Massachusetts Fruit IPM Report, 2021

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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%.

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.

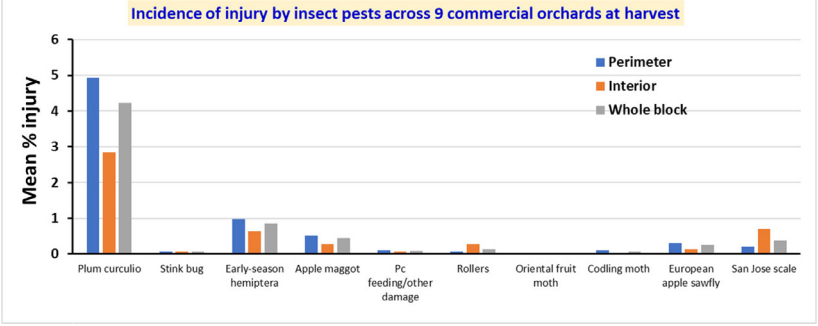

Figure 4. Average level of fruit showing insect pest injury at harvest according to sampling location in 9 commercial apple orchards in Massachusetts.

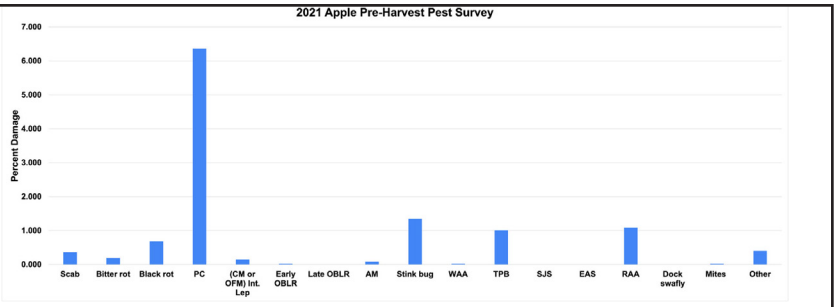

Figure 5. Average level of fruit showing insect pest injury at harvest in 11 commercial apple orchards in Massachusetts.

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.

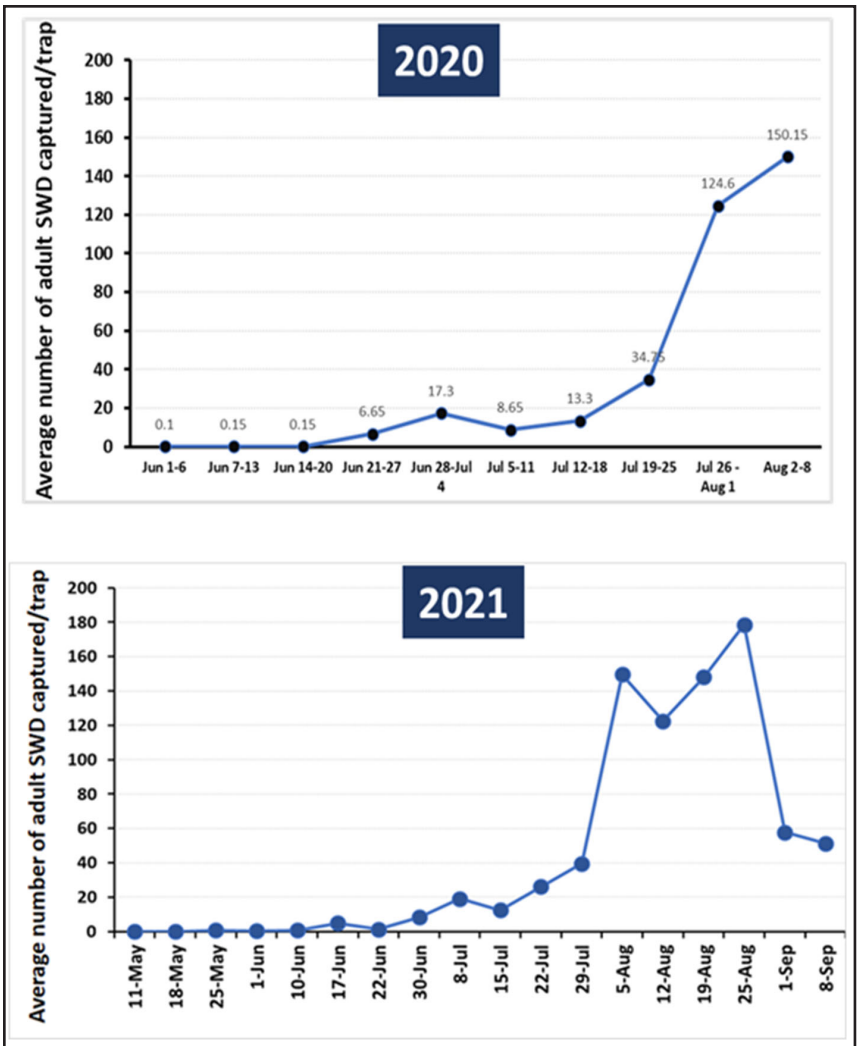

Figure 6. Seasonal captures of adult spotted-wing drosophila (males and females combined) in traps baited with fresh diluted Concord grape juice. Trap-capture data collected in five Massachusetts locations.

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

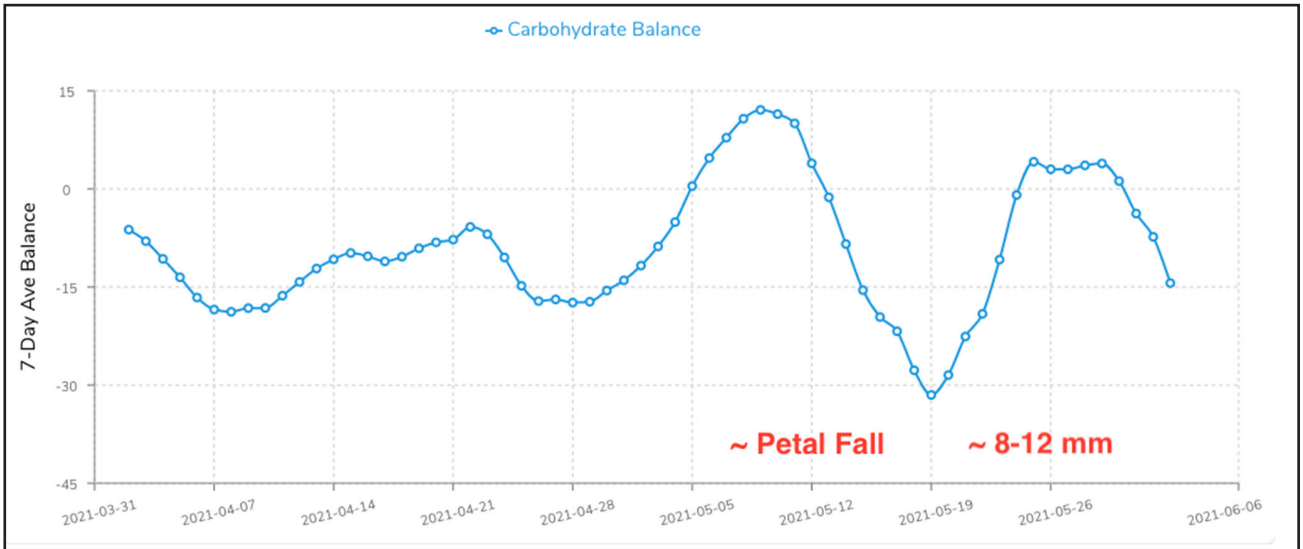

Figure 7. 2021 carbohydrate balance at UMass Orchard, Belchertown, MA (NEWA Apple Carbohydrate Thinning).

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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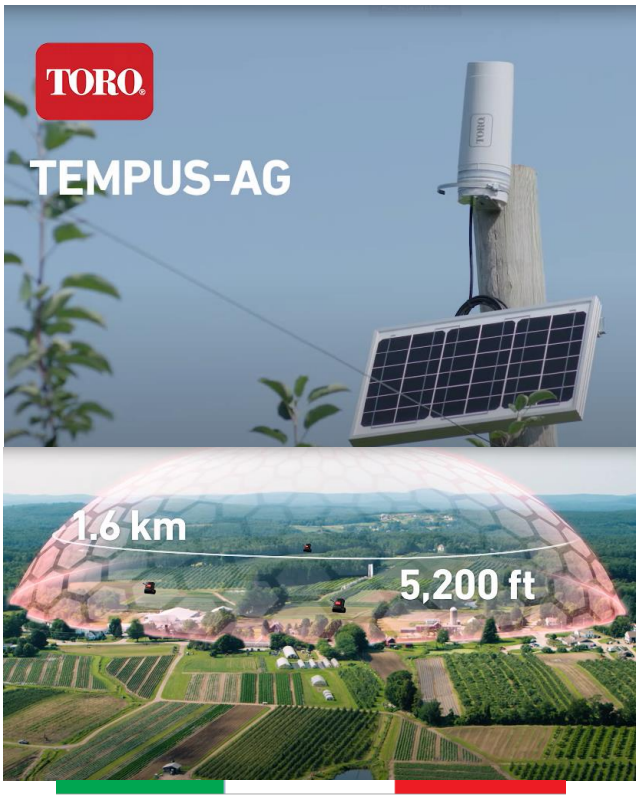

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