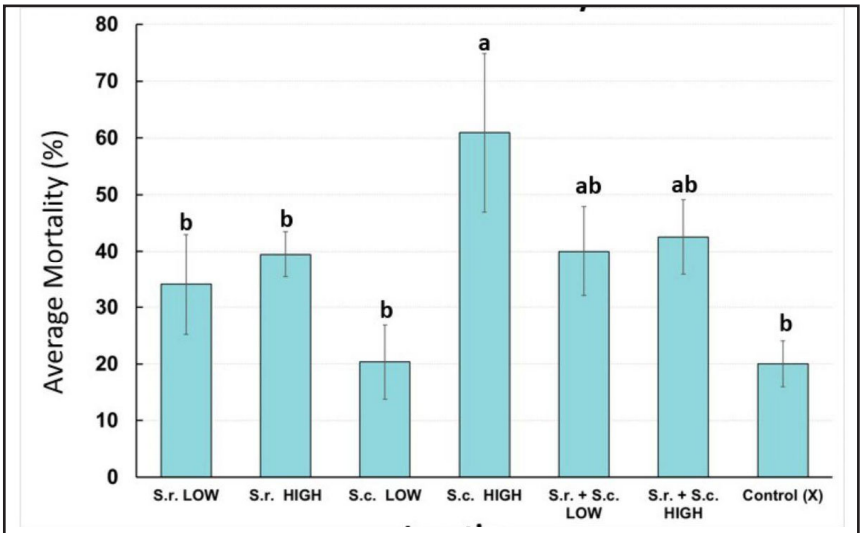

Figure 2. Average mortality of wax moth larvae in soil samples taken from X-block. S.r. = *Steinernema riobrave* strain 355; S.c. = *Steinernema carpocapsae* strain All. High and low refer to EPN application rates. EPNs were applied in early July 2020 and soil samples were taken on May 25, 2021.

rate achieved 10 months after initial application can be attributed to that EPN species. Because all the other species and concentration levels were not statistically different from the control, then the mortality rates could be explained by other factors such as native nematode species, or other insect pathogens.

Rock Mountain: The results from Rock Mountain suggest that *S. riobrave* may have survived the winter in that area because of the high mortality rate of wax moth larvae in the exterior (24.4%) and in the 2 inner rows (20.9%) vs. the control (2.5%) (= no EPNs applied), which was from the center of the block (Figure 3). Although the perimeter had the highest mortality, we acknowledge there could have been other factors in the soil such as a higher concentration of native nematode species or other insect pathogens in the perimeter.

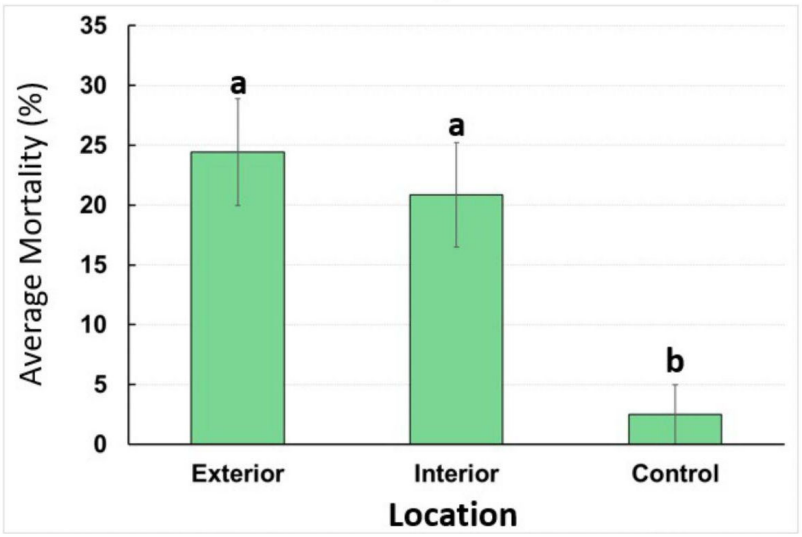

Figure 3. Average mortality of wax moth larvae in soil samples taken from Rock Mountain. The EPN *Steinernema riobrave* strain 355, donated by BASF, was applied in July 2020. Soil samples were taken on May 25, 2021. Exterior = Samples taken from perimeter-row trees; Interior = samples taken from 2 rows in; Control = Samples taken from the block center. Both exterior and interior samples received EPNs in the 2020 application.

Conclusions

The results from this study suggest that both *Steinernema carpocapsae* strain All and *Steinernema riobrave* strain 355 were indeed able to survive the winter in the study site. It was interesting to note that in X-block, where both EPN species were applied either, alone or in combination, only the SC – high release rate treatment was statistically higher than the control. This could suggest that the SR-SC combinations were antagonistic to each other, at least in terms of persistence. To confirm these results and better evaluate EPN pathogenicity over time, a follow up study should be conducted using larvae of common pests found in the field, such as plum curculio larvae. If EPNs are found to overwinter in the soil in high levels this could lead to a form of biological control that would require fewer re-applications by the grower, thereby saving time and expenses.

Acknowledgments

We thank Prabina Regmi and Ajay Giri for support. Funding for this research was provided by the UMass Center for Agriculture, Food and the Environment - Summer Scholars Research program.

Entomopathogenic nematodes (EPNs). Inside the plump wax moth cadaver are thousands of EPNs ready to serve as biocontrols against soil-dwelling crop pests.

Early Application of Chemical Thinners Should be Revisited

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Chemical thinning remains the most challenging management component in apple production that a grower must do. This situation has become even more challenging and difficult in recent years due to the wide variation in temperature frequently experienced during the thinning period that appear to be associated with climate change. In the past we have depended upon the thinning strategy that is termed the "Nibble" approach where several applications of thinners are applied at reduced rates over the thinning period. Yes, we have experienced some temperature fluctuations in the past, but this approach has become less useful in recent years because of unreliable and often extreme weather conditions (both hot and cold) that we have experienced with increasing frequency during the thinning period that have resulted in unsatisfactory thinning.

There are significant advantages to thinning apples early. We acknowledge the usefulness of thinning done during the dormant period and the use of caustic thinners applied at bloom but these techniques are not frequently used. However, in this experiment we focused on the application of hormone thinners at both bloom and petal fall. Thinner application at bloom and petal fall thinners in the eastern United States is not new but the hormone-type thinner rates used have been moderate at best and the end results are frequently disappointing. The purpose of this experiment was to try to identify bloom and petal fall treatments using either naphthaleneacetic acid (NAA) or naphthaleneacetamide (NAD) that would result in significant thinning and to determine if trees receiving either of these treatments would be thinned easier with a different thinner applied later at the 10-14 mm fruit size stage.

Materials and Methods

A block of mature Buckeye Gala/ Bud 9 was selected and 36 uniform trees were identified. At the pink stage of flower development all spur blossom clusters were counted on each tree. The trunk circumference was measured on these trees at 30 cm above the bud union. The blossom cluster density was then calculated by dividing the number of flowering spurs by the tree trunk cross sectional area. Trees were then blocked into six groups (Reps) based upon blossom cluster density. Within each group trees were randomly assigned to receive one of six treatments.

Treatment details. Two sets of trees received a bloom spray of 12 ppm NAA containing 1 pt/100 gal of the surfactant Regulaid®. This same group of trees was sprayed at petal fall with 12 ppm naphthaleneacetic acid (NAA) plus 1 pt/100 gal of Regulaid® and 1 pt/100 gal of carbaryl. Two other sets of trees were sprayed at bloom with 8 oz/100 gal naphthaleneacetamide (NAD) with 1 pt/100 gal Regulaid®. These trees were again sprayed at petal fall with 8 oz/100 gal of NAD plus 1 pt/100 gal of Regulaid® and 1 pt/100 gal of carbaryl. A third set of trees was sprayed with 125 ppm MaxCel® plus 1 qt carbaryl/100 gal at the 10 mm fruit size stage. One group of trees that previously were sprayed with the NAA treatments and one group of trees that received the NAD treatments were also sprayed with 125 ppm MaxCel® and 1 qt carbaryl at the 10 mm stage. All treatments were applied using a commercial airblast sprayer delivering the TRV dilute volume of 100 gal/ acre. Temperature maximum and minimum, the carbon balance and the thinning recommendation for several days before, on the day of and several days following spray application at each of these spray timings, as shown on the NEWA website, are shown in Table 1. Details of the spray applications are summarized in Table 2.

The weather conditions surrounding the bloom spray application (May 7) can be characterized as being unfavorable for thinning. In general, the high tempera-

ture averaged about 60º F and the low temperature was near 45º F. NEWA suggested that thinning recommendations should be increased by 30%. Weather conditions near the petal fall (5 mm) spray (May 17) were favorable for thinning with high temperatures hovering near 80º F. The NEWA website suggested to reduce the normal thinner application by 15%. The last thinning spray was applied when the fruit diameter averaged 10.4 mm (May 25). The weather the day of application and for the two days following was somewhat favorable for thinning but after that, low temperatures prevailed. At the time of application, the NEWA website suggested that the thinner rate should be increased by 30%. Because of the design of the experiment, it was possible only to relate weather information specifically to thinner activity for only the 10 mm fruit size spray (Treatment 6).

Table 1. Weather data prior to and following application of thinning treatments on Buckeye Gala/B.9 apples. Belchertown, MA, 2021.

Date	Temp max	Temp min	CHO daily balance	Degree day accumulation	Thinning recommendations
May 3	68	50	-26	10	Increase by 30%
May 4	58	49	-16	21	Increase by 30%
May 5	53	46	-15	36	Increase by 30%
May 6	62	44	+13	42	Increase by 30%
May 7 (Bloom)	61	42	+2	49	Increase by 30%
May 8	57	43	+4	55	Increase by 30%
May 9	61	40	+15	61	Increase by 30%
May 10	59	45	+1	68	Increase by 30%
May 11	59	45	+22	76	Increase by 30%
May 12	62	41	+17	82	Increase by 30%
May 13	69	41	+21	91	Increase by 30%
May 14	75	43	+2	102	Increase by 30%
May 15	75	48	-6	114	Apply standard rate
May 16	70	55	-23	128	Increase by 30%
May 17 (PF, 5 mm)	74	47	-13	140	Apply standard rate
May 18	80	51	-24	154	Decrease by 15%
May 19	84	54	-35	173	Decrease by 15%
May 20	81	51	-16	185	Decrease by 15%
May 21	82	52	-23	201	Decrease by 15%
May 22	86	58	-60	219	Apply standard rate
May 23	81	57	-40	236	Apply standard rate
May 24	68	50	+16	246	Apply standard rate
May 25 10 mm	74	47	+21	258	Increase by 30%
May 26	87	58	-28	277	Increase by 30%
May 27	75	58	+6	292	Increase by 30%
May 28	59	44	+26	299	Increase by 30%
May 29	47	42	+4	302	Increase by 30%
May 30	48	45	-15	306	Increase by 30%

Results

Bloom and petal fall thinner applications containing either NAA (Treatment 2) or NAD (Treatment 5) thinned comparably but neither reduced the crop load enough to be commercially acceptable (Table 3). Application of 125 ppm MaxCel® plus 1 pt of carbaryl per 100 gal at the 10 mm fruit size stage resulted in some reduction in crop load, but the thinning intensity was not sufficient be commercially acceptable. When trees that were previously sprayed at bloom and petal fall with either NAA or NAD containing sprays, and were also sprayed with MaxCel® plus carbaryl, the resulting thinning was significantly improved and there were no statistical differences between trees that received the different bloom and petal fall

Table 2. Influence of thinner combinations (NAA, NAD, Carbaryl, MaxCel) applied at 3 fruit growth stages on fruit of Buckeye Gala/B.9 apples. 2021.

	Treatment[1]	Time of application[2]			Fruit Set	
		Full bloom	Petal fall	10 mm	Fruit/cm LCSA	Percent set
1	Control	---	---	---	15.4 a	128 a
2	NAA 12 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only)	+	+		9.9 bc	85 bc
3	NAA 12 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only) + MaxCel 125 ppm + Carbaryl 1 qt/100	+	+	+	10.1 bc	87 bc
4	NAD 50 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only)	+	+		11.6 b	88 bc
5	NAD 50 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only) + MaxCel 125 ppm + Carbaryl 1 qt/100	+	+	+	8.0 c	67 c
6	MaxCel 125 ppm + Carbaryl 1 qt/100			+	11.0 bc	95 bc
Significance					***	***

[1]Treatments applied on May 7 (Bloom), May 17 (PF, 5.1 mm) and May 25 (10 mm).

Table 3. Influence of thinner combinations (NAA, NAD, Carbaryl and MaxCel) applied at 3 fruit growth stages on fruit quality parameters at harvest of Buckeye Gala/B.9 apples in 2021.

		Time of application[2]			Fruit	Flesh	Soluble	Starch
Treatments[1]		Full bloom	Petal fall	10 mm	weight (g)	firmness (lb)	solids (%)	rating (1-8)
1	Control	---	---	---	116 d	16.6 a	10.5 a	4.7 a
2	NAA 12 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only)	+	+		140 c	16.0 ab	10.4 a	5.3 a
3	NAA 12 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only) + MaxCel 125 ppm + Carbaryl 1 pt/100	+	+	+	156 ab	16.1 ab	10.7 a	5.5 a
4	NAD 50 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only)	+	+		136 c	15.9 b	10.2 a	5.5 a
5	NAD 50 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only) + MaxCel 125 ppm + Carbaryl 1 qt/100	+	+	+	165 a	16.2 ab	10.9 a	5.4 a
6	MaxCel 125 ppm + Carbaryl 1 qt/100			+	145 bc	16.4 ab	10.7 a	5.2 a
Significance					***	NS	NS	NS

[1]Treatments applied on May 7 (Bloom), May 17 (PF, 5.1 mm) and May 25 (10 mm).

[2]FB – Full bloom, PF – Petal Fall and 10 mm – fruit size 10.4 mm.

sprays. Fruit weight at harvest was the only harvest parameter that was significantly improved or changed by the thinning treatments. Fruit size increase mirrored the extent of thinning; the greater the thinning, the larger the final fruit size.

Discussion

In recent months there has been a great deal of discussion about climate change and how it affects many aspects of our lives. Fruit growing and apple production are no exceptions. Discussion often centers around global warming. Fruit growers have the capacity to adapt to changes that will allow them to grow fruit under warmer conditions. Therefore, from a cultural standpoint, production of fruit under warmer conditions may not be a barrier for growers in New England. However, the erratic and unpredictable weather that is occurring is posing enormous challenges. Chemical thinning is one area that is particularly influenced by temperature. This situation is further exacerbated by the relatively short time that chemical thinners may be used effectively. For chemical thinners to work effectively, they must be applied when warm temperatures occur following application. Cold temperatures following application generally result in little or no thinning.

The experiment that is reported on here was designed, in part, to determine if the use of more aggressive thinner combinations at bloom and petal fall would lead to a reduction in crop load close to the final desired level. The choice of thinners was made with the hope that the rates selected would not be too high to preclude grower use. Clearly, in this experiment these sprays under-thinned, so more aggressive rates would have been required under the weather conditions that prevailed at the time to achieve more acceptable thinning.

NAD presented a challenge since the label limits the application rate to 8 oz/100 gal (50 ppm), and by nature it is a mild thinner. The addition of the surfactant Regulaid® at 1 pt/ 100 gal was used in an attempt to increase NAD activity. No adverse effects were noted. NAD has been reported to cause pygmy fruit to form on some varieties if applied during the 10 mm or later fruit size stages. Although pygmy fruit were not counted, none were noted at harvest time on trees receiving any of the thinner sprays. The rate of NAA could be increased to 15 or 20 ppm but there may be some reluctance on the part of growers to do that.

MaxCel® at 125 ppm plus 1 pt/100 gal of carbaryl was applied at the 10 mm stage. That rate is higher than is recommended in the spray guide. Only modest thinning resulted and the final crop load on trees was nearly identical to the crop load on trees receiving the bloom and petal fall treatments containing either NAA or NAD. Additional thinning resulted when the 10 mm MaxCel® plus carbaryl spray was combined with either of the bloom and petal fall treatments.

The thinning results from bloom and petal fall applications of the NAA or NAD containing sprays appear to be identical or at least not statistically different. However, before suggesting that the treatment can be used interchangeably, we must wait until next spring. We will then be able to quantify return bloom in this experiment. We did a thinning experiment using NAA and NAD as the thinners on Macoun in 2016. When return bloom was taken the following spring, trees that received NAD as a thinner had significantly less return bloom, even though final crop load at harvest was similar to the crop load on trees receiving other thinning treatments.

Each thinning season is different. It is not possible to look into a crystal ball to learn what thinning opportunities or barriers you will face. If the return bloom appears to be good and no winter injury or frost damage has occurred, we suggest that you should be as aggressive as you feel that you can possibly be early. This may include doing some thinning with dormant pruning after first estimating the blossom cluster density on the trees. It may be prudent to be very aggressive with bloom and petal fall sprays. Historically, there has been reluctance on the part of growers to thin aggressively at bloom and the petal fall sprays and frequently an early application is a petal fall spray containing only the mild thinner carbaryl. **Keep in mind that trees are far less sensitive to thinners at bloom and petal fall.** I have never over-thinned an apple tree by applying hormone-type thinners at either bloom or petal fall or at both of these times of application.

Accede™ Experimental Use Permit in Massachusetts in 2021 (and what to expect in 2022)

Jon Clements, University of Massachusetts Extension
Duane Greene, Stockbridge School of Agriculture, University of Massachusetts

In late 2020 Valent Biosciences received Federal registration for Accede™ plant growth regulator. From their announcement "Accede is the first PGR based on a naturally occurring compound developed specifically for thinning of stone fruit, including peaches and nectarines. It also gives apple growers an effective tool to thin apples in the late thinning window when fruit are 15-20 mm in diameter. Until now, no fruit thinner has provided reliable thinning at this stage of development. Use of Accede has the potential to reduce the need for costly hand thinning to adjust the crop load and generate higher fruit quality and grower returns."

How does Accede work to thin apples and peaches? First, Accede is classified as a naturally occurring "biochemical" plant growth regulator. It is an immediate precursor to ethylene production. Application of Accede thus stimulates ethylene production which in turn triggers seed abortion and the formation of an abscission zone. Hence fruitlet drop (in apples when applied at 15-20 mm fruitlet diameter) and flower senescence (in peaches when applied at bloom) is promoted and accelerated. Application of ethephon can do the same thing, but ethephon is somewhat "unpredictable" whereas Accede appears to be "safer."

At the University of Massachusetts, Duane Greene started experimenting with ACC (the active ingredient of Accede) over 10 years ago. A couple years of trialing at the UMass Orchard in Belchertown on McIntosh apples resulted in significant fruit thinning that increased (less percent fruit set) with rate and with later timing (10 mm vs. 20 mm, Figure 1). He also noted some leaf yellowing/drop after Accede application, but it was not excessive. Phil Schwallier at Michigan State University in 2016 showed that ACC application increased fruit size of Gala apples to 160 grams per apple compared to 120 grams per apple for untreated trees.

Effect of time and concentration of ACC application on thinning of McIntosh apples.

Treatment (ppm)	Fruit/ cm LCSA	Percent set
1. Control 10 mm	10.2	83
2. ACC 200 10 mm	10.3	87
3. ACC 400 10 mm	4.6	39
4. Control 20 mm	10.7	87
5. ACC 200 20 mm	7.4	65
6. ACC 400 20 mm	1.4	13

Figure 1. 2011 results of ACC research at the UMass Cold Spring Orchard (Duane Greene).

Lacking a state label in Massachusetts in 2021, we were asked by Valent to supervise Experimental Use Permit (EUP) applications of Accede in a few Massachusetts apple orchards. Valent applied for and received the EUP from the Massachusetts Department of Agricultural Resources (MDAR) in January 2021. Notable stipulations of the EUP included:

- MDAR notified in writing prior to application
- Supervised by Cat 49 (Research & Demonstration) applicator
- Public access limited by signage "Notice Pesticide Testing"
- Report submitted to MDAR at conclusion of EUP

With enough Accede on hand in the spring of 2021 to cover about five acres, I solicited four Massachusetts orchards – one in the northeast, two in central Massachusetts, and one west of the Connecticut River – to use Accede under the EUP. I also

intended to use Accede at the UMass Orchard in Belchertown. Along with Jim Wargo, Valent sales rep for New England and New York, visits were made to the orchards in late May to assess the need for further thinning after they had already applied their petal fall and 10 mm chemical thinners (Figure 2). It was not too difficult to identify one-half to one acre apple blocks where additional thinning was desired at 15-20 mm fruitlet size.

Figure 2. Accede EUP application discussion with Jim Wargo (Valent USA) on 25 May 2021.

Valent supplied the directions for the growers to use when applying Accede under the EUP, including:

- Use a rate of 200-400 ppm (23-46 fl. oz./A) at 15-20 mm fruitlet diameter
- Use a non-ionic surfactant at 0.05% v/v (6.5 fl oz/100 gal)
- Use 100 gallons per acre (adequate coverage of fruit and foliage)
- DO NOT apply as tank mix partner with other thinning products
- Consider reduced rate if temperatures predicted to exceed 90 F. on day of application
- And allow 7-10 days to observe effect of thinning

Growers were instructed to follow these directions the best they could, and applications were made around 1 June. We should note that the NEWA Apple Carbohydrate model indicated a moderate carbohydrate deficit would occur shortly after most applications were made, so we expected to get some (good) results. Accede was applied to several varieties, including Gala, Honeycrisp, Fuji, Mc- Intosh, Cortland, Macoun, Golden Delicious, and Paulared (among a few others). Growers noted there were no problems mixing and applying Accede and most used LI-700 as the surfactant. The rate of Accede used was 34.5 to 46 fl. oz. in 50 to 100 gallons of water per acre. Except for Paulared and one Macoun block being larger trees, the rest of the blocks were smaller (150 gallons per acre dilute tree row volume approximately) but mature bearing trees on dwarfing rootstocks

.

A few weeks following the Accede applications, a visit was made to each orchard to visually assess the efficacy (or not) of the Accede application(s). Valent provided a form that included the assessment parameters of leaf yellowing/drop, tree vigor, thinning activity, and return bloom (Figure 3).

5. Assessments:
   a. Leaf yellowing / Leaf drop: at 7 days after application, rate leaf yellowing or leaf drop on the following scale:
      - ☐ 0 = None
      - ☑ 1 = Slight
      - ☐ 2 = Moderate
      - ☐ 3 = Severe (commercially unacceptable)

   b. Tree vigor: at 2-3 weeks after application, rate tree vigor or canopy density:
      - ☑ 0 = Excellent (no difference in canopy density vs non-treated)
      - ☑ 1 = Good (slight reduction in canopy density, but acceptable)
      - ☐ 2 = Fair (noticeable reduction in canopy density)
      - ☐ 3 = Poor (significant and unacceptable reduction in canopy density)

   c. Thinning activity: at 3 to 4 weeks after application, but prior to hand thinning, visually rate thinning activity of ACCEDE:
      - ☐ 0 = Under thinned (excessive hand thinning required)
      - ☑ 1 = Sufficient thinned (minimal to moderate hand thinning required)
      - ☐ 2 = Over thinned

   d. 2022 Return bloom: ACCEDE treated area vs non-treated area
      - ☐ 0 = ACCEDE area has lower return bloom compared to non-treated
      - ☐ 1 = ACCEDE area with same return bloom
      - ☐ 2 = ACCEDE area with greater return bloom

Figure 3. Portion of assessment form provided by Valent to evaluate Accede EUP applications.

When assessments were complete, it was agreed that leaf yellowing/leaf drop ranged from none to moderate. Leaf yellowing typically shows up three to four days after application on older and smaller leaves in the spur. Yellowed leaves fall off rapidly so there is little evidence of the leaf yellowing on the tree after 10 days. Tree vigor was generally good (slight reduction in canopy density) to excellent (no difference in tree canopy vs. untreated). Thinning activity varied widely by orchard and variety. As a rule, Golden Delicious types (including Gala) were sufficiently thinned compared to the untreated control. (Figures 4 and 5), thus little or no hand thinning was needed. McIntosh types seemed largely unfazed

Figure 4. Gala fruitlet drop following Accede application: untreated control on left vs. Accede application on right.

Figure 5. Typical Gala fruitlet clusters after Accede application: untreated control on left, Accede application on right.

by the Accede application(s). This was also observed in an ACC experiment conducted on McIntosh by Greene in 2021 where virtually no thinning occurred too. On Honeycrisp, it's unclear how Accede may work, it may be useful but this remains to be determined.

We are learning how Accede may be another useful chemical thinner in your toolbox but don't count on it being a silver bullet. Plan on starting chemical thinning early and often just as usual, and then use Accede if you get to the point when fruitlets are 15-20 mm in size and it appears that you will have to do considerable hand thinning. Accede will probably not be a good option at the 10 mm fruit size, but that is still being evaluated. Having some carbohydrate deficit on the trees during the timing and 3-4 days following Accede application will be helpful (and probably necessary). Accede may be particularly useful on Gala-type apples to increase thinning and improve apple size.

We alluded to the fact that Accede can also be used for thinning stone fruit, including peaches! That is a big deal as we don't have a chemical thinner for peaches. And it's a very promising thinner of peaches. For example, a summary of Accede EUP applied to peaches in 2021 in New York, Michigan, Ohio, and Pennsylvania across many peach varieties resulted in an average fruit reduction of 39% compared to the untreated control (Gregory Clarke, Valent USA). Peach varieties did vary quite widely in their thinning response to Accede, but that might have been a location effect. In Michigan, work by Anna Wallis and Phil Schwallier in 2021 showed that hand thinning time was reduced by approximately 50% with Accede application compared to non-treated peaches. That would be sweet!

New York already has a state registration for Accede, on both apples and stone fruit, but as of late 2021 not all the New England states had Accede registered, including Massachusetts (per CDMS Label Search). All state registrations, however, are expected in 2022. We have learned that Accede supply for 2022 may be somewhat limited, and Valent plans to expand a demo program like what was done in 2021. Reach out to your agrochemical supplier if you want to use Accede in 2022, particularly if you want to trial it on some peaches.

Acknowledgments

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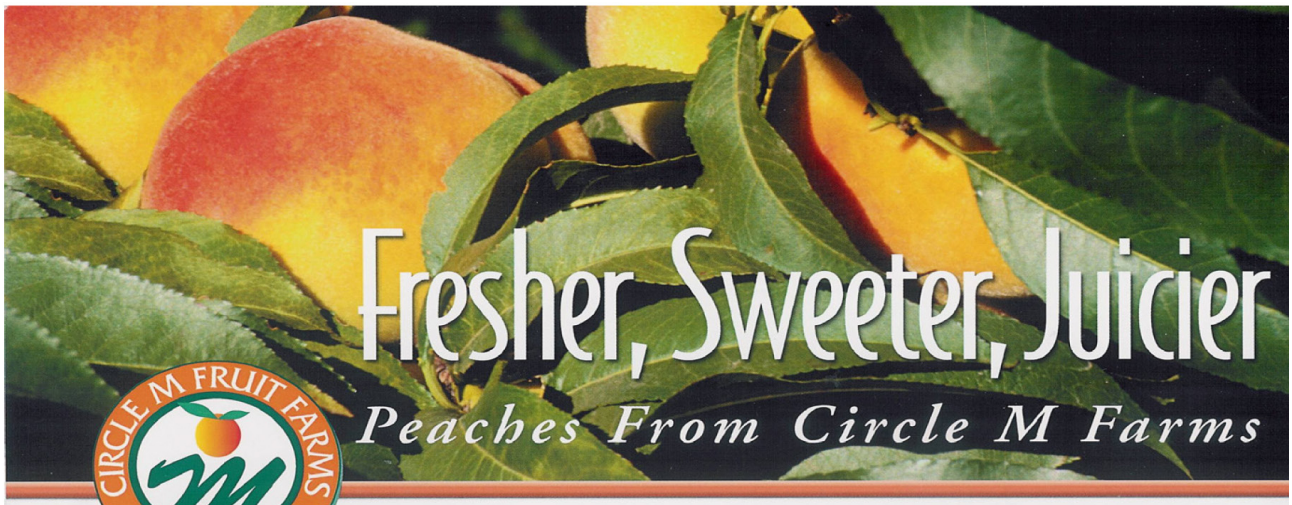

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