Proceedings of the 100th Annual

Cumberland-Shenandoah

Fruit Workers Conference

December 5 & 6, 2024

Hilton Garden Inn

Martinsburg, West Virginia

Submitted by: Steve Bogash, ProFarm Group / PSU (retired)

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2024 CSFWC Registrants

Name	Institution
Aaron Weber	NC State
Amolpreet Saini	Virginia Tech
Andrew Bierer	USDA AFRS
Ann Martenot	USDA AFRS
Anna Allen	USDA AFRS
Anna Wallis	Cornell
Anthony Rugh	USDA AFRS
Benjamin McManaway	Virginia Tech
Bill MacKintosh	Nutrien Ag Solutions
Brent Short	Trécé
Breyn Evans	USDA AFRS
Byron Phillips	Wilbur Ellis
Caitlin Barnes	USDA AFRS
Cameron Mehalek	Penn State
Cara Hodge	USDA AFRS
Carlos Antolinez	Cornell
Carol Allen	University of Maryland
Carrie Mansue	Rutgers
Chris Walsh	University of Maryland
Collin O'Neil	ProFarm
Dalton Miner	Wilbur Ellis
Daniel Beatty	Nutrien Ag Solutions
Danielle Curtis	USDA AFRS
Dave Rosenberger	Cornell, Retired
Dave Schmitt	Rutgers
David Biddinger	Penn State
Dianiris Luciano-Rosario	USDA Food Quality Lab
Doug Pfeiffer	Virginia Tech
Doug Raines	USDA AFRS
Emily Johnson	University of Maryland
Emma Waltman	Rutgers
Erin Hitchner	Syngenta
Faith Ketterman	USDA AFRS
Greg Clarke	Valent
Greg Hannig	FMC
Greg Krawczyk	Penn State

Gregory Comeau	Certis
Hemant Gohil	Rutgers
Hongjin Lu	University of Maryland
Jake Jones	FMC
Janine Spies	Rutgers
Jason Bielski	Virginia Tech
Jay Harper	Penn State
Jim Schupp	Penn State, Retired
Jim Steffel	LABServices
Jim Walgenbach	NC State
John Bennett	USDA AFRS
John Cullum	USDA AFRS
John O'Barr	BASF
Jonathan Ames	Virginia Tech
Joshua Mayfield	FMC
Kaitlin Quinn	Rutgers
Kari Peter	Penn State
Karly Regan	Certis
Katarzyna Madalinska	Rutgers
Kathryn Pevarnik	USDA AFRS
Kathy Hunt	University of Maryland
Keith Yoder	Virginia Tech, Retired
Kelly McIntyre	Virginia Tech
Kevin Peters	Penn State
Kevin Rice	Virginia Tech
Khalil Jahed	Virginia Tech
Kristin Pierce	Penn State
Kyle Bekelja	Virginia Tech
Laura Mellott	Penn State
Laura Nixon	USDA AFRS
Leah Fronk	Penn State
Lee Carper	USDA AFRS
Leyu Kalkidan	University of Maryland
Linda Davis	Wilbur Ellis
Lisa Tang	USDA AFRS
Long He	Penn State
Lynn Oakes	CBC America
Mark Shannon	Shannon Farm Services
Mark Sutphin	Virginia Cooperative Extension
Md Shipon Miah	University of Maryland
Mengjun Hu	University of Maryland
Mohammad Tipu	Virginia Tech

Nathanial Boeckman	Virginia Tech
Phillip Martin	LABServices
Sara Villani	NC State
Shannon Rotella	University of Maryland
Sherif Sherif	Virginia Tech
Sieger Bokschoten	Telamon Corporation
Steve Bogash	ProFarm, Retired
Sudeep Mathew	Syngenta
Tami Collum	USDA AFRS
Taylor Lucas	USDA AFRS
Tom Kon	NC State
Torri Hancock	USDA AFRS
Tracy Leskey	USDA AFRS

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Conference Agenda

100th Cumberland Shenandoah Fruit Workers Conference

December 5 & 6, 2024

Hilton Garden Inn, Martinsburg, WV

Thursday, December 5:

8:00 -9:00 AM: Registration
9:00 - 9:10 AM: Call to Order
9:10 – 10:10 AM: Call of the States
10:10 – 10:30 AM: Call of the Industry
10:30 – 10:45 AM: AM Break
10:45 – 11:00 AM: '***One Hundred Years of Digital Proceedings'*.**
Phillip L. Martin, Research Scientist
11:00 – 12:00 PM: Plenary Session:

"Perspectives on the Fruit Industry: Looking back and forward at the industry and its' many changes over the years and where it looks to be going today".
Panel Discussion with Dave Rosenberger, Cornell (retired), and Tracy C. Leskey, Research Leader / Station Director, USDA-ARS, Appalachian Fruit Research Station, Kearneysville, WV.

Audience Q & A and Discussion

12:00 PM – 1:15 PM: Lunch

1:15 PM: Student Presentations. Karly Regan, Moderator
Entomology:
1:15 – 1:30 PM: **Quantifying Increased Levels of Plum Curculio, *Conotrachelus nenuphar,* in Pennsylvania Apple Orchards.**
Kevin Peters, Heather Sahli (Shippensburg State University of PA), and David Biddinger (PSU FREC)

1:30 – 1:45 PM: **Multispecies Lepidopteran Trapping: Altered Trap Capture and Exploration of Uses in IPM.**
Kelly McIntyre, Alejandro Del Pozo, Aresh Rashed (VA Tech), Erin Hodgson, and Ashley Dean (Iowa State)

1:45 – 2:00 PM: **SLF Population Density Differences Based on Invasion Year.**
Katarzyna Madalinska and Anne L. Nielsen (Rutgers)

2:00 – 2:15 PM: **Effects of Release Habitat and Time on *Trissolcus japonicus* parasitism and Dispersal in an Augmented Release Experiment.**
Emma Waltman, Ann Rucker, and Anne Nielsen (Rutgers)

Horticulture:
2:15 – 2:30 PM: **Unlocking Premium Color and Early Harvest in 'Evercrisp' Apples via Reflective Groundcovers.**
Md Shipon Miah (Dept. of Plant Science and Landscape Architecture, UMD), James Schupp (PSU), and Macarena Farcuh (Dept. of Plant Science and Landscape Architecture, UMD).

2:30 – 2:45 PM: **Synergistic PGR Application Strategic Balancing of Red Color Enhancement and Fruit Drop Control in Apples.**
Mohammad Monirul Hasan Tipu, Khalil Jahed, and Sherif Sherif (VA Tech)

2:45 – 3:00 PM: **The Effect of plant growth regulator treatment on 'Honeycrisp' fruit drop, maturity, quality and related transcript accumulation.**
Emily Johnson and Macarena Farcuh (UMD)

3:00 – 3:15 PM: Afternoon Break

3:15 – 3:30 PM: **Rootstock Driven Frost Tolerance and Bud Mortality in Apple: Gene Identification for future germplasm development.**
Amolpreet kaur Saini, Khalil Jahed, Deisiany Ferrerira Neres, Clay Wright, and Sherif M. Sherif (VA Tech)

3:30 – 3:45 PM: **Digital Analysis as an Indirect Method of Assessing Apple Canopy.**
Annette Martenot (USDA)

3:45 – 4:00 PM: **Improving Red Color and Inactivation of *Listeria monocytogenes* on Apple Fruit Skin in Postharvest through Ultraviolet Irradiation.**
Leyu Kalkidan, Xueying Jiang, Yixin Cai (Dept of Plant Science and Landscape Architecture, UMD), Rohan Tikekar (Dept of Nutrition and Food Science UMD), Joseph Sullivan (Dept of Plant Science and Landscape Architecture, UMD), and Maracena Farcuh (Dept of Plant Science and Landscape Architecture, UMD).

Pathology:

4:00 – 4:15 PM: **Evaluation of Biorational and Biocontrol Agents for Apple Bitter Rot and Glomerella Leaf Spot.**
Nathanial Boeckman (VA Tech)

4:15 – 4:30 PM: **Understanding the Impact of Canopy Management Practices on Microclimate and Late-Season Rot Development.**
Shannon Rotella, and Mengjun Hu (UMD)

4:30 – 4:45 PM: **Phenotyping Pear Germplasm (*Pyrus spp*.) for Resistance to Post-harvest Decay caused by *Penicillium expansum* and, *Colletotruchum fioriniae*.**
Kathryn Pevarnik (ORISE Researcher @ USDA ARS AFRS), Breyn Evans (USDA ARS AFRS), John Bennett (USDA ARS AFRS), Lauri Reinhold (USDA ARS NCGR), Christopher Gottschalk (USDA ARS AFRS), and Tamara Collum (USDA ARS AFRS).

4:45 – 5:00 PM: **Biopesticide Product Trials Against Grape Downey Mildew, Winchester, VA in 2024.**
Jonathan Ames, Ian McLellan, and Mizuho Nita (VA Tech)

5:00 – 5:15 PM: **Profiles and a Novel Mechanism of Fungicide Resistance in *Botrytis* species from Strawberry Fields.**
Hongjin Lu, and Mengjun Hu (UMD)

5:15 - 5:30 PM: Group Photo(s)

5:30 – 7:00 PM: Student Awards and Mixer

7:00 PM: Adjourn

Friday, December 6:

9:00 AM: Concurrent Sessions: Entomology begins at 8:30 AM, Horticulture at 9:30 AM, and Pathology at 9:30 AM.

Horticulture: Moderator: Khalil Jahed

9:30 – 9:45 AM: **The Maryland Tree Architecture Project: Selection and Patenting New, Grower-Friendly Apple Trees.**
Chris Walsh, Julia Harshman, and Kathy Hunt, (UMD)

9:45 - 10:00 AM: **Is there a relationship between Accede® spray application and apple chemical thinner responses?**
Tom Kon and Chris Clavet (NC State)

10:00 – 10:15 AM: **Economics of Top Working versus Replanting an Apple Orchard**
Jayson Harper (PSU)

10:15 – 10:30 AM: **AM Break**

10:30 – 10:45 AM: **Robotic Technologies for Tree Fruit Crop Production**
Long He (PSU)

10:45 - 11:00 AM: **Strategies for Frost Mitigation in Apple: The Role of Cryoprotective Agents**
Khalil Jahed and Sherif Sherif (VA Tech)

11:15 AM: Horticulture Adjourn to Business Meeting

Entomology: Moderator: Greg Krawczyk

8:30 – 8:45 AM: **Integrating mating disruption and threshold sprays for managing key lepidopteran pests: Protocol and farm study.**
Laura Nixon (Rutgers and USDA-ARS), and Tracy Leskey (USDA-ARS)

8:45 – 9:00 AM: **Codling Moth Control in Pennsylvania Apple Orchards and Possible Impacts on the Biological Control of Secondary Pests.**
David Biddinger (PSU)

9:00 – 9:15 AM: **Widening the toolbox: Chemical Control for the New Invasive Tree Moth in the U.S.**
Jason Bielski (VA Tech), Alejandro Del Pozo (VA Tech), and Greg Simmons (USDA-APHIS,PPQ

9:15 – 9:30 AM: **Continuous Challenges with Codling Moth, *Cydia pomonella* Management in Pennsylvania.**
Greg Krawczyk, Laura Mellot, Tyler Seutter, and Joshua Gery (PSU FREC)

9:30 – 9:45 AM: **Current Status and Abundance of Spotted Lanternfly in Eastern New York.**
Carlos Antolinez (Cornell Hudson Valley Research Laboratory)

9:45-10:00 AM: **Chemical Control trial for Spotted Lanternfly, *Lycorma delicatula*, Adults**
Ben McManaway, Ryan Mays, Shaumik Dev, and Doug Pfeiffer (VA Tech)

10:00 – 10:15 AM: **The Use of Attract and Kill Technology to Manage *Drosophila suzukii* in berry crops.**

Janine Spies (Rutgers), Oscar Liburd (University of Fl), Gabrielle LaTora (UGA Extension), and Elena Rhodes (University of Fl).

10:15 – 10:30 AM: **AM Break**

10:30 – 10:45 AM: **Another Look at Drape Net for Protecting Apples Against BMSB damage.**
Jim Walgenbach, and Steve Schoof (NC State University)

10:45 – 11:00 AM: **Monitoring Ambrosia Beetles in New Jersey Orchards.**
Kaitlin Quinn (Rutgers)

11:00- 11:15 AM: **A Meta Analysis of Attract and Kill Efficacy in Agriculture.**
Kyle Bekelja (VA Tech), Kelsey Benthall (Ridge Quest Inc.), Kevin Cloonan (USDA-ARS), Alyssa Lucas (FL Dept of Ag and Consumer Services), Elizabeth Rowen (UC Riverside), & Emily Althoff (U of Minn), Layne Leake (U of Missouri), William R. Morrison III (USDA-ARS), Tracy Leskey (USDA-ARS), and Kevin B. Rice (VA Tech)

11:15 AM: Entomology Adjourn to Business Meeting

Pathology: Moderator: Kari Peter

9:15-9:30 AM: **Fear the FOM: Update on *Fusarium* Wilt of Blackberry in NC.**
Jamie Lanzalotto, Aaron Weber, Melissa Munoz, and Sara Villani (NCSU)

9:30- 9:45 PM: **How Do I Make an Agricultural Water Risk Assessment?**
Carol Allen (UMD)

9:45 – 10:00 AM: **Weeds as Hosts to *Colletotrichum* Species Affecting Strawberry.**
Leah Fronk (PSU Extension)

10:00 – 10:15 AM: **Harvest Bins Harbor Viable Inoculum that can be Reduced using Novel Sanitation Methods to Manage Blue Mold Decay of Apples.**
Dianiris Luciano-Rosario (Oak Ridge Inst. for Science and Education, USDA-ARS), Johanny Castro (PSU), Kari Peter (PSU FREC), Jorge Fonseca (USDA-ARS), Verneta L. Gaskins (USDA-ARS), and Wayne M. Jurick (USDA-ARS).

10:15 – 10:30 AM: **AM Break**

10:15 -10:30 AM: **Southern Blight: A New Threat to Pennsylvania Apple Growers.**
Cameron Mehalek, and Kari Peter (PSU)

10:30-10:45 AM: **Plant Defense-Related Gene Induction by *Methlyobacteria* Towards Biocontrol of Fire Blight in Apples.**

John Bennett (USDA-ARS Appalachian Fruit Research Station), Gage Shepherd (USDA-ARS Appalachian Fruit Research Station), Breyn Evans (USDA-ARS Appalachian Fruit Research Station), Kari Peter (PSU FREC), and Tamara Collum (USDA-ARS Appalachian Fruit Research Station).

10:45 -11:00 AM: **Alternative Management Strategies for Fire Blight in Apple using Biopesticides.**

Aaron Weber, Aleksander Tako, and Sara Villani (NCSU)

11:15 AM: Plant Pathology Adjourn to Business Meeting

12:15 PM: Lunch

1:30 PM: Adjourn

Business Meeting Minutes

CSFWC Inc. Business Meeting Minutes, December 6 Dec 2024

Compiled and respectfully submitted by Srdjan Acimovic, CSFWC Inc. Secretary/Treasurer

Steve Bogash, CSFWC President, called the meeting to order. He said that Brent Short is going to start going through the Secretary/Treasurer's report. Steve said there's a part, of this report that's really important right now other than just seeing our finances. It is the current venue (Hilton) expenses compared to the Holiday In. I think it was worth every penny, but that is my opinion. So Brent is going to share with you where we spent the money. Brent said, OK, so normally Srdjan would do this since it is his report. As you can see, the Treasurer's report is based on 2023 fiscal year. He has always providing this information from a year ago. So the numbers that you may or may not be able to see are not going to be terribly reflective of what occurred here at this new venue. But I will give you a brief synopsis of what happened so you can get a sense of it. So the vast majority of our income comes from registration. So the more folks that sign up, the more we bring in. You can see here that we had about 100 folks who had registered in 2023. And then of course the sponsors they provide money which typically has been just kind of our way of offsetting the the mixer cost. And so that income was shown there to be about twelve $12,500 for 2023. And then we go below there with the meeting expenses. I made some notes on my phone comparing rough numbers from this year (2024) at this new venue (Hilton) compared to what we've been doing. The meeting rooms 2,421 dollars for meeting rooms. So $2,400 is $2,000 more in comparison to Holiday Inn in Winchester. Lunch, coffee, soda. There's a lot of differences. So here if you want drinks, you pay extra for that. That's not included in any of the lunches. So, lunch, coffee, and soda was $2,500, we're at about, it's not as bad, we are about $3,000 or so per lunch in Hilton. Of course, we have two lunches which we may not need going forward, but about $3,000 for that in the new venue. Then the mixer, which is basically going to be the bartender, the mixer and then the tips, you're looking around $950 in Holiday Inn, maybe $2,850 here in Hilton. And then that there was a deposit we put down, but that gets applied to it. So the other things that I want to mention is that here we also had a a break with the pretzels and the popcorn. That was $950. And then every time they move a wall, we pay $125 in Hilton for that, per wall. And then there is a service charge of $1,600. So my ballpark estimate of all of it combined — mixer, lunch, room space, everything is about about $14,000 for this day and a half at Hilton (Martinsburg, WV). Whereas if you look over here for Holiday Inn costs, basically put a one in front of the total meeting expenses from before (Holiday Inn in Winchester VA). So it was more spacious. Most people seem to be happy with the food and things like that, but it cost

another $10,000 to do so. Then we have our other expenses. So, student awards are around $900 because it's three students times $300. And then you have some just general fees, taxes, attorneys. And then of course the fees for $2,500 for me, $2,500 for Srdjan (honorariums). And then the PayPal takes off the PayPal fee. So from $100, we get $96 because PayPal takes a cut. So from 2023 we spent $7,800 in category other, #3,800-ish on the meeting. We pulled in the $12,550 and so poorly there. But you can see the bottom. It gives you an idea of the breakdown of costs. $421 facility, food and non adult beverages, $2,500, the mixer about $900 and we were doing, better financially. Come here, to this new venue, we spent $14,000 just for the meeting and that doesn't include all of our attorney fees and the tax stuff and $2,500 honorarium for me, $2,500 honorarium for Srdjan. So you can see going forward what this would mean financially. We're not “married” to this facility or any of the ways that they've done, just breaking down, you see how we did was last year. This is the first year we have done two lunches. And, and a lot of these things were done because we knew it was the hundredth anniversary CSFWC meeting. We were making decisions about that. In regard to attendance, this was the lowest attendance since 2011. We're normally in the 100 or so range. We were down to about 90 this year (2024). You can see the highest numbers here was 2018, 2019, 2021. And even in 2020, actually COVID was actually very good for the organization because people who don't normally want to come, would still pay a registration fee and watch it online. And we had discussions about making this a hybrid meeting, but that was voted down by the board of CSFWC. Looking at the presentations, that's not all that different. We've still had a good showing from each group. There have been years, obviously, as you can see, where there have been more submitted presentations, but the number of presentations will also affect how long the meeting runs. So we switched the students to the back-to-back talks so that we can all see them with the recommendation from before — that everybody wanted to be able to see competitors across disciplines, i.e. all the student presentations. And then the second day was going to be as as we did, separated by discipline. Well, the more talks you get, the longer that day to go. So had we had several more talks, let's say we end at 2:30 pm 3 pm o'clock probably some talks would be available for the second day. So this is it – the breakdown of what Srdjan has provided. I'm opening this up to discussion and questions because we do have to have an approval on on this before we go. Tracy. How much would registration be if you had to cover an extra $10,000? It Ddpends on the number of attendees. If you say, we're going to guess, 100, so you know you had a per capita registration of $150.00 and before it was $100, so you're going to be around $15,000. Previous registration was a $100. Now, in the past we have had a few more people who registered late but this actually benefits us because they had to pay more, but we would think we had more registrants. Tracy added, so we would go from a $100 to $150 is that what you said. Brent responded yes, so if you went to 150 or 140, that would be a breakthrough or a little bit better than what we spent

just on the meeting that does not include any of the other expenses. I'm not saying that we can't reduce costs from what we spent. Tracy said “I'm just trying to find out what the number would be if we did things the exact same way”. Brent said we did things in the exact same way. There are ways to reduce the costs. Steve Bogash said “Like the lunch that's coming up. If, we had known ahead of time that we weren't going to have presentations that pushed the day longer, probably would not have bought that lunch. But it is the jubilar 100th CSFWC, and we made it so that we're not sending you guys on the road with no lunch. Hundreds. Right, so you could drop $3,000 by not having this lunch and it would put it down to about $11,000 and if you say, well we don't want a break, youcan save another $1,000. If you don't want drinks other than coffee, you can save, $700. Brent continued that everything has a cost here that we didn't experience in the previous place (Holiday Inn in Winchester VA). Greg Krawczyk said “ I think we can safely assume the second lounge will not be needed. I think we never needed it. Well, ten years maybe we run the tomorrow sessions. Bit not now. Brent said “I think that that's very reasonable subtraction. Another member saif he thinks that he is not convinced that going into the afternoon on Friday would be successful. One other member agreed. If that requires shortening talks a little bit we could. We're starting earlier in the morning one members said. Brent replied, historically, the prior times for starting discussed in these business meetings would be 8 to 9 am and then we would start presentations concurrently at 9:00. And so this is probably in the 20 something years I've been coming about the most attended business meeting I've ever been. I think last year we were like 14 people because we “sandwiched” it more in the mid of the day. We just don't get people to come. Brent said, they're like, “oh, I don't need to come here as 9:00 am is the start of the talks.” A lot of folks don't come. Sara Villani said “Do you have to rent the room for the whole day today? Do they have 1/2 day price?” Brent said “So I don't recall the answer to that question. I know that the cost was the same for both days and we have the space yesterday until 7 pm and today until 2 pm. If we cut it off at noon, I don't know if it would be a little bit cheaper. I'll talk to them.”

A member said “Hey, Brett, would you take a straw poll for me. Would you ask the the membership if they would pay$150.00 to come to this meeting.” Brent said: “well, I think that's kind of one of the things that needs to be decided today. What do we want to do? Because we've always talked about sort of this idea of like changing the cost of registration and this is a consideration. Do we spend more time looking for other venues? Maybe there's a venue that's a little bit less expensive? Or do we just raise the cost of attendance and stay here. So I guess maybe the first question is how do people feel about this Hotel? Like do you do you want to stay here? One member said she would like to ask how many people would come back here? I'm asking to this location. Raise your hand. OK, I feel pretty good about this location. Another member said let’s raise it up to 150 and come back here

and do it like we just did it. Other member said $50 is not much money. That's really cheap. Brent asked — so the people who did not want the $150 registration, would it deter you from coming? Because not everybody raised their hand. You have to cover the extra cost. Steve Bogash asked “How many people agreed that the last facility had kind of lived at its usefulness? He asked how many of you loved the food at the last facility (Holiday Inn)?” So, based on the number of raised hands (votes) he called it and said “we're, we're done with that place”. He continued “So the way to make this place work for us, I think what I'm reading here is that we've agreed we're going to have to raise the rate. So when we do the executive part in this business feeding, when we go back into these numbers, it may not be $150, it might be $140 for registration. I've worked with this group now for the year, and it is very conservative in finances, but very progressive in how we do the meeting. They do a wonderful job of coming up with money. The primary way we can gain the money has been through the sponsorship for the mixer and then also what we pay in registration. That doesn't have to be the only way that we can get money. I'm a former company rep, I'm a contractor, I was in private industry, I was extension before that. So, my opinion is, that we in this industry, and the growers, all of us who make recommendations and the folks who produce product are we have a close relationship. We're all in this together. And so one of the things that I have long observed, as I did product development for Maroon/Pro Farm, going through a lot of meetings throughout the Northeast is much of the research that all of us pay for. All of us on the industry side see well replicated work often done by some of you never really gets to see the light of day. We use a lot of this internal stuff. We help develop new labels, product manuals, etc. But a lot of it never gets to see the light of day. And so what I was thinking is that we should include industry in a slight step more than just that 20 minute call of the industry and actually have industry reps who show research that's been done. And like we did for the student competition, we set up some really hard guardrails for doing that so that it's not a sales pitch looking like “I'm going to try to sell you guys snake oil”. Not me. But field development people, tech people from the companies can present actual research that you guys wouldn't see. And the one thing that came to mind is Kerik Cox is who is not here. I did a lot of fire blight work with Kerik Cox. Now, Kari Peter did some of that work as well, but not all of it. I think that that as an example, that work, you guys would get a benefit out of seeing some of the stuff that we did because you're just not normally going to see it. Kerik has his own way of doing things and there are persons in the industry 20 or 30 of them who have a lot of research that's very well done that never gets seen. So my thought was that industry could pick up a little bit more because the industry pays basically pay for everything. And so industry could pay for a 20 minute slot to go and now you get to see some work that you would not normally see. I believe that Pro Farm would probably be very willing to do that. That's one of the things — I mean, this is like our archives, we spend millions every year on that stuff or they do. So Greg is in the room. Greg

and I have talked about this a lot. Carly, I know you probably have some thoughts on this from the industry side. Why don't you guys say something. Greg, you and I talked about this somewhat this morning". Greg said "Yeah, I mean, I'm, in favor of that. I like the idea of industry people being encouraged or allowed to bring presentations into the various disciplines where it might be appropriate to bring data, maybe from outside this region. But also there's good work done internally or with contract researchers that, like you said, doesn't generally get seen, but could be useful to forward the discussions, the ideas in in this region. So I'm in for it." Steve Bogash said "so do you believe that Valent would kick in money to help make the meeting happen in order to accomplish that?" Greg replied "Yeah, I think so. I'm a little nervous about the 'pay for 20 minutes kind of thing'" Steve Bogash said: "But that's what we do at the NECC meeting though. So if you go to Andy Vega's meeting, you know we're paying for 1/2 an hour time and paying dearly." Greg returned "That could be a mechanism, but I also like the idea that we could bring a paper to be relevant to one of the disciplines. That's sort of different than the 20 minute deal, but sure, yeah. Right." Steve offered to the room "So comments from everybody, I mean, is this this is a different thing. But I thought that going back to some of Phillip's comments yesterday, you know, the organization has a lot of flexibility. There's an informality here that I think would probably allow some of this. And again, I have to have really strong guardrails, guardrails here so that is not a sales pitch. That's the last thing we want, i.e. selling stuff. Sarah said Villani said "I like the idea. I think a lot of the talks since my first years here in 2008 or 2009 have transitioned right from doing more field trials type of talks by the PIs and faculty members to doing other types of field trial work and more applied work. Like, to some extent, getting to see what everybody else what, what kind of results everyone else is getting. So I think on that, it would be a nice summary from the industry to say, hey, we replicated these trials basically in multiple locations. And here's the summary of what we have. I think the concern is how do we make it happen? We were pretty full this year with talks? If that's some extra time how do we accommodate? Do we use the first morning where the plenary session is? Do we change that a little bit around so we can accommodate more of that? And the other positive is we only have about 6 sponsors and some sponsors that we work with regularly are notably absent. So maybe that would encourage greater revenue too to try to get the ASF here to pay or? Or others, right?" Steve Bogash said "Those were my thoughts." Sara Villani continued "You said that the part of the issue is growers aren't here, but if we could take that information and bring it to the growers, it might be good. Yeah, I do prefer this option as long as it's kind of 'apolitical as I always say to the apple growers, we can kind of get that information out." Chris said "this is off topic, but it is about money cost. We're the only ones here. What would they be getting money from – the hotel? Are they giving you a minimum number of rooms that you have to book? Are they giving us a break on the rooms because we booked rooms?" Steve Bogash

said “I saw the hotel manager for a moment and they were really excited that we booked more than 30 rooms and so they were happy with that. We get a discount for the rooms.” Chris asked “Yeah, you mean the space?” Steve Saidd, “No, the rooms. Steve said “Yeah there a discount for us upstairs or is there a discount down here? I mean.” Brent Shorts said, “there's no discount down here, it's a flat fee. If you want all three rooms which which we needed because of the different sessions?” Chris said “No, I was talking about if you had a minimum number i.e. X number of rooms sold upstairs to be able to get this for nothing. That's what I want.” Doug Pfeiffer said “You know the eastern branch of the ESA, the meeting room is free if there's a certain number of bedrooms sold”. Someone replied “Not anymore. The past few years the hotels aren't doing that anymore, but they did used to.” So Steve said “it's conference space — I was talking with the folks here, and they're booked so far out already for this facility. I mean, if we're going to stay here, one of the things we kind of need to decide today is that we want to do it again in 2025”. Brent said “they don't have any problem filling this up.” Stev e said “You know, demand – this is pure in demand.” One other member said “If we are here, there's nobody else here.” Steve said “So we all want to do it again here next year, right? Is that so? I'm sorry, by a show of hands, express who wants to do this again here next year? And same date(s)? I haven't looked at the dates in December next year, same dates — the week after Thanksgiving.” Brent said “Yeah, Thursday, Friday. Is everybody's good for that?” Steve said “So off to a flying start” Brent said “So the only other thing which I found out we must do is that we need a, a motion to approve Srdjan's (treasurer’s), report and a second just to have it officially. Sara Villani made a motion to approve Srdjan's financial report verbally by saying I motion”. Someone said, I second. All members confirmed in favor Brent said thank you. Steve said “So the other thing that I skipped over because we were messing with the projector, you all got the notes from last year. I know they went out right before we have assumed duties. I need a motion to approve in a second. We need to do that again for minutes. You all, I'm sure, read those in great detail.” Sara Villani said “I'm motioning to approve minutes even though I don't know if I read them.” Steve said “This is the Srdjan's version of comments (minutes) from last year. I need a second,” a member said “I second” and the minutes were approved.

Steve said, “All right, good. We're past all that. One of the challenges every year and this starts to involve looking at next year, is you know next year will be the 101st CSFWC. And so we need suggestions for the plenary session speakers. I have had the pleasure of doing them the last two years because we just did not have anybody last year. And so I've done this two years in a row. And so I would like to make it a little easier for Carly. And if folks have either suggestions for topics or speakers that can attend, I think it should be something about looking forward since it's the year 101. But we need any input that you can

give the Executive Committee and Carly for coming up with next year's plenary session. Chris?" Chris said "Is there a way to work the industry sort of thing that people were talking about, the trials you were talking about with Kerik, into the plenary session so that it's not really blinf time for everybody? You know, I mean, is there a way to do that? We did that a few years ago when DuPont was breaking up. They had three people talking about where these things were going and stuff like."

Steve said "Sure I think that it would be relatively easy. Last year was a Keith Pitts came from Pro Farm last year to talk about regulatory. So I think it would probably be relatively easy to get somebody further up the line in service with the big picture. Carly, do you have no idea of the speaker suggestions. And Greg, I mean who else is here from industry right now? I don't want to just keep picking up. Will Burrell? So, I think it would be relatively easy to get somebody at the visionary level from multiple companies we're looking." One member said "Going forward for whether it is happening with these biologicals or something like that". Steve Sauid "you can get sure horticulture as well. So anybody has any ideas, get them to Carly. If you get them to me, I will forward them to Carly.

Steve said "Does anybody else have any other business that they would like to discuss? Thoughts about the meeting, anything? This is the open opportunity at this." A member said "I would just say we need to come up some nominations for the president of CSFWC after Carly. Steve said "So let's get let's get on with that part now. So as as you all know now, Carly Regan is our President now or in a few minutes, we need to come up with her Vice president, her shadow for the next year and 2026. So the floor is open to nominations. I have a list of some of you I'm going to nominate if nobody else gets nominated. So this is your opportunity to nominate people. Somebody should have been here for a couple years at least. If you're a newbie, it is really not going to work very well. You have to at least experience this. I'm not doing it again." Brent Short said " I don't know that he's actually interested, but I didn't realize this, that Doug Pfeiffer has never been president. In fact, whenever, when we used to do the cycle through the states, Virginia, North Carolina, he didn't have to do it because he wasn't in Winchester." Doug said "It's more appropriate . . ." Brent said "so I'm going to nominate Doug because he's trying to back out." Steve said "Doug, are you willing to accept the nomination? What's that?" Doug said "I'll do it." Steve called up and said "Are there any other nominations because this is going to be real quick like this. We got a vote on it, but I think we're done at this point. Everybody in favor of Doug being the president-elect for 2026 as I'm also a favor raise your hand". It was well accepted by the members clapping their hands. Steve Bogash said "So I can tell you as a pre-retirement thing, it's a good gig. So we I will do what I can to help unless anybody has any other business going once, going twice?" A members said "I had a quick thing to bring up. To get feedback from the group. Tom Kon said "You know there was a change in structure. I

think with the graduate student competition occupying the first day all in one room. And I just wanted to see what other people thought about that, is that something that you're planning to carry forward in this meeting, or do you want to keep it within disciplines as we did the year before?" Steve Bogash said "Well, I'm going to share my opinion, and I heard this from a number of other people that everybody seems to like hearing all the grad students versus breaking up. We are all somewhat, and I'm parroting other folks, we are all somewhat interdisciplinary anyhow. And so that just seemed to be a fine way to do it. Plus it's better for them to get the bigger crowd. It makes them more nervous. Any other comments about the about the student session? I thought it ran really well. I was really pleased with it."

Doug Pfeiffer said "I think if time gets to be a quench in the meeting, you know, we could go back to doing it in individual silos, but I think it's a benefit to having an interdisciplinary exposure. One other members said "I agree with this. I also like the fact that we didn't all sit in our own little silos at the tables. I mean, I was stuck with Dave Rosenberger." Steve offered: "Other comments, did anybody not like it? All right, I think, I think we're probably going to try and keep doing it the same way. I think it's kind of a special competition. It was good last year. I thought it was better this year. Yeah. All right, so I move that we adjourn this meeting to lunch. Thank you very much. We're adjourned."

CSFWC, Inc. Treasurer's Report for 2023 (99th CSFWC)

Respectfully submitted on December 6, 2024, by Srdjan Acimovic, Secretary/Treasurer

Income	
Registration/memberships (87×$100.00, 11×$150; 8 refunds/comps)	10,350.00
Sponsorships (6)	2,200.00
Interest	NA
	12,550.00
Meeting Expenses (In person meeting)	
Meeting rooms (rental)	421.20
Lunch, coffee, soda	2,495.30
Mixer set-up and bartender	322.95
Mixer	109.37
Gratuities	509.00
Advance deposit (carried over from 2022)	1000.00
	3,857.82
Other Expenses	
Deposit for 2024 meeting paid ($1,000 on file 12/1/2023; returned 4/1/2024)	1,000.00
3 x $300 Student awards first implemented in 2023 CSFWC 99th (12/2-6/2023)	900.00
Village Square Dinner - plenary speakers $219.99 (11/30) & parking cost $4.00	223.99
Attorney (Owen & Truban PLC on 10/26/2023)	100.00
VA State Corporation registration 10/26/2023	25.00
1099 NEC 1096 Tax forms (purchased from Staples 2/1/2023)	34.35
Soft board easel backings for sponsor ads from Amazon	34.20
Postage costs for sending 1099 NEC Tax filing to IRS 2/1/2024	9.65
Single Ticket Roll for drinks (Amazon)	7.38
Executive director honorariums (2 checks CSFWC 2022 and 2023 on 1/29/2024; cashed 2/7/2024)	5,000.00
PayPal fees ($-3.98 per $100.00 or -$5.73 per $150, -$60.75 for donations)	470.04
	7,804.61

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CSFWC, Inc. Treasurer's Report for 2023 (99th CSFWC)

Registrations/memberships (100)	10,350.00
Sponsorships	2,200.00
Meeting expenses	(3,857.82)
Other expenses (Legal fees, SCC reg fee, PayPal, etc.)	(7,804.61)
Balance forward	**887.57**
Account balances as of Dec. 31, 2023	$46,400.57
Truist (formerly BB&T) on Dec. 29, 2023	$46,098.91
PayPal	$301.66

CSFWC, Inc. 2023 Meeting Cost Breakdown

Total meeting cost = 3,857.82

Facility	421.20	(4.21 per attendee)
Food and non-adult beverages	2,495.30	(24.95 per attendee)
Adult beverages plus all gratuities	941.32	(9.41 per attendee)
Total cost per attendee (2,857.82/100)	28.58	(42.17 in 2022)
Income per attendee (12,350/100)	125.50	(119.39 in 2022)

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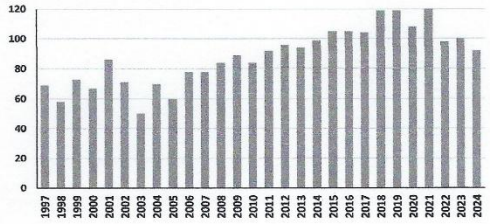
CSFWC Costs Per Meeting

Year	Total Cost	Cost/attendee
1999	1,916.78	26.25
2000	2,134.64	31.86
2001	2,453.93	28.53
2002	2,055.61	28.95
2003	1,876.73	26.80
2004	2,297.78	32.83
2005	2,356.91	39.28
2006	3,636.68	46.62
2007	5,063.82	64.92
2008	6,093.40	72.54
2009	6,052.39	67.25
2010	6,573.02	78.25
2011	6,769.27	73.57
2012	7,581.78	71.97
2013	6,765.92	71.98
2014	7,520.00	82.44
2015	7,172.99	65.16
2016	5,791.70	56.16
2017	6,157.97	59.21
2018	6,137.87	43.17
2019	6,141.11	43.20
2020	covid 0.0	0.0
2021	covid 0.0	0.0
2022	5,132.59	42.17
2023	3,857.82	28.58

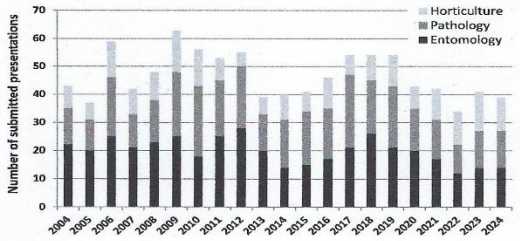
3

Attendance records (1997 – 2024)



4

Submitted Presentations (2004 – 2024)



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Call of the States

Pennsylvania State Report for CSFWC, 2024

Krawczyk, Grzegorz.[1], Kari Peter[2] and Shanthanu Kumar[3]

The Pennsylvania State University, Fruit Research and Extension Center, Biglerville, PA

[1)] Department of Entomology, [2)] Department of Plant Pathology and Environmental Microbiology
[3)] The Pennsylvania State University, Department of Plant Sciences, University Park, PA

Pomology:

Pennsylvania had a successful peach season this year. We enjoyed flavorful peaches despite their size suffering due to the prolonged drought in June and July. Prices remained stable and profitable for most growers, even with excellent production and yields across the state, indicating a steady or growing consumer base for locally produced peaches in the state.

After a bumper crop of apples in Pennsylvania last year, production this year has been lower than in previous years. An extremely wet spring, followed by a drought in June and July, and then another wet fall, presented unique challenges for production. Overall, the drought had some impact on fruit size, especially in early harvest varieties. We also experienced excellent thinning weather with two periods of carbohydrate deficits during the fruitlet growing stages to support a successful thinning program. With last year's heavy crop load and growers' diligent efforts to thin fruit due to excess, many blocks were over thinned. Multiple rain events throughout May resulted in more russeting in cultivars than usual. Overall, fruit size and quality were good in Pennsylvania, while prices remained low to moderate.

Early varieties like Premier Honeycrisp, Gala, and Honeycrisp were harvested 1 to 2 weeks earlier than standard harvest dates. However, as we progressed to later varieties such as Golden Delicious, Red Delicious, and Pink Lady, we gradually aligned with regular harvest times. Many growers noted a significant gap in harvest times between the early and mid-late apple varieties, highlighting the need to identify and cultivate varieties that bridge this harvest gap schedules.

Entomology:

The biofix dates for the most common pests were similar to those in previous years. The first moths in pheromone traps during the 2024 season for the Oriental fruit moth were

observed on April 9, the codling moth on April 30, and the tufted apple bud moth on May 3. Due to the very low OBLR pressure, we could not establish a reasonable biofix for this pest. In contrast, the codling moth managed to have three full generations, likely for the first time in history. The OFM and CM first-generation flights were greatly extended once more, and moths from the same early generations were still present in June. Many commercial orchards continued to report high levels of fruit injured by plum curculio in 2024.

The spotted lanternfly has been officially reported in nearly all southern and south-central counties of Pennsylvania, including Adams County. All surrounding states have also implemented at least partial quarantine restrictions in some of their counties. In contrast to the severe damage to grapes, no injuries to fruit trees caused by the spotted lanternfly were reported in Pennsylvania during 2024 season.

Plant pathology:

The 2024 season kicked off with green tip around 17 March. We had a fairly wet spring through the end of May; however, early June through harvest was quite dry. We did have 2-3 significant rain events in August – October when we experienced the remnants of hurricanes or tropical storms. Between those storms, it was significantly dry.

Apple and pear diseases:

Apple scab was an issue where growers used half sprays and stretched the intervals. This was due to persistent rain events occurring when the apple scab ascospores were peaking in high numbers and dispersal. There were 21/31 days in May with measurable precipitation and were considered apple scab infection events. However, in the PSU FREC plant pathology research orchards, we had a lower-than-typical incidence of apple scab, which is a trend we have been observing for the last several years. **Powdery mildew** was more problematic this season since there were plenty of dry days during the primary infection window in April. There is some concern of fungicide resistance in some orchards since myclobutanil (in particular) was not effective this season for several large growers in the state. **Marssonina/Apple blotch** was not a critical issue and this was most likely due to the cooler conditions during the primary infection period in May. This disease is contingent upon wetness hours while it's warm (greater than 68°F). There were moderate conditions for **fire blight** during bloom with an infection event with an EIP near 130 April 16 – 17; another major infection event was April 29 – May 3, which was well past bloom but rattail bloom could have been an issue. There were isolated incidences of fire blight in the state; however, it was controlled overall. **Bitter rot** snuck up on many growers since infection events most likely started several weeks earlier than anticipated due to the very high temperatures coinciding with rain events in late May and very early June. We typically see these conditions late June. After the early part of June, we experienced long stretches of very dry conditions. Significant rainfall did not return until August, when we had over 6 inches of rain during

the first week, and the average temperature was 76°F. These were ideal bitter rot infection conditions this time of the season, and later season cultivars had some issues. This was an excellent year for **rust (cedar apple ruse and quince rust)** in Adams County. The only time there was an issue was when there was inadequate spray coverage, otherwise it was controlled well. ***Soilborne diseases:*** We experienced several “flare ups” of southern blight of apple in Adams County, which occurred after significant wetting events (and ideal temperatures): May 2024: 4.15 in of rain during the month; 21/31 days had a recorded wetting event and the average temperature for the month was 64.9°F; August 6 – 9 with 6.24 in of rain during this period with an average temperature of 75.3°F; August 29 – 31 with 2.10 in of rain and average of 72.9°F; and September 21 – October 3 with 4.48 in of rain and average temperature of 64.3°F.

Stone fruit diseases: Due to the cool May and dry summer, **bacterial spot of peach** was not an issue in 2024. **Fruit rots,** particularly brown rot, was not an issue most likely due to the dry conditions during June and July. **Rusty spot** was more prevalent this season on susceptible peaches due to the dry conditions during the petal fall – shuck split time period in mid- to late April. It was an average year for **cherry leaf spot** on sour cherries.

Entomology Proceedings

The use of attract-and-kill technology to manage *Drosophila suzukii* in berry crops in Florida

Janine Spies[1], Oscar Liburd[2], Gabrielle LaTora[3], and Elena Rhodes[2]

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Drosophila suzukii, Spotted wing drosophila (SWD) is an important insect pest of berry crops. Successful pest management of this pest relies heavily on an intensive insecticide spray program. This is not a sustainable approach and there is a need to integrate alternative control tactics that are comparable to the use of broad-spectrum pesticides in efficacy and cost. Attract-and-kill can be a useful tactic in managing insect pests as part of an integrated pest management (IPM) program. An attractant, either pheromone or food-based volatile blend, is mixed with a killing agent, typically an insecticide formulated as baits, gels, or pastes and delivered in some form of applicator or dispenser. In this study, HOOK SWD™ technology (ISCA Technologies, Inc.) using SPLAT® gel matrix [Specialized Pheromone and Lure Application Technology] was evaluated in combination with insecticide applications to manage *D. suzukii* in conventional and organic blackberry and blueberry farms in north-central Florida. HOOK SWD applied at 7-and 14-day intervals demonstrated efficacy in reducing *D. suzukii* trap catch and emergence at the organic blackberry and conventional blueberry farms. *Drosophila suzukii* trap catch and emergence from infested fruit at the conventional u-pick blackberry and the organic blueberry farms were not significantly different among treatments. Variability in ground cover management and proximity and plant species composition of unmanaged areas may have contributed to the high variability in efficacy. HOOK SWD attract-and-kill shows promise as a *D. suzukii* management tactic, but further research is needed to optimize its efficacy.

Chemical control for spotted lanternfly adults in a winegrape vineyard

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Introduction

Spotted lanternfly (SLF), *Lycorma delicatula* (White), is an invasive fulgorid planthopper originating in eastern Asia, and found in southeastern Pennsylvania USA in 2014. SLF has since been spreading in eastern United States, and is now established near the Canadian border, in Erie and Monroe Counties in New York.

Efficacy data are needed to support registrations of pesticides for SLF control in Canada. A grape growing region in Ontario lies in close proximity to the US infestation. A chemical control study was carried out in Loudoun County, Virginia, in a vineyard with known SLF population activity.

In Virginia, overwintered SLF eggs hatch in late April or early May, with adults appearing in mid-July (Table 1). Early instars of nymphal development have a wide host range, including more than 70 species. Fourth instars and adults have a strong preference for tree-of-heaven (TOH), *Ailanthus altissima*).

Table 1. Phenological events in spotted lanternfly life cycle in northern Virginia since its discovery in the date in 2018.

Year	1st egg hatch	Adult eclosion	1st eggs
2018	May 9	Jul 20	Sep 17
2019	Apr 27	Jul 9	Sep 12
2020	Apr 22	Jul 13	Sep 15
2021	Apr 28	Jul 9	Sep 16
2022	Apr 21	Jul 11	Sep 18
2023	Apr 10	Jul 12	Na
2024	Apr 13	Jun 29	Sep 19

Methods

The site selected was located at Bluemont Vineyard in Loudoun County Virginia. SLF adults were common on vines in the previous season.

Insecticides representing several IRAC mode of action classes (Insecticide Resistance Action Committee) were selected for use in the SLF trial (Table 2).

Two vineyard blocks were selected for use in our trial, both near wooded areas including TOH. The upper block included Viognier, the lower block Petit Verdot. A randomized complete block experimental design was used with distance from woods within each variety as the blocking factor. Two blocks were assigned in each varietal section (4 replicated total).

Table 2. Insecticides included in the Loudoun County spotted lanternfly control trial. IRAC 1B organophosphates, IRAC 3A pyrethrins and pyrethroids, 4A neonicotinoids, 4C sulfoxaflor, 4D flupyradifurone, IRAC 23 acetyl CoA carboxylase inhibitors, IRAC 30 (new) GABA-gated chloride channel allosteric modulators.

IRAC	Common Name	Trade Name
1B	malathion	Malathion
3A	permethrin	Perm-UP
3A	cypermethrin	UP-Cyde
3A	pyrethrins	PyGanic
4A	imidacloprid	Admire Pro
4C	sulfoxaflor	Closer
4D	flupyradifurone	Sivanto Prime
4D/23	flupyradifurone and spidoxamat	Plenexos

30	broflanilide	Cimegra

Each block was a replicate containing a panel of 3 grapevines, marked with treatment-specific flagging ribbon. Treatment panels were separated by a buffer panel. Buffers were not unsprayed, but each treatment spray overlapped onto the near half of the adjacent buffer.

Each spray date was a 3-day operation. On day 1, ground sheets (Fig. 3A) were deployed under each panel to collected dead insects (sheets were left deployed after the first spray post treatment counts, but after the final first application count were rolled under the panel to avoid damage. Sheets were spread out again for the second spray). Some rows had bird netting, which was pulled down before the trial. Some dead SLF ended up on the netting – these were counted and added to the ground sheet total for that panel. Canopy counts of living adults were completed before ground sheet counts, in order to avoid disturbing insects. Pretreatment counts, as well as subsequent counts, were made with one observer on each side of the vine row; a third person recorded data (Fig. 3B). On day 2, treatments were applied. On day 3, first day mortality was assessed. Additional counts were carried out 7 days after the first application, and 7 and 14 days after the second application. The dates for the two applications are as follows:

Spray date 1

Application 31 July. Day 1 count – 1 August. Day 7 count – Aug 7.

Spray date 2

Application 21 Aug. Day 1 count – 22 August. Day 7 count – 28 August. Day 14 count - 4 September.

Spray amounts were based on 701 L/ha) (75 gallons per acre). All treatments were applied twice, except for malathion, which was applied on in the first spray date, as per the protocol, and Plenexos, applied only in the second spray date (flupyradifurone/spidoxamat) because of delayed shipment from the manufacturer. Amounts of each formulated product applied per ha were: malathion 880 ml, permethrin 175 ml, cypermethrin 245 ml, pyrethrin 4.0 L, imidacloprid 200 ml, Closer 400 ml, Sivanto 750 ml, Plenexos 1,049 g, Cimegra Low 125 ml, Cimegra High 250 ml. Treatments were compared with an untreated

control. Materials were applied using a hand-pumped backpack sprayer, until the allotted volume was applied.

Statistical analysis – Date were transformed before analysis, using $y=(x + 0.5)^{-1}$. Analysis used JMP Pro version 18. Untransformed data are presented in tables. Following ANOVA, Tukey's HSD test was used, with $\alpha=0.05$.

Results

The upper section (Viognier) consistently had higher SLF numbers than the lower section (Petit Verdot); in each section, the block closest to the woods had higher SLF numbers. This was accounted for in the Randomized Complete Block experimental design. In most cases the blocking factor was significant.

First application.

There were no differences in the replicate panels that were to be allocated to the various chemical treatments before application (Table 3).

Table 3. Pretreatment canopy counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 30 July 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, $\alpha=0.05$.

Treatment	Grouping	Mean
sulfoxaflor	A	45.0
broflanilide High	A	33.5
malathion	A	28.0
control	A	32.8
cypermethrin	A	20.0
flupyradifurone	A	27.8
pyrethrin	A	26.8
imidacloprid	A	21.5
broflanilide Low	A	18.2
permethrin	A	19.8

1-day post-treatment counts after first application

Imidacloprid, permethrin, malathion and pyrethrin caused a high degree of reduction in SLF adults (Table 4). Cypermethrin and flupyradifurone were not different from those treatments, but were also not different from broflanilide Low. Sulfoxaflor and both rates of broflanilide were not significantly different from the untreated control.

Table 4. Day 1 post-treatment canopy counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 1 August 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, α=0.05.

Treatment	Grouping	Mean
control	A	22.2
broflanilide High	A B	20.8
sulfoxaflor	A B	18.0
broflanilide Low	A B C	12.8
flupyradifurone	B C D	6.8
cypermethrin	C D	3.5
imidacloprid	D	1.8
permethrin	D	1.8
malathion	D	1.5
pyrethrin	D	1.2

There were no differences among treatments in dead adults found on ground sheets (Table 5).

Table 5. Day 1 post-treatment ground sheet counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 1 August 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, α-0.05.

Treatment	Grouping	Mean
imidacloprid	A	10.8
sulfoxaflor	A	8.2
malathion	A	3.5
flupyradifurone	A	3.0
permethrin	A	1.2
broflanilide High	A	1.0
cypermethrin	A	0.8
pyrethrin	A	0.8
broflanilide Low	A	0.5
control	A	0.2

7-day post-treatment counts after first application

Imidacloprid, permethrin, cypermethrin and pyrethrin were the only treatments that caused a greater reduction in live adults in the canopy than the next statistical grouping (Table 6). The two rates of broflanilide, malathion and flupyradifurone were not different from those materials, but were also not different from the control, and should be considered intermediate in effect. Sulfoxaflor was also not different from the control.

Table 6. Day 7 post-treatment canopy counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 7 August 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, α=0.05.

Treatment	Grouping	Mean
sulfoxaflor	A	36.2
control	A B	25.8
broflanilide Low	A B C	18.5
broflanilide High	A B C	17.5
malathion	A B C	16.5
flupyradifurone	B C	12.0
Imidacloprid	C	8.2
permethrin	C	5.2
cypermethrin	C	4.5
pyrethrin	C	4.2

There were no differences among replicate panels in the number of dead SLF adults on ground sheets (Table 7).

Table 7. Day 7 post-treatment ground sheet counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 7 August 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, α-0.05.

Treatment	Grouping	Mean
sulfoxaflor	A	7.5
flupyradifurone	A	6.2
imidacloprid	A	6.2
malathion	A	4.2
broflanilide High	A	3.5
cypermethrin	A	3.2
pyrethrin	A	1.2
broflanilide Low	A	1.2
permethrin	A	1.0
control	A	0.0

Second application

There were no differences in the replicate panels that were allocated to the various chemical treatments before application (Table 8).

Table 8. Pretreatment (before second application) canopy counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 20 August 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, α=0.05.

Treatment	Grouping	Mean
broflanilide High	A	51.8
flupyradifurone/spidoxamat	A	50.0
control	A	50.5
sulfoxaflor	A	45.0
malathion	A	44.0
broflanilide Low	A	38.8
imidacloprid	A	34.2
permethrin	A	31.2
flupyradifurone	A	30.5
pyrethrin	A	27.5
cypermethrin	A	24.0

1-day post-treatment counts after second application

Flupyradifurone, pyrethrin, imidacloprid, permethrin and cypermethrin provided the highest degree of control, though flupyradifurone and pyrethrin were not different from the next grouping (low rate of broflanilide, flupyradifurone, broflanilide, malathion and the flupyradifurone/spidoxamat blend (Table 9). The treatment noted here as malathion had not been treated since the first application, and so there is no real comparison here. The flupyradifurone/spidoxamat blend (Plexenos) was used for the first time since it was not available in time for the first application; it showed moderate efficacy.

Table 9. Day 1 post-treatment (second application) canopy counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 22 August 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, α=0.05.

Treatment	Grouping	Mean
control	A	57.2
sulfoxaflor	A	35.8

malathion	A B	32.8
broflanilide High	A B	31.8
broflanilide Low	A B	26.5
flupyradifurone/spidoxamat	A B	22.2
flupyradifurone	B C	6.8
pyrethrin	B C	6.8
imidacloprid	C	0.8
cypermethrin	C	0.0
permethrin	C	0.0

For the first time, there were treatment differences in dead adults on ground sheets, following the second application (Table 10). Pyrethrin, imidacloprid, and especially cypermethrin and flupyradifurone resulted in the highest number of dead adults on the ground sheets. Malathion (not applied since the first application), both rates of broflanilide, and sulfoxaflor, the untreated control, and also permethrin and the flupyradifurone/spidoxamat blend, produced the fewest

Table 10. Day 1 post-treatment (second application) ground sheet counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 22 August 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, α=0.05.

Treatment	Grouping	Mean
cypermethrin	A	19.2
flupyradifurone	A	18.8
imidacloprid	A B	13.5
pyrethrin	A B C	7.2
permethrin	B C	7.0
flupyradifurone/spidoxamat	B C	5.8
malathion	C	2.2
broflanilide Low	C	1.5
broflanilide High	C	1.0
sulfoxaflor	C	0.8
control	C	0.5

7-day post-treatment counts after second application

Imidacloprid and the two pyrethroids permethrin and cypermethrin, provided the greatest reduction in SLF adults in the canopy (Table 11). Sulfoxaflor, the high rate of broflanilide, and malathion were not different from the control. The other products were intermediate, not different from higher groups, but also not from lower groups.

Table 11. Day 7 post-treatment (second application) canopy counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 28 August 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, α=0.05.

Treatment	Grouping	Mean
control	A	79.8
sulfoxaflor	A B	42.8
broflanilide High	A B	38.2
malathion	A B	36.0
broflanilide Low	B	34.5
flupyradifurone/spidoxamat	B C	23.5
pyrethrin	B C	17.4
flupyradifurone	B C D	16.4
imidacloprid	C D E	2.5
permethrin	D E	1.2
cypermethrin	E	0.0

Imidacloprid, flupyradifurone, the flupyradifurone/spidoxamat blend, and sulfoxaflor produced the greatest number of dead SLF on ground sheets, 7 days following the treatment (Table 12). The pyrethroids, pyrethrin, malathion and both rates of broflanilide caused the fewest dead SLF.

Table 12. Day 7 post-treatment (second application) ground sheet counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 28 August 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, α=0.05.

Treatment	Grouping	Mean
imidacloprid	A	23.0
flupyradifurone/spidoxamat	A B	18.8
flupyradifurone	A B C	15.2
sulfoxaflor	A B C	15.0
pyrethrin	B C D	3.5
cypermethrin	C D	2.2
malathion	C D	2.0
broflanilide Low	C D	1.5
control	D	0.8
permethrin	D	0.8
broflanilide High	D	0.5

14-day post-treatment counts after second application

Two weeks following the second application, there were still treatment differences in live SLF in the canopy (Table 13). The two pyrethroids provided the greatest control. Imidacloprid, pyrethrin, flupyradifurone and the flupyradifurone/spidoxamat blend were not different from those materials, but were also not different from the next statistical grouping. Sulfoxaflor and malathion were not different from the control.

Table 13. Day 14 post-treatment (second application) canopy counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 4 September 2024. Means followed by the same letter are not significantly different. Tukey's HSD test, α=0.05.

Treatment	Grouping	Mean
control	A	53.5
sulfoxaflor	A B	25.0
malathion	A B	25.0
broflanilide High	B C	18.5
broflanilide Low	B C	17.5
flupyradifurone/spidoxamat	B C D	17.0
flupyradifurone	B C D	17.2
pyrethrin	B C D	13.2
imidacloprid	C D	6.5
permethrin	D	3.5
cypermethrin	D	2.5

By day 14 following the second application there were no longer treatment differences in numbers of dead SLF on ground sheets (Table 14).

Table 14. Day 14 post-treatment (second application) ground sheet counts of spotted lanternfly adults in Loudoun County vineyard. Data were collected on 4 September 2024. Tukey's HSD test, α=0.05.

Treatment	Grouping	Mean
imidacloprid	A	6.5
cypermethrin	A	4.8
flupyradifurone/spidoxamat	A	3.5
sulfoxaflor	A	3.5
flupyradifurone	A	3.0
permethrin	A	1.2
malathion	A	2.2
broflanilide High	A	2.0
permethrin	A	1.2

broflanilide Low	A	2.0
control	A	0.0

Discussion

There was a wide range in efficacy of the insecticides used in this trial. Imidacloprid (Admire), permethrin (Perm-Up), cypermethrin (Up-Cyde) and malathion were the most consistently effective insecticides for SLF. Adult SLF are problematic approaching and during harvest. Pre-harvest intervals (PHI) will be important in vineyard pest management planning. The PHIs of these most effective materials are: cypermethrin 7d, imidacloprid 0d, malathion 3d, and permethrin 21 d.

Pyrethrin (PyGanic) (0d) was effective in first day counts, but had lost most effectiveness by Day 7. It was surprising that at least some effect was noted at that late date. Pyrethrin is known to have short residual activity. This material gave short term control, but caution should be used for longer intervals. It will be a useful option in organic vineyards or when an application will be made shortly before harvest.

There is a wide range of PHI among the pyrethroid class. In this study, permethrin and cypermethrin were considered. Additional choices that could be considered for future testing are Mustang Maxx (zeta-cypermethrin 1d) and beta cyfluthrin (Baythroid 3d).

A note of caution – pyrethroids have a significant impact on populations of predatory and parasitic arthropods. Secondary pests may be induced to outbreak after application. While a concern across crops, a specific concern in vineyards is grape mealybug, the vector of grapevine leafroll virus. As pyrethroids are incorporated for SLF management, extension efforts will be needed to remind growers to be vigilant for mealybugs and other secondary pests.

Flupyradifurone (Sivanto Prime 0d) was variable in effect, often not different from the pyrethroids, sometimes not different from the control. The blend of flupyradifurone and spidoxamat (Plenexos 7d) was likewise variable, but could be considered moderately effective.

Sulfoxaflor (Closer) does not appear very effective against SLF. Reductions of live SLF in the canopy were low. However, in one count, numbers of dead SLF on the ground sheets were still high. More research on this material may be needed.

There were never statistically significant treatment differences in SLF adults on ground sheets following the first application. The story was different following the second

application. On Day 1 post treatment, cypermethrin, flupyradifurone, imidacloprid and pyrethrin showed the greatest number of dead SLF. Following Day 7, the highest numbers were in imidacloprid, flupyradifurone, the blend of flupyradifurone/spidoxamat, and sulfoxaflor. The presence of sulfoxaflor here was unexpected in light of the limited reduction in live SLF in the canopy. By Day 14, there were no longer significant differences.

Ground sheets are difficult to interpret. High numbers here could reflect rapid mortality, and this was sometimes seen under vines treated with pyrethroids. This approach may be most meaningful in 1-day post treatment counts; after longer periods, it is harder to know where the insect acquired its lethal dose. Adult SLF were sometimes seen flying off immediately upon being sprayed. Low numbers could reflect either low mortality or slow mortality, giving insects time to move off the treated vine before dying. Another source of variation is activity of scavengers in the night. Occasionally, wings alone were found on sheets, probably resulting from bodies being consumed.

Widening the tool box: In-field insecticide efficacy and residuality for the new invasive Box Tree Moth in the U.S.

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Abstract: The invasive box tree moth (*Cydalima perspectalis*, Lepidoptera: Crambidae, BTM) poses a growing threat to North American horticulture, endangering the $141 million U.S. boxwood industry. This study evaluated the efficacy and residual activity of six insecticides (Neonicotinoids: Dinotefuran (4a); Spinosyns + Sulfoximines: Spinetoram + Sulfoxaflor (5 +4c); Tolfenpyrad (21a); Diamides (28): Chlorantraniliprole, Cyantraniliprole; Diamides + Flonicamid (28 + 29): Cyclaniliprole + Flonicamid.) against box tree moth larvae in a nursery-like field setting. We were particularly interested in determining whether insecticides currently used for lepidopteran pests are effective against box tree moth and understanding their residual activity. Treatments were applied to 3-gallon *Buxus microphylla* 'Winter Gem' plants, and larvae were infested onto treated plants at intervals up to 49 days post-treatment. In-field survival assessments provided critical insights into effective chemical options against this invasive pest. Results highlighted the strong efficacy and extended residual activity of diamide insecticides, up to 49 days post-treatment, with treatment efficacy reaching up to 89.5% and 75.0%, respectively, when applied as foliar sprays or drenches, suggesting their potential as regulatory treatments. These findings provide vital guidance for protecting the boxwood industry from this invasive threat by informing quarantine management strategies and shaping treatment requirements under compliance agreements.

Table Below. Percent control of foliar and soil drenches 7, 21, 35, and 49 days after application on BTM larvae (instars 2–6). The statistical analysis assessed the proportion of BTM controlled (dead + sick + missing larvae) using a generalized linear mixed model with a beta distribution and a logit link function. The model included Treatment and Days After Treatment (DAT) as fixed effects, with Replication and Replicate-ID as random effects, accounting for variability across replicates. The study was repeated twice, with four replicates per treatment. Both repetitions were pooled, and the results were converted to percent. Residual diagnostics ensured model assumptions were met, and post hoc pairwise comparisons were conducted using estimated marginal means.

Active	**Rate per 100 gal**	**7 days percent control**	**21 days percent control**	**35 days percent control**	**49 days percent control**
Dinotefuran (Safari 20 SG, 20.0% active, EPA Reg. # 86203-11-59639)	0.5 lb (foliar)	49.4 ± 14.6 ab	45.8 ± 13.3 abc	31.3 ± 9.6 a	18.8 ± 10.6 a
Dinotefuran (Safari 20 SG, 20.0% active, EPA Reg. # 86203-11-59639)	0.5 lb (drench)	55.6 ± 11.6 ab	52.1 ± 14.3 abcd	79.5 ± 11.2 bc	52.1 ± 17.1 abc
Chlorantraniliprole (Acelepryn, 18.4% active, EPA Reg. # 100-1489)	16 fl oz (foliar)	94.9 ± 3.3 b	96.8 ± 3.1 d	97.7 ± 1.5 c	89.5 ± 7.0 c
Chlorantraniliprole (Acelepryn, 18.4% active, EPA Reg. # 100-1489)	16 fl oz (drench)	70.6 ± 8.19 ab	62.5 ± 10.7 bcd	64.0 ± 13.9 bc	75.0 ± 13.3 bc
Cyantraniliprole (Mainspring GNL, 18.66% active, EPA Reg. # 100-1543)	16 fl oz (foliar)	93.3 ± 3.9 b	96.8 ± 3.1 d	77.8 ± 7.7 bc	75.0 ± 12.6 bc
Cyantraniliprole (Mainspring GNL, 18.66% active, EPA Reg. # 100-1543)	12 fl oz (drench)	60.9 ± 8.8 ab	70.4 ± 9.4 bcd	60.8 ± 11.5 bc	50.9 ± 8.9 abc
Cyantraniliprole + Flonicamid (Pradia, 4.46% + 5.96% active, EPA Reg. # 71512-33-59807)	17.5 fl oz (foliar)	99.9 ± 0.0 b	86.4 ± 6.3 cd	74.4 ± 9.2 bc	39.6 ± 16.0 ab
Tolfenpyrad (Hachi-Hachi SC, 15.0% active, EPA Reg. # 71711-36-67690)	27 fl oz (foliar)	61.3 ± 13.4 ab	36.3 ± 13.3 ab	70.4 ± 7.4 bc	39.6 ± 11.3 ab
Spinetoram + Sulfoxaflor (XXpire, 20.0% + 20.0% active, EPA Reg. # 62719-676)	2.75 oz (foliar)	99.3 ± 0.6 b	62.5 ± 8.3 bcd	61.1 ± 10.2 bc	31.3 ± 12.8 a
Untreated Control (UTC)	N/A	40.0 ± 10.8 a	23.0 ± 10.8 a	31.7 ± 7.9 ab	33.8 ± 11.7 a

SLF population Density Differences Based on Invasion Year

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Abstract

Lycorma delicatula (Spotted Lanternfly, SLF) is an invasive planthopper native to China. It was first detected in Pennsylvania in 2014 and has since spread to neighboring regions, including New Jersey in 2018. SLF is a highly polyphagous insect that feeds on the phloem of more than 100 plant species, including ornamentals, agricultural crops, and hardwood trees. Their feeding acts as a plant stressor, weakening plant health and reducing tolerance to abiotic stress with compounded years of gregarious feeding. To improve pest management strategies, understanding the seasonal and cyclical interactions between SLF and their host plants is crucial. From 2020 to 2023, a trapping and visual survey study was conducted across New Jersey to document SLF abundance on four key host plants: *Ailanthus altissima* (tree of heaven), *Juglans nigra* (black walnut), *Acer spp.* (maple), and *Vitis vinifera* (grape). The study revealed life stage variations in host plant utilization and shifts in population density over invasion year. These findings provide valuable insights into SLF population dynamics and suggest that targeted surveillance, based on host plant usage throughout the season, and invasion year could enhance detection and management efforts by researchers, growers, and the public.

Introduction

Lycorma delicatula White (Hemiptera: Fulgoridae), spotted lanternfly (SLF) is an invasive planthopper native to China (Chu 1930). It was first detected in Pennsylvania in 2014 and has since spread to neighboring states including New Jersey in 2018 (Barringer et al. 2015, Dara et al. 2015). SLF is highly polyphagous, feeding on more than 100+ different plant species (Barringer and Ciafre 2020), including agricultural crops and hardwoods. SLF feed on plant phloem, acting as a plant stressor. Prolonged gregarious feeding negatively impacts plant health, reducing their ability to withstand abiotic stressors (Song 2010; Hao et al. 2016; Harner et al. 2022). SLF excrete large amounts of honeydew, which coats understory plants, promoting the growth of sooty mold and inhibiting photosynthesis (Harper et al. 2019). In areas with heavy SLF infestations, this can result in substantial plant dieback. Additionally, their honeydew attracts numerous Hymenopterans, creating a nuisance for humans.

SLF is univoltine within its current range, completing one generation per year. Their life cycle begins with overwintering egg masses hatching in spring (Lee et al. 2019). They remain active in the environment through November or until the first frost. The species progresses through four nymphal stages before reaching the adult stage. All life stages are mobile and capable of jumping, with mobility increasing with each molt. While adults can fly, they are not strong fliers, primarily relying on wind currents and human-mediated transport for long-distance

dispersal (Baker et al. 2019). SLF exhibits negative gravitaxis, moving vertically upward on nearby surfaces if dislodged (Kim et al. 2011). Their adhesive ability increases with development, aided by specialized adhesive pads called arolium located between their tarsal claws (Frantzevich et al. 2008; Kim et al. 2011). Nymphs in earlier life stages are more easily dislodged from substrates compared to later life stages. This behavior enables the use of large circle traps for monitoring affixed to tree trunks to intercept individuals as they climb (Nixon et al. 2021; Nixon et al. 2023). Currently, there is no known lure for SLF (Cooperband et al. 2018). However, their aggregative behavior and the sheer number of individuals allow for effective monitoring without such attractants. In mid to late September, there is a significant migration of adults to surrounding areas, including vineyards (Leach and Leach 2020). This dispersal lasts for approximately six weeks and coincides with grape harvest.

As SLF spread across state lines into New Jersey, we aimed to monitor their movement. While SLF's host range narrows as it develops (Kim et al. 2011), there are key hosts they utilize at all life stages. Considering New Jersey's landscape and host species abundance we focused on four key hosts in this study: *Juglans nigra* L. (Fagales: Juglandaceae) (black walnut), *Ailanthus altissima* (Mill.) Swingle (Sapindales: Simaroubaceae) (tree of heaven), *Acer spp.* L. (Sapindales: Sapindaceae) (maple) and *Vitis vinifera* L. (Vitales: Vitaceae) (grape)—an important agricultural commodity for New Jersey's growing grape industry. In this study we looked at host utilization by life stage throughout the season, and density differences between invasion years. Our study highlights the spread of SLF across the state and reveals population density shifts over time.

Materials and Methods

Vineyards

Visual surveys were conducted from 2020 to 2023 across six New Jersey vineyards (Figure 1). The number of vineyards sampled varied annually. The survey encompassed five counties with a known invasion history: Warren, Hunterdon, Gloucester, Salem, and Cumberland (Table 1). At each vineyard, a 30-second visual survey was performed on both sides of 15 vines at three locations, with a total 45 vines per vineyard. Sampling was conducted weekly from April through October.

Traps on hardwood trees

Modified circle traps were fastened to hardwood tree trunks one meter above the ground (Nixon et al. 2021; Nixon et al. 2023) in wooded habitats to monitor SLF populations from 2020 to 2023, during April through October (Figure 1). The study covered six sites in six New Jersey counties: Warren, Hunterdon, Gloucester, Salem, Cumberland, and Middlesex. The number of sites varied across years. Three host tree species were included in this trapping survey: tree of heaven, black walnut, and red maple. Not all sites had all three host species present. At each location, three traps were deployed on each available host species. A kill strip (Dichlorvos, Vaportape II, Hercon, PA) was placed inside the canister and replaced biweekly. Traps were checked weekly, and cadavers were separated by life stage and counted.

Analysis

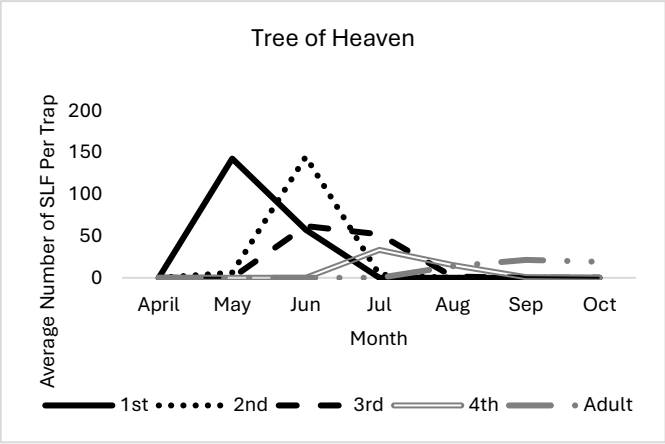
To identify differences in SLF seasonal phenology on host plants we ran a generalized linear mixed model (GLMM). We compared the average density of SLF at each life stage between host plants as our fixed factor. We used trap ID as a random variable in our model to account for individual tree capture differences as well as site location differences. Grape was not included in the analysis with the hardwoods due to differences in sampling methods. JMP Pro 2017 was used for analysis (2023).

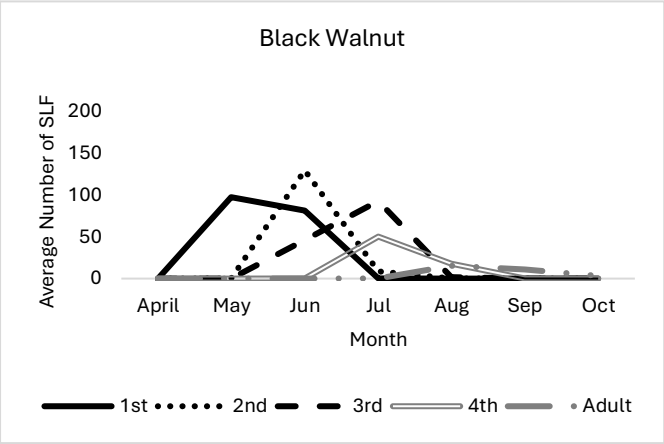
To identify if invasion history impacted SLF abundance, cumulative nymphal and adult SLF numbers in traps from April to October were analyzed with a generalized linear mixed model (GLMM) for tree of heaven, black walnut, and maple with invasion year as a fixed effect. Trap ID was used as random variable in the model. A separate GLMM was run on the visual surveys in grape with cumulative SLF density per vine as the fixed variable and survey site as a random variable. JMP Pro 2017 was used for analysis (2023).

Results

Host utilization by life stage on host

The average number of SLF captured per trap was examined by life stage and compared between host species. All four sampling years (2020-2023) were combined for this analysis. First and second instars did not show significant difference between hardwood hosts tree of heaven, black walnut, and maple (1^{st}: d.f. = 2; $F = 2.4706$; $P = 0.0849$; 2^{nd}: d.f..= 2; $F = 2.8908$; $P = 0.0558$). Peak abundance of first instars occurred in May for all hardwood hosts. Numerical differences were present for first instar peak average abundance on tree of heaven (142.723 ± 22.476), black walnut (81.404 ± 33.716), and maple (221.791 ± 53.564). Second instar peak average abundance occurred in June for all hardwood hosts. Numerical differences were present for second instar peak average abundance on tree of heaven (144.919 ± 1.446), black walnut (129.192 ± 2.262), and maple (63.486 ± 1.169). There was a significant difference between the average number of third instars captured between hardwood hosts (d.f. = 2; $F = 3.7073$; $P = 0.0248$) tree of heaven (61.910 ± 0.524 ab), black walnut (92.564 ± 0.465 a) and maple (39.059 ± 0.265 b). Third instar peak average abundance occurred in July for black walnut and maple, and June for tree of heaven. There was a significant difference between the average number of fourth instars captured between hardwood hosts (d.f. = 2; $F = 8.1773$; $P = 0.0003$) tree of heaven (33.377 ± 4.370 ab), black walnut (50.107 ± 2.814 a), and maple (15.793 ± 0.936 b). Fourth instar peak average abundance occurred in July for all hardwood hosts. There was no significant difference between the average number of adults captured between hosts (d.f. = 2; $F = 2.8592$; $P = 0.0576$). Adult peak average abundance occurred in August for black walnut, and September for maple and tree of heaven. Numerical differences were present for adult peak average abundance on tree of heaven (21.429 ± 3.831), black walnut (15.284 ± 2.806), and maple (10.163 ± 3.299). Sampling was terminated by October 30^{th} despite adult presence in November.


Tree of Heaven
Average Number of SLF Per Trap
200
150
100
50
0
April
May
Jun
Jul
Aug
Sep
Oct
Month
1st
2nd
3rd
4th
Adult


Black Walnut
Average Number of SLF
200
150
100
50
0
April
May
Jun
Jul
Aug
Sep
Oct
Month
1st
2nd
3rd
4th
Adult

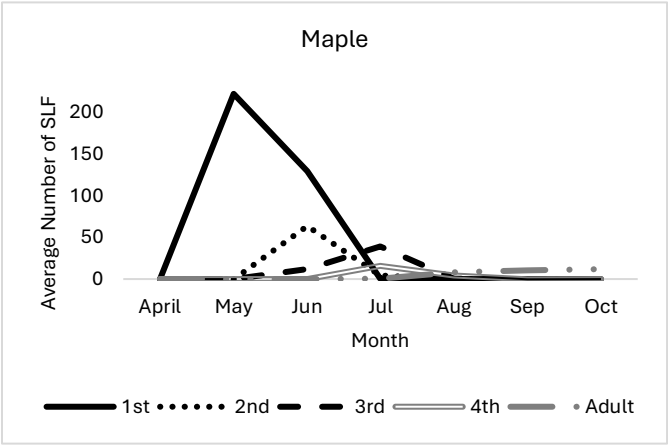

Maple
Average Number of SLF
200
150
100
50
0
April
May
Jun
Jul
Aug
Sep
Oct
Month
1st
2nd
3rd
4th
Adult

Figure 1. Average number of SLF captured per trap across months for first instar, second instar, third instar, fourth instar, and adult SLF between hosts; tree of heaven, black walnut, and maple.

Due to sampling differences, grape was modeled separately. Peak average abundance of SLF populations were documented in May for first instars (18.829 ± 0.187), June for second instars (12.105 ± 0.020), June for third instars (5.419 ± 0.101), July for fourth instars (0.491 ± 0.006), and September for adults (8.751 ± 0.114). There were approximately 90% fewer SLF observed within vineyards than SLF captured on hardwoods in the surrounding areas. SLF counts within vineyards were highest for first instars directly following hatch from egg masses laid the previous year, with a gradual decrease in counts for each subsequent life stage. SLF population increased in vineyards with adult dispersal in September (Figure 2).

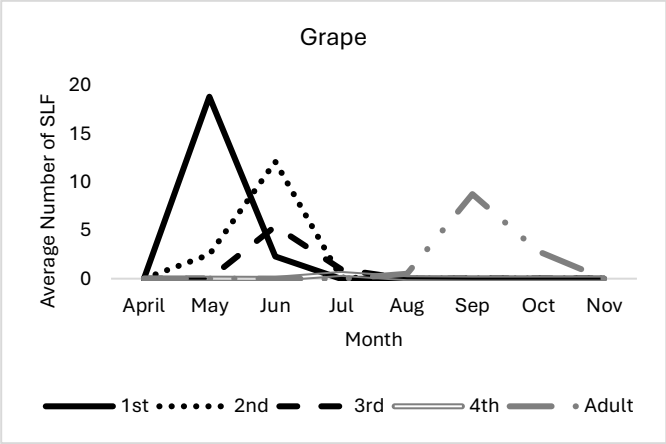
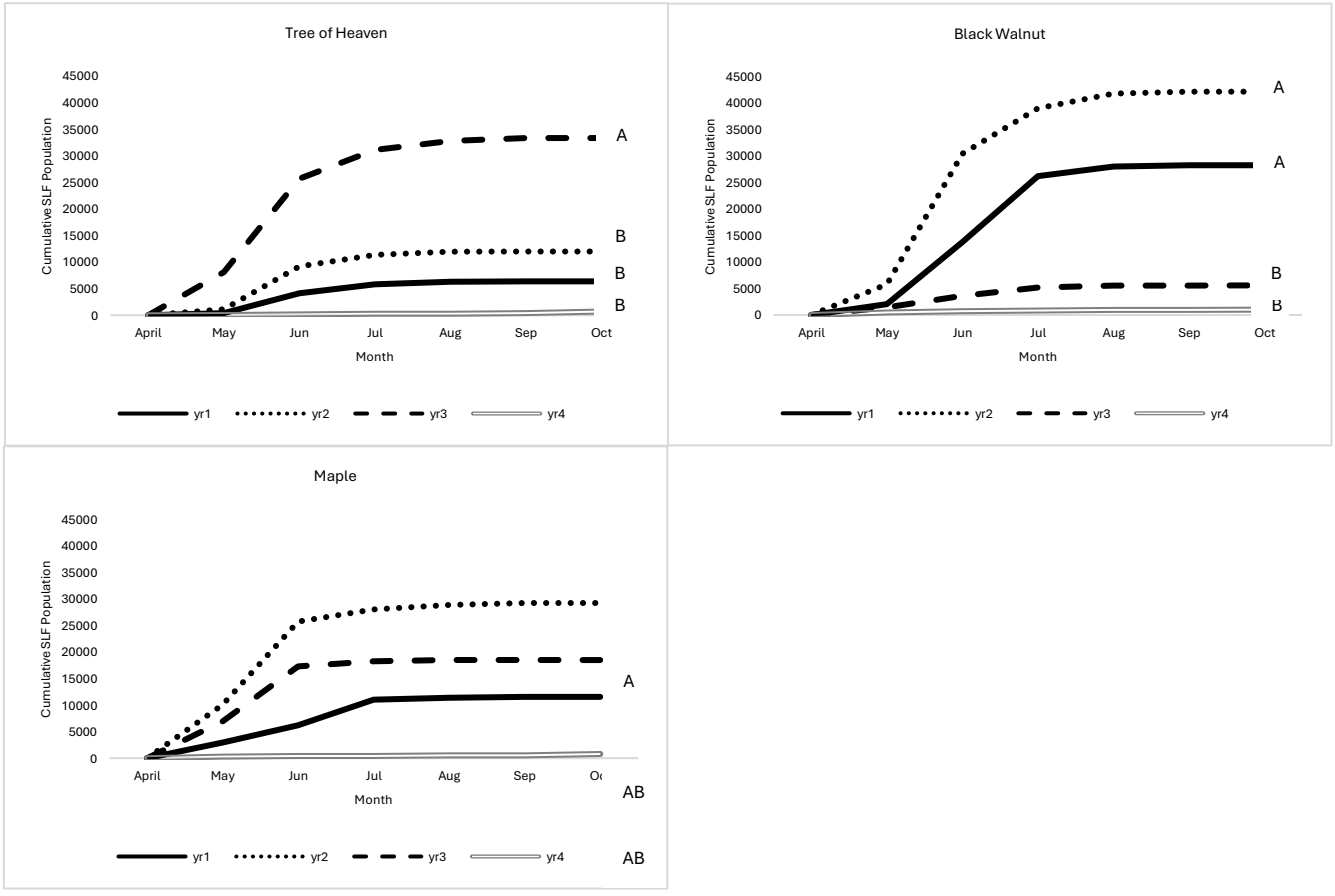


Figure 2. Average SLF population on grapes using visual surveys. Sampling period includes data from 2020-2023 across five vineyards

Abundance differences between invasion year

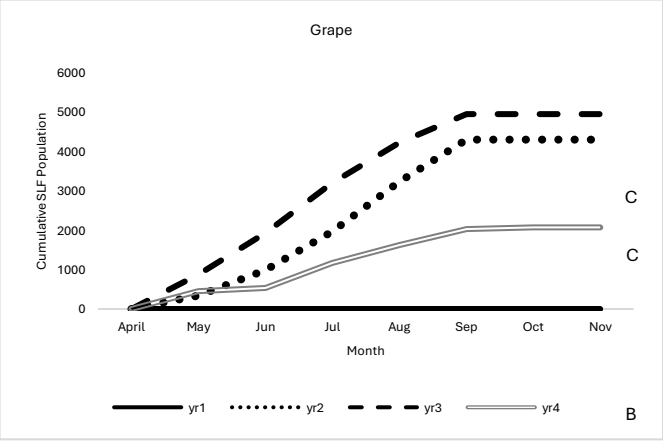
Cumulative SLF population curves for the sampling season was calculated for each invasion year to identify population density differences between years. The overall trend, based on a four-year sampling period, showed an increase in SLF populations after invasion in year one and a decrease by invasion year four across all hosts (Fig. 3). There was a significant difference between invasion years on black walnut (d.f. = 3; $F = 11.3232$; $P < 0.0001$). Cumulative SLF population in invasion year one across sample sites was 28,250, which increased to 42,133 in the second invasion year, decreased to 5,590 in the third invasion year, and decreased to 1,009 in the fourth invasion year. Sampling sites varied as SLF populations spread across the state and new sites became available. There was only a numerical difference between invasion years on maple (d.f. = 3; $F = 2.8391$; $P = 0.0374$). Cumulative SLF population in invasion year one across sample sites for maple was 11,541, which increased to 29,212 in the second invasion year, decreased to 18,467 in the third invasion year, and decreased to 793 in the fourth invasion year. There was a significant difference between invasion years on tree of heaven (d.f. = 3; $F = 20.2091$; $P < 0.0001$). Cumulative SLF population in invasion year one across sample sites was 6,377, which increased to 11,991 in the second invasion year, increased to 33,338 in the third invasion year, and decreased to 700 by the fourth invasion year.



B

Figure 3. Differences in cumulative SLF populations between invasion years by hosts. Where $P < 0.05$, Tukey's HSD was used for pairwise analysis; letters denote Tukey's HSD significance levels within year.

Due to sampling differences, grape was not included in the original model to identify differences between invasion year on tree of heaven, black walnut, and maple. Grape was analyzed independently and showed a significant difference between invasion year (d.f. = 3; $F = 98.1866$; $P < 0.0001$). For the first invasion year of sampling there was no SLF present within the vineyards. SLF populations increased in the second year of invasion (4,296), were similar in the third year of invasion (4,944) and decreased by the fourth invasion year (2,070) (Figure 4).



A

Figure 4. Differences in cumulative SLF population between invasion year in grapes. Where $P < 0.05$, Tukey's HSD was used for pairwise analysis; letters denote Tukey's HSD significance levels within year.

Discussion

Examining how seasonal and climatic changes impact the life cycle of SLF and its interactions with plant species has provided valuable insights. Studies such as these refine monitoring efforts and identify potential population shifts throughout the season and between invasion years. Host-switching behavior, a common trait in polyphagous insects, often occurs as nutrient acquisition needs and host suitability change over time (Barbosa et al. 1986; Bernays and Minkenberg 1997). Life stage development time and survivorship can be influenced by the host plant used for feeding (Bernays and Chapman 1994; Gallon and Smilanich 2023; Panizzi and Slansky 1991). Our findings agree with the current literature examining host utilization between life stages and in field conditions (Kim et al. 2015; Leach and Leach 2020; Liu 2020; Kreitman et al. 2021; Kreitman et al. 2023; Madalinska and Nielsen 2024).

SLF have been documented in New Jersey since 2018. Our trapping and visual survey efforts have tracked SLF's spread across the state, beginning with its initial populations at our sampling sites. This study evaluated two surveillance methods—trap captures and visual surveys—to identify SLF occurrence in vineyards and adjacent wooded areas. Results indicate that peak SLF populations occur early in development, with first instars being the most abundant, followed by a decline across subsequent life stages. Black walnut trees supported the most consistent population densities across all life stages throughout the season. Insect presence on grape experienced a decrease in the later juvenile stages and a notable return of adult SLF back into vineyards in September, a finding consistent with other studies (Leach and Leach 2020). Maple trees had the highest population capture rates immediately after hatching in spring despite the host having a low suitability index for long-term development in first instars (Madalinska and Nielsen 2024). This population boom may be a result of red maple's late senescence in the fall, making it a stable host for late-season adult feeding and egg mass deposition (Liu 2019).

SLF captures in traps and vineyard surveys differ in methodology but are comparable. Traps provide a cumulative weekly count, while surveys capture a momentary snapshot, influenced by site-specific management. Less than 10% of SLF populations were documented within vineyards in comparison to capture rates on hardwoods within surrounding areas. SLF movement within vineyards once there is limited. Early instars (first and second life stages) tend to remain near their hatching sites. Mobility increases with the third instar, and by the fourth instar, SLF begins to disperse out of the vineyard.

This study was conducted over four years in a state with recent invasion status. We identified differences in SLF host utilization across life stages and population densities across invasion years. These results can provide critical data for understanding the population dynamics of this invasive species. The results reveal a four-year population trend in New Jersey: SLF population increase following the first invasion year, peaking in the second or third invasion year depending on host, followed by a collapse in the fourth invasion year. Additionally, a one-year delay was observed between populations in wooded habitats and those in vineyards. This delay is consistent with a previous study that showed a two-year delay from initial detection in wooded habitats to nymphal presence in vineyards (Madalinska et al. 2022). This study highlights the importance of longitudinal research to better understand the cyclical nature of SLF population dynamics which can help with management preparation in newly invaded areas.

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Monitoring Ambrosia Beetle in New Jersey Orchards

Kaitlin Quinn

North Jersey Tree Fruit IPM Program Associate at Rutgers University

Introduction

Ambrosia beetles have been a longtime pest of ornamental crops in New Jersey. In more recent years they have begun attacking our tree fruit orchards. This has caused significant economic damage to our tree fruit growers. In the 2023 growing season, one Hunterdon County grower lost 5% of their apple trees and a Warren County grower lost 4% of their apple trees due to this pest. During the 2023 season two other growers also experienced significant tree loss but the exact percentage was not calculated. The Rutgers Diagnostic lab has confirmed attacks of both black stem borer, *Xylosandrus germanus*, and granulate ambrosia beetle, *Xylosandrus crassiusculus*, in our New Jersey orchards. Rutgers University offers North and South Tree Fruit IPM Programs to our New Jersey growers. Our North Jersey Tree Fruit IPM Program includes 29 growers from seven different counties. Each grower's farm is scouted on a weekly basis, the grower then receives a weekly scouting report and recommendation. All 29 of these growers participated in our pilot ambrosia beetle monitoring program.

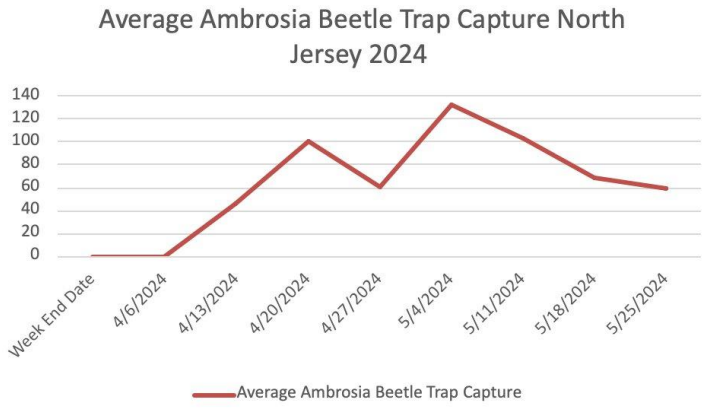
Methods

I received a grant from the New Jersey State Horticultural Society to begin this program. Janine Spies, who is our Statewide Fruit IPM Program Leader, received special purpose funding from Rutgers University to help support this project. We utilized two types of traps to monitor this pest, a clear sticky trap and wood bolt traps. The clear sticky traps were baited with a commercially available Trécé ethanol lure, and these were used to monitor the flight of this pest. The wood bolts were baited with 99.5% denatured ethyl alcohol, and they were used to monitor attacks and time management decisions as this pest moves into the orchard. For the wood bolts we mostly used black walnut and dogwood limbs. The bolts were all cut to be 1.5'-2' long and 2"-4" in diameter. A ½" hole was drilled down the center of the bolt to be filled with ethyl alcohol and corked, this hole was refilled on a weekly basis. Each trap was then placed on a 3' stake on the border of the orchard closest to a woodlot since this is where this pest typically overwinters. The clear sticky traps were placed in the field between 3/28 and 4/5, they were used to monitor the ambrosia beetle flight over a 6-week period since this was the field life of the lure. The wood dowel traps were placed after the first trap catch on the clear sticky traps. We used one clear sticky trap and 3 wood dowel traps on each farm, all traps were spaced 20 meters apart. All traps were

checked on a weekly basis and data was reported to growers on their weekly scouting report.

Results

Both trap types captured ambrosia beetles at each of the 29 farms they were placed at. The first trap capture on the clear sticky trap was noted on 4/8 and the first attacks to the wood dowel traps were noted on 4/18. Our highest trap capture during our monitoring period was 529 beetles in one week. Our peak trap capture occurred during the week ending on 5/4. Some growers who had a history of this pest in their orchard utilized the data from our traps to optimize their spray timing and expressed they felt they lost fewer trees this season. We found one grower who had no prior history of attacks in their orchard lost 43.3% of their topworked trees to this pest this season.



Discussion

Based on this year's data, ambrosia beetles are present at all 29 farms in our North Jersey Tree Fruit IPM program, but they do not attack trees until they exhibit some type of stress. This is important for growers to understand so they continue to implement cultural practices that maintain the health of their orchard since this is still the best management practice for this pest. In orchards with a history of damage caused by this pest, proper timing of chemical applications is essential because insecticides have no effect once the ambrosia beetle has bored into the trunk. Monitoring for this pest in orchards with a history of damage may help growers better time insecticide applications to reduce tree loss. Moving forward, we plan to use more dogwood bolts for our traps since these seemed more attractive than the other wood bolts. We also plan to monitor the flight for the entire growing season in 2025. We had a warm spell in mid-March before the traps had been placed, the first flight may have begun then. We plan to get the clear sticky traps placed in the field earlier this season to be sure we capture an accurate first flight. The clear sticky

traps were not a good method to collect ambrosia beetles to have their species identified. In 2025 we will also be incorporating juice bottle traps to collect ambrosia beetles and identify the species distribution in North Jersey by collaborating with the Rutgers Plant Diagnostic Lab.

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Evaluation of Biorational and Biocontrol Agents for Apple Bitter Rot and Glomerella Leaf Spot

Nathanial Boeckman

Cumberland Shenandoah Fruit Workers Conference 2024

Overview

1. Biology of Apple Bitter Rot and Glomerella Leaf Spot
2. Challenges for Management
3. Testing New Materials
4. Results
5. Take Home Messages

Biology of Apple Bitter Rot and Glomerella Leaf Spot

What are ABR and GLS?

- Caused by the fungal genus *Colletotrichum*
- Apple Bitter Rot – Losses up from 14%-100%
- Glomerella Leaf Spot – Up to 75% defoliation

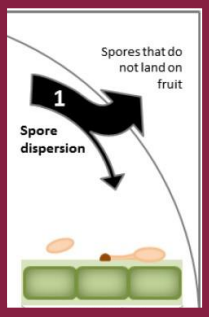
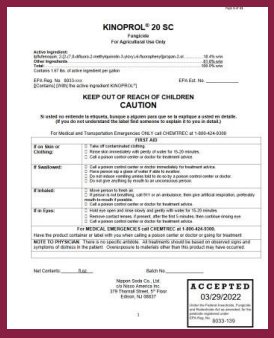


Diagram by P. Martin

Challenges for Management

Addressing Challenges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CAUTION

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03/29/2022

8933-109

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Fungicide, Bactericide, and Nematicide Liquid Concentrate

Tidal Grow® Spectra aids in the control of agricultural fungal diseases, bacterial diseases, viral diseases, and insect pests while boosting plants' natural defense mechanisms and stimulating growth and vigor.

Active Ingredient: Chitosan 5.75%

Inert Ingredients: Vinegar, Water 94.25%

Total 100.0%

CONTENTS: ☐ 4 x 1 Gallon ☐ 2 x 2.5 gallon ☐ 265 gallon tote

Contains 0.496 lbs chitosan/gallon Spectra weighs 8.62 lbs/gallon

CAUTION - KEEP OUT OF REACH OF CHILDREN

Tidal Vision Products, Inc. DBA Tidal Grow® AgriScience

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HOWLER EVO

KEEP OUT OF

SEE INSIDE FOR ADD

AgBIOME INNOVATIONS

THEIA Fungicide

Group | BM02 | Fungicide

ACTIVE INGREDIENT:

Bacillus subtilis strain AFS032311 ..... 100.0%

TOTAL 100.0%

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE INSIDE FOR ADDITIONAL PRECAUTIONARY STATEMENTS.

FIRST AID

HOTLINE NUMBER

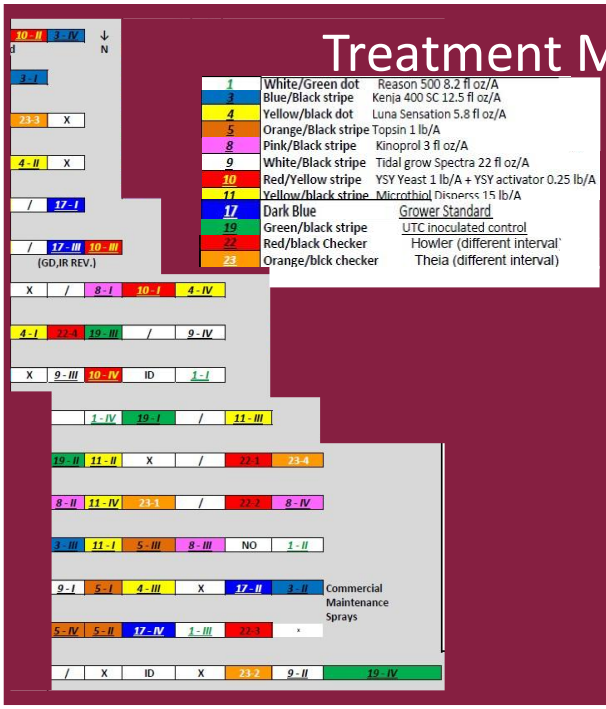
AgBIOME INNOVATIONS

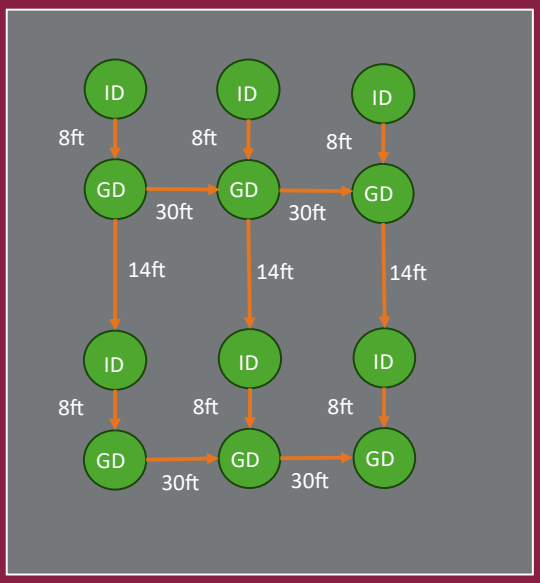
Biocontrols

Testing New Materials

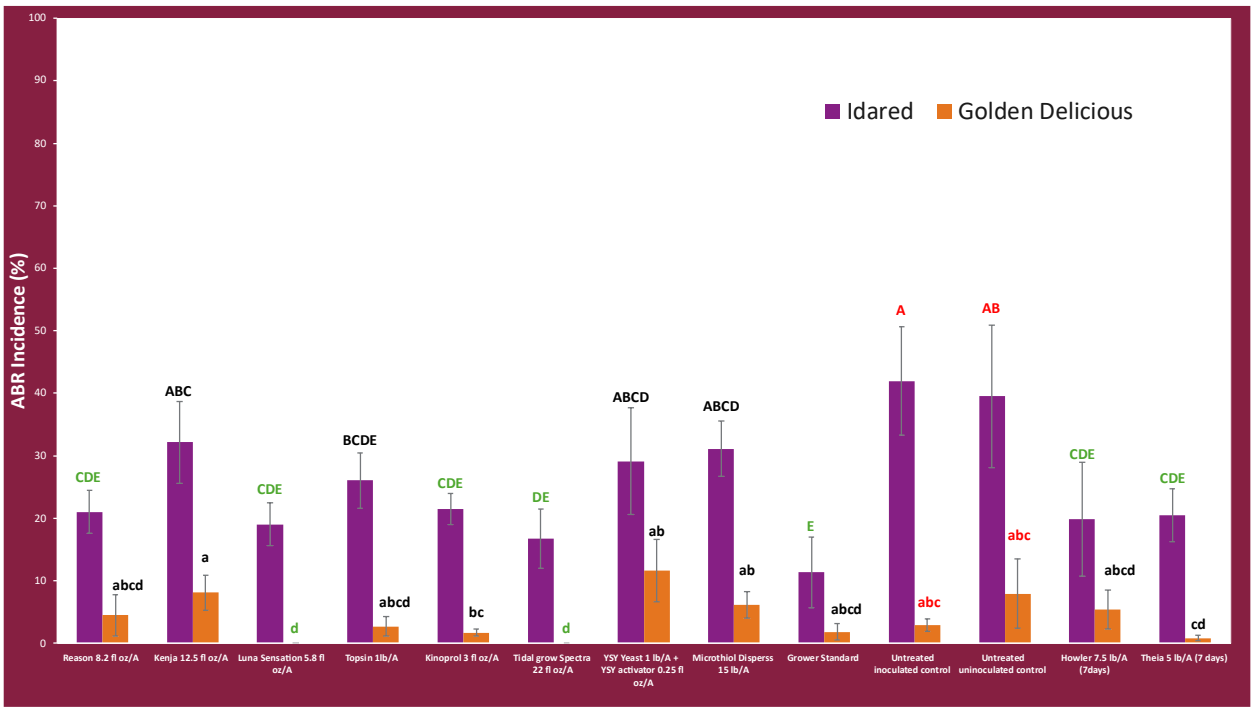
Spray materials	Rate	Active Ingredient/FRAC Code	Spray Interval

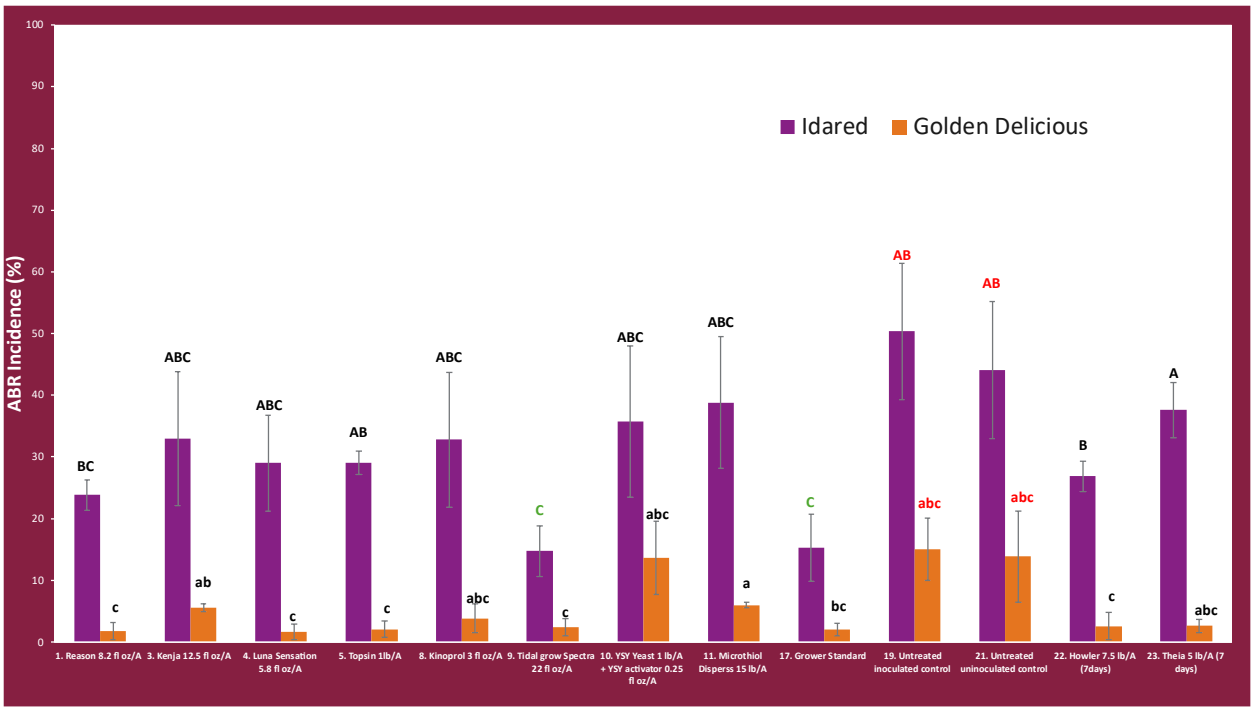
Treatment Maps



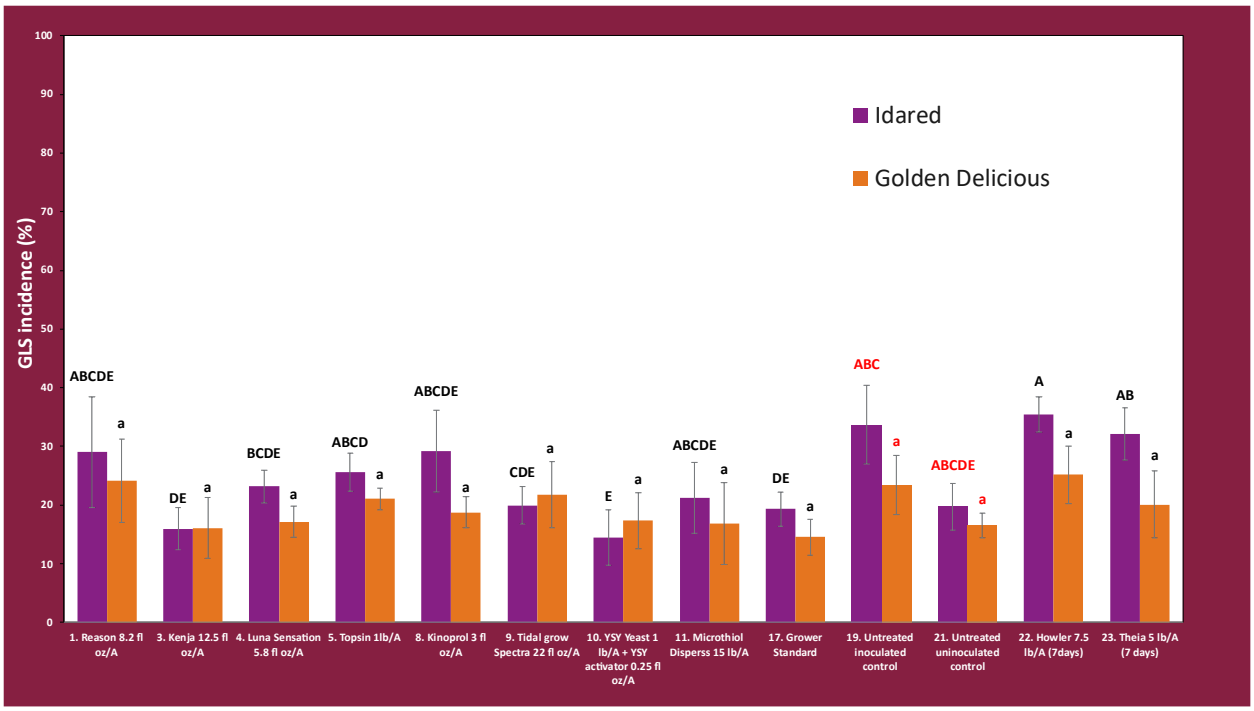


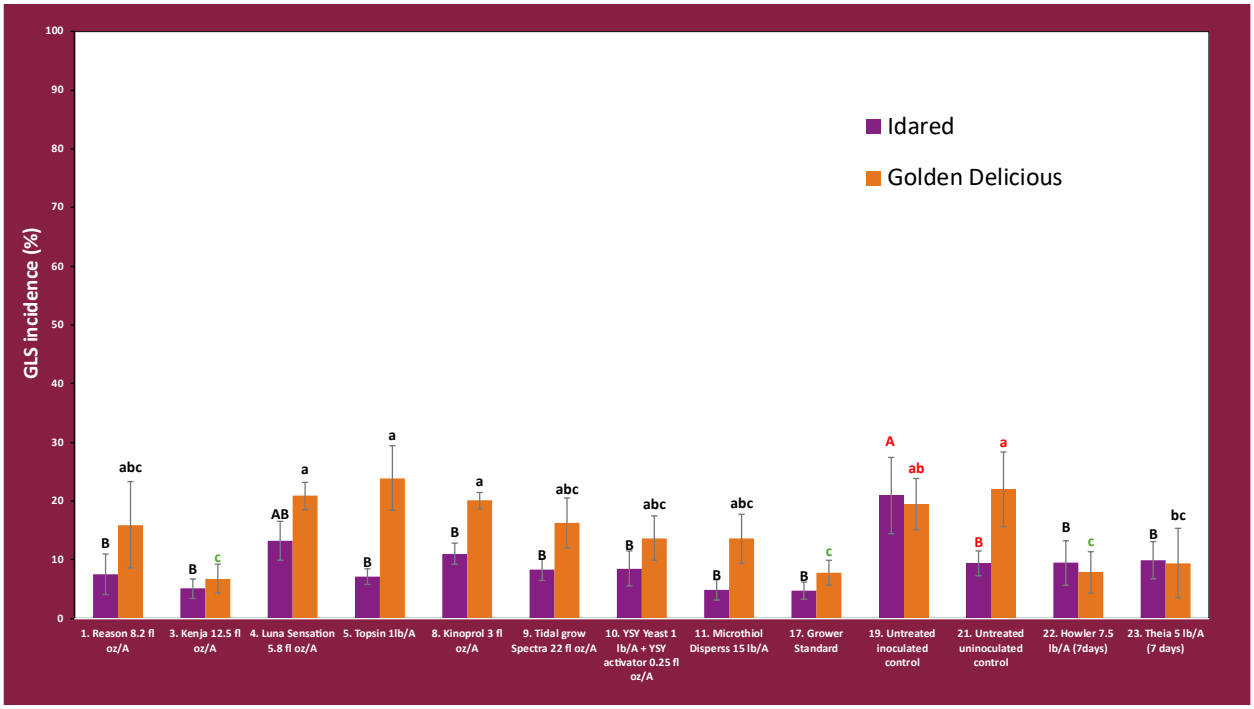
Results: Apple Bitter Rot





Results: Glomerella Leaf Spot


GLS incidence (%)
Idared
Golden Delicious
ABCDE
a
DE
a
BCDE
a
ABCD
a
ABCDE
a
CDE
a
E
a
ABCDE
a
DE
a
ABC
a
ABCDE
a
A
a
AB
a
1. Reason 8.2 fl oz/A
3. Kenja 12.5 fl oz/A
4. Luna Sensation 5.8 fl oz/A
5. Topsin 1lb/A
8. Kinoprol 3 fl oz/A
9. Tidal grow Spectra 22 fl oz/A
10. YSY Yeast 1 lb/A + YSY activator 0.25 fl oz/A
11. Microthiol Disperss 15 lb/A
17. Grower Standard
19. Untreated inoculated control
21. Untreated uninoculated control
22. Howler 7.5 lb/A (7days)
23. Theia 5 lb/A (7 days)


GLS incidence (%)
Idared
Golden Delicious
B
abc
B
c
AB
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B
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abc
B
abc
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abc
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c
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ab
B
a
B
c
B
bc
1. Reason 8.2 fl oz/A
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19. Untreated inoculated control
21. Untreated uninoculated control
22. Howler 7.5 lb/A (7days)
23. Theia 5 lb/A (7 days)

Take Home

Conclusions

- Some effective biocontrols:
  - Howler (52.9% incidence reduction)
  - Theia (51.2% incidence reduction)
- Tidal Grow Spectra promising biorational:
  - 60.2% incidence reduction
- Some control of GLS
  - Most materials were effective on shoot leaves
  - Low untreated uninoculated control incidence
- Second year data needed to confirm these findings

Acknowledgements

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Matheus C. Borba

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Weeds as Hosts to Strawberry Anthracnose

Leah Fronk, PSU Extension; Kathy Demchak, PSU Extension; Sara May, Penn State University; Rich Marini, Penn State University

Introduction

Anthracnose, caused by fungi in the *Colletotrichum acutatum* and *C. gloeosporioides* species complexes, is responsible for significant economic losses in strawberry production worldwide in nursery and farm environments. Symptoms can be seen on fruit, petioles, leaves, and crowns. The presence of diseases caused by *Colletotrichum* in nursery transplants is of great concern to strawberry growers. The pathogen is often present without symptoms in transplants and may be further spread to soil, equipment, and other plants by water-splashed spores. It is also possible that some spores may be wind-blown into the planting from the surrounding environment. *Colletotrichum* can remain asymptomatic on strawberry and other plant material for some time until it causes lesions on fruit or other plant parts.

Since strawberry is often managed as a perennial crop or in fields with minimal crop rotation, weeds in strawberry fields are suspected to be another source of the disease. In other studies, *Colletotrichum* of the same species infecting strawberries was found on various weed species in strawberry fields. We hypothesized that common weeds in strawberry fields are hosts to *Colletotrichum* and thus could serve as reservoirs of disease inoculum either infecting disease-free plants or exacerbating disease problems. Funded by the Pennsylvania Vegetable Growers

Association, the objectives of this 2-year study were to survey Pennsylvania strawberry fields to determine if weeds in strawberry fields are infected with *Colletotrichum*, and compare the species found on weeds to those infecting strawberry.

Methods

During 2021 and 2022, strawberry fruit and plant parts and 144 weed plants were collected from 6 Pennsylvania strawberry production fields with active anthracnose infections. Plant parts were processed with two lab methods: 1) sterilizing and plating, 2) sterilizing, freezing, and plating. Weed samples were collected within or just outside of the strawberry planting, and consisted of primarily above-ground plant parts. From both lab methods, single spore isolates were established from colonies growing on PDA plus streptomycin. PCR amplifications were performed for the TUB2 and GAPDH genes. To verify the pathogenicity of the fungal pathogen, isolates were selected to inoculate healthy strawberry fruit and subsequently evaluate their ability to cause anthracnose.

Results

Fourteen of the 20 weed species showed *Colletotrichum* presence and detection frequency in weed species was 37.50%. One hundred single-spore isolates were catalogued, 54 from weeds and 46 from strawberry. While detection frequency varied among plant species and processing methods, all perennial weed species were infected with *Colletotrichum.* Amplification, sequencing, and phylogenetic analysis of 63 concatenated GAPDH and β-tubulin genes revealed 62 isolates clustered with *C. nymphaeae,* and 1 isolate with *C. fioriniae*, both in the *C. acutatum* SC. Pathogenicity tests for all weed isolates trialed caused typical anthracnose symptoms on strawberry fruit. In all instances, isolates from weed species induced more severe infection (percentage of fruit surface with symptoms) than the positive control (strawberry fruit isolate).

Discussion

Strawberry growers should be aware that allowing weeds to persist in strawberry fields can allow *Colletotrichum* to hide. Whether weeds or strawberry plants are infected first is unknown, but the fact that *Colletotrichum nymphaeae* could persist on weeds means weed control takes on added importance. Much more work is needed, but for now, we have more answers on how clean plants may first become infected in nursery or grower fields.

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PROFILES AND A NOVEL MECHANISM OF FUNGICIDE RESISTANCE IN *BOTRYTIS* SPECIES FROM STRAWBERRY FIELDS

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Introduction

Gray mold, caused by *Botrytis* species, is a critical fungal disease affecting strawberry production. The disease is mainly managed through frequent fungicide applications, which inevitably leads to the development of resistance. However, the species and their resistance profiles, as well as underlying resistance mechanisms have not been investigated in depth. Therefore, this study was conducted to determine fungicide resistance in *Botrytis* isolates collected from the Northeastern strawberry fields and to investigate the mechanisms of resistance using a Genome-Wide Associate Study (GWAS). Additionally, isolates from California strawberry fields were also included in the study.

Materials and Methods

Between 2023 and 2024, *Botrytis* isolates were collected from strawberry fields in California, Maryland, New York, Pennsylvania, and Virginia. Samples came from both plasticulture and matted-row systems. In addition, 73 *B. fragariae* isolates collected between 2012 and 2022 were included to aid in GWAS. DNA was extracted from mycelia (Chi et al., 2009) and species identified by PCR with NEP2 primers (Dowling et al., 2017). Unclear results were confirmed by sequencing ITS or G3PDH regions (White et al., 1990; Staats et al., 2005). Products were purified, sequenced at Genewiz, and aligned using NCBI BLAST.

Resistance frequency was assessed on 24-well plates with fungicide-amended media (Fernández-Ortuño et al., 2014; Cosseboom et al., 2019). Isolates were tested against 10 fungicides from seven classes, including boscalid, cyprodinil, fenhexamid, fludioxonil, iprodione, isofetamid, penthiopyrad, pyraclostrobin, thiophanate-methyl, and pydiflumetofen. Controls contained non-amended Czapek-Dox Agar (CzA). Mycelial plugs were inoculated with sterile toothpicks and incubated at 22 °C for 5 days. Growth presence/absence was visually evaluated to classify isolates as resistant or sensitive.

We analyzed 105 *Botrytis fragariae* isolates collected from strawberries across multiple U.S. states and years. Fludioxonil resistance was assessed by mycelial growth on fungicide-amended media. Genomic DNA was extracted, whole-genome sequenced at ~50× coverage on Illumina NovaSeq, and reads were quality-controlled, mapped to the *B. fragariae* reference genome, and variants called using GATK best practices. After filtering, ~526k high-quality SNPs were retained. A GWAS was then performed using a linear mixed model to associate SNPs with fludioxonil resistance, revealing candidate loci potentially linked to resistance mechanisms.

Results

Among the fungicides tested, pyraclostrobin showed the highest resistance frequency, while pydiflumetofen showed the lowest. High resistance levels were commonly observed for fungicides from several chemical classes, including FRAC 1, 2, 9, 11, and 17. In contrast, fungicides from FRAC 7 and FRAC 12 generally showed lower resistance frequencies. Notably, resistance varied even within the FRAC 7 group, with some fungicides showing markedly lower resistance than others.

Resistance frequencies varied considerably across geographical regions and production systems. As shown in Fig. 1, California isolates exhibited the highest resistance frequencies across six of the ten fungicides tested, spanning five different chemical classes. In contrast, isolates from New York had the lowest resistance frequencies for four fungicides, each belonging to a distinct class (Fig. 1).

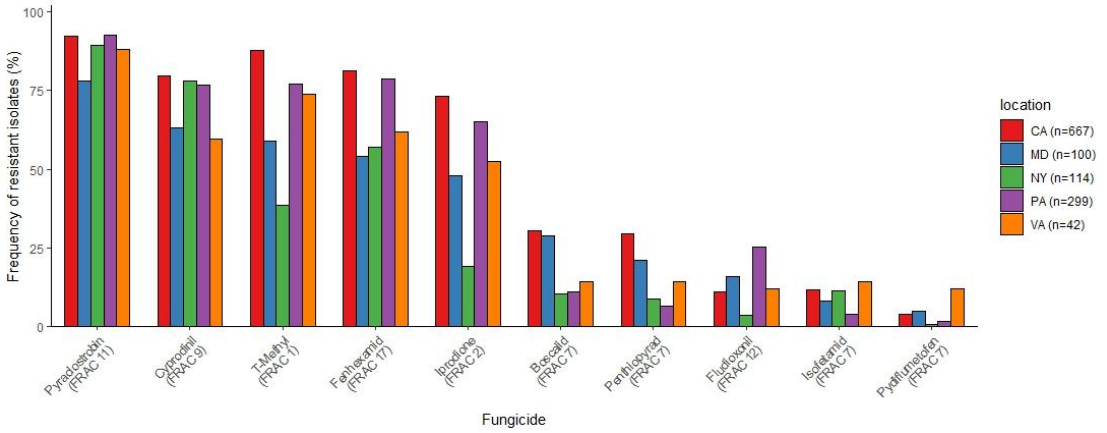

Figure 1. Frequency of fungicide-resistant *Botrytis* spp. isolates collected from strawberry fields in California (CA), Maryland (MD), New York (NY), Pennsylvania (PA), and Virginia (VA).

When comparing production systems, isolates from plasticulture exhibited higher resistance frequencies than those from matted-row systems for eight of the ten fungicides tested. This difference was especially pronounced for thiophanate-methyl, iprodione, boscalid, penthiopyrad, and pydiflumetofen. In contrast, resistance to pyraclostrobin and cyprodinil was slightly higher in matted-row isolates, though the difference was minimal (Fig. 2).

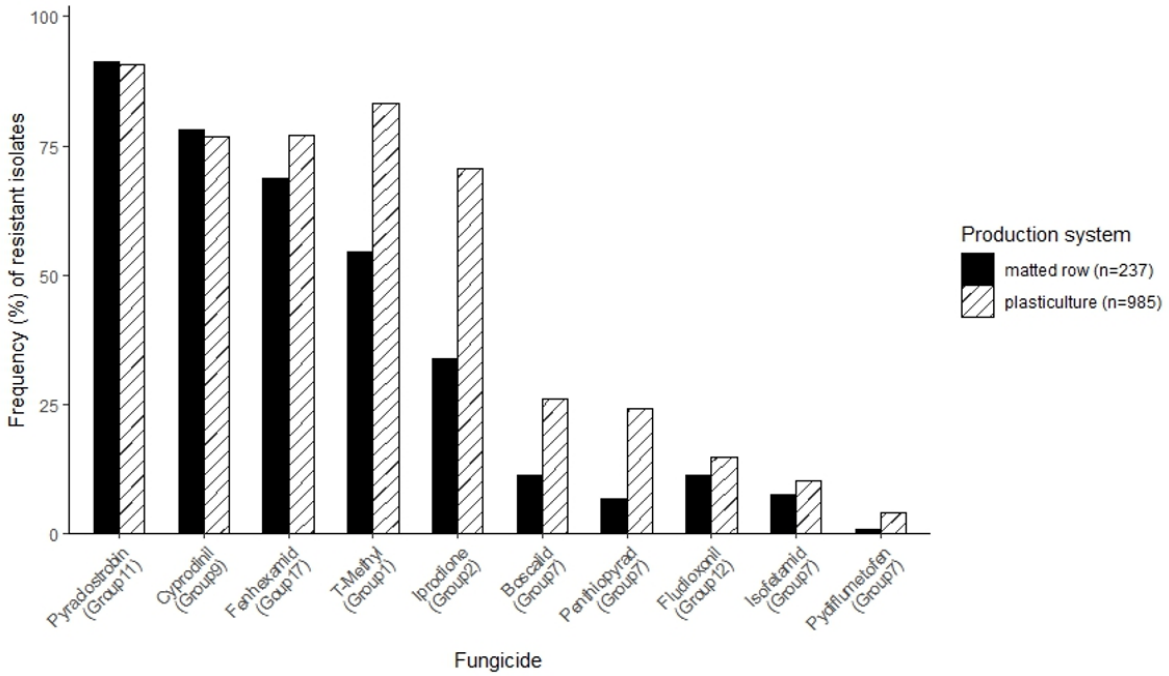

Figure 2. Comparison of fungicide resistance frequencies in *Botrytis* spp. isolates collected from strawberry production systems.

While *B. fragariae* displayed various resistant phenotypes similar to *B. cinerea*, distinct differences were observed between the two (Fig. 3). No resistance was found to any FRAC 7 fungicides tested in *B. fragariae* isolates we collected. In addition, a lower frequency of resistance to fenhexamid and a higher resistance frequency to fludioxonil were detected in our *B. fragariae* isolates compared to *B. cinerea*. Our results also showed similar frequencies of resistance to other fungicides were detected between the two species.

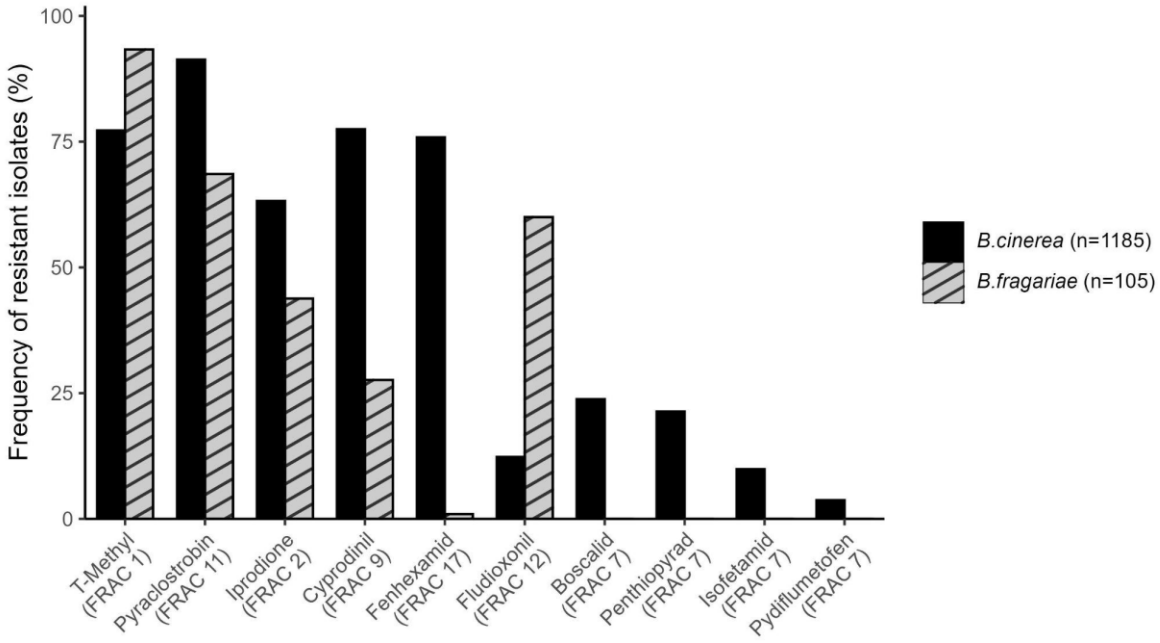

Figure 3. Resistance frequencies of *Botrytis cinerea* (n = 1185) and *B. fragariae* (n = 105) isolates to fungicides representing different FRAC groups.

Whole-genome sequencing of 105 *B. fragariae* isolates revealed over 500,000 SNPs, which were filtered and pruned for population structure analysis. Fludioxonil resistance was determined by mycelial growth on fungicide-amended media, classifying 65 isolates as resistant and 40 as sensitive. Genome-wide association analysis using high-quality SNPs and a mixed linear model identified a significant SNP that was completely segregated between resistant and sensitive groups (Fig. 4). This variant, located within a gene encoding a C6 transcription factor, results in a nonsynonymous substitution (R324L or R324Q), suggesting a potential role in fludioxonil resistance.

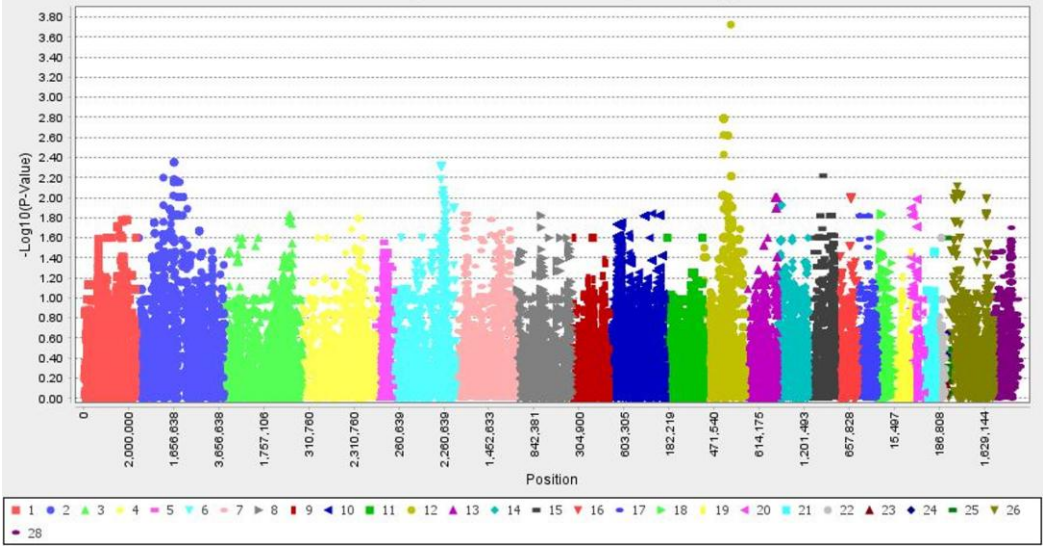

Figure 4. Manhattan plot of genome-wide association study (GWAS) results for fludioxonil resistance in *Botrytis fragariae*.

Discussion

Fungicide resistance in *Botrytis* spp. continues to be a major threat to sustainable strawberry production. Our study revealed high levels of resistance to several commonly used fungicides across multiple regions, consistent with previous reports (Hahn, 2014). The observed differences in resistance frequencies between regions and planting systems appear to be shaped by variation in spray programs and fungicide use intensity. In plasticulture systems, frequent fungicide applications—both in the field and potentially during nursery production of plug plants—likely impose higher selection pressure, resulting in elevated resistance. In contrast, the lower resistance observed in matted-row systems, which are typically managed with fewer sprays, may reflect reduced selection pressure and the possible fitness cost of resistance mutations under fungicide-free conditions.

While resistance patterns were broadly similar between *B. cinerea* and *B. fragariae*, our results revealed some differences. In agreement with previous studies, *B. fragariae* isolates remained fully sensitive to all FRAC 7 fungicides tested, yet showed a relatively high frequency of resistance to fludioxonil. The underlying mechanisms also appear to differ between the two species.

Although *atrB* overexpression has been previously implicated in fludioxonil resistance in *Botrytis*, the specific genetic basis in the US *B. fragariae* remains unclear. In this study, GWAS identified a significant SNP in a C6 zinc finger transcription factor gene that was segregated between resistant and sensitive *B. fragariae* isolates. This variant likely

represents a novel regulatory mutation contributing to resistance. Further validation using functional approaches such as CRISPR and qPCR is needed to confirm its role. A broader analysis of transcription factor families may also help identify additional regulatory elements involved in fungicide resistance.

In conclusion, our findings underscore the complexity of fungicide resistance in *Botrytis* populations and highlight the value of integrating genomic tools with phenotypic monitoring. A deeper understanding of resistance mechanisms, along with reduced reliance on high-risk fungicides, will be critical for developing sustainable and effective disease management strategies in strawberry production.

Acknowledgement

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Economics of Topworking versus Replanting an Apple Orchard

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Introduction

The decision of whether to top-work versus replant an apple orchard is a complex one involving a multi-year comparison of cash flows including income projections and costs for grafting activities, land preparation, planting, and training. As part of an Extension project funded by the State Horticultural Association of Pennsylvania, we interviewed eight growers during May and June 2023 about their production activities and costs associated with top-working apple trees. The data obtained from these interviews provided the basis for developing an Excel workbook that allows growers to evaluate the economics of top-working versus replanting for their own operations (discussed in more detail at the end of this report).

Methods

Information collected from the growers included: the advantages and disadvantages of top-working, the age and diameter of top worked trees, the sourcing and care of scion wood, grafting preparation and grafting practices, training and support systems used, labor requirements, and their yield expectations for a top-worked orchard block.
All growers say that the most important benefit of top-working their trees is to change apple strain or cultivar quickly. Individual grower comments included:

- Can quickly change from varieties that are not as marketable to varieties that are more in demand in their market.
- The apple market is demanding redder strains of red cultivars. Grafting is a quicker way to change varieties than replanting, as long as you are comfortable with your current spacing.
- Don’t need to wait on trees from the nursery to get the latest cultivars.
- Grafting was required to change varieties in a shorter amount of time.
- Replaced a pick-your own block with an old variety on M26 rootstock to newer, more profitable variety. They also planted trees between each existing tree.
- Moving away from Red and Golden Delicious, Rome, and older strains of Fuji that are not as red. Changing to newer strains of apples that better fit marketing mix.
- Mainly using grafting to return to production quicker. Believes the cost is comparable with removing existing trees, working the land, and replanting with new dwarfing rootstocks.

All growers said that another advantage of top-working is avoiding tree removal, land preparation, and planting costs. But they also noted that:

- Cutting and removing the tops of the trees is a time-consuming process that requires working around cut trees and moving large brush to ends of the rows.
- The time and expense to cut the existing tree, remove larger wood, carry larger wood to ends of the rows and load them on a wagon, and chop brush is considerable. Must work around trees and protect nurse limb.
- Requires two trips through the orchard with a chainsaw, one to remove tops and one to make clean cuts ahead of the grafting crew.

When asked about the age and diameter of the top-worked trees, the growers indicated a wide range of ages and sizes. Grower comments on size and age included:

- Trees are 30-years old on M26 rootstock.
- Trees were of various ages with several varieties being topworked.
- Grafted trees were of various ages and spacings.
- Trees were on dwarfing rootstock.
- Some 30-40 years old, some 10-20 years old, and one was in the second leaf.
- The trunks are about 2 inches in diameter on Bud 9 or dwarf rootstocks.
- Trees were about four to five inches across.
- Trees were on various rootstocks with many on M26. The observation from this grower was that M9 does not work well for top-working.
- Various sizes. They graft one scion for each inch of diameter.
- The trees were three to four inches in diameter.
- Trees were 2 inches in diameter.

When asked about whether they do the grafting themselves our use a service 6 out of the 7 operations indicated they use a grafting service; only one did it himself. Comments on grafting included the following points:

- Several growers said the grafting service charges $1 per graft.
- One grower said he pays $1.50 per graft, but only if the graft takes.
- Another grower said his cost was $1 per graft for 1,000 or more grafts and $1.50 for less than 1,000 grafts.
- All growers supply the labor to reseal grafts. The grafting service leaves adequate grafting compound for resealing.
- All grafts were held in place with electrical tape.
- All growers said that grafting success is at least 90%.

Three growers purchased scion wood directly from a nursery, three collected scion wood from their own trees, and one contracted with the grafting service for whips. Some grower comments on scion wood included:

- Scion wood was harvested from early February to the beginning of March.

- Whips were cut to between 12”-18”, wrapped in wet towels or rags, and kept in a refrigerator until the grafting service arrives.
- Scion wood purchased from a nursery generally costs around $2.00 per whip or around $0.50 to $0.75 per bud.
- All growers indicated they paid royalties to the nursery for their scion wood.
- Only one grower indicated he grafted some cultivars that have no royalty.

All growers indicated they are re-using their existing support/training system. However, there was considerable variation in the types of support systems being used. Individual grower comments included:

- Using existing stakes as support. If the stakes were still solid, they were left as is. If the stakes were not sufficiently stable, they were cut so the top of the stake was about eight to ten feet above ground level and then fastened it to the trunks with screws.
- Reused existing conduit and wire system which incorporates the existing system for each tree. They use conduit or a fiberglass rod.
- Used the existing trellis system which incorporates a vertical wire for each tree.
- Attaching grafts to the existing trellis system.
- Using a two-wire training system. They put 2 grafts per tree and train the two grafts parallel to the row.

For training the grafted trees, the growers used a variety of practices. Some specific grower comments on their training practices included:

- Using a three-leader system when grafting in a block that has an existing trellis system. Keeps a central leader then brings a graft out and ties it fast to bottom wire creating the three-leader system. The leaders should be no closer than 2’-3’. When grafting on larger trees, supports are attached to the trunks to support the grafts. Takes about the same time as a new planting.
- Same training practices as for a new planting. The grafts are not braided.
- Training requires about 5 minutes per tree at 2nd leaf and 7-8 minutes at 3rd leaf.
- Use a wire attached to the trellis wire. They also extend the wire to wrap around the trunk, which partially girdles the trunk to slow tree vigor. They also use tomato clips to attach the tree to the wire.
- Braiding the grafts and taping the braids. Plan to hold the height to the top of the stake support as they are a pick-your-own operation.
- The grafts were braided using three limbs. Later two of the three braided limbs are bench cut, leaving a central leader.
- In the 2nd leaf, they braid the grafts together to form a central leader and possibly scaffold limbs. Believe that this somewhat reduces vigor in the new growth.

Growers were also asked if they felt there were any problems using the old tree spacing, rootstock, and existing support system. Most growers didn’t consider this an insurmountable issue, but several noted that tree vigor for larger diameter or older trees can be a challenge. One grower used root pruning and bark girdling to help control

vigor. Another grower said he would never graft an orchard with spacing greater than 5' x 16'. Another grower said he has no problems when staying with his current high-density spacing and systems; the spacing on most of his grafted trees is 3' x 12'.

Another problem often cited with topworking is that there is no opportunity to address weed/nematode issues or incorporate fertilizer. However, none of the growers felt these issues were a problem for them. A couple growers indicated that they didn't apply fertilizer because of the vigor of the trees, which resulted in a savings of $50-$75/acre compared to replanting.

Finally, we asked the growers when they expect to harvest fruit in their top-worked orchards. Some growers indicated they expect to harvest a light crop in the 2nd leaf and all expected be in full production by 4th or 5th leaf. About half the growers cropped the nurse limb(s) on their trees, with an expected yield of 100-200 bushels per acre. Some specific grower comments on expected yields in top-worked orchards included:

- Plan to fill the space in second leaf. Removed fruit in second leaf and will begin cropping in third leaf.
- Expect to fill the space in second leaf, have some production by third leaf, and full production by fourth leaf.
- Plan to crop in year three to reduce vigor.
- Working to fill the space in second leaf and have 400-500 bushels per acre in third leaf and full production in fourth leaf.
- Expect substantial production by fourth leaf.
- Yield in 2nd leaf is estimated to be around 400 bu./A, 3rd leaf 400-500 bu./A, 4th leaf 500-600 bu./A, with full production by year 5.
- Aim to produce a full crop in the 4th leaf. They use a full spray program beginning in second leaf.

Results

Based on the information collected during the grower interviews, a top-working workbook was constructed to help other growers evaluate whether this practice is economical for them. Growers can use the workbook to help evaluate whether topworking an established apple block to another cultivar is economical for their operation. It compares the cost of the various steps in the grafting process with the alternative of purchasing new trees, preparing the site, and replanting the orchard. The workbook is available at:

https://agsci.psu.edu/research/centers-facilities/extension/frec/resources/self-help/top-working-decision-workbook.

This analysis is conducted on a one-acre basis. The data collected in the various spreadsheets are used to calculate yearly cash flow estimates over the life of each alternative. The cash-flows are then used to generate various investment performance measures including net present value, internal rate of return, and cumulative cash flow to help you decide if top-working is a financially viable alternative to replanting. Top-

working and replanting are also compared to the alternative of keeping the existing orchard (the "do nothing" option).

This workbook is comprised of 12 spreadsheets contained in the tabs at the bottom of the page. Each tab is set up as a series of data entry steps which allow the user to customize the analysis to their particular situation. In some cases, default values can be selected rather than entering their own numbers. However, to get the most accurate results users should use their own values for this important financial decision. For many of the grafting questions, a range of values based on the grower interviews is provided to help you think through the process. These numbers vary greatly from grower to grower and are only meant for guidance.

The individual workbook tabs are:

- “Instructions” tab provides information about the purpose of the workbook and instructions about how to use it.

- "Parameters" tab collects information on interest rates, labor costs, harvest costs, pruning costs, fuel prices, and machinery usage.

- "Yield & income projections" tab collects information on the projected yields and prices to be used for the comparisons.

- "Grafting prep" tab collects information on the number of grafts and amount of time required to complete the various steps to get the trees ready for grafting.

- "Grafting" tab collects information about whether the growers is doing the grafting or having a service do it for them. It also collects data on time spent on post-graft care and nurse limb management.

- "Year after Grafting" tab collects information about time required for resealing grafts, training and tying of grafts, and nurse limb removal.

- "Land prep" tab collects data on the cost of removing trees and preparing the land for replanting. Users have the option of using Penn State Tree Fruit Production Guide (TFPG) budgets or adjusting them to fit their own situation.

- "Planting" tab collects data on the cost of planting either a medium- or high-density orchard. Users again have the option of using TFPG budgets or adjusting them to fit their own situation.

- "Non-bearing year" tab collects data on the cost of maintaining a non-bearing orchard including training and fruit removal costs.

- "Intermediate year" tab collects data on the cost of maintaining and harvesting an immature orchard. Harvest cost will be adjusted in the cost flow estimates

reflecting the data provided in the "Yield & income projections" tab.

- "Mature year" tab collects data on the cost of maintaining and harvesting a mature orchard. Harvest cost will be adjusted in the cost flow estimates reflecting the data provided in the "Yield & income projections" tab.

- "Financial comparisons" tab compares the estimated cash flows from the "do nothing", "top-working", and "replanting" options. The financial investment measures net present value, internal rate of return, and cumulative cash flows are presented to help you determine which option is the best choice for the operation.

Discussion

The results of the analysis are very sensitive to the labor costs and the apple price and yield assumptions used. Top-working an orchard requires more labor than replanting, so labor availability is a critical consideration. Some preliminary analysis indicates that top working might be done for around half the cost of replanting. However, it is extremely important that each grower conducts their own evaluation and uses their own costs wherever possible. The length of the planning horizon also plays a role in how an individual grower views the decision to top-work of replant. For those with shorter planning horizons (10-15 years), top working an existing orchard might make the most financial sense. Growers with a longer planning horizon (20+ years) may be better off by replanting.

Acknowledgements

We would like to acknowledge the growers who graciously shared their knowledge and experiences with us on top-working apple trees: Dave Benner (El Vista Orchards), Bob Black (Catoctin Mountain Orchard), Steve Frecon (Frecon Orchard), Rick and Ben Keim (Keim Orchards), Mark Boyer (Ridgetop Orchards), Matt Boyer (Boyer Orchards), and Tim Strathmeyer (Orchard Valley Farm).

Financial support for the development of this workbook was provided through an Extension grant from the State Horticultural Association of Pennsylvania: Orchard Replacement Strategies: The Economics and Procedures for Grafting (OSP: #236472).

Strategies for Frost Mitigation in Apple: The Role of Cryoprotective Agents

Khalil Jahed and Sherif M. Sherif

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Abstract: Spring-frost represents significant abiotic stress for deciduous perennial fruit trees, often causing tissue damage, leading to substantial yield losses. Cold-induced damage in plant tissues occurs following the formation of extracellular ice crystals, which leads to cellular dehydration and subsequent cell death. This study presents preliminary data on the efficacy of several cryoprotectant compounds—ThermoMax, diKap, KDL, and Glacier—in mitigating frost damage in 'Pink Lady', an early-blooming apple cultivar. The treatments were applied at distinct phenological stages: tight-cluster, first pink, and full pink. Following application, floral buds were subjected to controlled freezing temperatures below critical damage thresholds or exposed to a natural frost event. Observations from percent mortality of floral buds, electrolyte leakage, fruit quality attributes at harvest, and the incidence of Calyx-End cracking, were assessed. Our 2024 preliminary results indicate that ThermoMax and KDL significantly reduced floral bud mortality in a stage-specific manner compared to the untreated control. While no significant differences in electrolyte leakage were observed among treatments, fruit quality was not negatively impacted. Furthermore, the ThermoMax application was associated with a significant reduction in Calyx-End cracking. These findings suggest that specific cryoprotectant applications are a promising strategy for enhancing the resilience of apple production against increasingly variable climate conditions.

Student Competition Entomology Abstracts

Effects of release habitat, distance, and time on *Trissolcus japonicus* parasitism and dispersal in an augmentative release experiment

Emma Waltman, Ann Rucker, and Anne Nielson (Rutgers)

Incorporating floral strips adjacent to crop blocks is a conservation biological control technique that attracts and retains natural enemies on farms, reducing pest pressure. In this study, we coupled this technique with the augmentative release of a parasitoid wasp, *Trissolcus japonicus,* which is a parasitoid of the Brown marmorated stink bug (BMSB). We hypothesized that wasps released directly into nectar-rich buckwheat strips would be effective biological control agents in neighboring orchard blocks. We deployed colony-laid BMSB egg masses and yellow sticky card traps in orchard blocks adjacent to release points to monitor parasitism performance and dispersal into the orchard, respectively. We compared parasitism and recapture in this orchard block to these data in a different orchard block adjacent to *T. japonicus* released in into mowed grass instead of buckwheat. Egg masses and yellow sticky cards were deployed 3-4 days at a time over 2 weeks and at distances 7-25 m away from release points following *T. japonicus* releases. Overall, 39% of egg masses were parasitized, and 7% of released parasitoids were recaptured on sticky traps. Release habitat significantly affected egg mass parasitism but not recapture. Additionally, parasitism and recapture occurred more closer to release points and the most 4-8 days after release.

Furthermore, we utilized an immuno-marking technique to apply a 10% egg white solution to the buckwheat before releases so insects would become “marked” by the protein when foraging. We utilized enzyme-linked immunosorbent assays (ELISAs) to detect egg white antigens on recaptured insects to infer foraging and dispersal. Twenty-eight percent of *T. japonicus* recaptured in the orchard adjacent to the buckwheat were marked, while 14% of recaptured insects near the mowed grass were positive. These parasitoids were 120-220 m from the buckwheat release points. Information about *T. japonicus* dispersal from this experiment can inform augmentative release efforts and future experiments.

SLF Population Density Differences Based on Invasion Year

Katarzyna Madalinska and Anne L. Nielsen (Rutgers

Spotted Lanternfly (SLF) is an invasive plant hopper native to China. They were first detected in Pennsylvania in 2014 and have since spread to surrounding areas, including New Jersey in 2018. SLF is a highly polyphagous insect, feeding on the phloem of over 100 plant species, including agricultural crops and hardwood trees. SLF acts as a plant stressor, weakening the plant's health and its ability to tolerate abiotic stress over multiple years of gregarious feeding. To improve pest management strategies, it is crucial to understand the seasonal and cyclical interactions between SLF and its host plants. Over four years (2020-2023), a trapping and visual survey was conducted across New Jersey to document SLF abundance on four key hosts: *Ailanthus altissima* (tree of heaven), *Juglans nigra* (black walnut), *Acer rubrum* (red maple), and *Vitis vinifera* (grape). The study revealed seasonal variation in the types of host plants utilized by SLF and shifts in population density across different years of invasion. These findings offer insights into SLF population dynamics and suggest that targeted surveillance efforts, based on host plant usage throughout the season, could improve detection and management by researchers, growers, and the public.

Multispecies Lepidopteran Trapping: Altered Trap Capture and Exploration of Uses in IPM

Kelly McIntyre [1], Alejandro Del Pozo[1], Arash Rashed[1], Erin Hodgson[2], Ashley Dean [2], and Kevin B. Rice[1]
Virginia Polytechnic Institute and State University[1]
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Synthetic pheromones are used in integrated pest management (IPM) programs to monitor insect dispersal, inform management decisions, and reduce economic damage through behaviorally-based control strategies. Combining pheromone lures from multiple lepidopteran species into a single trap often results in reduced trap capture, or antagonism, compared to single-species traps. Antagonism is an undesirable outcome for monitoring programs, and combining lures for population monitoring or mating disruption should be avoided unless lure compatibility is evaluated. In a series of field experiments in orchards and field crops, we compared trap captures in traps baited with individual pheromones with trap captures baited with combined pheromones from eight lepidopteran pests: corn earworm, codling moth, diamondback moth, European corn borer, fall armyworm, oriental fruit moth, true armyworm, and tobacco budworm. We found antagonism in combined pheromone trap captures for corn earworm, fall armyworm, and true armyworm and an increase in trap capture, or synergism, for oriental fruit moth. We discuss potential uses for antagonistic responses in IPM programs.

Controlling Increased Levels of Plum Curculio, *Conotrachelus nenuphar*, in Pennsylvania Apple Orchards

Kevin Peters and David Biddinger – Penn State FREC

In the past five years, fruit growers and integrated pest and pollinator (IPPM) managers have seen up to a 10-fold increase in plum curculio (PC) (*Conotrachelus nenuphar*) damage in Pennsylvania orchards. While not a new pest, the pesticides (e.g., azinphosmethyl, methyl parathion, chlorpyrifos & thiacloprid) used to effectively control it in the past have been phased out due to vertebrate toxicity, worker and dietary exposure, and negative environmental impacts such as toxicity to bees and other beneficial arthropods. This has allowed resurgence of this pest, but it's providing the opportunity for refining our detection techniques which will provide the grower with novel methods for making control decisions. We'll present data from Penn State's FREC with a trapping technique utilizing kairomone baited pyramid traps showing promising results for post-diapause PC captures, and we'll present a hypothesis using initial data suggesting a change in a growers IPPM program which could be researched that may save the growers money.

Student Competition Horticulture Abstracts

Digital Image Analysis as an Indirect Method of Assessing Apple Canopy Density

Amanda Martenot-USDA

Digital Image Analysis as an Indirect Method of Assessing Apple Canopy Density Canopy density of a fruit tree indicates tree health, growth, productivity, and ecophysiological processes such as photosynthesis or carbon fixation, but it has long been a challenge to quantify due to natural variation within the canopy and throughout the year. While there are tools available for assessing foliage, they are often expensive, time consuming, complex, or require highly specific conditions for accurate results. This experiment aims to evaluate a new method of assessing canopy density by percentage of light interception using bottom-up canopy images taken with a consumer (smartphone) camera and analyzed with the open-source image processing software ImageJ. Data collection took place from monthly May to July 2024 in two experimental apple (Malus × domestica) blocks consisting of 30 trees of 'Enterprise' on 'Bud.9' rootstocks planted in 2009 and 27 trees of 'GoldRush' on 'Bud.9' rootstocks planted in 2018, respectively. For validation of the new method data was also collected with two established methods including canopy light interception which was measured with a line quantum sensor and leaf area index (LAI) measured with a hemispheric lens-based canopy analyzer. For the 15-yearold 'Enterprise' apple, both LAI and light interception data correlated strongly significantly with image-based density estimates ($r = 0.70$, $P < 0.0001$ and $r = -0.69$, $P < 0.0001$ respectively). However, 6-year-old 'GoldRush' was not significantly correlated with LAI but was with light interception ($r = 0.19$, $P > 0.05$ and $r = -0.53$, $P < 0.0001$ respectively). Between the two apple blocks the different relationships of the results acquired based on the new and old methods could be due to variation in canopy size (2.69 m for 'Enterprise' and 1.96 m for 'GoldRush') possibly associated with tree age. While the results of this study were not conclusive, they indicate that image-based density estimation is reliable in mature apple orchards yet still shows some promise for young tree blocks.

Rootstock Driven Frost Tolerance and Bud Mortality in Apple: Gene Identification for future germplasm development

Amolpreet kaur Saini, Khalil Jahed, Deisiany Ferrrerira Neres, Clay Wright, and Sherif Sherif

Late spring frosts present a significant threat to the productivity and economic stability of deciduous fruit trees. Our study assessed the frost tolerance of two apple cultivars, 'Fuji' and 'Gala,' each grafted onto ten different rootstocks, over the springs of 2021-2023. Trees grafted onto the 'B.9' rootstock demonstrated superior frost tolerance, showing significantly lower flower bud mortality compared to other rootstocks, especially 'M.26,' which exhibited high bud mortality.

In this research, we focused on enhancing frost tolerance in apple cultivars, recognizing that plants use two main strategies against freeze-induced damage: frost tolerance and frost avoidance. While avoidance mechanisms involve cryoprotectants, our study targeted frost tolerance strategies, where plants acclimate to progressively colder temperatures, building resistance over time. Using RNA-sequencing, we analyzed leaf samples from the suckers of ‘B.9’ and ‘M.26’ rootstocks, as well as flower and leaf tissues from ‘Gala’ trees grafted onto these rootstocks. Samples were collected 12 hours before and 6 hours after a natural frost event in April 2021.

Our analysis showed extensive shifts in gene activity following frost exposure, with 4,549 genes increasing and 5,469 genes decreasing in expression. Using weighted gene co-expression network analysis (WGCNA), we identified three significant groups of genes (modules ME 6, 7, and 9) that contribute to frost response. The ME 6 and ME 7 modules contained 1,210 and 1,011 genes, respectively, with pronounced changes in expression levels. In comparison, the ME 9 module comprised 163 genes, 6 of which showed specific responses to the frost event. By examining the relationships among genes within these modules, we identified several central "hub" genes likely to play key roles in frost tolerance.

Further functional analysis indicated that these hub genes are primarily involved in ABA signaling, cold response, and water stress pathways. These pathways are crucial for enhancing frost tolerance in apple rootstocks, providing insights into the genetic foundation of cold tolerance and identifying promising targets for developing frost-tolerant apple cultivars.

The effect of plant growth regulator treatment on ‘Honeycrisp’ fruit drop, maturity, quality and related transcript accumulation

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‘Honeycrisp’ is a commercially important apple cultivar that experiences extensive crop loss due preharvest fruit drop. Harvesting earlier to avoid this phenomenon can lead to poor quality and marginal color development below the 50-60% red blush recruitment for marketability. Plant growth regulators, such as aminoethoxyvinylglicine (AVG) and 1-methylcyclopropene (1-MCP), can alter preharvest fruit drop, maturity and quality by hindering ethylene biosynthesis and perception, respectively. Knowledge of their effect on ‘Honeycrisp’ grown in the US mid-Atlantic is lacking. The objective of this study was to evaluate the effects of AVG and 1-MCP on preharvest fruit drop, ethylene production, fruit physicochemical parameters, skin color, and transcript accumulation of ethylene and anthocyanin-related genes in 'Honeycrisp' apples throughout on-the-tree ripening. Our results demonstrate that AVG and 1-MCP diminish preharvest fruit drop and ethylene production, including gene expression, and delay fruit maturity, as compared to the control treatment. While AVG showed the highest decrease in ethylene production and exhibited the greatest downregulation of ethylene biosynthesis and perception-related gene expression, it also negatively impacted red color and anthocyanin biosynthesis related gene expression and failed to reach the minimum 50% red blush until the last ripening stage. 1-MCP also displayed lower but similar decreases in ethylene and maturity parameters and simultaneously reached the blush requirements one week prior to AVG.

Improving red color and inactivation of *Listeria monocytogenes* on apple fruit skin in postharvest through ultraviolet irradiation

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Due to rising temperatures, Honeycrisp fruit growing in the Mid-Atlantic have not met industry standards of 50-60% red blush by harvest. Another concern for apple growers at large is Listeria monocytogenes contamination, particularly since the pathogen can survive for several months during cold storage. Postharvest ultraviolet (UV) irradiation is a promising technology for promoting red skin coloration and maintaining fruit safety. We aimed to evaluate and compare the effect of different postharvest UV irradiation treatments on (a) skin red coloration of 'Honeycrisp' and (b) L. monocytogenes inactivation. Our group conducted a screening study assessing color improvement of UVA (600, 800, 1200, 2400 kJ m^{-2}) and UVB (200, 400, 600, 800 kJ m^{-2}) treatments during fruit conditioning at either 5 ºC or 10 ºC followed by storage in 3 ºC, along with dark and white light controls. We then conducted a separate study to determine if a 3 kJ m^{-2} dose of UVC would effectively inactivate Listeria on Honeycrisp fruit. Our results from the first study showed a dose-dependent increase in skin blush, with 2400 kJ m^{-2} of UVA and 800 kJ m^{-2} of UVB displaying the best results. These differences in red skin coloration were higher in fruit treated at 10 ºC than at 5 ºC. In addition, our results from the second study showed that a treatment of 3 kJ m^{-2} dose of UVC was able to bring a 5-log reduction of Listeria with respect to a control. Overall, UV radiation, of different wavelengths and doses, has shown great potential as a postharvest solution for fruit color improvement and contamination of bacterial pathogens in Honeycrisp apples.

Synergistic PGR Application for Strategic Balancing of Red Color Enhancement and Fruit Drop Control in Apples

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Fruit coloration, primarily driven by anthocyanin, is critical for fruit maturation, ripening, and its economic value. The exogenous applications of ethylene can intensify the red color in apples by regulating anthocyanin biosynthesis but at the expense of pre-harvest fruit dropping. To address this issue, ethylene inhibitors are commonly used but it compromises fruit color. To strike a balance between reducing fruit drop and enhancing color, we tested various chemical approaches in 'Honeycrisp' apples for two consecutive years. In both 2023 and 2024, Accede (ACC-10%) alone or in combination ReTain (AVG-15%) increased chlorophyll degradation and enhanced red color at harvest and two weeks after harvest. For fruit drop control, ReTain as well as the mixes of ReTain with Accede showed promise in reducing pre-harvest fruit drop in both years, compared to the untreated control. With regards to extending the harvest window, the ReTain+Accede combination was the standout performer in both years, reducing fruit drop by 27.05-46.30% two weeks after harvest, while significantly enhancing red color. Applying Accede or Motivate (Ethephon-21.7%) improved fruit coloration but also increased fruit drop. These findings suggest ReTain+Accede jointly act as a game changer to enhance fruit color and minimize pre-harvest fruit drop.

Unlocking Premium Red Color and Early Harvest in ‘Evercrisp’ Apples via Reflective Groundcovers.

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Abstract: Enhanced skin blush is crucial for the marketability and profitability of many apple cultivars, with anthocyanin levels significantly influencing skin coloration. Reflective groundcovers serve as a preharvest method to improve skin blush in apples, but studies investigating their comprehensive effects on environmental, physiological, genetic, and metabolic factors are scarce. This study hypothesized that if reflective groundcovers could intensify light levels, they would increase reflectance in the lower canopy, thereby enhancing red skin blush on apples growing at this level. We examined how reflective groundcovers affected light exposure, fruit drop, internal ethylene concentration (IEC), skin coloration, and anthocyanin production in lower canopy ‘Evercrisp’ apples. Results showed that reflective groundcovers enhanced red skin blush, achieving over 60% coloration one week before commercial harvest or two weeks earlier than untreated apples. This effect was linked to increased gene expression associated with anthocyanin synthesis and a marked rise in light reflectance (5–25 times higher than controls), boosting anthocyanin levels. Additionally, treated apples showed elevated IEC and advanced maturity without an increase in fruit drop compared to controls. The use of reflective groundcovers enables an earlier harvest by about one week, producing high-grade fruit that increases crop value.

Student Competition Plant Pathology Abstracts

Profiles and a Novel Mechanism of Fungicide Resistance in *Botrytis* species from Strawberry Fields.

Hongjin Liu, and Mengjun Hu, UMD

Gray mold, caused by Botrytis species, is a critical fungal disease in strawberries. The disease is mainly managed through frequent fungicide applications, inevitably leading to resistance development. In this study, Botrytis isolates collected from northeastern and California strawberry fields were tested for resistance to commonly used fungicides, followed by the characterization of novel resistance mechanisms. Isolates from California strawberry fields seemed to have higher resistance frequencies than those from the northeastern states, with New York isolates exhibiting the lowest resistance frequencies in general. Further analysis showed significantly higher chemical class resistance (CCR) associated with isolates collected from plasticulture strawberries than matted-row strawberries. In addition, phenotypic and genotypic analysis of Botrytis isolates revealed two prevalent Botrytis species, including *B. cinerea* and *B. fragariae*. Using genome-wide association studies (GWAS), we identified significant single nucleotide polymorphisms (SNPs) related to fludioxonil resistance, located in a C6 transcription factor gene of *B. fragariae*. CRISPR/Cas9 is underway to validate the impact of this SNP on the fungicide sensitivity. Our results reemphasized the importance of resistance management and discovered a possible novel mechanism underlying the highest level of resistance to fludioxonil in *B. fragariae* from the field.

Biopesticide Product Trials Against Grape Downy Mildew, Winchester, Virginia, in 2024

Jonathan Ames, Ian McClellan, and Mizuho Nita, VA Tech

Grape downy mildew (caused by Plasmopara viticola) rapidly spreads and causes severe foliar and fruit damage to grapes (Vitis spp.), reducing crop yields by up to 75% in unprotected vineyards. Although the need for protection against downy mildew is essential for grape production in the Eastern US, we only have a handful of modes of action, and we lost some due to fungicide resistance development. Moreover, potential legal restrictions on EBDC and captan could further diminish the list. Two field trials were conducted in Winchester, VA, in 2024 to determine the efficacy of nine biopesticides and four conventional products on Chardonnay vines: the experimental design was a randomized complete block design with four blocks. Treatments were applied to panels consisting of six consecutive vines. Disease incidence and severity of downy mildew were visually estimated from 60 leaves of each treatment per block. We used a linear mixed model to determine the treatment effect on disease severity. The traditional products (captan, copper, and Ranman) resulted in significantly lower mildew severity ($P \leq 0.05$) when compared to the no-spray treatment, while the others did not. The only exception was Zonix. Lifegard and Actigard did not result in statistical significance in either trial but remained close and may hold importance as a secondary product in mixing.

Phenotyping pear germplasm (*Pyrus* spp.) for resistance to post-harvest decay caused by *Penicillium expansum* and *Colletotrichum fioriniae*

Kathryn Pevarnik, Breyn Evans, John S. Bennett, Lauri Reinhold, Christopher Gottschalk, Tamara D Collum

Blue mold caused by *Penicillium expansum* and bitter rot caused by *Colletotrichum fioriniae* are major post-harvest disease concerns for pome fruits leading to large losses during cold storage. Resistance to *P. expansum* and *C. fioriniae* is lacking in commercial varieties of pome fruit crops but has been described in wild apple germplasm. In this study, 90 pear genotypes (*Pyrus* spp.) from the USDA ARS pear germplasm collection in Corvallis, Oregon and the USDA ARS AFRS breeding program in Kearneysville, West Virginia were evaluated for resistance to *P. expansum* and *C. fioriniae* using a wound inoculation method. Disease severity was monitored by measuring the decay lesion diameter at 3-, 5-, and 7-days post inoculation. Bartlett was included as a susceptible control for comparison. Among the genotypes tested, 11 had significantly decreased 7-day lesion sizes for *P. expansum* compared to Bartlett. Additionally, 28 of these genotypes had significantly decreased 7-day lesion sizes for *C. fioriniae*. 9 of these genotypes had significantly reduced lesion development for both *P. expansum* and *C. fioriniae*. Further evaluation and studying of these varieties could lead to more insight into the genetics underlying susceptibility to fruit rot pathogens in pears and will aid pear breeding efforts.

Evaluation of Biorational and Biocontrol Agents for Apple Bitter Rot and Glomerella Leaf Spot

Nathaniel Boeckman

Apple bitter rot (ABR) and Glomerella leaf spot (GLS), caused by the species in fungal genus *Colletotrichum*, is an economically devastating pathogen for apple growers worldwide. Some ABR outbreaks can cause losses between 14%-100% and GLS can defoliate trees up to 75%, severely impacting plant health. The EPA is currently cancelling or limiting uses of key multisite fungicides like mancozeb, ziram, and ferbam. To provide new options for apple growers in the Mid-Atlantic region, we screened 10 fungicides for their efficacy against ABR and GLS including 3 biocontrol agents and 2 biorational materials. Our results show that bacterial based biocontrol agents (Howler, Theia) are effective at reducing ABR by 53% and 51% respectively. Tidal Grow Spectra, a chitosan-based fungicide, reduces ABR by over 60%. YSY Yeast was effective at reducing GLS incidence by 57% on 'Idared' spur leaves and Howler was effective at reducing GLS incidence by 59% on 'Golden Delicious' shoot leaves when compared to the untreated inoculated control. Traditional synthetic fungicides were also effective at reducing ABR incidence on 'Idared' with the exception of Kenja (FRAC 11) and Topsin (FRAC 1) which were not effective on either cultivar tested. Reason (FRAC 7), Luna Sensation (FRAC 11+7), and Kinoprol (FRAC 52) reduced ABR incidence by 50%, 55% and 49% respectively when compared to untreated inoculated control. These materials are considered for inclusion in the future spray programs in commercial apple production.

Understanding the impact of canopy management practices on microclimate and late-season rot development

Shannon Rotella and Mengjun Hu

The creation of an open grapevine canopy with improved airflow and sunlight has been a standard practice to aid in fruit cluster disease management. However, such viticultural practices have yet to be validated in Mid-Atlantic vineyards where diverse diseases are present. During the 2023 and 2024 seasons, field trials were conducted at two locations to determine the effects of shoot thinning and post-bloom leaf removal on late-season fruit rots. Combinations of low/high leaf removal and shoot thinning treatments were applied in each vineyard plot varying in cultivar, pruning method, geographic location, and topography. Interestingly, low-leaf removal treatments (LL) resulted in significantly lower ripe rot severity compared to high-leaf removal treatments (L). While shoot density did not have a significant effect on ripe rot, high shoot thinning treatments (S) resulted in significantly lower cluster powdery mildew and Botrytis compared to low shoot thinning treatments (SS). None of the treatment combinations (LS, LSS, LLS, LLSS) seemed to affect sour rot disease. These findings indicate the importance of understanding disease dynamics concerning canopy microclimates within a vineyard, enabling the development of precise and targeted canopy management strategies tailored to the disease management requirements of specific cultivars and locations.

2024 Graduate Student Presentation Award Winners

Entomology:

Kasia Madalinska

Plant Pathology:

Kathryn Pevarnik

Horticulture:

Emily Johnson