**Project No. and Title: NCERA 224: IPM Strategies for Arthropod Pests and Diseases in Nurseries and Landscapes 2022 chair Brian Kunkel, UDE; 2023 chair Vera Krischik UMN**

**2022 report filed by Vera Krischik on September 29 2023 as the 2022 report was not filed by the chair.**

**Period Covered: 01/01/2022 to 12/31/2022**

**Date of Report: 09/29/2023**

**Annual Meeting Dates: 12/11/2022 to 12/13/2022**

**In attendance:**

Jill Pollock, UDE

Brian Kunkel, UDE

Gary Chastagner, WSU

JKC Chong, Clemson University

**In attendance by Zoom:**

Vera Krischik, UMN

Jana Beckman, Purdue University

Lynnae Jesse MSU, Director NCIPM Center

Administrator Thomas Payne UMO, not in attendance

**Brief summary**

NCERA 224 meet on Dec 12 2022 at the Dobletree Hilton to discuss state reports in person and by zoom. Members attended an IPM tour of Coastal Georgia Botanical Garden (formerly as the Bamboo Farms), which is managed by University of Georgia (UGA) on Dec 13 2022.Ten state reports were discussed.

**Accomplishments 10 state reports were submitted.**

**Members spoke of their local IPM research and outreach programs on plant diseases and insect issues.**

**Gary Chastagner of WSU discussed:**

Completed the national CoFirGE project, which evaluated the potential of 60 families of Turkish fir and 40 families of Trojan fir to produce high quality Christmas trees in the PNW. Scions from 10 to 20 top performing trees with excellent needle retentions are being used to establish a series of grafted seed orchards in OR and WA.

Developed an effective heat treatment to eliminate *Megastigmus* larvae in imported conifer seed and confirmed this treatment has no adverse effect on the germination and viability of seed.

Demonstrated that *Botrytis* is a limiting factor in the ability to use modified atmosphere systems to prolong the storage of peony flowers.

Data from Postdoctoral Research Associate Joey Hulbert’s Forest Health Watch program is being used by community members to monitor the distribution and severity of Western Red Cedar decline, leaf blight on Pacific Madrone, and the emerging sooty bark disease on trees in urban landscapes and forests. Surveys and molecular DNA tests on samples from WA, OR, CA, MI, MO, NC, and SC, have detected *C. corticale* on 31 new potential host species in 19 genera. These results indicate that C. corticale, which causes sooty bark disease on trees and maple bark disease in humans is widespread on declining trees throughout western Washington and has a much broader potential host range and distribution than previously known.

In collaboration with the US Forest Service installed an Oregon Ash common garden trial to evaluate genetic diversity in this species.

**Dr. Steven Franks of NCSU discussed:**

We conducted research and extension related to IPM and biological control in greenhouses, nurseries, and urban landscapes. 1) Research is ongoing to understand conservation biological control in urban landscapes and specifically the role of urban trees in supporting natural enemy populations. 2) We conducted research on augmentation biological control and microbial control of mealybugs, scales, and other pests in greenhouses and how to integrate biological control with insecticides. 3) Research was conducted to understand the biology and management of European pepper moth. We now have knowledge of the life cycle, feeding preferences, effective insecticides, and we are beginning work with nematodes and other biological control measures. Our extension activities have been increasing since COVID. We gave several presentations and produced other extension resources this year.

**Drs. Cliff Sadoff and Jana Beckerman of Purdue discussed:**

In recent years, nurseries in multiple states have reported moderate to severe dieback, chlorosis and stunting of redbud, including vascular streaking. This issue is impacting seedlings, grafted plants, older nursery stock produced in container or field production settings and landscape plants. In September, several varieties of redbud being sold from a large nursery at their Noblesville location tested positive for the tentatively identified *Rhizoctonia theobromae*. An additional finding at an unrelated location was documented, as well. All redbuds from the TN shipping location were destroyed. Oregon redbuds have yet to develop symptoms or test positive. No additional species at that site were found to be symptomatic.

Testing is still ongoing regarding dying sassafras/laurel wilt in southern Indiana.

Endemic pathogens outbreaks were mostly (with some exceptions) mild due in part to an unusually dry spring.Cedar-quince rust (*Gymnosporangium clavipes*) continues to be severe on crabapples, hawthorns, serviceberry, and even Callery pear.Despite these dry conditions **Botryosphaeria canker** continues to be a problem on redbud, crabapple, white-cedar, dogwood, and viburnum. **Powdery mildew** was more severe as well, particularly on lilac, buckeye, ninebark, susceptible roses, and dogwood. A dry August resulted in an excellent mum crop. **Phomopsis** on Norway spruce continue to plague spruce across the state, replacing Rhizosphaera as the primary problem on (Colorado blue) spruce.

**Insect Update**

Relatively dry conditions during spring and summer facilitated spider mite outbreaks, and borer problems on landscape flowers and trees. Borer problems were also exacerbated by dry conditions.

Exotic invasive species continue to dominate the entomological landscape. Spongy moth (*Lymantria dispar*) caused significant defoliation in the northern tier counties of Indiana. Examination of larvae by Indiana DNR personell indicated a enough nuclear polyhedrosis virus and *Entomophaga maimaiga* fungus in the current population to help reduce outbreaks next year. Nevertheless we worked with the Indiana DNR to develop protocols to apply for suppression funds for this pest.

Emerald ash borer is still active in much of Indiana, albeit to a lesser extent due to the death of most ash trees. Resurgence is being seen in areas that stopped treating as well as ash forests that have regrown since

**Dr. Vera Krischik of UMN discussed:**

First introduced to the US from Japan in 1916, Japanese beetle was commonly found in MN by the 1990’s. Adult feeding by Japanese beetle results in damage to foliage and fruits, reducing food for bees and wildlife.

The long term research outcome is to establish an endemic pathogen to kill Japanese beetle. The pathogen *Ovavesicula popilliae* was first described in CT and was introduced by researchers into MI, KY, AR, CO, and KS.

For short-term management, research on the efficacy of new EPA approved microbial products, GrubGone (*Bacillus thuringiensis galleriae*), soil applied fungus *Beauveria bassiana*, parasitic nematodes, and bee-friendly insecticide chlorantraniilprole will be studied. The outcome will be site specific IPM protocols, demonstration projects in parks, and educational programs for outreach to increase implementation.

Overwintering success of infected grubs and adult fecundity is reduced by as much as 50%. Beetle populations can decrease by 60 % in 5 years and 75% over 20 years. The pathogen has been found in MN through collaboration with Michigan State University.

Outcomes are to provide IPM management that protects pollinators in established bee lawns and restorations using biocontrol to reduce non-target effects from insecticides for native pollinators and beneficial insects. Websites, talks, and field days are important for education to tell the difference between deadly wasps and polite ground nesting bees.

Demonstration projects in parks will help with IPM adoption. For instance consumers need to know the difference in management for JB grubs that does not effect ground nesting bees or flower visiting bees. Bee identification is important so native ground nesting bees are not killed as consumers think that the bees are ground nesting wasps.

The Minneapolis Park and Rec Board, Lyndale Gardens, Hiawatha Golf Course, Washington Co Parks, Washington Co Conservation District, UM Hort Display Gardens, and Twin Cities Seed are cooperating with us on establishing a outside poster with information on IPM, managing JB with microbial insecticides, and the establishment

**Dr. Pierluigi (Enrico) Bonello of OSU discussed:**

Ohio State University mapped the environmental risk for beech leaf disease (BLD) across northeast Ohio, western Pennsylvania and western New York.

Ohio State University showed the deleterious effects of climate change on the physiology of tree responses to *Diplodia pinea* that make the host much more susceptible to disease.

Ohio State University clarified the temporal expression of the various BLD symptoms.

Ohio State University formalized methodological pipelines on the use of metabarcoding for the diagnosis on novel tree diseases.

**Dr. Ada Szczepaniec of CSU sent a state report:**

Emerald ash borer status: EAB is active in the Front Range of Colorado and active infestations have been identified in major Northern Colorado cities, e.g., Colorado Springs, Boulder, Fort Collins. Infestations appear localized, and some municipalities like Fort Collins have been proactive in treating ash trees and assessing the extent of spread. Releases of parasitoid wasps are planned in collaboration with the City of Fort Collins Forestry Division in 2025, given the low populations of beetles that are localized to two sites in the northern part of town.

Japanese beetle: Japanese beetles remain the key pest of Colorado landscapes and are now well established in the western part of the State.

*Ips spp.* status: Bark beetles remain a key pest of spruce, elm, and ash trees weakened by EAB infestations. Recent wet spring and summer have alleviated the impact some, but infested trees continue to decline.

**Dr. Karla Addesso of TSU sent a state report:**

In 2023, we had our first report of major flea beetle management problems in a middle Tennessee nursery. There have been sporadic reports of flea beetles in the last few years, but no known established farm populations. This population was causing heavy damage to *Itea*, despite contact sprays being applied to control the adult population. We conducted a sweep net survey of the infested containers and blocks of host and non-host areas adjacent to the *Itea*. Sweep samples of the *Itea* collected 73 beetles on average. *Fothergilla*, a plant which was adjacent to the *Itea* and had minor evidence of feeding, had 8 beetles when directly adjacent to the *Itea* and 7 beetles in a plot located directly across a gravel driveway to the left of the *Itea*. One beetle was recovered from the boxwood block directly adjacent to the *Itea* with no visible feeding damage. A sweep was also made of the woodline located across a gravel drive on the right of the *Itea*. One beetle, on average, was collected in those sweeps. Media/root cores were taken from the containers to see if eggs or larvae were present. Core samples were taken from 10 pots in each of the previously described plot locations. The plants were being grown in felt bags, so root balls could not be removed to look for larvae, as is commonly done with plastic containers. The cores were held for a week and observed for eggs or larval hatch. No definitive sign of flea beetle larvae or eggs were present in the media samples. The grower was provided with management suggestions for control.

**Dr. William Kilingemn of UTN sent a report:**

Research team members are involved in several projects to evaluating disease diagnostics and insect monitoring approaches for horticultural landscape and native plant pests. Molecular markers (SSRs) and TaqMan fluorescing probes are being developed and screened for detecting DNA of plant pathogenic diseases including

Laurel Wilt Disease, *Harringtonia* (syn. *Raffaelea*) *lauricola*; Oak wilt disease, *Bretziella fagacearum*, and other plant pathogens of interest (including vascular streak disease, *Diplodia corticola* and other canker-forming pathogens on oaks). Several of these pathogens have been found infecting host plant tissues and insects associated with host plants in Tennessee. Other diseases occur in adjacent states and potentially threaten TN (and SEUS) urban/forest and landscape hosts and insects may become candidate vectors in pathogen spread and persistence. Trapping optimization studies are being employed, with captured adult *Chrysobothris* beetles being used for molecular systematics in the genus and between *C. femorata* species group members, as part of a larger USDA NIFA SCRI project.

Two new faculty have joined the Entomology and Plant Pathology Department at UT as Assistant Professors with responsibilities in specialty horticulture/landscape crop IPM: Dr. Nar Ranabhat (Plant Pathologist) and Dr. Midhula Gireesh (Entomologist). Dr. Gireesh also works with arthropod pests in turfgrass systems.

**Dr. JC Chong of Clemson U discussed:**

Crapemyrtle bark scale (*Acanthococcus lagerstroemiae*)has expanded its distribution in South Carolina since its first detection near Columbia, SC, in 2019. While available information indicated that this invasive felt scale species is distributed in two counties (Richland and York; https://www.eddmaps.org/distribution/uscounty.cfm?sub=80722), this team has received information on its establishment in at least seven other counties throughout the state. More importantly, this invasive species has been spread into nursery production in the state, causing significant damage to nursery growers who produce and sell crapemyrtles. The distribution and impact of this invasive species throughout SC and the southeastern US is likely to expand in the coming years.

Research team at Clemson University had conducted 30 trials in 2021-2022 to evaluate the efficacy of reduced-risk insecticides and miticides (e.g., afidopyropen, flupyradifurone, spiromesifen), biopesticides (e.g., *Beauveria bassiana*), and novel chemistries and biopesticides (e.g., ISM-555, SP3014, and V-10433) against sweetpotato whitefly, western flower thrips, Madeira mealybug, striped mealybug, redheaded flea beetle, omnivorous leafroller, and twospotted spider mite.

**Impacts**

All research and outreach programs were concerned with using IPM principles to reduce pesticide use, better time pesticide use, use cultural management, better identify pests, and protect pollinators and improve worker safety. Please see the individual state reports for details.

**Publications**

All members submitted citations on research and outreach papers.Please see the individual state reports for details.

**2022 Members:**

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Administrator, Payne, Thomas L. (CAFNR)" <paynet@missouri.edu>,

**Agenda**

NCERA-224 Savannah, GA 11 – 13 December 2022

DoubleTree Hilton, 411 W Bay St, Savannah, GA 31401

Date Day Time Activity

11 December Sunday 6:30 pm Meet in Lobby for group dinner

12 December Monday 8:0 am Breakfast/Intro

9:00 am Begin State Reports

10:30 am Break

Noon Group lunch out

1:30 pm Resume reports

3: 00 pm Break

5:00 pm Finish Business

13 December Tuesday 8:00 am Meet for breakfast; planned Tour

At the end of the meeting we discussed the 2023 meeting site. The 2023 Meeting was decide to be on the West Coast as the 2022 meeting was on the East Coast. Vera Krischik was nominated as the chair. The final site for the 2023 meeting was determine in August 2023 for Santa Barbara, CA on Dec 11. The members request this time period as classes and teaching responsibilities are over for the semester.

**2023 members, a new Administrator Dr. Shibu Jose around 9 members added for 2023**

Samuel-Foo, Michelle - REE-NIFA <Michelle.Samuel-Foo@usda.gov>, Christina Hamilton <christina.hamilton@wisc.edu>

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**State reports: 10 state reports attached, Washington, North Carolina, Indiana (2), Minnesota, Tennessee (2), Colorado, Ohio, South Carolina**

# NCERA-224 Annual Meeting Report 2022

# State: Washington

# Name of Representative: Gary Chastagner, Professor of Plant Pathology

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**WSU PUYALLUP ORNAMENTAL PLANT PATHOLOGY PROGRAM OVERVIEW**

The Ornamental Plant Pathology Program (PPO) at WSU Puyallup is a diverse program which conducts research covering a wide range of host/pathogen systems that include bulbs, flowers, Christmas trees, urban forests, and many nursery crops. In addition, PPO conducts research on invasive species and the genetics of host/pathogen/environment interactions of several tree species, climate resilience, and the postharvest quality of Christmas trees and peonies. Outreach programs disseminate research-based information to stakeholders – improving disease management and the sustainability of production systems. Through community engagement activities such as educational outreach to local schools, citizen science projects, Master Gardeners and other stewardship groups, people in the community can increase their scientific literacy and learn about their role and impacts on the ecosystem, leading to a better-informed public that potentially will influence policy decisions at the local and state levels.

PPO STAFF

1. Dr. Marianne Elliott – Research Associate
2. Dr. Joseph Hulbert, Postdoctoral Fellow
3. Collin Marshal – Ag. Res. Tech. II
4. Travis Bonnette – Plant Tech. II
5. Non-student temporary employees – six (6)

The PPO program’s core areas of focus include:

* Molecular disease diagnostics to improved identification and detection of pathogens
* Diversity of *Phytophthora* and *Botrytis* species in agroecosystems
* Optimization of disease management programs
* Steaming as a mitigation tool to eradicate native and exotic pathogens and pests
* Identification of Christmas trees with genetically superior postharvest needle retention
* Engagement of community members through citizen science programs

Selected accomplishments in 2022

* Completed the national CoFirGE project, which evaluated the potential of 60 families of Turkish fir and 40 families of Trojan fir to produce high quality Christmas trees in the PNW. Scions from 10 to 20 top performing trees with excellent needle retentions are being used to establish a series of grafted seed orchards in OR and WA.
* Developed an effective heat treatment to eliminate *Megastigmus* larvae in imported conifer seed and confirmed this treatment has no adverse effect on the germination and viability of seed.
* Demonstrated that *Botrytis* is a limiting factor in the ability to use modified atmosphere systems to prolong the storage of peony flowers.
* Data from Postdoctoral Research Associate Joey Hulbert’s Forest Health Watch program is being used by community members to monitor the distribution and severity of Western Red Cedar decline, leaf blight on Pacific Madrone, and the emerging sooty bark disease on trees in urban landscapes and forests,
* Surveys and molecular DNA tests on samples from WA, OR, CA, MI, MO, NC, and SC, have detected *C. corticale* on 31 new potential host species in 19 genera. These results indicate that C. corticale, which causes sooty bark disease on trees and maple bark disease in humans is widespread on declining trees throughout western Washington and has a much broader potential host range and distribution than previously known.
* In collaboration with the US Forest Service installed an Oregon Ash common garden trial to evaluate genetic diversity in this species.

Below is an overall summary of activities in 2022.

**GRANTS RECEIVED - $591,852**

**USDA Floriculture and Nursery Research Initiative (FNRI)**

$42,635. Chastagner. Improved pathogen detection and management of bulb diseases.

**Northwest Agricultural Research Foundation (NARF) and Wally Statz Foundation**

$9,831. Chastagner. Management of *Botrytis* basal stem decay on peonies.

**USDA NW Nursery Crops Research Center**

$24,000. Chastagner. Management of *Botrytis* on cut flowers.

**WSDA**

$50,000. Chastagner and Elliott. *Phytophthora* CCP assessment & BMP training for WA nurseries. WSDA.

$25,000. Elliott and Chastagner. Invasive snail steaming at the Port of Tacoma.

**WA DNR Community Forestry Assistance Grant**

$40,000. Hulbert and Chastagner. Tacoma Sooty Bark Disease Vulnerability.

$6,000. Chastagner and Hulbert. DNR SBD big leaf maple survey

**APHIS PPA Suggestion**

$43,356. Chastagner and Elliott New techniques using aerated steam to eradicate *P. ramorum* and other pests/pathogens.

$59,228. Chastagner and Elliott. NORSDUC-Lateral movement of *Phytophthora ramorum* inoculum in soil Year 2.

$77,763. Chastagner and Hulbert. Increasing Native Vigilance, Awareness and Surveillance of Invasions via Education (INVASIVE) project.

**U.S. Real Christmas Tree Board**

$11,947. Chastagner, Jetten, and Walse. Efficacy of Bluefume (HCN) fumigation in eradicating elongate hemlock scale on Christmas trees and Profume (sulfuryl flouride) fumigation for controlling *Megastigmus* larvae in conifer seeds

$26,881. Chastagner. Susceptibility of Trojan fir to *Phytophthora* root rot

$17,930. Chastagner. Improving the viability and vigor of Nordmann and Turkish fir seeds in long-term storage.

**PNWCTA**

$9,500. Chastagner. Management of diseases on Christmas trees.

**USFS International Program**

$108,114. Chastagner, Hulbert, Elliott, and Murray. Detecting biological invasions with sentinel plants

**Chicona Endowment Fund**

$16,667. Chastagner. High performance energy efficient LED greenhouse lights

**CAHNRS**

$5,000. Chastagner and Hulbert. Two undergraduate student summer internships

**BASF CORP AG**

$10,000. Chastagner. Efficacy of fungicides in controlling rust and *Botrytis* on ornamental plants

**Gift Grants**

$8,000. Chastagner. Industry/Stakeholders

**PUBLICATIONS**

*REFEREED JOURNAL*

1. Coats, K., A. DeBauw, D. K. Lakshman, D. P. Roberts, A. Ismaiel, and G. Chastagner. 2022. Detection and molecular phylogenetic-morphometric characterization of *Rhizoctonia tuliparum*, causal agent of gray bulb rot of tulips and bulbous iris. J. Fungi 8(2), 163; https://doi.org/10.3390/jof8020163

*REFEREED JOURNAL MANUSCRIPT ACCEPTED*

1. Wang, X., C. Mattupalli, G. Chastagner, L. Tymon, Z. Wu, S. Jung, H. Liu, and L. W. DeVetter. Accepted pending revision. Physical characteristics of soil-biodegradable and nonbiodegradable plastic mulches impact conidial splash dispersal of *Botrytis cinerea*. PLOS ONE

*REREREED JOURNAL MANUSCRIPT SUBMITTED*

1. Lanning, K.K., N. Kline, M. Elliott, E. Stamm, T. Warnick, J. M. LeBoldus, M. Garbelotto, G. Chastagner and J. Hulbert. (Submitted). Citizen science can add value to *Phytophthora* monitoring: five case studies from western North America. Frontiers in Forests and Global Change

ABSTRACTS FOR INTERNATIONAL MEETINGS

1. Chastagner, G. 2022. Potential Impacts of climate change on diseases and the postharvest quality of Christmas trees. p. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA. <https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf>
2. Chastagner, G. and McLoughlin. 2022. A final look at bud break variation in families of Turkish and Trojan fir trees in the CoFirGE plots in Washington. p. 45. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA. <https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf>
3. Chastagner, G., Riley, K., and Sherry, D. 2022. Effectiveness of preharvest application of 1-MCP in reducing needle loss on cut Christmas trees. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA. <https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf>
4. Chastagner, G., Sidebottom, J., Jetton, R., Walse, S., and Corbett, S. 2022. Efficacy of eFume and Bluefume (HCN) fumigation in eradicating elongate hemlock scale on Christmas trees. p. 35. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA <https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf>
5. Whitney, T., Casciola, A., and Chastagner, G. 2022. Heat treatment - A potential approach of killing *Megastigmus* larvae in imported conifer seeds. p. 36. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA. <https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf>
6. Chastagner, G., McLoughlin, D., Riley, K., and Sherry, D. 2022. Identification of top performing trees for establishing Turkish and Trojan fir clonal seed orchards. p. 15. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA. <https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf>
7. Chastagner, G., McLoughlin, D., Riley, K., and Sherry, D. 2022. Regional variation in postharvest needle loss from trees in CoFirGE planting sites. p. 44. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA. <https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf>
8. Landgren, C., Ober, H., and Chastagner, G. 2022. Grower’s need assessment of Pacific Northwest Christmas tree and allied product producers. p. 14. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA. <https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf>
9. Landgren, C., Chastagner, G., and Bates, R. 2022. A national progeny test (CoFirGE 2) – A discussion about next steps. p. 18. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA. https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf
10. Whitney, T., Casciola, A., and Chastagner, G. 2022. Insecticide toxicity, application efficacy, and degree-day modelling of an emergent Christmas tree pest, the Douglas-fir twig weevil (*Cylindrocopturus furnissi*). p. 37. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA. <https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf>
11. Whitney, T., Casciola, A., Landgren, C., and Chastagner, G. 2022. Effect of moisture content on the 022. Fallen Leaf Lake, CA viability and vigor of Nordmann, Turkish and Trojan fir seeds. p. 46. Proceedings 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA. <https://www.iufro.org/fileadmin/material/publications/proceedings-archive/20209-ctre-proceedings-22.pdf>
12. Chastagner, G., Hulbert, J., Brooks, R., Elliott, M. Omdal, D., and Johnson, N. 2022. Sooty Bark Disease – An emerging disease of deciduous urban trees in western Washington. IUFRO Foliar, Shoot, Stem and Rust Diseases of Trees Conference. June 26-July 1, 2022. Durham, NH
13. Elliott, M., Hulbert, J.M., and Chastagner, G. 2022. *Phytophthora ramorum* in Washington State, USA: Management successes and failures. 10th IUFRO Working Party S07-02-09 "Phytophthora in Forests and Natural Ecosystems" Conference. June 19-25, 2022. Berkeley CA p. 45. <https://nature.berkeley.edu/matteolab/wp-content/uploads/2022/06/Schedule-and-Program-UFRO2022-v3_9.pdf>
14. Hulbert, J., J. Olson, N. Vonberckefeldt, T. Warnick, K. Lanning, M. Elliott, G. Chastagner. 2022. Are oomycetes associated with the dieback of western redcedar? 10th IUFRO Working Party S07-02-09 "Phytophthora in Forests and Natural Ecosystems" Conference. June 19-25, 2022. Berkeley CA p. 23-24. <https://nature.berkeley.edu/matteolab/wp-content/uploads/2022/06/Schedule-and-Program-UFRO2022-v3_9.pdf>

*EXTENSION PUBLICATIONS*

1. Brooks, R., Hulbert, J., Elliott, M., Omdal, D., and Chastagner, G. 2022. Sooty bark disease diagnostic guide. FS325E, WSU Extension. https://pubs.extension.wsu.edu/sooty-bark-disease-diagnostic-guide

*INDUSTRY OR POPULAR PERIODICALS*

1. Kowalski, J., G. Chastagner, C. Landgren and D. McLoughlin. 2022. The CoFirGE Progeny Trial-10 years later, what have we learned? Christmas Tree Lookout 54(1): 17-20.
2. Ober, H., C. Landgren, G. Chastagner, and J. Kowalski. 2022. Survey results: Christmas tree industry needs assessment. Christmas Tree Lookout 55(2): 10-13.

**WEBSITE Updates**

1. WSU Sudden Oak Death Program (<http://ppo.puyallup.wsu.edu/sod/>)
2. Pacific Madrone Research (<http://ppo.puyallup.wsu.edu/pmr/>)
3. National Elm Trial (<http://www.puyallup.wsu.edu/ppo/net/>)
4. Sooty Bark Disease (<http://www.puyallup.wsu.edu/ppo/sbd/>)

**PRESENTATIONS**

*Scientific Meetings*

1. Sooty Bark Disease – An emerging disease of deciduous urban trees in western Washington. 22nd Ornamental Workshop on Insects and Diseases, Oct. 18 - 20, 2022, J.C. Raulston Arboretum, Raleigh, NC
2. NCERA 224 meeting – Overview of 2022 ornamental research at WSU Puyallup, Dec. 11-12, Savannah, GA.
3. Overview of the use of DMI fungicides on ornamental bulb crops in Washington. National Academy of Science workshop on azole-resistant Aspergillus fumigatus in the Environment. May 9, 2022 (Invited virtual presentation)
4. A final look at bud break variation in families of Turkish and Trojan fir trees in the CoFirGE plots in Washington. (Poster).15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA
5. Potential Impacts of climate change on diseases and the postharvest quality of Christmas trees. 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA
6. Efficacy of eFume and Bluefume (HCN) fumigation in eradicating elongate hemlock scale on Christmas trees. (Poster) 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA
7. Heat treatment - A potential approach of killing *Megastigmus* larvae in imported conifer seeds. (Poster) 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA
8. Regional variation in postharvest needle loss from trees in CoFirGE planting sites. (Poster) 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA
9. Effect of moisture content on the viability and vigor of Nordmann, Turkish and Trojan fir seeds. (Poster) 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA
10. Identification of top performing trees for establishing Turkish and Trojan fir clonal seed orchards. 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA
11. Insecticide toxicity, application efficacy, and degree-day modelling of an emergent Christmas tree pest, the Douglas-fir twig weevil (*Cylindrocopturus furnissi*). (Poster) 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA
12. Effectiveness of preharvest application of 1-MCP in reducing needle loss on cut Christmas trees. (Poster) 15th IUFRO International Christmas Tree Research and Extension Conference, June 3-8, 2022. Fallen Leaf Lake, CA
13. Sooty Bark Disease – An emerging disease of deciduous urban trees in western Washington. IUFRO Foliar, Shoot, Stem and Rust Diseases of Trees Conference. June 26-July 1, 2022. Durham, NH

*Stakeholders*

1. Plant Pathology Research at WSU Puyallup. Pierce County Agriculture Advisory Committee. May 25, 2022. Puyallup, WA (Invited)
2. Management of needle cast diseases. Michigan Christmas Tree Association Summer Meeting, July 26-28, 2022. Armada, MI (Invited)
3. Management of *Botrytis* and *Phytophthora* Diseases on Ornamentals and Cut Flowers. Lane County Master Gardner virtual meeting. July 19, 2022. (Invited)
4. Overview of Christmas tree research at WSU Puyallup. Puget Sound Christmas Tree Association Annual Meeting. Feb. 12, 2022. (Invited)
5. Chastagner. Botrytis, Compost, Hydration & Storage. Alaska Farm Bureau Annual Convention, Anchorage, AK, November 11, 2022 (Invited)

**TOURS**

1. Master Gardner training class tour, May 10, 2023, Puyallup, WA
2. PPO research tour for PlP525 class, June 15m 2023, Puyallup, WA
3. Ripelocker/Peony storage trial tours, July 13th, and Aug. 1, 2022. Puyallup, WA
4. Danish Christmas Tree Industry tour, Sept. 5, 2023, Puyallup, WA
5. WSU tailgate party and tour, Oct. 8, 2022, Puyallup, WA
6. CAHNRS Dean’s visit to PREC, Oct. 31, 2022, Puyallup, WA

**MEDIA NEWS RELEASES AND INTERVIEWS**

1. Jim Bradeen. APS Plantopia podcast titled “The Science Behind Healthy Christmas Trees”. <https://www.plantopiapodcast.org/32>.
2. Adriana Janovich. 2022. Oh, Christmas trees! Washington State Magazine, Winter 2022. <https://magazine.wsu.edu/2022/10/28/oh-christmas-trees/>
3. Seth Truscott. 2022. The search for Christmas trees that can withstand climate change. WSU INSIDER

NEWS AND INFORMATION FOR FACULTY, STAFF, AND THE WSU COMMUNITY. December 14, 2022. <https://news.wsu.edu/news/2022/12/14/the-search-for-christmas-trees-that-can-withstand-climate-change/>

1. Amber Betts. 2022. Donation for Endowed Chair at WSU Puyallup. WSDA News Release. 4/1/2022 <https://agr.wa.gov/about-wsda/news-and-media-relations/news-releases?article=33950>
2. Elaine Williams, WSU researcher working to preserve the Christmas tree industry in NW. Moscow-Pullman Daily News, Moscow, Idaho. December 21, 2022
3. Lauren Wellbank. 2022. Is It Too Early to Put Up Your Christmas Tree? MARTHASTEWART.COM. November 09, 2022. <https://www.marthastewart.com/8330957/when-should-you-put-up-christmas-tree>
4. Sal Vaglica. 2022. 12 Tips to Pick — And Care For — A Real Christmas Tree. Nov. 29, 2022. Upkept by Consumer Reports. <https://upkepthome.com/blog/twelve-tips-to-pick-and-care-for-a-real-christmas-tree.html>

**SERVICE ACTIVITIES PROVIDED**

*Department*

1. Member, Chakradhar Mattupalli T & P Mentoring Committee, 2021-date
2. Chair, Office of Research – Innovation & Economic Development Seminar Speaker Committee, 2021-2022
3. Chair, Statewide Faculty Meeting Research Discussion Committee, 2021-2022
4. Member, Research Assistant Professor Advisory Committee, 2021-2022

*WSU Puyallup Research and Extension Center*

1. Member, Land Use Committee

*Professional Society*

1. Co-chair organizing committee for the ISHS 14th International Symposium on Flower Bulbs and Herbaceous Perennials
2. Member of the organizing committee for the 15th IUFRO Christmas Tree Research and Extension Conference (2022)
3. Ad Hoc manuscript reviews: Plant Disease, Arboriculture and Urban Forestry
4. Member Association of Specialty Cut Flower Grower’s research application review panel.
5. Member WSDA Specialty Crop Block Grant review panel

*Outside Reviewer*

1. The Volcani Center - Dr. Iris Yedidia’s professional performance

**TEACHING**

1. Plant Pathology 515 – Fall Seminar
2. Plant Pathology 525 – Guest lecture
3. Plant Pathology 499 – Grant Ivey (3 credits)

**GRADUATE ADVISING**

1. *Committee Member:* Marilen Nampijja (PhD)
2. *Committee Member:* May Wang (MS Hort.)

**CAHNRS UNDERGRADUATE INTERNS MENTORED**

1. Grant Irey, Washington State University, Pullman, WA
2. Daviti Vardishvili, Washington State University, Pullman, WA

**UNDERGADUATE STUDENT MENTORING**

1. Taylor McNees University of Washington, Tacoma, WA
2. Anthony Johnson, Green River College, Auburn, WA
3. Leah Seagren-Hoesley, Green River College, Auburn, WA

**YOUTH ENGAGEMENT**

1. Puyallup High School STEM Program – As part of their science program, PHS students measured the growth of trees in an Oregon Ash genetic trial at WSU Puyallup.

**AWARDS AND HONORS RECEIVED**

1. Gary Chastagner received the Pacific Northwest Christmas Tree Association’s Herb and Helen Plumb Award

**NCERA 224 annual meeting report 2022**

**State: North Carolina**

Name of representative: Steve Frank Professor of Entomology,

Address: Department of Entomology & Plant Pathology

North Carolina State University

2303 Gardner Hall

PHONE: 919-515-8880

E-MAIL: sdfrank@ncsu.edu

ACCOMPLISHMENTS: We conducted research and extension related to IPM and biological control in greenhouses, nurseries, and urban landscapes. 1) Research is ongoing to understand conservation biological control in urban landscapes and specifically the role of urban trees in supporting natural enemy populations. 2) We conducted research on augmentation biological control and microbial control of mealybugs, scales, and other pests in greenhouses and how to integrate biological control with insecticides. 3) Research was conducted to understand the biology and management of European pepper moth. We now have knowledge of the life cycle, feeding preferences, effective insecticides, and we are beginning work with nematodes and other biological control measures. Our extension activities have been increasing since COVID. We gave several presentations and produced other extension resources this year.

UTILITY OF FINDINGS: Our results in greenhouses, nurseries, and landscapes are valuable to improve pest management and to encourage adoption of biological control due to increased efficacy and integration with other methods. Creating more resilient landscapes with conservation biological control reduces insecticide use and associated risks in these places where people live, work and play. It also enhances the conservation value of urban areas.

WORK PLANNED FOR NEXT YEAR (2023)

We will continue work in all three systems. Biological control research will continue to provide solutions for growers and managers of urban spaces.

PUBLICATIONS:

Frank, S.D., Backe, K. (2022) Effects of urban heat islands on temperate forest trees and arthropods. Current Forestry Reports. doi.org/10.1007/s40725-022-00178-7.

Wilson, C.J., Frank, S.D. (2022) Scale insects support natural enemies in both landscape trees and shrubs below them. Environmental Entomology. https://doi.org/10.1093/ee/nvac081.

Dale, A. G., & Frank, S.D. (2022). Water availability determines tree growth and physiological response to biotic and abiotic stress in a temperate North American urban forest. Forests, 13(7), 1012.

IMPACT STATEMENT:

The impact of our research is to reduce insecticide use in the production and management of ornamental plants. This will impact human health and improve environmental quality. Our management methods should also have a positive impact on grower profits as we increase the efficacy and simplicity of IPM.

**NCERA 224 annual meeting report 2022**

**State: Indiana**

Name of representative: Janna Beckerman, Professor Plant Pathology and Cliff Sadof, Professor Entomology

Address: Department of Botany and Plant Pathology and

Department of Entomology, Purdue University

Email: jbeckerm@purdue.edu

**Growing Conditions and Pest Incidence**

In recent years, nurseries in multiple states have reported moderate to severe dieback, chlorosis and stunting of redbud, including vascular streaking. This issue is impacting seedlings, grafted plants, older nursery stock produced in container or field production settings and landscape plants. In September, several varieties of redbud being sold from a large nursery at their Noblesville location tested positive for the tentatively identified *Rhizoctonia theobromae*. An additional finding at an unrelated location was documented, as well. All redbuds from the TN shipping location were destroyed. Oregon redbuds have yet to develop symptoms or test positive. No additional species at that site were found to be symptomatic.

Testing is still ongoing regarding dying sassafras/laurel wilt in southern Indiana.

Endemic pathogens outbreaks were mostly (with some exceptions) mild due in part to an unusually dry spring.Cedar-quince rust (*Gymnosporangium clavipes*) continues to be severe on crabapples, hawthorns, serviceberry, and even Callery pear.Despite these dry conditions **Botryosphaeria canker** continues to be a problem on redbud, crabapple, white-cedar, dogwood, and viburnum. **Powdery mildew** was more severe as well, particularly on lilac, buckeye, ninebark, susceptible roses, and dogwood. A dry August resulted in an excellent mum crop. **Phomopsis** on Norway spruce continue to plague spruce across the state, replacing Rhizosphaera as the primary problem on (Colorado blue) spruce.

**Insect Update**

Relatively dry conditions during spring and summer facilitated spider mite outbreaks, and borer problems on landscape flowers and trees. Borer problems were also exacerbated by dry conditions.

Exotic invasive species continue to dominate the entomological landscape. Spongy moth (*Lymantria dispar*) caused significant defoliation in the northern tier counties of Indiana. Examination of larvae by Indiana DNR personell indicated a enough nuclear polyhedrosis virus and *Entomophaga maimaiga* fungus in the current population to help reduce outbreaks next year. Nevertheless we worked with the Indiana DNR to develop protocols to apply for suppression funds for this pest.

Emerald ash borer is still active in much of Indiana, albeit to a lesser extent due to the death of most ash trees. Resurgence is being seen in areas that stopped treating as well as ash forests that have regrown since

**State Diagnostic Records-Ornamentals Pathology**

the first defoliation. Spotted lanternfly was found in Huntington County in July. When combined with the July 2021 detection in Switzerland county near the Ohio River, we now have two distinct infestations in the state.

**Report to date 2022: Top 20 pathology related diagnoses of 2022.**

|  |  |
| --- | --- |
| **DIAGNOSIS/ID COMMON NAME** | **Total** |
| Herbicide injury; Exposure | 213 |
| Cultural/environmental problem | 123 |
| Environmental stress; Problem | 44 |
| Dieback; Canker; Twig blight | 34 |
| Anthracnose | 31 |
| Leaf spot | 27 |
| Phytophthora dieback; Blight | 25 |
| Drought stress damage | 25 |
| Pythium root and/or crown rot | 24 |
| Nutritional deficiency | 22 |
| Phomopsis dieback; Tip blight; Canker | 17 |
| Decline; Dieback | 16 |
| Planting too deep | 15 |
| Rhizosphaera needle cast | 12 |
| Septoria leaf spot | 12 |
| Cercospora leaf spot | 11 |
| Fusarium crown rot | 11 |
| Geranium bacterial wilt; Bacteria blight | 10 |
| White pine decline | 10 |
| Alternaria leaf spot and blight | 10 |

**State Diagnostic Records-Ornamentals Pathology Entomology**

Report to date 2022: Top arthropod related diagnoses of 2022.

|  |  |
| --- | --- |
| DIAGNOSIS/ID COMMON NAME | Total |
| Thrips damage | 24 |
| Spider mites | 46 |
| Insect damage unspecified | 18 |
| Periodical Cicada egg-laying injury | 12 |
| Boxwood leafminer | 11 |
| Wood boring insect damage | 10 |

**Joint Research Extension Activity.**

The [**Purdue Plant Doctor**](http://www.purdueplantdoctor.com/) website ([**www.purdueplantdoctor.com**](http://www.purdueplantdoctor.com)) was released in August to help users diagnose and manage the thousands of plant health problems (insect, disease, and other biotic or abiotic conditions) on over 250 species of the most common Midwest landscape plants.  Just like the apps, the Purdue Plant Doctor website has thousands of color photos, and current recommendations to help homeowners, arborist or plant health care professional diagnose and manage the most common plant problems in the Midwest and Northeast US.  New features include the ability to compare lookalike diagnoses. Photos of host plants are also included to help users confirm proper host diagnosis. This web page provides our clientelle the ability to access the thousands of accurately identified and curated, high-resolution photos to help educate yourself or your clients regarding important plant health management decisions.

**Purdue Landscape Report-Cliff Updates**

The Purdue Landscape Report comes out twice each month with reports written by our team of plant pathologists, entomologists and horticulturalists. It was designed to be optimized for finding with search engines and for sharing via social media. With 3500 subscribers we had > 155,000 page visits, 205,000 unique views with a residency time of 12.5 minutes. Our design for sharing was highly successful with > 43% of all visits the result of referrals, (37% from facebook alone).

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**Beckerman, J. and Haas, M. 2022.** [Comparison of fungicides for control of Pythium root rot on lavender, 2021.](https://www.plantmanagementnetwork.org/pub/trial/pdmr/volume16/abstracts/ot014.asp) PDMR 16:OT004.

**Beckerman, J. and Haas, M. 2022.**  [Evaluation of fungicides for the treatment of rust on hollyhock, 2021.](https://www.plantmanagementnetwork.org/pub/trial/pdmr/volume16/abstracts/ot014.asp) PDMR 16:OT004.

**Beckerman, J. and Haas, M. 2022.** [Comparison of fungicides for control of Cladosporium in peony, 2021.](https://www.plantmanagementnetwork.org/pub/trial/pdmr/volume16/abstracts/ot013.asp)16:OT013.

**Sadof, C., Gula, S., Purcell, L., and Ginzel, M. 2022.** [Factors Affecting Efficacy of Trunk-Injected Emamectin Benzoate to Manage Emerald Ash Borer.](https://scholar.google.com/citations?view_op=view_citation&hl=es&user=gCPvQOoAAAAJ&sortby=pubdate&citation_for_view=gCPvQOoAAAAJ:uJ-U7cs_P_0C) Arboriculture and Urban Forestry. 48:165-175.

**Dawadi, S., and C. S. Sadof 2022.** [Urban microclimate warming improves overwintering survival of evergreen bagworms](https://scholar.google.com/scholar?oi=bibs&cluster=5755596951754573689&btnI=1&hl=es) Journal of Urban Ecology 8:1-7. https://doi.org/10.1093/jue/juac014

**Books:**

Book: Fungicides in Practice. Richard Oliver and Janna Beckerman, CABI press. 2022.

**Book Chapters:**

Beckerman, J. 202X. Crabapple. In ‘Diseases of Woody Ornamentals and Trees in Nurseries, second edition’. Jay Pscheidt, ed. APS Press. In preparation.

Beckerman, J. 202X. Flowering Pear. In ‘Diseases of Woody Ornamentals and Trees in Nurseries, second edition’. Jay Pscheidt, ed. APS Press. In preparation.

**NCERA 224 annual meeting report 2022**

**State: Minnesota**

Name of representative: Vera Krischik, Associate Professor of Entomology,

Address: Department of Entomology,

1980 Folwell Ave #219, St. Paul, MN 55108

PHONE: 612.625.7044

E-MAIL: krisc001@umn.edu

**Research:** My research promotes sustainable management by releasing biocontrol agents of pests to reduce reliance on pesticides that have potential non-target impacts on beneficial insects and pollinators. The current LCCMR grant supports research on biocontrol of invasive Japanese beetles (JB) with an obligate native soil inhabiting pathogen that manages JB in the East, but spreads slowly and needs to be released in MN. Also, we are performing research on the benefits of using biocontrol agents and newly EPA registered biorational insecticides for JB grubs and adults to conserve bees, butterflies, predators, and parasitoids.

**Outreach:** I have collaborations with 4 different MN commodity groups (MNLA, MN Nursery and landscape Association; MN GCSA, MN Gold Course Superintendents Association; MNCTA, MN Christmas Tree Growers Association; MNISA, MN International Society Arboriculture), as well as extension educators, master gardeners, and community groups. I provide talks, write articles in commodity journals, write bulletins for my website, host online and in person workshops, and create and maintain websites to disseminate IPM information to clients. My program spreads research data to practitioners to improve IPM programs by conserving pollinators and beneficial insects, lowering insect damage, increasing economic benefits, and improving pesticide safety. The Krischiklab created and maintains 2 websites on IPM, pollinator conservation, and pesticide safety, UM Krischik Greenhouse, nursery, turf, landscape IPM at [http://pesticidecert.cfans.umn.edu/](https://urldefense.com/v3/__http%3A/pesticidecert.cfans.umn.edu/__;!!NLFGqXoFfo8MMQ!oQOLNWaRhl4R4aCVwBf3ZwTx3NgNVNE0xyb9GfAcRli_TBeKUlnkGDeSICxEq3uoRMWp18wjj3gUQfZQwzmKKA$) and UM Pollinator Conservation at [http://ncipmhort.cfans.umn.edu/](https://urldefense.com/v3/__http%3A/ncipmhort.cfans.umn.edu/__;!!NLFGqXoFfo8MMQ!oQOLNWaRhl4R4aCVwBf3ZwTx3NgNVNE0xyb9GfAcRli_TBeKUlnkGDeSICxEq3uoRMWp18wjj3gUQfawWDDQHA$) Through our outreach program on Japanese beetle, and biocontrol, we worked with Minneapolis Park and Recreation Board, MPRB, to educate park visitors on IPM and biocontrol with a poster at the Lyndale rose garden and Hiawatha Gold Course and a booth, a table and tent, with extension educational materials at the Sept 10 Monarch Festival

**Expertise:** IPM (Integrated Pest Management) for the MN green industry (landscapes, turf, greenhouse, nursery, Christmas trees) beneficial insects, pesticide safety and training, and educational programs for industry, state, and consumers.

**Publications**

Deans C, V Krischik. 2023. The current state and future potential of microbial Control of scarab pests.Appl. Sci. 2023, 13(2), 766; <https://doi.org/10.3390/app13020766>

Prouty C, LJ Bartlett­­, V Krischik and Saltizer 2023. Adult monarch butterflies show high tolerance to neonicotinoid insecticides. Ecological Entomology. 13 April 2023 <https://doi.org/10.1111/een.13245>

Krischik V, M Lagus, T Balaxashvili, N Partington. 2022 submitted. Field insecticide residues, acute and chronic bioassays with bumblebee, honeybees, monarch, and painted lady butterfly, Env Tox,

Prouty Cody, Paola Barriga, Andrew K. Davis, **Vera Krischik**, and Sonia Altizer. 2021. Host plant species mediates impact of neonicotinoid exposure to monarch butterflies. Insects 2021, 12, 999. <https://doi.org/10.3390/> insects12110999

Krischik V, C Deans, M Angstman. 2022. Biocontrol of Japanese beetle. MNGCSA Hole Notes 57 (5, June):14-23, https://issuu.com/mgcsa/docs/june\_20225.

Krischik V, C Deans, M Angstman. 2022. Japanese beetle online survery. MNGCSA Stimpmeter (June 2 2022.

**Invited presentations**

Feb 15, 2022, LCCMR online meeting, Vera Krischik, UMN ENTO; Snell Road, UMN EEB: Eric Runquist, MN Zoo Endangered Species, 3 online talks

April 19, 2022, NC ESA, Minnie, MN, Session: Pesticide Exposure to non targets: Field residues and effects of insecticide on bees and butterflies

Nov 12, 2022, ESA International Symposium, Vancouver BC, Session: Recent advances in IPM and PPM: Field residues and effects of insecticide on bees and butterflies, Krischik

### Sept 28,2022 UMN COP Invasive species working group, MN Arbo, Pollinator Conservation and Japanese Beetle biocontrol, Krischik, Deans, Prouty

**Contributed presentations**

22nd Ornamental workshop on insects and diseases, NCSU, Oct 16, 2022, Greenhouse residue of pymetrozine and neonic and effects on monarchs, painted ladies, and Eastern bumblebees. Krischik and Prouty

**Mentee presentations**

Departmental seminar Dec 6, Cody Prouty

**Grants**

MITTPC, Nursery and landscape IPM strategies for mitigating the spread of invasive jumping worms, Krischik, Deans, Calkins, $406,649, Krischiklab entire budget

USDA SARE, Long- term biocontrol of Japanese beetle with native Ovavesicula soil pathogen, $250,000, Krischik, Deans, $243,000, Krischiklab entire budget

UMN RR Fund, Biocontrol of Japanese beetle with soil pathogen for grapes, hops, apples, golf courses, Krischik, Deans, $230,339, Krischiklab entire budget, Funded

USDA Pollinator Partnership, Chronic and acute toxicity of commonly used pesticides to monarch and painted lady butterflies, $10,000, Krischiklab entire budget

**LCCMR 2021 to 2024 Biocontrol of Japanese beetle with a native pathogen *Ovavesicula popilliae*, $425,000 funded** <https://ncipmhort.cfans.umn.edu/ipm-krischik-lab-research/ipm-case-study-2021-2024-lccmr-biocontrol-bee-lawns-parks-and-landscapes>

First introduced to the US from Japan in 1916, Japanese beetle was commonly found in MN by the 1990’s. Adult feeding by Japanese beetle results in damage to foliage and fruits, reducing food for bees and wildlife.

The long term research outcome is to establish an endemic pathogen to kill Japanese beetle. The pathogen *Ovavesicula popilliae* was first described in CT and was introduced by researchers into MI, KY, AR, CO, and KS.

For short-term management, research on the efficacy of new EPA approved microbial products, GrubGone (*Bacillus thuringiensis galleriae*), soil applied fungus *Beauveria bassiana*, parasitic nematodes, and bee-friendly insecticide chlorantraniilprole will be studied. The outcome will be site specific IPM protocols, demonstration projects in parks, and educational programs for outreach to increase implementation.

Overwintering success of infected grubs and adult fecundity is reduced by as much as 50%. Beetle populations can decrease by 60 % in 5 years and 75% over 20 years. The pathogen has been found in MN through collaboration with Michigan State University.

Outcomes are to provide IPM management that protects pollinators in established bee lawns and restorations using biocontrol to reduce non-target effects from insecticides for native pollinators and beneficial insects. Websites, talks, and field days are important for education to tell the difference between deadly wasps and polite ground nesting bees.

Demonstration projects in parks will help with IPM adoption. For instance consumers need to know the difference in management for JB grubs that does not effect ground nesting bees or flower visiting bees. Bee identification is important so native ground nesting bees are not killed as consumers think that the bees are ground nesting wasps.

The Minneapolis Park and Rec Board, Lyndale Gardens, Hiawatha Golf Course, Washington Co Parks, Washington Co Conservation District, UM Hort Display Gardens, and Twin Cities Seed are cooperating with us on establishing a outside poster with information on IPM, managing JB with microbial insecticides, and the establishment of *Ovavesicula* for long term biocontrol.

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**Heavy *Ovavesicula* infection of malpighian tubules of Japanese beetle**



MN has less pathogen spores compared to Eastern states with lower JB populations. Spores per beetle consistently increase with years after introduction until JB population collapses. Data are estimated from samples of 96 beetles per site and a standardized scale based on an established relationship between PCR Ct values and spores per ml counted with a microscope. (Hulbert et al. 2020

**2022 qPCR results**



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Location** | **Time** | **Mean CT** | **% Infection (96 ind)** | **Mean Spore Count/Beetle (qPCR)** |
| **Applewood Hills** | 8/11/22 | 32.78 | 25.00 | 263.97 |
| **Applewood Hills** | 7/28/22 | 35.74 | 33.33 | 8685.50 |
| **Applewood Hills** | 7/13/22 | 32.19 | 16.67 | 1081.93 |
| **Logger's Trail** | 7/13/22 | 29.77 | 100.00 | 555374.69 |
| **Logger's Trail** | 7/28/22 | 29.89 | 50.00 | 71618.05 |
| **Logger's Trail** | 8/11/22 | 28.89 | 27.27 | 1135408.17 |
| **Logger's Trail** | 8/24/22 | 35.32 | 58.33 | 388116.56 |
| **Logger's Trail** | 9/8/22 | 35.32 | 75.00 | 10189.34 |
| **Oak Glen** | 7/13/22 | 25.64 | 100.00 | 4440746.38 |
| **Oak Glen** | 7/28/22 | 29.36 | 75.00 | 4640.97 |
| **Oak Glen** | 8/11/22 | 31.59 | 58.33 | 7514.69 |
| **Royal Golf Course** | 7/13/22 | - | - | - |
| **Royal Golf Course** | 7/28/22 | 35.43 | 16.67 | 11807.24 |
| **Royal Golf Course** | 8/11/22 | 37.45 | 16.67 | 94.78 |
| **Royal Golf Course** | 8/24/22 | 35.19 | 8.33 | 874.21 |
| **Stillwater GC** | 7/13/22 | - | - | - |
| **Stillwater GC** | 7/28/22 | 27.87 | 91.67 | 53583.76 |
| **Stillwater GC** | 8/11/22 | 28.46 | 91.67 | 20433.74 |
| **Stone Ridge** | 7/13/22 | - | - | - |
| **Stone Ridge** | 7/28/22 | 31.13 | 41.67 | 10216.41 |
| **Stone Ridge** | 8/11/22 | 31.70 | 41.67 | 45254.01 |
| **St. Croix Vineyard** | 7/13/22 | - | - | - |
| **St. Croix Vineyard** | 7/28/22 | 32.10 | 33.33 | 1442.42 |
| **St. Croix Vineyard** | 8/11/22 | 33.65 | 33.33 | 1813.35 |
|  |  |  |  |  |

Morphological vs qPCR Methods

For pathogen presence/absence data, we found strong agreement across methods.

|  |  |
| --- | --- |
|  | **# Observations** |
| **Pos (qPCR)- Pos (morph)** | 17 |
| **Neg (qPCR)- Neg (morph)** | 54 |
| **Pos (qPCR)- Neg (morph)** | 3 |
| **Neg (qPCR)- Pos (morph)** | 4 |
| **% agree** | 92.21 |
| **% disagree** | 3.09 |

# NCERA-224 Annual Meeting Report 2022

**State: Tennessee**

# Name of Representative: Bill Klingeman, Professor, Graduate Director, Assistant Depart Head

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Research team members are involved in several projects to evaluating disease diagnostics and insect monitoring approaches for horticultural landscape and native plant pests. Molecular markers (SSRs) and TaqMan fluorescing probes are being developed and screened for detecting DNA of plant pathogenic diseases including

Laurel Wilt Disease, *Harringtonia* (syn. *Raffaelea*) *lauricola*; Oak wilt disease, *Bretziella fagacearum*, and other plant pathogens of interest (including vascular streak disease, *Diplodia corticola* and other canker-forming pathogens on oaks). Several of these pathogens have been found infecting host plant tissues and insects associated with host plants in Tennessee. Other diseases occur in adjacent states and potentially threaten TN (and SEUS) urban/forest and landscape hosts and insects may become candidate vectors in pathogen spread and persistence. Trapping optimization studies are being employed, with captured adult *Chrysobothris* beetles being used for molecular systematics in the genus and between *C. femorata* species group members, as part of a larger USDA NIFA SCRI project.

Two new faculty have joined the Entomology and Plant Pathology Department at UT as Assistant Professors with responsibilities in specialty horticulture/landscape crop IPM: Dr. Nar Ranabhat (Plant Pathologist) and Dr. Midhula Gireesh (Entomologist). Dr. Gireesh also works with arthropod pests in turfgrass systems.

# NCERA-224 Annual Meeting Report 2022

**State: Tennessee**

# Name of Representative: Karla Addesso

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1. Monitor and characterize new and emerging arthropod pests and host plant pathogens (including invasive species and climate change induced range expansion). Investigate and develop detection methods, biology, and management.

In 2023, we had our first report of major flea beetle management problems in a middle Tennessee nursery. There have been sporadic reports of flea beetles in the last few years, but no known established farm populations. This population was causing heavy damage to *Itea*, despite contact sprays being applied to control the adult population. We conducted a sweep net survey of the infested containers and blocks of host and non-host areas adjacent to the *Itea*. Sweep samples of the *Itea* collected 73 beetles on average. *Fothergilla*, a plant which was adjacent to the *Itea* and had minor evidence of feeding, had 8 beetles when directly adjacent to the *Itea* and 7 beetles in a plot located directly across a gravel driveway to the left of the *Itea*. One beetle was recovered from the boxwood block directly adjacent to the *Itea* with no visible feeding damage. A sweep was also made of the woodline located across a gravel drive on the right of the *Itea*. One beetle, on average, was collected in those sweeps. Media/root cores were taken from the containers to see if eggs or larvae were present. Core samples were taken from 10 pots in each of the previously described plot locations. The plants were being grown in felt bags, so root balls could not be removed to look for larvae, as is commonly done with plastic containers. The cores were held for a week and observed for eggs or larval hatch. No definitive sign of flea beetle larvae or eggs were present in the media samples. The grower was provided with management suggestions for controlling both larvae and adults in containers in spring and to scout incoming plant material.

It was clear that the beetles were actively dispersing from plots of preferred hosts, through other less preferred hosts, but they did not congregate in those areas. However, these areas could provide refuge for adults if left untreated. It is also unclear if they were laying eggs in the media of non-preferred hosts since the soil sampling method used here was not effective. There is a need to better define how far outside the infested plot should be treated and whether treating adjacent, less preferred hosts is necessary for adequate control. If this location or others becomes a perpetual hotspot, more work on this pest may be initiated.

1. Pesticide alternatives: Develop management strategies for key pests based on classical biological control (i.e., predators and parasitoids), host plant resistance, and cultural control.

We have initiated a survey of parasitoids attacking Japanese maple scale in nursery and landscape settings. Two collections made in early July 2023 from heavily infested euonymus and privet had 7.8 and 7.0% parasitized scales, respectively. Three species of parasitoids were reared from collections. One is the exotic parasitoid, *Marlattiela prima* Howard. The other two are a species of *Aphytis* [possibly *Aphytis hispanicus* (Mercet)] and *Encarsia*. Species level identifications are being confirmed by Dr. Jim Woolley, an Aphelinid expert at Texas A&M. More funding is being sought to expand this survey.

# NCERA-224 Annual Meeting Report 2022

**State: Colorado**

# Name of Representative: Ada Szczepaniec, Associate Professor Entomology

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1. Engaged scholarship activities:
	1. Colorado Center for Sustainable Pest Management has been working on creating accessible web pages detailing best IPM practices for key pests of urban trees and ornamental shrubs: <https://agsci.colostate.edu/agbio/ipm/tree-and-shrub-pests/>. The pages meet ADA accessibility standards and are easily viewed on mobile devices as well. Seventeen pages have been created and more are under preparation.
	2. Train the trainer Master Gardener workshop and presentation were conducted in October 2022, and over 120 MGs participated.
	3. Educational activities in support of green industry representative training provided by City of Fort Collins Forestry Division (~200 participants).
	4. We are building our infrastructure to improve monitoring for Japanese beetles and provide up to date data on the website for the Colorado Center for Sustainable Pest Management.
	5. We have updated the factsheet for spotted lanternfly in collaboration with Colorado Department of Agriculture. This will be published in 2023 and translated into Spanish.
2. Research activities:
	1. City of Boulder has implemented parasitoid wasp releases to suppress emerald ash borer in ash and the impact is still being quantified. Similar releases are planned in 2025 in Fort Collins.
3. Key pests of landscape trees and shrubs in Colorado:
	1. Emerald ash borer status: EAB is active in the Front Range of Colorado and active infestations have been identified in major Northern Colorado cities, e.g., Colorado Springs, Boulder, Fort Collins. Infestations appear localized, and some municipalities like Fort Collins have been proactive in treating ash trees and assessing the extent of spread. Releases of parasitoid wasps are planned in collaboration with the City of Fort Collins Forestry Division in 2025, given the low populations of beetles that are localized to two sites in the northern part of town.
	2. Japanese beetle: Japanese beetles remain the key pest of Colorado landscapes and are now well established in the western part of the State.
	3. *Ips spp.* status: Bark beetles remain a key pest of spruce, elm, and ash trees weakened by EAB infestations. Recent wet spring and summer have alleviated the impact some, but infested trees continue to decline.

# NCERA-224 State meeting report 2022

# State: Ohio

# Representative: Pierluigi (Enrico) Bonello, Professor

# Address: Department of Plant Pathology

# The Ohio State University

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1. Impact Nugget
	* Ohio State University mapped the environmental risk for beech leaf disease (BLD) across northeast Ohio, western Pennsylvania and western New York.
	* Ohio State University showed the deleterious effects of climate change on the physiology of tree responses to *Diplodia pinea* that make the host much more susceptible to disease.
	* Ohio State University clarified the temporal expression of the various BLD symptoms.
	* Ohio State University formalized methodological pipelines on the use of metabarcoding for the diagnosis on novel tree diseases.
2. New Facilities and Equipment. Include production areas, sensors, instruments, and control systems purchased/installed.
3. Accomplishment Summaries.
* We conducted an analysis of BLD risk across Northern Ohio, Western Pennsylvania, and Western New York, USA. Since the absence of BLD in the absence of symptoms cannot be certain, due to its fast spread and the lag in observed symptoms after infection, we employed two widely used presence-only species distribution models (SDMs). The Maxent model provided a quantification of variable contribution for different environmental factors, indicating that meteorological (isothermality and temperature seasonality) and land cover type (closed broadleaved deciduous forest) factors are likely key contributors to BLD distribution. In addition to offering the ability to predict where the disease may spread next, our work contributes to the epidemiological characterization of BLD, providing new lines of investigation to improve ecological or silvicultural management. Furthermore, this study shows strong potential for extension of environmental risk mapping over the full American beech distribution range, so that proactive management measures can be put in place. Similar approaches can be designed for other significant or emerging forest pest problems, contributing to overall management efficiency and efficacy.
* We conditioned 3-year-old Austrian pine saplings to a simulated climate change (CC) environment (combined drought and elevated temperatures), followed by pathogenic inoculation with two sister fungal species characterized by contrasting aggressiveness, *Diplodia pinea* (aggressive) and *D. scrobiculata* (less aggressive). As expected, CC conditions enhanced host susceptibility to the less aggressive pathogen, *D. scrobiculata*, to a level that was not statistically different from the more aggressive *D. sapinea*. Under controlled climate conditions, *D. pinea* induced suppression of critical pathways associated with host nitrogen and carbon metabolism, while enhancing its own carbon assimilation. This was accompanied by suppression of host defense-associated pathways. In contrast, *D. scrobiculata* infection induced host nitrogen and fatty acid metabolism as well as host defense response. The CC treatment, on the other hand, was associated with suppression of critical host carbon and nitrogen metabolic pathways, alongside defense associated pathways, in response to either pathogen. We propose a new working model integrating concurrent host and pathogen responses, connecting the weakened host phenotype under CC treatment with specific metabolic compartments. Our results contribute to a richer understanding of the mechanisms underlying the oft-observed increased susceptibility to fungal infection in trees under conditions of low water availability and open new areas of investigation to further integrate our knowledge in this critical aspect of tree physiology and ecology.
* Understanding the phenological relationship of the host tree and its pathogens is essential for identifying optimal management strategies to help prevent future spread of the disease. Since beech leaf disease (BLD) is a recently discovered disease, information about the general epidemiology and symptom phenology is largely unavailable. This study sought to answer questions related to symptom progression by conducting two observational studies on ten trees from Cleveland Metroparks during the 2019 and 2020 growing seasons. BLD symptoms are characterized by two distinct leaf symptom types: dark green interveinal banding pattern or completely dark green and thickened leaf. Since there is evidence that the exotic nematode *Litylenchus crenatae* ssp. *mccannii* is associated with symptom development after direct inoculation into the buds, we hypothesized that symptoms would be apparent on the leaves at bud break. In our study, we visually confirmed the presence of both BLD leaf symptom types at bud break in naturally infected trees. Along with visual confirmation, a generalized linear mixed model (GLMM) showed that symptoms do not change throughout the growing season as time was not a significant variable when comparing symptoms across a growing season. Using both a Fisher’s Exact Test and GLMM, we also determined that BLD leaf symptoms from a single leaf-bud pair do not progress in a specific or predictable pattern through subsequent growing seasons. These results formally validate the timing of BLD symptom expression and patterns of severity between years which will assist in furthering our understanding of the BLD pathosystem.
* Metabarcoding, which uses phylogenetically informative reference genes to taxonomically classify short DNA sequences amplified from environmental samples. Using metabarcoding, we are able to compare the microbiota of symptomatic and asymptomatic (including presumably naïve) samples and identify microbe(s) that are only present in symptomatic samples and could therefore be responsible for the undiagnosed disease. Metabarcoding involves two main steps: library preparation and bioinformatic processing. For library preparation, the appropriate reference gene for the organism of interest (i.e. bacteria, phytoplasma, fungi, or other eukaryotes, such as nematodes) is amplified from the DNA extracted from the environmental samples using PCR and prepared for sequencing. The bioinformatic processing includes four major steps: (1) quality check and cleanup on raw reads; (2) classification of the sequences into taxonomically informative groups (ASVs or OTUs); (3) taxonomy assignments based on the reference database; and (4) differential abundance and diversity analyses to identify microbes that are significantly associated with just symptomatic samples and that point towards the putative causal agent of the disease.
1. Impact Statements.

Objective 1, New and emerging pests (including invasive species and climate change-induced range expansion): Investigate detection methods, biology, and management of new and emerging pests.

* Ohio State University has continued important work to characterize beech leaf disease, a new disease of unknown etiology that, after being detected first in 2012 in NE Ohio, is now affecting forest areas across the northeastern US and Canada.

Objective 2, Pesticide technology development: Evaluate effectiveness of reduced-risk pesticides, biopesticides, new and novel chemistries, and application technologies for control of key disease and arthropod pests of landscapes, nurseries, and Christmas trees.

Objective 3, Pesticide alternatives: Develop management strategies for key pests based on classical biological control (i.e., predators and parasitoids), host plant resistance, and cultural control.

Objective 4, Technology transfer: Develop and deliver science-based educational materials focused on management of key pests through outlets such as mass media, publications and fact sheets, eXtension.org and social media.

1. Published Written Works.
2. Fearer CJ, Malacrinò A, Rosa C, **Bonello P** (2022) Phytobiome Metabarcoding: A Tool to Help Identify Prokaryotic and Eukaryotic Causal Agents of Undiagnosed Tree Diseases. In: Luchi N (ed) Plant Pathology: Method and Protocols. Springer US, New York, NY, pp 347-366. doi:10.1007/978-1-0716-2517-0\_19
3. Fearer CJ, Conrad AO, Marra RE, Georskey C, Villari C, Slot J, **Bonello P** (2022) A combined approach for early in-field detection of beech leaf disease using near-infrared spectroscopy and machine learning. Frontiers in Forests and Global Change 5. doi:10.3389/ffgc.2022.934545
4. Ghosh SK, Slot JC, Visser EA, Naidoo S, Sovic MG, Conrad AO, Kyre B, Vijayakumar V, **Bonello P** (2022) Mechanisms of Pine Disease Susceptibility Under Experimental Climate Change. Frontiers in Forests and Global Change 5. doi:10.3389/ffgc.2022.872584
5. **Bonello P**, Carnegie AJ, Ormsby M (2022) Editorial: Forest Biosecurity Systems and Processes: A Global Perspective. Frontiers in Forests and Global Change 5. doi:10.3389/ffgc.2022.867860
6. Fearer CJ, Volk D, Hausman CE, **Bonello P** (2022) Monitoring foliar symptom expression in beech leaf disease through time. Forest Pathology n/a (n/a):e12725. doi:https://doi.org/10.1111/efp.12725
7. Scientific and Outreach Oral and Poster Presentations.
8. Lee-Rodriguez J, Ranger C, Michel A, **Bonello P**, and Canas L. 2022. Sweet potato whitefly (*Bemisia argentifolii*) detection integrating plant volatiles, near infrared spectroscopy and environmental DNA in tomato plants for integrated pest management automation. Annual Meeting of the Entomological Society of America. Vancouver, BC, Nov. 13-16.
9. **Bonello P.** 2022. Sentinel trees - A fully reciprocal international sentinel planting collaboration as a case study. Society of American Foresters National Convention. Baltimore, MD, Sept. 20-24. (Invited presentation.)
10. Ghosh SK, Slot JC, Visser EA, Naidoo S, Sovic MG, … **Bonello, P.** 2022. Mechanisms of pine disease susceptibility under experimental climate change. 7th IUFRO International Workshop on the Genetics of Tree-Parasite Interactions in Forestry. Pontevedra, Spain, Sept. 12-16.
11. Ghosh SK, Ishangulyyeva G, Erbilgin N, **Bonello, P.** 2022. Is there a role of terpenoids in systemic induced resistance in Austrian pine? 7th IUFRO International Workshop on the Genetics of Tree-Parasite Interactions in Forestry. Pontevedra, Spain, Sept. 12-16.
12. **Bonello P**, Conrad AO. 2022. Infrared spectroscopy and machine learning for rapid host resistance screening. 7th IUFRO International Workshop on the Genetics of Tree-Parasite Interactions in Forestry. Pontevedra, Spain, Sept. 12-16.
13. Eisenring M, Perret-Gentil A, Britt E, Ladd T, Dedes J, Roe A, **Bonello P**, Queloz V, Gossner MM. 2022. European ash genotypes with increased resistance against the ash dieback disease may also be more resistant against the emerald ash borer. IUFRO Conference Division 7 – Forest Health Pathology and Entomology. Lisbon, Portugal, Sept. 6-9.
14. Fearer CJ, Conrad AO, Marra RE, Georskey C, Villari C, Slot J, **Bonello P**. 2022. Early *in situ* detection of beech leaf disease using near infrared spectroscopy and machine learning. IUFRO Conference Division 7 – Forest Health Pathology and Entomology. Lisbon, Portugal, Sept. 6-9.
15. Kime CG, Cleary MM, Digirolomo M, Migliorini D, Munck I, Santini A, Sun H, Sherwood P, Shetlar D, Bonello P. 2022. Lessons learned from an international reciprocal sentinel planting project. IUFRO Conference Division 7 – Forest Health Pathology and Entomology. Lisbon, Portugal, Sept. 6-9.
16. Ghosh SK, Slot JC, Visser EA, Naidoo S, Sovic MG, … **Bonello, P.** 2022. Mechanisms of pine disease susceptibility under experimental climate change. IUFRO Conference Division 7 – Forest Health Pathology and Entomology. Lisbon, Portugal, Sept. 6-9.
17. Ghosh SK, Ishangulyyeva G, Erbilgin N, **Bonello, P.** 2022. Is there a role of terpenoids in systemic induced resistance in Austrian pine? IUFRO Conference Division 7 – Forest Health Pathology and Entomology. Lisbon, Portugal, Sept. 6-9.
18. Kime CG, Cleary MM, Digirolomo M, Migliorini D, Munck I, Santini A, Sun H, Sherwood P, Shetlar D, **Bonello P.** 2022. A reciprocal sentinel planting approach for assessment of risk from invasive alien tree pests. Annual Meeting of the American Phytopathological Society. Pittsburgh, PA, Aug. 6-10.
19. Peart A, Ralston Z, Fearer C, **Bonello P**, Lopez-Nicora H. 2022. Early detection of soybean cyst nematode (SCN)-infected soybean plants using near-infrared (NIR) spectroscopy and machine learning techniques. Annual Meeting of the American Phytopathological Society. Pittsburgh, PA, Aug. 6-10.
20. Ghosh SK, Slot JC, Visser EA, Naidoo S, Sovic MG, … **Bonello, P.** 2022. Mechanisms of pine disease susceptibility under experimental climate change. Annual Meeting of the American Phytopathological Society. Pittsburgh, PA, Aug. 6-10.
21. Ghosh SK, Ishangulyyeva G, Erbilgin N, **Bonello, P.** 2022. Is there a role of terpenoids in systemic induced resistance in Austrian pine? Annual Meeting of the American Phytopathological Society. Pittsburgh, PA, Aug. 6-10.
22. Fearer CJ, Conrad AO, Marra RE, Georskey C, Villari C, Slot J, Bonello P. 2022. Early *in situ* detection of beech leaf disease using near infrared spectroscopy and machine learning. Annual Meeting of the American Phytopathological Society. Pittsburgh, PA, Aug. 6-10.
23. Ghosh SK, Ishangulyyeva G, Erbilgin N, **Bonello, P.** 2022. Is there a role of terpenoids in systemic induced resistance in Austrian pine? International IUFRO Meeting on *Foliar, Shoot, Stem and Rust Diseases of Trees*. Durham, NH, June 26-July 1.
24. Fearer CJ, Conrad AO, Marra RE, Georskey C, Villari C, Slot J, **Bonello P**. 2022. Early *in situ* detection of beech leaf disease using near infrared spectroscopy and machine learning. International IUFRO Meeting on *Foliar, Shoot, Stem and Rust Diseases of Trees*. Durham, NH, June 26-July 1.
25. Ghosh SK, Slot JC, Visser EA, Naidoo S, Sovic MG, … **Bonello, P.** 2022. Mechanisms of pine disease susceptibility under experimental climate change. International IUFRO Meeting on *Foliar, Shoot, Stem and Rust Diseases of Trees*. Durham, NH, June 26-July 1.
26. Kime CG, Cleary MM, Digirolomo M, Migliorini D, Munck I, Santini A, Sun H, Sherwood P, Shetlar D, **Bonello P.** 2022. A reciprocal sentinel planting approach for assessment of risk from invasive alien tree pests. International IUFRO Meeting on *Foliar, Shoot, Stem and Rust Diseases of Trees*. Durham, NH, June 26-July 1.
27. **Bonello P.** 2022. Mechanisms of pine disease susceptibility under experimental climate change. Western International Forest Disease Work Conference: *Climate, Climate Change and Tree Diseases*. Virtual, April 13.

**NCERA-224 state meeting report**

**State: South Carolina**

Representative: JC Chong, Professor, **Adjunct Professor of Entomology
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Accomplishment Summaries

*Objective 1: New and emerging pests: Investigate detection methods, biology, and management of new and emerging pests*

Crapemyrtle bark scale (*Acanthococcus lagerstroemiae*)has expanded its distribution in South Carolina since its first detection near Columbia, SC, in 2019. While available information indicated that this invasive felt scale species is distributed in two counties (Richland and York; https://www.eddmaps.org/distribution/uscounty.cfm?sub=80722), this team has received information on its establishment in at least seven other counties throughout the state. More importantly, this invasive species has been spread into nursery production in the state, causing significant damage to nursery growers who produce and sell crapemyrtles. The distribution and impact of this invasive species throughout SC and the southeastern US is likely to expand in the coming years.

Experiments were conducted to develop more effective and efficient monitoring methods for ambrosia beetles in nursery productions. The first experiment was designed to determine the most effective trap types (bolt vs. soda bottle trap) and ethanol concentrations (10% vs. 90%) for capturing ambrosia beetles. Results suggest that soda bottle traps captured the most beetles, but bolt traps were more effective in indicating actual attacks, and soda bottle and bolt traps baited with 90% ethanol captured more beetles. Bolts soaked in ethanol is slightly but not significantly more effective than bolts filled with ethanol. In the second experiment, the team attempted to identify the best alternatives to commonly used tree species (e.g., redbuds, dogwoods and tulip poplar) for constructing bolt traps. Results suggest that horsesugar, mimosa and smooth-barked sweetgum were better than, whereas American holly, callery pear, wax myrtle and southern magnolia are comparable to redbud and tulip poplar in capturing ambrosia beetles.

*Objective 2: Pesticide technology development: Evaluate effectiveness of reduced–risk pesticides, biopesticides, new and novel chemistries, and application technologies for control of key disease and arthropod pests of landscapes, nurseries, and Christmas trees*

Research team at Clemson University had conducted 30 trials in 2021-2022 to evaluate the efficacy of reduced-risk insecticides and miticides (e.g., afidopyropen, flupyradifurone, spiromesifen), biopesticides (e.g., *Beauveria bassiana*), and novel chemistries and biopesticides (e.g., ISM-555, SP3014, and V-10433) against sweetpotato whitefly, western flower thrips, Madeira mealybug, striped mealybug, redheaded flea beetle, omnivorous leafroller, and twospotted spider mite.

*Objective 3: Pesticide alternatives: develop management strategies for key pests based on classical biological control, host plant resistance and cultural control*

A laboratory bioassay was conducted to determine if bifenthrin incorporation in potting media, as part of the fire ant quarantine requirement, has any impact on the survival and reproduction of the predatory mite *Phytoseiulus persimilis* emerging from breeding piles placed directly on the media. The experiment arena was constructed from untreated media or media with bifenthrin residue aged 1 week, 2 weeks, 1 month, 2 months and 3 months in nursery conditions, a saucer where the media was placed, a pipette tip where the predatory mites may emerge, and a bean plant where spider mites were present as food. Results suggest that bifenthrin residue, regardless of their ages, did not have impact on the survival and reproduction of the predatory mites that had to crawl over the treated media to reach the bean plants.

*Objective 4: Technology transfer: Develop and deliver science-based educational materials focused on management of key pests through outlets such as mass media, publications and fact sheets, eXtension.org and social media*

Team at Clemson University had provided 23 extension presentations and webinars to audience throughout the country. In addition, 23 e-newsletters “PestTalks” (with about 27,800 biweekly subscriptions) and 9 extension bulletins or factsheets had been published. The team provided 342 species identification and management recommendations.

Impact Statements

Myriad of arthropod pests attack ornamental plants and turfgrass grown in nurseries and landscapes, among which scale insects, whiteflies, thrips, aphids and spider mites are the most commonly encountered and damaging. Novel insecticide and miticide active ingredients and biopesticides evaluated by this program provided a greater range of options for managing important arthropod pests and formed the basis for developing an IPM program that truly integrates reduced-risk insecticides, biopesticides and biological control. The information generated by this project is provided to the stakeholders via publications (both peer-reviewed and layman), presentations and training programs.

Papers

Gill, G. S., and J. H. Chong. 2021. Efficacy of selected insecticides as replacement for neonicotinoids in managing sweetpotato whitefly on poinsettia. HortTechnology 31: 745-752.

Joseph, S. V., J. H. Chong, B. Campbell, B. Kunkel, D. Lauderdale, S. Jones, S. Gill, Y. Chen, P. Schultz, D. Held, F. Hale, A. Dale, E. Vafaie, W. Hudson, D. Gilrein, and A. Del Pozo-Valdivia. 2021. Current pest status and management practices for *Systena frontalis* (Coleoptera: Chrysomelidae) in ornamental plants in the eastern United States: An online survey. Journal of Integrated Pest Management 12: 17. doi:10.1093/jipm/pmab012

Chong, J. H. 2022. Hard-learned lessons on managing scale insects and mealybugs, pp. 26-27. *In* 2022 GrowerTalksInsecticide, Miticide & Fungicide Guide. <https://www.growertalks.com/pdf/2022_IMF_Guide.pdf>

Jeffers, A. H., and J. H. Chong. 2021. Integrated pest management strategies for fungus gnats in ornamental plant propagation. LGP 1131. Land-Grant Press by Clemson Cooperative Extension, Clemson, SC. <https://lgpress.clemson.edu/publication/integrated-pest-management-strategies-for-fungus-gnats-in-ornamental-plant-propagation/>

Chong, J. H. 2022. A special garden mum edition. PestTalks 22 June 2022.

Chong, J. H. 2022. Soft scale scouting and new scouting tool. PestTalks 23 May 2022.

Chong, J. H. 2022. Mysterious vines and halos, SLF egg hatch, and pre-plant dip. PestTalks 9 May 2022.

Chong, J. H. 2022. Management of root aphids and root mealybugs. PestTalks 21 April 2022.

Chong, J. H. 2022. Postiva fungicide, ambrosia beetle, lichens and research grants. PestTalks 7 March 2022.

Chong, J. H. 2022. All about crapemyrtle bark scales. PestTalks 21 February 2022.

Chong, J. H. 2021. Finishing up the 2021 poinsettia crop. PestTalks 25 October 2021.