

**Project Title:** Sustainable Fruit Production and Marketing. **Website:** <http://ag.umass.edu/fruit>.

**Project Leader:** Jaime Pinero, [umassfruit@umass.edu](mailto:umassfruit@umass.edu).

**Team Members:** Wesley Autio, Jon Clements, Daniel Cooley, Elizabeth Garofalo, Duane Greene, Kristen Hanley, James Krupa, Shawn McIntire, Elsa Petit, Hilary Sandler, James Cronk, Katherine Khantous.

*2020 was a challenging year, with the complications brought on by COVID-19 and the drought throughout the region. We have been inspired to see the resiliency of farms throughout New England and have been proud to continue serving our commercial growers this past year.*

### Project Overview

The fruit industry is a significant driver for the Massachusetts economy. In addition, fruit farms and vineyards provide open space and scenic vistas that add significantly to the quality of life in Massachusetts. The lands surrounding agricultural production provide buffer zones for native species of plants and animals and corridors for their movement or expansion. To remain a vital part of the Massachusetts economy, both new and established growers must learn to produce crops sustainably and to adapt production systems to market opportunities. New varieties provide fruit farmers with opportunities for enhancing production, quality, sales and consumption. Delivering appropriate research-based information on new and alternative fruit species and

Activity	Occurrence	Number of People Reached
Classes & Tours	14	430
Diagnostics & Consultations	440	440
Publications	173	28,204
Research & Demonstration Projects	11	142
Workshops, Conferences, Presentations	42	3,073
Websites maintained	6	7,754



varieties, advanced horticultural management techniques, marketing and business management strategies, pest ecology, and pest-management strategies that addresses the current needs of Massachusetts fruit growers is critical to the UMass Extension Fruit program to fulfill its mission and deliver high-quality services. Research on pest ecology and management informs approaches that optimize control, reduce chemical use and increase fruit quality. The

knowledge and resources provided by Extension forge successful partnerships with Massachusetts's fruit producers that in turn foster a more secure, diverse and healthful food supply for the Commonwealth.



- During 2020, the Extension fruit team adjusted its Extension programming for online delivery. Unfortunately, we had to cancel dozens of educational events, some staff took furloughs, extended grants and canceled projects because we could not hire the people to do them.
- The team hosted, organized, and presented research-based information at 42 events (mostly online) across New England and the Northeast, reaching over 3,000 people. At these events, we shared vital information ranging from invasive insect pest management to time sensitive horticultural guidance to climate mitigation strategies and integration of cutting-edge agricultural technologies.



UAV in use at UMass Cranberry Station – H. Sandler

- We conducted 11 different on-farm research and demonstration projects. The fruit team's projects addressed research needs such as innovative attract-and-kill IPM systems for controlling native and invasive fruit pests, apple and peach rootstock performance evaluations, precision thinning, optimizing cider apple production for high value markets, the effect of shoot and cluster thinning on wine grape juice quality and many more.
- Fruit team members produced and maintained 173 publications that reached over 28,000 people. Those publications include newsletters and production guides, fact sheets, reports, abstracts and articles (both in refereed journals and in industry publications). An archived library of works by multiple team members continues to provide reference material to growers,

service providers, gardeners, students, and educators in the field. Additionally, team members also served on numerous editorial and review boards.

- Compared to 2019, individual consultations and/or diagnostic services were drastically reduced and they involved phone calls and e-mail.
- Social media significantly widened the team's audience. The UMass Fruit Team website (UMass Fruit Advisor), when linked together with social media platforms (twitter, Facebook, Instagram), extended the team's collective impact by making it available to over 7,700 people. This, along with all other high quality outputs, is a vital part of sustainability and the production of safe, affordable fruit.

### **Selected Grants Awarded (primary or as sub-award)**

- Mupambi, G., Sandler, H.A., Uppala, L.S., Jeranyama, P. and Mann, K. *Evaluation of new hybrid cranberry cultivars with improved fruit quality, yield and disease resistance.* 8/1/20 - 10/31/2023 \$24,828.
- Mupambi, G., Sandler, H.A., and Jeranyama, P. *Evaluation of new hybrid cranberry cultivars with improved fruit quality, yield and disease resistance.* 8/1/20 - 10/31/2023 \$24,828.
- Sandler, H.A. and Ghantous, K.M. *Weed management studies* CCCGA and CRF. May 2020-Apr 2021. \$10,000.
- Sandler, H.A. and Caicedo, A. L. *Documenting the genetic variation of dodder species in Massachusetts cranberry bogs to optimize efficacy of dodder management-Year 2 CAFÉ Integrated Research and Extension Grant.* \$30,901.
- Petit, E. Center for Agriculture, Food and the Environment, May-October 2020, \$5,500.
- Goodell, B. Collaborators: J. Jellison, E. Petit, American Vineyard Foundation, 2019-2275 Role of LMW fungal metabolites in *Eutypa dieback*, 2019-2021, \$70,000 (about \$35,000 each year with second year only awarded after progress report).
- Modestow, I. and Petit, E. Northeast SARE Farmer Grant, Protecting European Grape Vines from Cold Weather Damage in New England, 2020-2021 Award number: FNE20-959-34268, Amount awarded: \$13,698.
- Cooley, D.R. and Clements, J.M. Using Computer Vision to Improve Data Input for Precision Thinning Models in Apples USDA-NIFA 6/1/2020 – 5/31/2023, \$430,762.
- Cooley, D.R., Piñero, J.C., and Clements, J.M. New England Cider Apples Program: Optimizing Production for High-Value Markets 9/1/2019 – 8/31/2022, \$75,728.
- Robinson, T., Chang, L., Clements, J. Precision crop load management of apples. USDA-NIFA-SCRI SREP 2020-51181-32197. 09/01/2019 - 08/31/2021. (Co-PI). \$80,000 Clements sub-contract over four years
- Cooley, D.R. Disease Management of Fruit Crops III. 6.26.2020 - 6/25/2024. \$5,100
- Piñero, J.C. Evaluation of a grower-friendly attract-and-kill strategy for apple maggot control in New England apple orchards. New England Tree Fruit Growers Research Committee 6/1/20 – 11/30/20) \$2,600.
- Piñero, J.C. 2020-2021 Multi-cultivar grafting: a new low-cost, grower-friendly IPM approach for key apple pests in Massachusetts. Massachusetts Society for Promoting Agriculture \$21,964

Sandler, H. A., K. Campbell-Nelson, and J. Clements, *Supporting IPM on Massachusetts Specialty Crop Farms through the Integration of Applied Research and Extension Outreach*. USDA-NIFA, Extension Implementation Program. 9/1/2020 – 8/31/2021. \$291,002.

### Selected Publications

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- Ghantous, K.M. and H.A. Sandler. 2020. Seasonal nonstructural carbohydrate patterns in dewberry (*Rubus* spp.) roots. *Weed Sci.* (accepted with revisions Sept 18, 2020).
- Garofalo, E., H.A. Sandler, and J.C. Piñero. 2020. Identifying weed management priorities from the ground up: 2019 New England Vegetable and Fruit Conference Survey Results. *Fruit Notes* 85(1).
- Greene, D. W. 2020. Evaluation of apple varieties and comments made by students in the Stockbridge School of Agriculture Deciduous Orchard. *Fruit Notes* 85(2) 1-3.
- Greene, D. W. 2020. Influence of foliar urea on branching of apple in response to MaxCel application at bloom. *Fruit Notes* 85(2): 4-5.
- Clements, J. 2019. IFTA Tours Ontario. *Fruit Notes* 84(4):5-7. *Fruit Notes* 85(3): 8-10.
- Clements, J. 2020. Malusim App and Precision Apple Thinning – Trials and Tribulations. *Fruit Notes* 85(1): 10-11.
- Clements, J. 2020. DTN Smart Traps - Worth it or Not? *Fruit Notes* 85(1): 16-17.
- Clements, J., E. Garofalo, and W. Autio. 2020. 2015 Modi Organic NC-140 Apple Rootstock Trial and Drapenet Demonstration. *Fruit Notes* 85(3): 8-10.
- Clements, J., J. Krupa, P. O'Connor, L. Ware, and D. Cooley. 2020. 'OrchardWatch' Weather Monitoring Grid at UMass Cold Spring Orchard. *Fruit Notes* 85(3): 12-15.
- Clements, J. and E. Garofalo. 2020. Increasing Branching of Cider Apple Trees. *Fruit Notes* 85(1): 22-24.
- Bradshaw, T., Clements, J. Cooley, D., Garofalo, E., Pinero, J.C. and Moran, R. 2020. New England Cider Apple Project. *Fruit Notes* 85(1):12-14
- Bolton, L.G., Piñero, J.C., and Barrett, B.A. Olfactory cues from host- and non-host plant odor influence the behavioral responses of adult *Drosophila suzukii* (Diptera: Drosophilidae) to visual cues. *Environmental Entomology* (in press).
- Souder, S.K., Piñero, J.C. Spafford, H., and Vargas, R.I. 2020. *Bactrocera cucurbitae* and *Bactrocera dorsalis* (Diptera: Tephritidae) females differ in their visual and olfactory responses to papaya, an (un)common host fruit. *Proceedings of the Hawaiian Entomological Society* (in press).
- Usman, M., Gulzar, S., Wakil, W., Wu, S., Piñero, J.C., Leskey, T.C., Nixon, L.J., Oliveira-Hofman, C., Toews, M.D., and Shapiro-Ilan, D. 2020. Virulence of entomopathogenic fungi to the apple maggot *Rhagoletis pomonella* (Diptera: Tephritidae) and interactions with entomopathogenic nematodes. *Journal of Economic Entomology* (in press).
- Lopez-Ortega, M., Díaz-Fleischer, F., Piñero, J.C., Valdez-Lazalde, J.R., Hernández-Ortiz, J.M. and Hernández-Ortiz, V. 2020. The Mayan tropical rainforest: an uncharted reservoir of tritrophic host-fruit fly-parasitoid interactions. *Insects* 11(8), 495 <https://doi.org/10.3390/insects11080495>.
- Usman, M., Gulzar, S., Wakil, W., Piñero, J.C., Leskey, T.C., Nixon, L.J., Oliveira-Hofman, C., Wu, S. and Shapiro-Ilan, D. 2020. Potential of entomopathogenic nematodes against the pupal stage of the apple maggot *Rhagoletis pomonella* (Walsh) (Diptera: Tephritidae). *Journal of Nematology* e2020-79 | Vol. 52.
- Piñero, J.C. and Manandhar, R. 2020. Ant attendance and arthropod diversity on elderberry extrafloral nectaries are influenced by plant genotype and pruning method. *Arthropod-Plant Interactions* 14: 595-604 <https://doi.org/10.1007/s11829-020-09771-8>.
- Piñero, J.C., Shapiro-Ilan, D., Cooley, D.R., Tuttle, A.F., Eaton, Drohan, P., Leahy, K., Zhang, Hancock, T., Wallingford, A.K., and Leskey, T.C. 2020. Toward the integration of an attract-and-kill approach with entomopathogenic nematodes to control multiple life stages of plum curculio (Coleoptera: Curculionidae) *Insects* 11(6), 375; <https://doi.org/10.3390/insects11060375>.
- Piñero, J.C., Souder, S.K., and Vargas, R.I. 2020. Synergistic and additive interactions among components of food-based baits underlie female fruit fly (Diptera: Tephritidae) attraction. *Entomologia Experimentalis et Applicata* 168: 339-348 <https://doi.org/10.1111/eea.12890>.
- Bolton, L.G., Piñero, J.C., and Barrett, B.A. 2019. Electrophysiological and behavioral responses of *Drosophila suzukii* (Diptera: Drosophilidae) towards the leaf volatile  $\beta$ -cyclocitral and selected fruit-ripening volatiles. *Environmental Entomology* 48: 1049-1055 <https://doi.org/10.1093/ee/nvz092>.
- Piñero, J.C., Barrett, B.A., Bolton, L.G., and Follett, P.A. 2019.  $\beta$ -cyclocitral synergizes the response of adult *Drosophila suzukii* (Diptera: Drosophilidae) to fruit juices and isoamyl acetate in a sex-dependent manner. *Scientific Reports* 9:10574. <https://doi.org/10.1038/s41598-019-47081-z>.
- Piñero, J.C., Shapiro-Ilan, D., Cooley, D.R., Tuttle, A.F., Eaton, Drohan, P., Leahy, K., Zhang, Hancock, T., Wallingford, A.K., and Leskey, T.C. 2020. Controlling plum curculio adults and larvae using odor-baited trap trees and entomopathogenic nematodes: Results from a six-year study. *Fruit Notes* 85(3): 1-5.

Piñero, J.C., Cooley, D.R., Clements, J., Schloemann, S., and Garofalo, E. 2020. Massachusetts Fruit IPM Report for 2019. Fruit Notes 85: 1-8.

Piñero, J.C., Cooley, D.R., Greene, D., Clements, J., Garofalo, E., Schloemann, S., Leahy, K., and Simisky, T. 2020. 28<sup>th</sup> Annual March Message to Massachusetts Tree Fruit Growers. University of Massachusetts Extension.

### **Fact Sheets:**

Ghantous, K.M., H.A. Sandler, and W. Kerrester. Fall 2019. Moss: Biology, diversity, and yield impacts on cranberry. [https://scholarworks.umass.edu/cranberry\\_facsheets/44](https://scholarworks.umass.edu/cranberry_facsheets/44).

Cooley, D., Garofalo, E., and Faubert, H. 2020. Apple scab. IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AD-001.

Cooley, D., Garofalo, E., and Faubert, H. 2020. Apple bitter rot. IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AD-002.

Garofalo, E., Cooley, D., and Faubert, H. 2020. Apple bitter rot. IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AD-004.

Petit, E.L. 2020. Fact sheet on grape trunk diseases presented at the Connecticut Farm Winery Development Council, CT.

Clements, J, and Cowgill W. 2020. HRT-Precision crop load management of Honeycrisp: flower bud identification and precision pruning (new). UMass Extension Fruit Program.

Cowgill W., Clements, J., and Autio, W. 2020. HRT-Apple Tree Training and Pruning (update). UMass Extension Fruit Program.

Greene, D., Autio, W., and Clements, J. 2020. HRT-Thinning Apples Chemically (update). UMass Extension Fruit Program.

Schloemann, S. and Piñero, J.C. 2020. Strawberry IPM: Tarnished Plant Bug. IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #SI-008.

Schloemann, S., Piñero, J.C. and Garofalo, E. 2020. Strawberry IPM: Spotted Wing Drosophila. IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #SI-006.

Schloemann, S., Piñero, J.C. and Garofalo, E. 2020. Blueberry IPM: Spotted Wing Drosophila. IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #BI-005.

Schloemann, S. and Piñero, J.C. 2020. Blueberry IPM: Cranberry and Cherry Fruit Worm. IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #BI-003.

Schloemann, S. and Piñero, J.C. 2020. Blueberry IPM: Blueberry maggot. IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #BI-002.

Schloemann, S. and Piñero, J.C. 2020. Blueberry IPM: Aphids. IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #BI-001.

Piñero, J.C., Garofalo, E., Schloemann, S. 2020. Apple IPM: Apple maggot fly (*Rhagoletis pomonella*). IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AI-001.

Garofalo, E., Piñero, J.C., Schloemann, S. 2020. Apple IPM: Codling Moth (*Cydia pomonella*). IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AI-002.

Piñero, J.C., Garofalo, E., Schloemann, S. 2020. Apple IPM: European Apple Sawfly (*Holocampa testudinea*). IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AI-003.

Piñero, J.C., Garofalo, E., Schloemann, S. 2020. Apple IPM: Leafhoppers: Potato leafhopper (*Empoasca fabae*), white apple leafhopper (*Typhlocyba pomaria*), rose leafhopper (*Edwardsiana rosae*). IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet #AI-004.

Piñero, J.C., Garofalo, E., Schloemann, S. 2020. Apple IPM: Mites: European red mite (*Panonychus ulmi*) and two-spotted spider mite (*Tetranychus urticae*). IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AI-005.

Garofalo, E., Piñero, J.C., Schloemann, S. 2020. Apple IPM: Obliquebanded Leafroller (*Choristoneura rosaceana*). IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AI-006.

Piñero, J.C., Giri, A., and Garofalo, E. 2020. Apple IPM: Oriental fruit moth (*Grapholita molesta*). IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AI-012.

Piñero, J.C., Garofalo, E., Schloemann, S. 2020. Apple IPM: Plum Curculio (*Conotrachelus nenuphar*). IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AI-007a.

Piñero, J.C., Garofalo, E., Schloemann, S. 2020. Apple IPM: Plum Curculio (*Conotrachelus nenuphar*): Effective plum curculio monitoring using lures. IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AI-007b.

Piñero, J.C., Garofalo, E., Schloemann, S. 2020. Apple IPM: San Jose Scale (*Quadraspidiotus perniciosus*). IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AI-009.

Piñero, J.C., Garofalo, E., Schloemann, S. 2020. Apple IPM: Tarnished plant bug (*Lygus lineolaris*). IPM Fact Sheet Series, University of Massachusetts Extension, Fact Sheet # #AI-011.

Piñero, J.C., Wallingford, A., and Koehler, G. 2020. Evaluation of a Grower-friendly Attract-and-kill Strategy for Apple Maggot Control in New England Apple Orchards. Fruit Notes 85: 6-9.



Garofalo, E., and Piñero, J.C. 2019. Effective Brown Marmorated Stink Bug Identification in Massachusetts. University of Massachusetts Extension Fruit Program, IPM Fact Sheet.

Garofalo, E., and Piñero, J.C. 2019. Effective Brown Marmorated Stink Bug Monitoring and Management in Massachusetts. University of Massachusetts Extension Fruit Program, IPM Fact Sheet.

## Guides & Newsletters

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[\*2020 New England Tree Fruit Management Guide\*](#) – J. M. Clements, General Editor

[\*2020 New England Small Fruit Management Guide\*](#) – S. G. Schloemann, General Editor

Fruit Notes Quarterly (<http://umassfruitnotes.com/>)

Healthy Fruit Newsletter (<http://ag.umass.edu/fruit/healthy-fruit-archive>)

IPM Berry Blast (<http://ag.umass.edu/fruit/ipm-berry-blast>)

Cranberry Station Newsletter (<http://ag.umass.edu/cranberry/newsletters>)

## Selected Collaborations and Working Groups

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- European Apple Disease Working Group (International)
- Great Lakes Fruit Workers (Upper Midwest)
- NE-1720 Multi-state Evaluation of Winegrape Cultivars & Clones
- NC-140 Regional Rootstock Project, Technical Committee (National)
- Northeast Berry Call-In (USDA Region I/Eastern Canadian Provinces)
- Northeast Plant Growth Regulator Working Group (Northeast)
- Organic IPM Working Group (Eastern US)
- Spotted Wing Drosophila Working Group (Eastern US)
- Northeast Tree Fruit IPM Working Group (Northeast)
- Network for Environment and Weather Applications
- UMassAir 5-College Collaborative with UMass Transport Center (Local)

## Narrative Summary

The UMass Extension Fruit Team seeks to introduce new ideas, technologies and techniques for fruit production in New England, provide timely relevant & research-based information to our audiences that is ecologically and economically sound, respond to current issues effectively and efficiently, and alert growers to high impact issues if/when they occur. We work with fruit growers from small- and large-scale operations who range from beginners to experienced growers and use organic to conventional production systems to produce a variety of fruit crops ranging from apples to strawberries. Fruit Program activities are carried out statewide and also regionally around New England and are delivered via workshops, field days and trainings, conferences and meetings, individual consultations, newsletters, factsheets and pest alerts, guides and other publications. As a result of this work our track record includes: reduced pesticide use on fruit crops, increased use of ecologically-based IPM strategies including biological controls and reduced-risk pesticide materials, introduction of new crops and production systems such as growing seedless table grapes and the introduction of high density apple production systems.

## Collaborating Organizations:

- US Department of Agriculture
- Massachusetts Department of Agricultural Resources
- Massachusetts Society for Promoting Agriculture
- Massachusetts Fruit Growers' Association
- New England Vegetable & Berry Growers Association
- Massachusetts Farm Winery & Growers Association
- Massachusetts Cultivated Blueberry Growers Association
- Massachusetts Horticultural Society
- Massachusetts Master Gardeners Association



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