Spotted Lanternfly Past, Present, and Future: Impacts and Management of this Invasive Pest

Dr. Julie Urban
Department of Entomology
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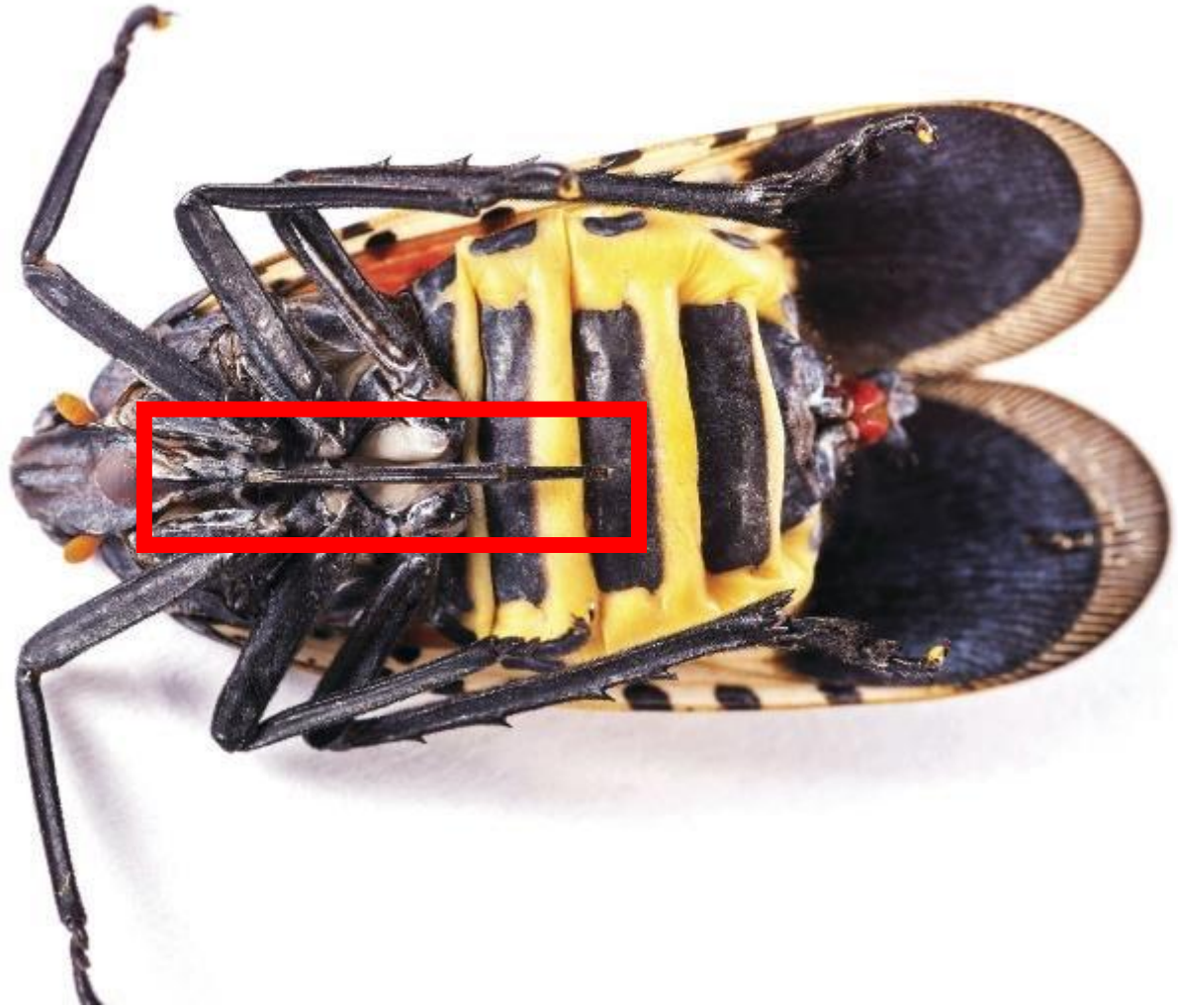
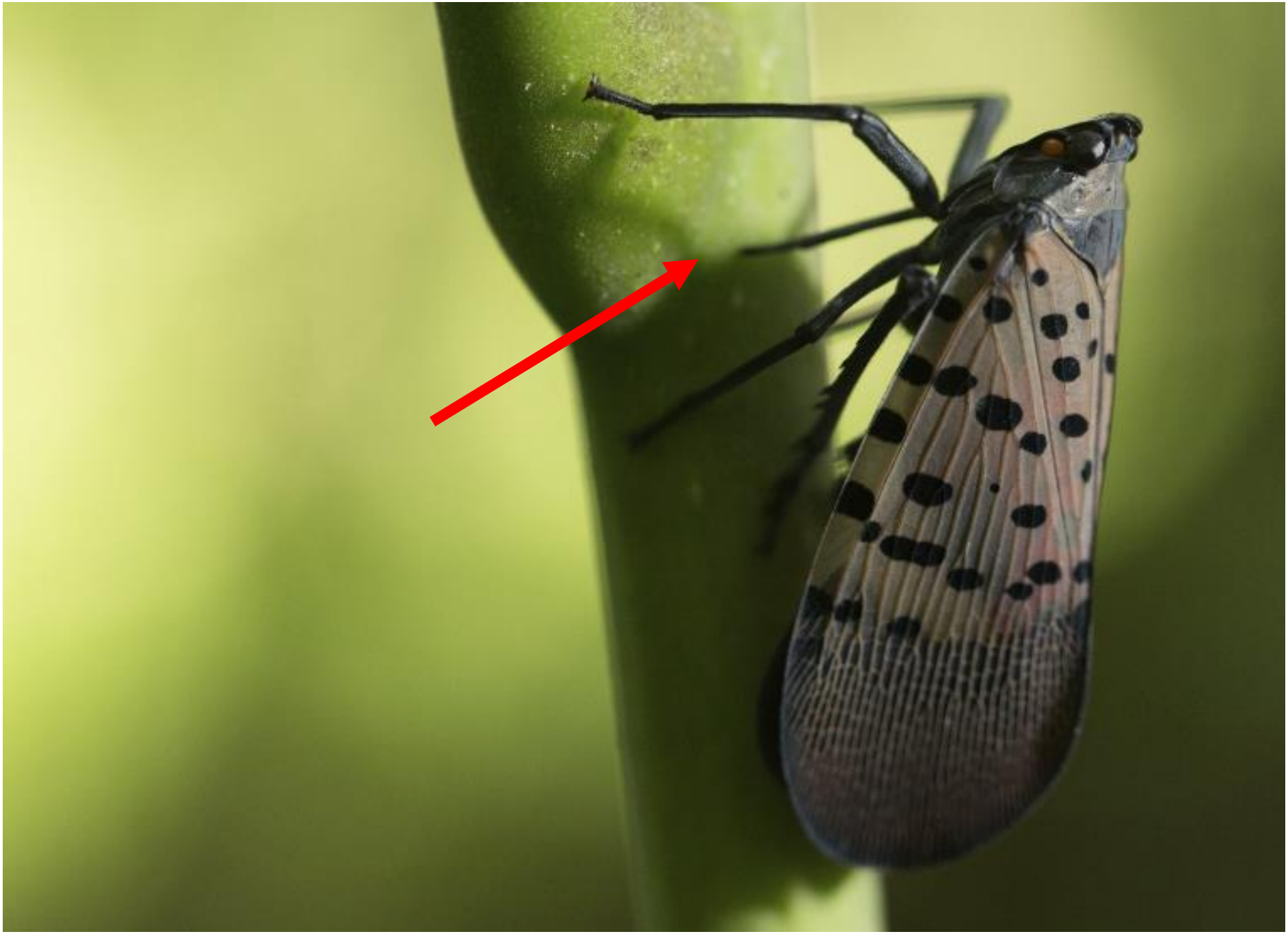
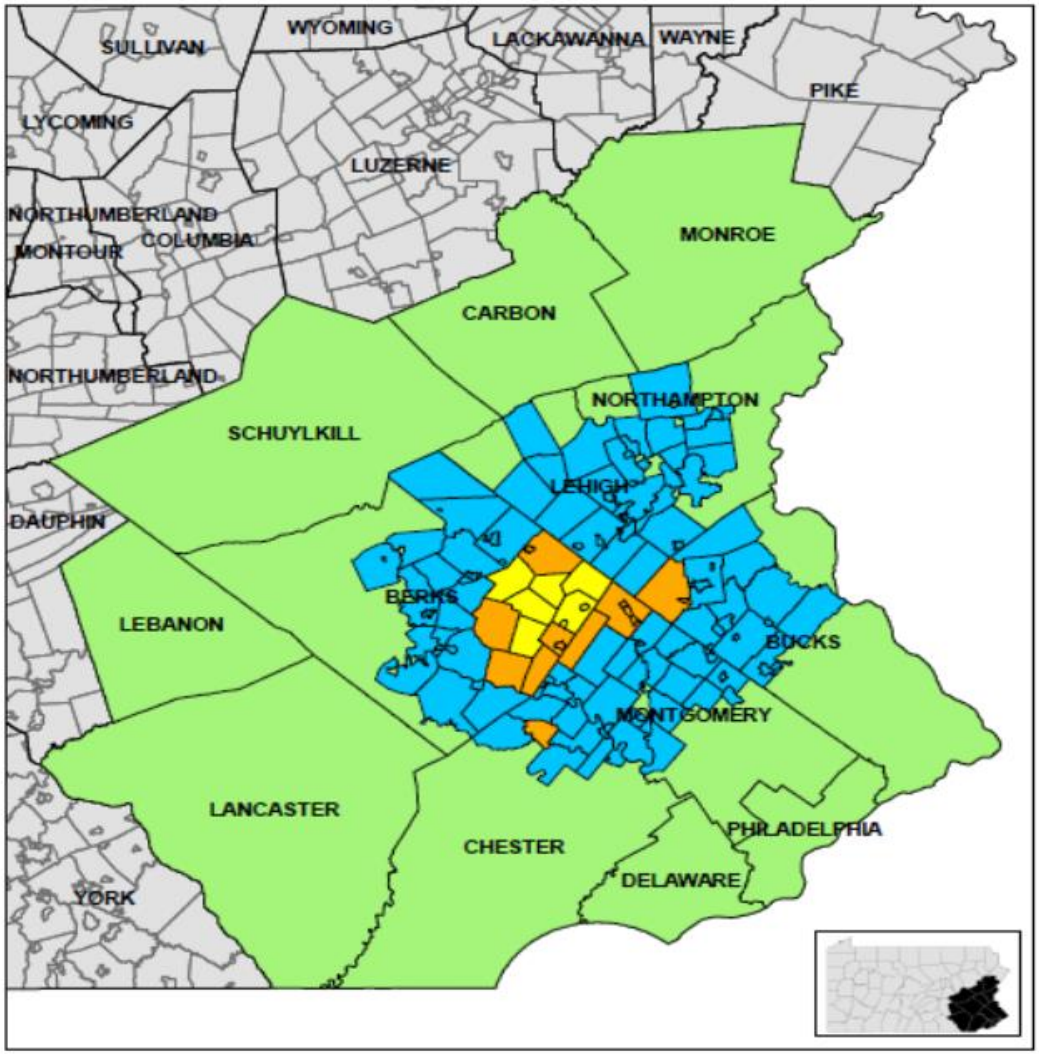
Spotted Lanternfly is a Planthopper

Phloem feeders: piercing-sucking mouthparts





Pennsylvania Spotted Lanternfly Quarantine Map by Year 2014-2017



Legend

- Quarantine2014
- Quarantine2015
- Quarantine2016
- Quarantine2017

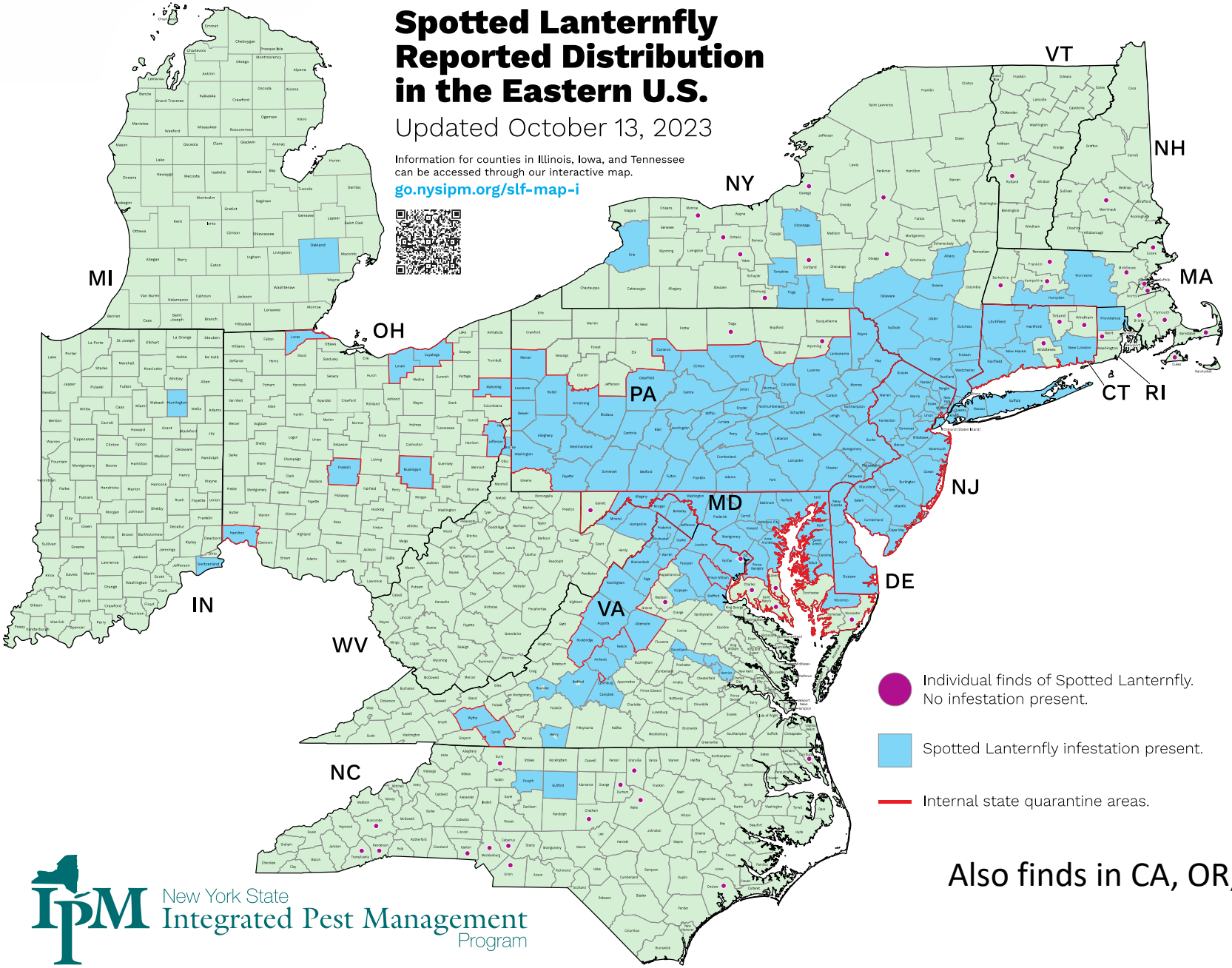
pennsylvania
DEPARTMENT OF AGRICULTURE

Spotted Lanternfly Reported Distribution in the Eastern U.S.

Updated October 13, 2023

Information for counties in Illinois, Iowa, and Tennessee can be accessed through our interactive map.

go.nysipm.org/slf-map-i



Also finds in CA, OR, WA

New York State Integrated Pest Management Program

SLF Feeding and Damage

First Records of Impacts in Grapes: 2016-2018

Economic Impact Studies on Grapes: Harper, Kime, Leach, Centinari

<u>Recorded damage:</u>
In 2017, 90% yield loss in 40 acre planting

In 2018, 100% death of a 8 acre Pinot Noir planting

From 2016-2018, 45% yield reduction in 10 acres Chardonnay planting

More vineyards detecting SLF in 2019 and reporting damage from 2018 feeding

<u>Increased application and cost of insecticides (5 vineyards in SE PA):</u>

The number of insecticide applications in 2016-2018 increased from an average of 4.2 applications to 14.0

This increases the average insecticide cost from $54.63/acre in 2016 to $147.85/acre in 2018 (+171%)

SLF Feeding and Damage

First Observations of Damage to Vineyards

May 2019

SLF Feeding and Damage

First Observations of Damage to Vineyards

Sept. 2019

SLF Feeding and Damage

To Date: SLF Feeding Kills Grapes and Tree of Heaven

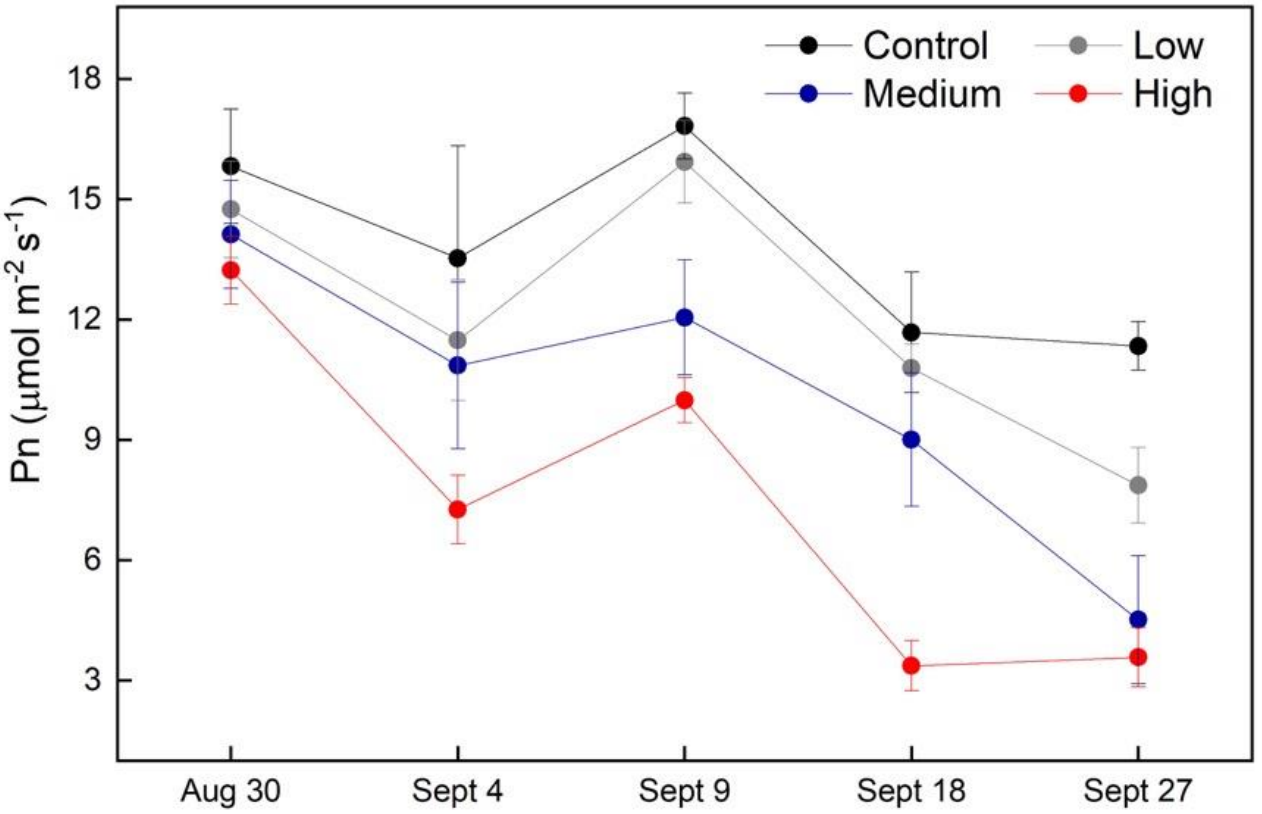
SLF Feeding and Damage

Studying SLF Impacts on Grapes

- Impacts of SLF feeding on grapevines: Michela Centinari (PSU Plant Science):
  -- 2019 – 2021: study of effects of SLF feeding on multiple aspects of grape physiology

  -- 2022 – 2023: determining impacts of SLF feeding by each instar on grapes to establish damage thresholds; Centinari & Flor Acevedo (PSU Behrend and Erie Grape station) at vineyard at Penn State Fruit Research & Experimental Station (FREC), near Gettysburg, PA

SLF adults decrease photosynthesis in grapevines: the higher the density the greater and faster is the suppression



Measurements were taken the last day of each introduction cycle (cycle 1 to cycle 5)

Control = 0 SLF; Low = 4 SLF/shoot; Medium = 8 SLF/shoot; High = 12 SLF/shoot
For each of 5 feeding cycles, SLF introduced to cage and left to feed for 4 days

In 2020 and 2021 seasons, experiment was being replicated, extending to 6 feeding cycles

ORIGINAL RESEARCH

Prolonged phloem feeding by the spotted lanternfly, an invasive planthopper, alters resource allocation and inhibits gas exchange in grapevines

Andrew D. Harner[1] | Heather L. Leach[2] | Lauren Briggs[1] | Michela Centinari[1]

Heavy and extensive SLF feeding:

- Reduces accumulation of sugars and nitrogen
- Decreases vine capability to produce sugar (photosynthesis)

Hoover et al. report parallel results on ornamentals – impact of SLF feeding depends upon size of trees (potted vs. common garden vs. larger enclosures)

Findings of Hoover et al. experiments:

- Nymphs have minimal impact on studied ornamentals
- High numbers of adult feeding can reduce gas exchange over time, but effects are minimal
- SLF acts as a stressor on trees; does not kill them (rare to kill saplings)
- Effects of SLF could be amplified by other stressors

SLF Feeding and Damage

Not a Problem in Apple, Stone Fruit Orchards

What is Risk from SLF on other specialty crops?

(H. Leach, 2020; Now led by Holly Shugart, 2021, 2022 Berks trials, 2023 Lab)

Adult	4th Instar	1st – 3rd Instar
• Peach	• Peach	• Strawberry
• Kiwi berry	• Avocado	• Blueberry
• Grapevine	• Kiwi berry	• Hops
• *V. Vinifera*	• Fig	• Cucumber
• Chardonnay & Riesling	• Hops	• Pumpkin
• *V. Labrusca,* Concord	• Raspberry	• Watermelon
• Hops	• Cucumber	• Sunflower
	• Pumpkin	• Tomato
	•	

Young Nymph (1st-3rd instar) Survivorship & Damage

Host	Field reports of populations/damage?	Survivorship > 50%?	Damage documented in controlled experiments?	Anticipated risk
Strawberry	No	Yes	No. Results are not clear.	Unknown
Blueberry	No	Yes	No. Results are not clear.	Unknown
Hops	Low levels	Yes	Low levels	Low risk from nymphs
Cucumber	Low levels, backyard growers	Yes	No observed damage	Low risk from nymphs
Pumpkin	Low levels, backyard growers	Yes	No observed damage	None
Watermelon	Low levels, backyard growers	Yes	No observed damage	None
Sunflower	Low levels, backyard growers	Yes	No observed damage	None
Tomato	Low levels, backyard growers	Yes	No observed damage	None

4th Instar Nymph Survivorship & Damage

Host	Field reports of populations/damage?	Survivorship > 50%?	Damage documented in controlled experiments?	Anticipated risk
Peach	Medium- low levels	Yes	Yes, fruit drop and defoliation	Medium-high
Avocado	No	Yes	No observed damage	Low
Kiwi berry	High density reports from Asia	Yes	No observed damage	Medium-Low
Fig	No	Yes	No observed damage	Low
Hops	Low levels	Yes	Low levels	Low risk from nymphs
Raspberry	Low levels	Yes	Reduction in shoot growth	Medium- low
Cucumber	Low levels, backyard growers	Yes	Reduction in yield	Medium-low
Pumpkin	Low levels	Yes	No observed damage	Low
Watermelon	Low levels	Yes	No observed damage	Low

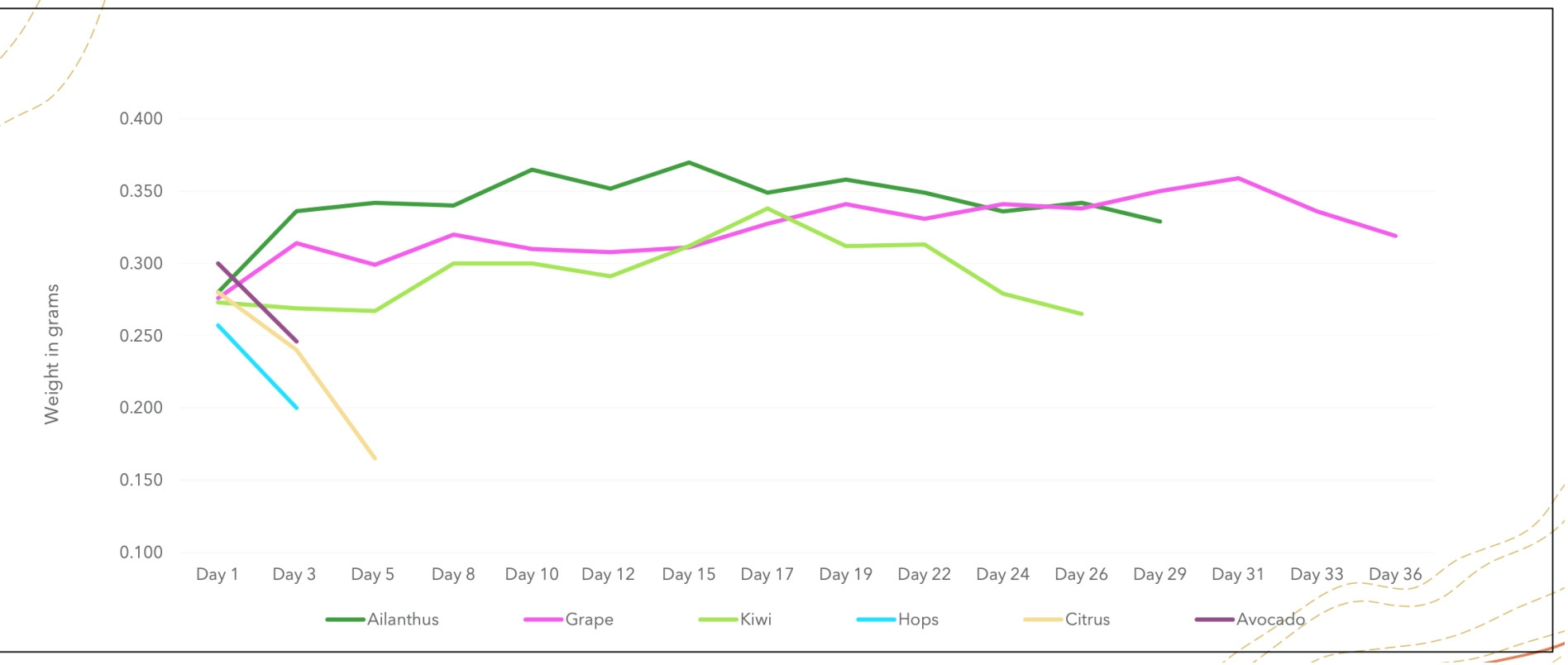
Adult Survivorship & Damage

- Based on studies where we "force-fed" SLF on plants

Host	Field reports of populations/damage?	Survivorship > 50%?	Damage documented in controlled experiments?	Anticipated risk
Peach	Medium- low levels	Yes	Yes, fruit drop and defoliation	Medium-high
Kiwi berry	High density reports from Asia	Yes	No direct feeding damage Worry of sooty mold damage	Medium-Low
Grapevine	Yes	Yes @ low density	Yes, defoliation and vine necrosis	High
V. Vinifera Chardonnay & Riesling	Yes	Yes @ low density	Yes, defoliation and vine necrosis	High
V. Labrusca Concord	No	Yes @ low density	Yes, defoliation and vine necrosis	Med-high Damaged but recovered
Hops	Low levels	Yes @ low density	Minor yield reduction Defoliation and vine necrosis	Medium-high
Raspberry	Low levels	Yes	Reduction in shoot growth	Medium- low

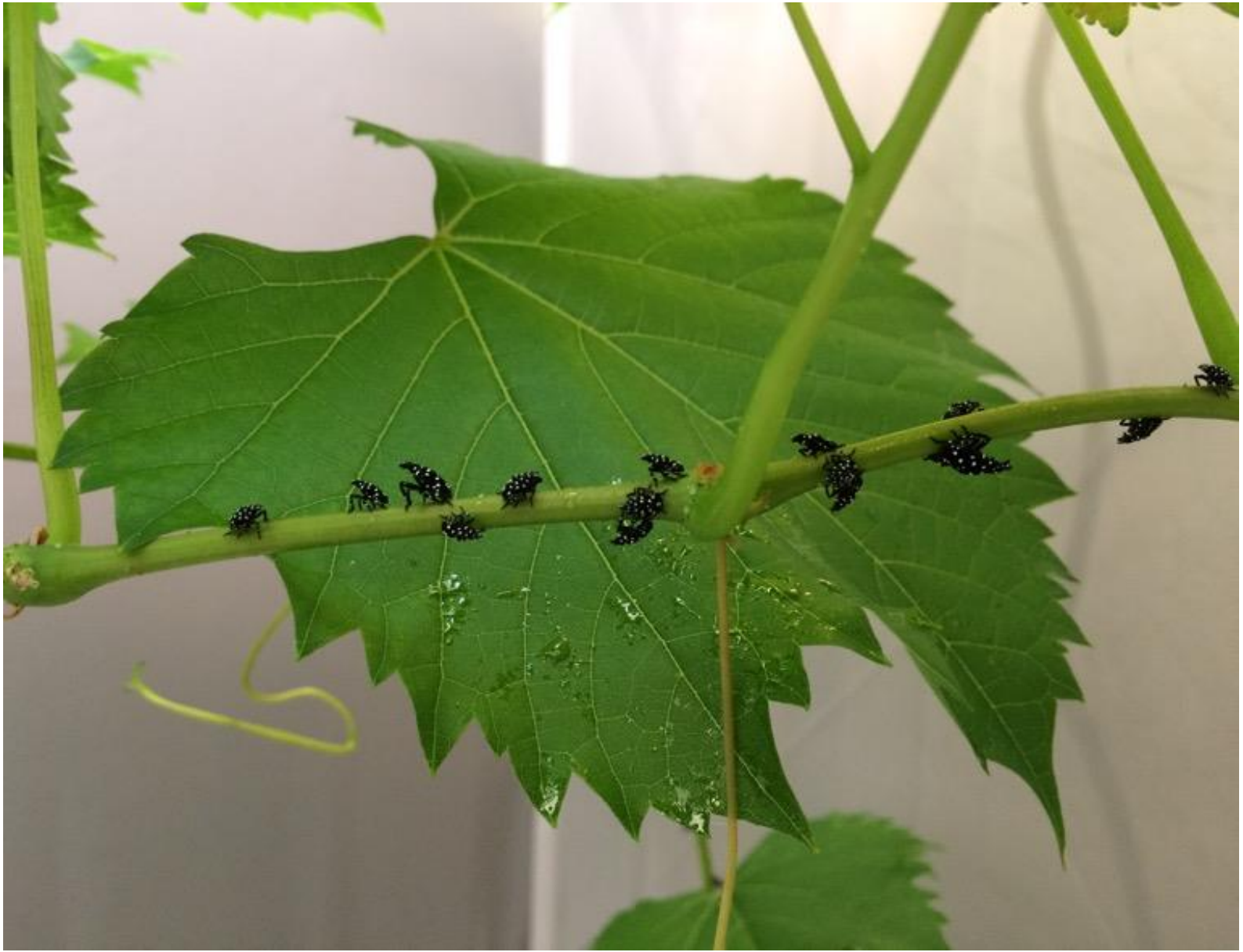
Adult SLF Mean Weight and Survival Duration

- More realistic assessment of impact on other specialty crops – Dr. Holly Shugart, Terese Kaveney, 2023
- SLF adult mass and survival over time on:
  - Ailanthus (TOH)
  - Grape
  - Kiwi
  - Hops
  - Citrus
  - Avocado



SLF Feeding and Damage

Sooty Mold: Grows on SLF Honeydew



SLF Feeding and Damage

Sooty Mold: Grows on SLF Honeydew

- Has not been reported as a serious problem in vineyards

SLF Feeding and Damage

Sooty Mold: Grows on SLF Honeydew

SLF Feeding and Economic Impacts

Nurseries and Egg Deposition

- Keeping all stages of SLF out of products (esp. shipments)
- Some reports of feeding damage to nursery stock

SLF Feeding and Economic Impacts

Nurseries and Egg Deposition

SLF Feeding and Economic Impacts

Nurseries and Egg Deposition

SLF Economic Impacts

Agrotourism:

Movement with Vineyard Visitors (any life stage)

Vehicle Checklist for Vineyard Visitors:

http://www.met.psu.edu/browse-by-audience/faculty-staff/extension_single_inspection_vehicle_checklist.pdf

PennState Extension

pennsylvania DEPARTMENT OF AGRICULTU

Spotted Lanternfly Quarantine Checklist for Vehicle Inspection

IMPORTANT: Before traveling from the quarantine area, check for spotted lanternfly egg masses, and nymphs. Make sure your vehicle and all transported items are pest free. *Help stop this pest from spreading!*

On May 26, 2018, a Spotted Lanternfly Order of Quarantine and Treatment was published in the PA Bulletin has been updated several times. The Pennsylvania Department of Agriculture (PDA) established the quarant to stop this pest from moving out of the current quarantine zone. PDA is also trying to minimize the movemen within the quarantine zone from areas with higher populations into areas with low to no populations.

The current quarantine zone encompasses these counties: **Adams, Allegheny, Armstrong, Beaver, Bedfo Berks, Blair, Bucks, Butler, Cambria, Cameron, Carbon, Centre, Chester, Clearfield, Clinton, Columbi Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Huntingdon, Indiana, Juniata, Lackawann Lancaster, Lawrence, Lebanon, Lehigh, Luzerne, Lycoming, Mercer, Mifflin, Monroe, Montgomery, M Northampton, Northumberland, Perry, Philadelphia, Pike, Schuylkill, Snyder, Somerset, Union, Wash Wayne, Westmoreland, and York**. Travel within or out of those counties requires a permit and vehicles mu inspected.

TRAVEL INFORMATION

DATE:_____

DRIVER:_____

VEHICLE:_____

INSPECTION

☐ Adams	☐ Cumberland	☐ Mifflin
☐ Allegheny	☐ Dauphin	☐ Monroe
☐ Armstrong	☐ Delaware	☐ Montgomer
☐ Beaver	☐ Fayette	☐ Montour
☐ Bedford	☐ Franklin	☐ Northampto
☐ Berks	☐ Fulton	☐ Northumber
☐ Blair	☐ Huntingdon	☐ Perry
☐ Bucks	☐ Indiana	☐ Philadelphia
☐ Butler	☐ Juniata	☐ Pike
☐ Cambria	☐ Lackawanna	☐ Schuylkill
☐ Cameron	☐ Lancaster	☐ Snyder
☐ Carbon	☐ Lawrence	☐ Somerset
☐ Centre	☐ Lebanon	☐ Union
☐ Chester	☐ Lehigh	☐ Washington
☐ Clearfield	☐ Luzerne	☐ Wayne
☐ Clinton	☐ Lycoming	☐ Westmorela
☐ Columbia	☐ Mercer	☐ York

The following is a list of items / places that may harbor SLF. This list is not all-inclusive but should serve as a starting point in actively inspecting for SLF.

☐ Vehicles (Interior)	☐ Trailers	☐ Storage Bins
☐ Vehicles (Exterior)	☐ Tool Boxes	☐ Storage Crates
☐ Truck Beds / Caps	☐ Dollies	☐ Pallets
☐ Wheel Wells		

Please see reverse side for life cycle information. Depending on the time of year, check for both live insects and / or egg masses. If you find live insects, destroy them. If you find egg masses, remove and destroy them. When inspection is complete, sign and date the reverse side.

SPOTTED LANTERNFLY QUARANTINE CHECKLIST FOR VEHICLE INSPECTION

IMPORTANT: Before traveling from the quarantine area, check for spotted lanternfly egg masses, adults, and nymphs. Make sure your vehicle and all transported items are pest free. *Help stop this pest from spreading!*

If you find any live insects, kill them. If you find any egg masses, scrape them into a plastic bag, seal the bag, and dispose of it in the garbage.

Adult spotted lanternfly, present in autumn months.

Spotted lanternfly nymphs, present in spring and summer months.

Spotted lanternfly egg mass (outlined in red). Egg masses are present in autumn and winter months, blending in with their surroundings.

By signing this checklist, I am confirming that I have inspected my vehicle and those items I am moving from the Spotted Lanternfly quarantine area, and do not see any egg masses or insects in or on anything I am moving.

Signature: _____ **Date:** _____

For more information, visit the websites of Pennsylvania Department of Agriculture and Penn State Extension.

extension.psu.edu

SLF Economic Impacts

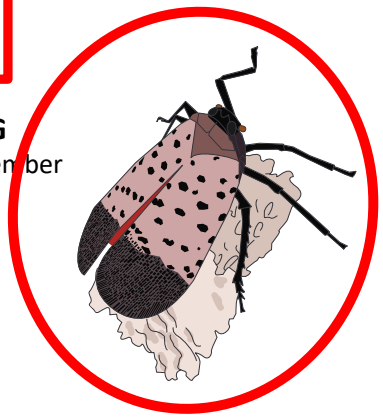
Quarantine Compliance:
Movement on Conveyances or with Products being Shipped

Timber:
Movement on logs (egg masses)

Tree Fruit:
Movement on fruit crates (egg masses)

SLF LIFE CYCLE
(in eastern PA)

Late season adults:
Bouts of flight



EGG LAYING
September - December

EGGS
October - June

Early instars (1-3): broad ranging on herbaceous plants

HATCH AND FIRST INSTAR
May - June

SECOND INSTAR
June - July

THIRD INSTAR
June - July

FOURTH INSTAR
July - September

Begin to feed on woody tissues

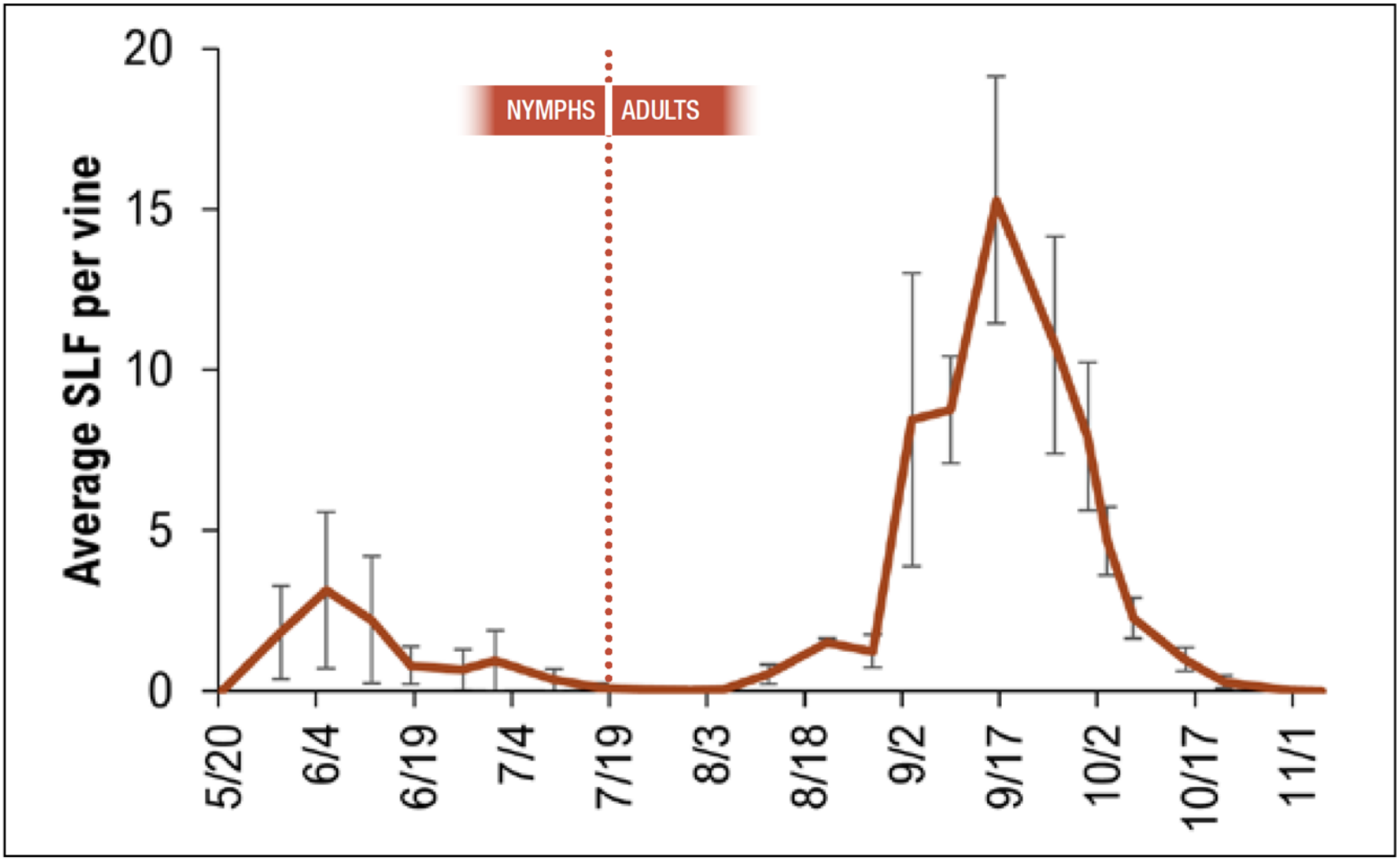
ADULTS
July - December

SLF Management in Vineyards

https://extension.psu.edu/spotted-lanternfly-management-in-vineyards

(data collected by H. Leach)

Adult SLF moving into vineyards from surrounding areas is biggest threat, often within 50 ft. of vineyard edge



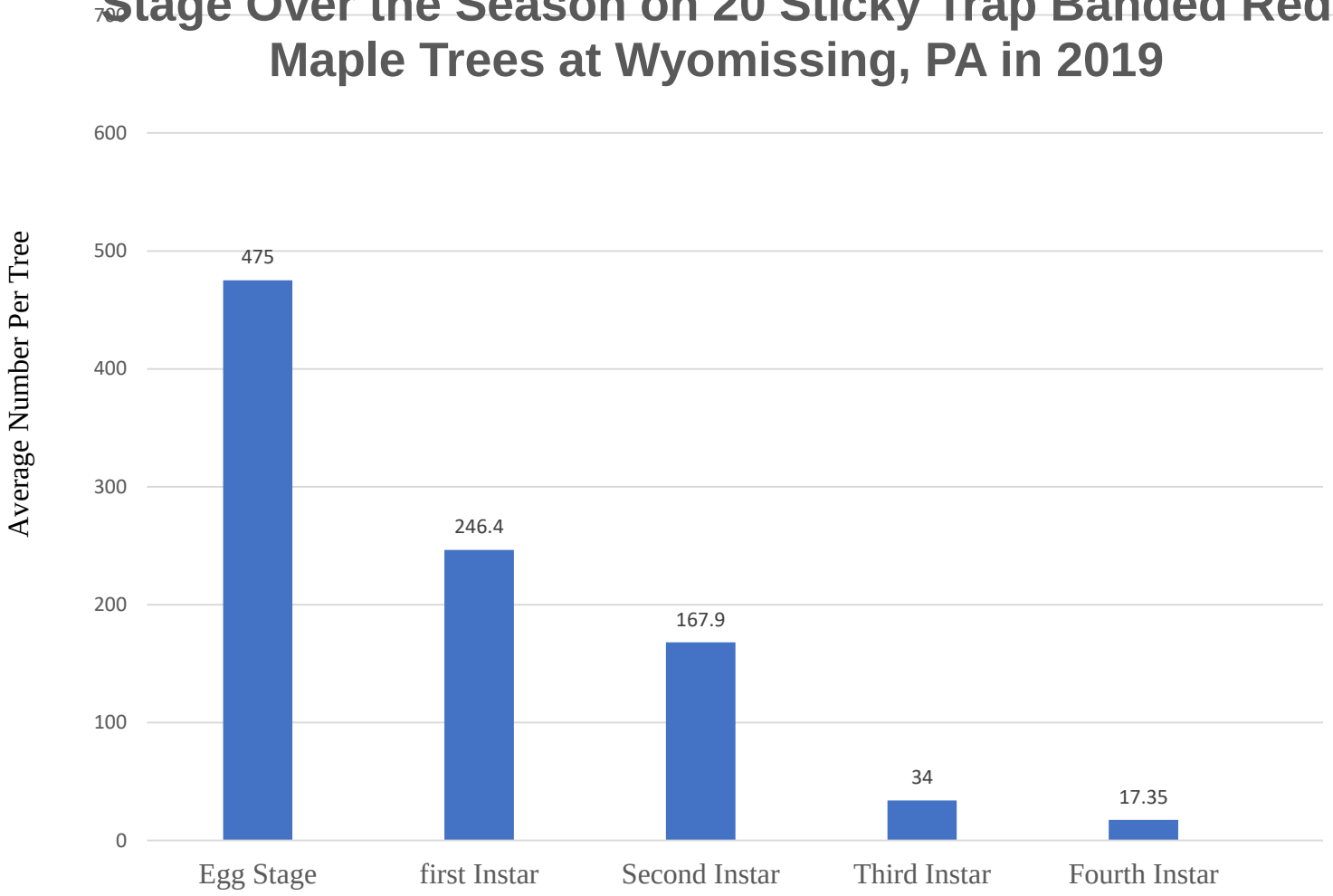
Late Season Movement

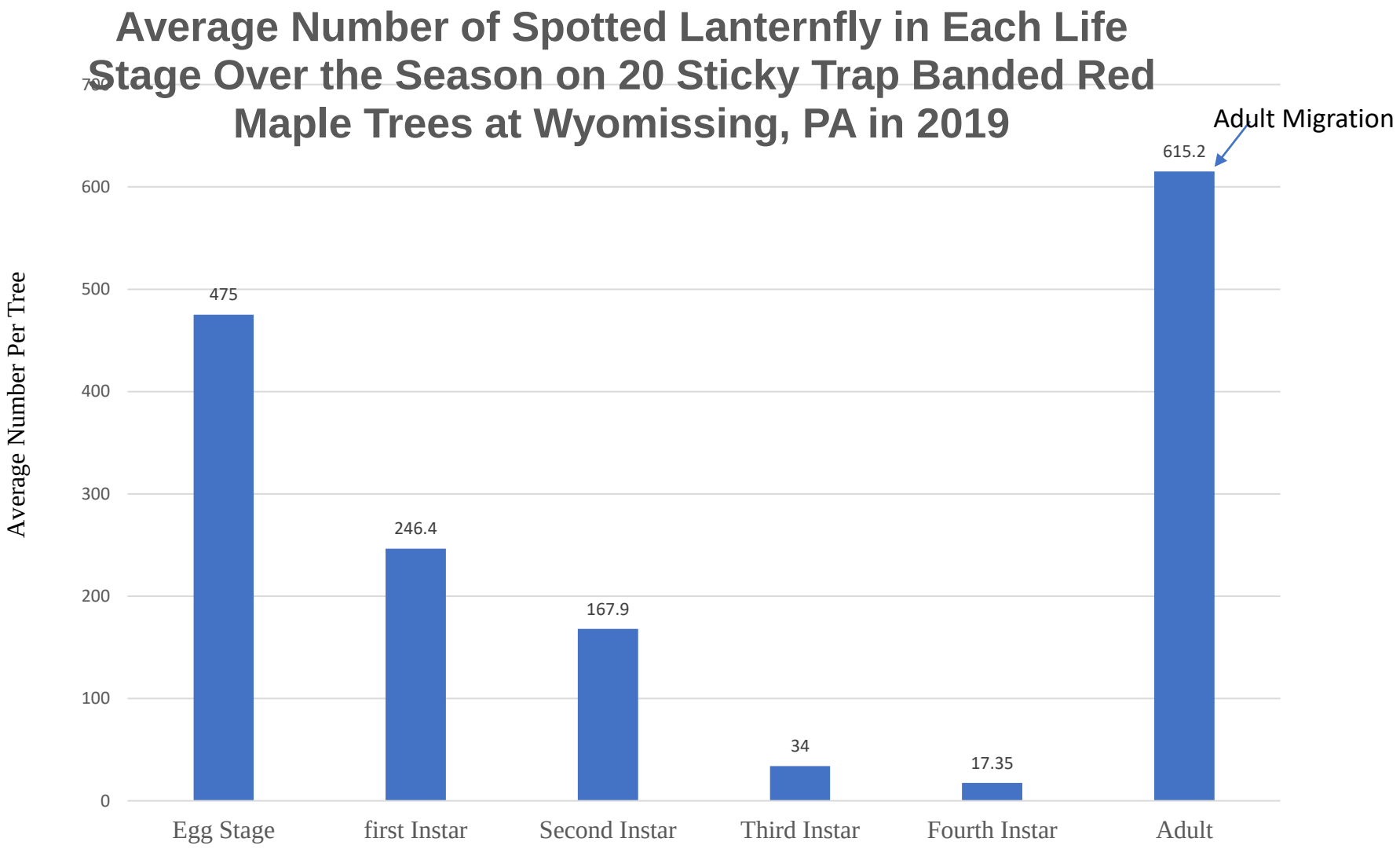
Wyomissing, PA Weekly Sampling Study:
Dennis Calvin, John Rost

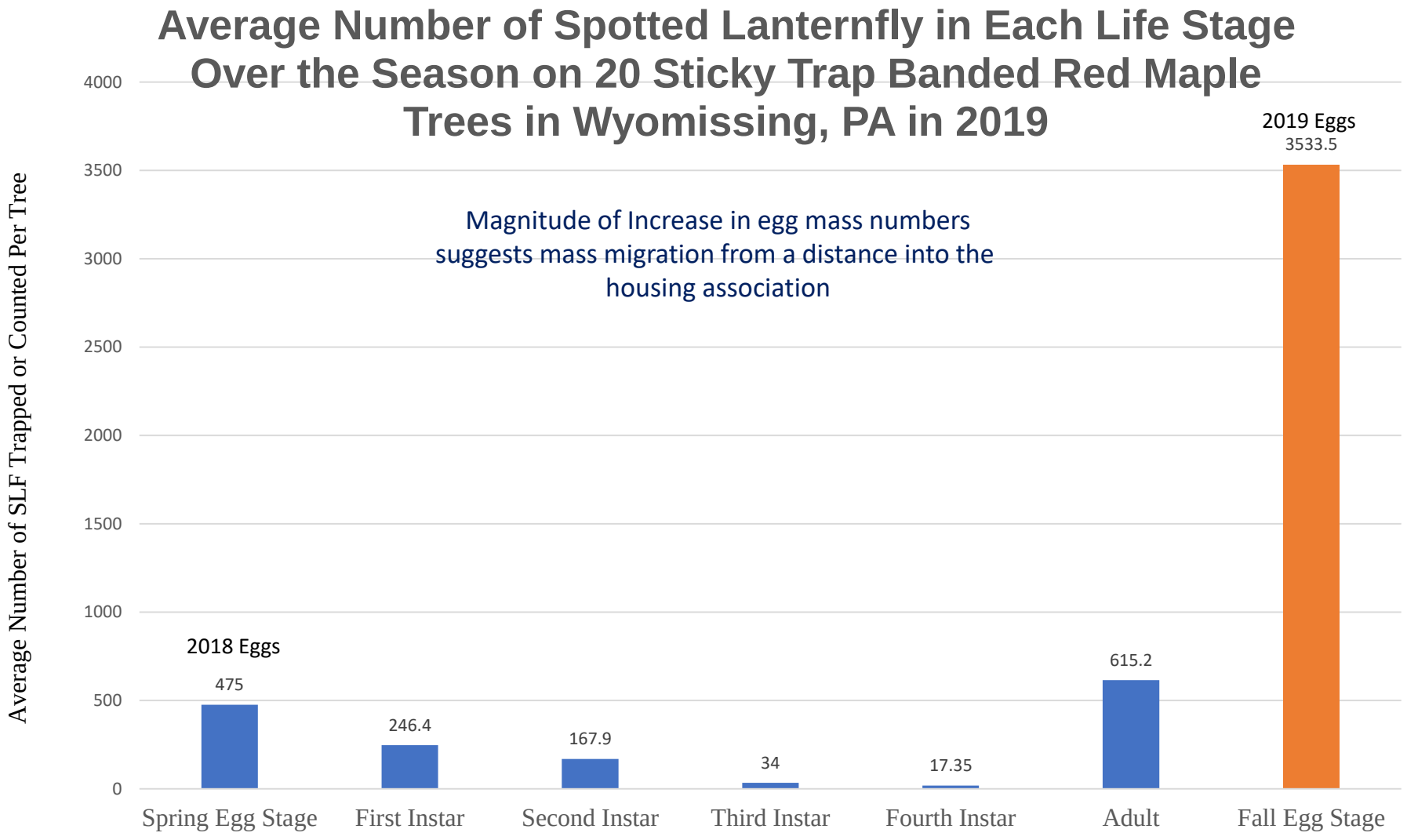
Late Season Movement

- Sticky bands (which can be modified to reduce bycatch)

Average Number of Spotted Lanternfly in Each Life Stage Over the Season on 20 Sticky Trap Banded Red Maple Trees at Wyomissing, PA in 2019

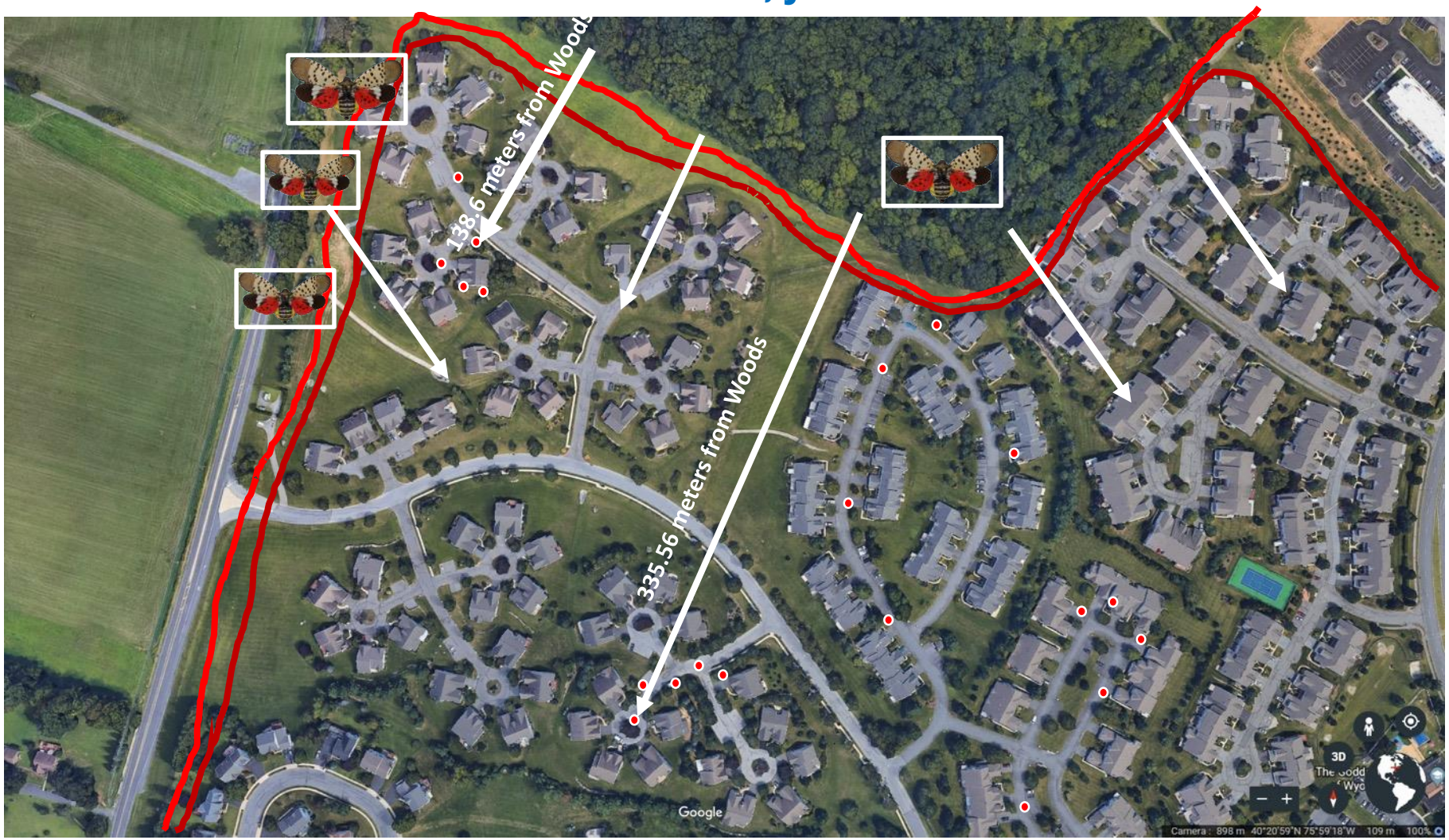



Average Number of Spotted Lanternfly in Each Life Stage Over the Season on 20 Sticky Trap Banded Red Maple Trees at Wyomissing, PA in 2019
Average Number Per Tree
700
600
500
400
300
200
100
0
475
246.4
167.9
34
17.35
615.2
Adult Migration
Egg Stage
first Instar
Second Instar
Third Instar
Fourth Instar
Adult


Average Number of Spotted Lanternfly in Each Life Stage Over the Season on 20 Sticky Trap Banded Red Maple Trees in Wyomissing, PA in 2019
Average Number of SLF Trapped or Counted Per Tree
4000
3500
3000
2500
2000
1500
1000
500
0
Magnitude of Increase in egg mass numbers suggests mass migration from a distance into the housing association
2018 Eggs
475
246.4
167.9
34
17.35
615.2
2019 Eggs
3533.5
Spring Egg Stage
First Instar
Second Instar
Third Instar
Fourth Instar
Adult
Fall Egg Stage

Late Season Movement

Wyomissing, PA Weekly Sampling Study:
Dennis Calvin, John Rost

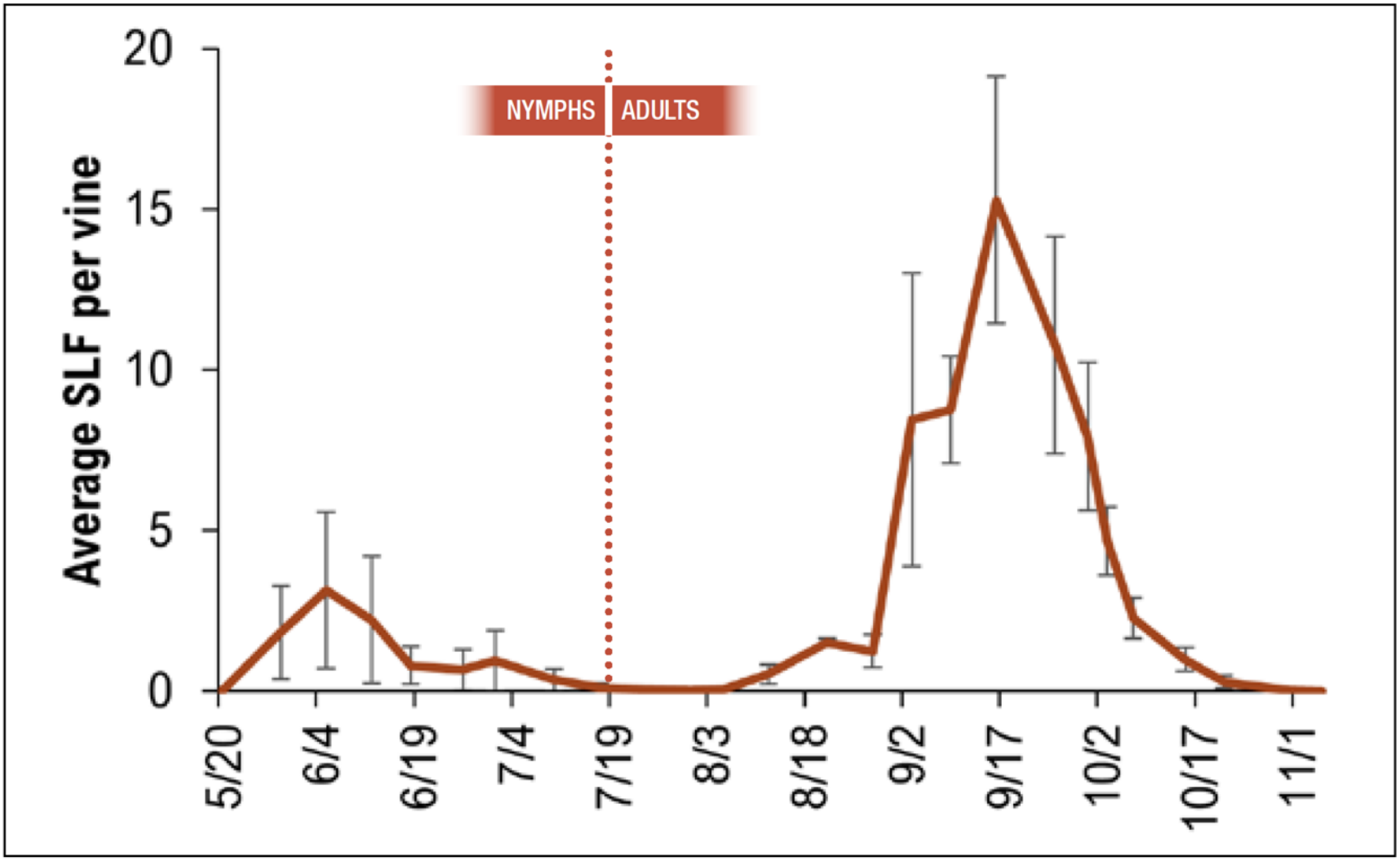


SLF Management in Vineyards

https://extension.psu.edu/spotted-lanternfly-management-in-vineyards

(data collected by H. Leach)

Adult SLF moving into vineyards from surrounding areas is biggest threat, often within 50 ft. of vineyard edge



SLF Late Season Movement

Chemical Control

- Current management dependent on preventative chemical control
  - https://extension.psu.edu/spotted-lanternfly-management-in-vineyards

Active Ingredient	Trade Name(s) Tested	Class (IRAC Group)	Toxicity to Bees	Rate Per Acre	PHI (days)	REI (hours)	Target Life Stage Tested	Longevity of Product (days)*	Efficacy Rating
Bifenthrin	Brigade 2EC/ Bifenture EC**	Pyrethroid (3)	High	6.4 oz	30	12	Adults	7–14	Excellent
Beta-cyfluthrin	Baythroid	Pyrethroid (3)	High	3.2 oz	3	12	Adults	7–14	Excellent
Fenpropathrin	Danitol	Pyrethroid (3)	High	21.33 oz	21	24	Adults	21	Excellent
Zeta-cypermethrin	Mustang Maxx 0.8EC	Pyrethroid (3)	High	4 oz	1	12	Nymphs, adults	0 (knockdown only)	Excellent
Dinotefuran	Venom/ Scorpion	Neonicotinoid (4A)	High	3 oz/ 5 oz	1	12	Nymphs, adults	3–5	Excellent
Thiamethoxam	Actara	Neonicotinoid (4A)	High	3.5 oz	5	12	Nymphs, adults	3–5	Excellent
Carbaryl	Sevin XLR Plus/ Carbaryl 4L	Carbamate (1A)	High	2qt	7	12	Nymphs, adults	0 (knockdown only)	Good to excellent
Malathion	Malathion 8F	Organophosphate (1B)	High	1.88 pt	3	12	Nymphs, adults	0 (knockdown only)	Excellent
Chlorpyrifos	Lorsban Advanced	Organophosphate (1B)	High	1 qt	35	24	Eggs	—	Excellent
Paraffinic oil	JMS Stylet Oil	Mineral oil (n/a)	Low	3%	14	4	Eggs	—	Good

Efficacy and nontarget effects of broadcast treatments to manage spotted lanternfly (Hemiptera: Fulgoridae) nymphs

Journal of Economic Entomology, XX(XX), 2023, 1–14
https://doi.org/10.1093/jee/toad121
Research

Joseph A. Keller[1,*], Brian Walsh[2], Anne Johnson[1], Nina Jenkins[1], John Rost[3], Brianna Treichler[4], David Biddinger[5], Dennis D. Calvin[6], Kelli Hoover[1], Julie Urban[1], Richard T. Roush[6]

Tested the efficacy *Beauveria bassiana* (available as a biorational insecticide) to control SLF nymphs (first 3 instars)

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Tested the efficacy *Beauveria bassiana* (available as a biorational insecticide) to control SLF nymphs (first 3 instars)

Treatments:

-- BoteGHA: B. bassiana, water-based formulation (3X)

-- Aprehend: B. bassiana, oil-based formulation (3X)

-- Safari: dinotefuran (neonicotinoid) (1X)

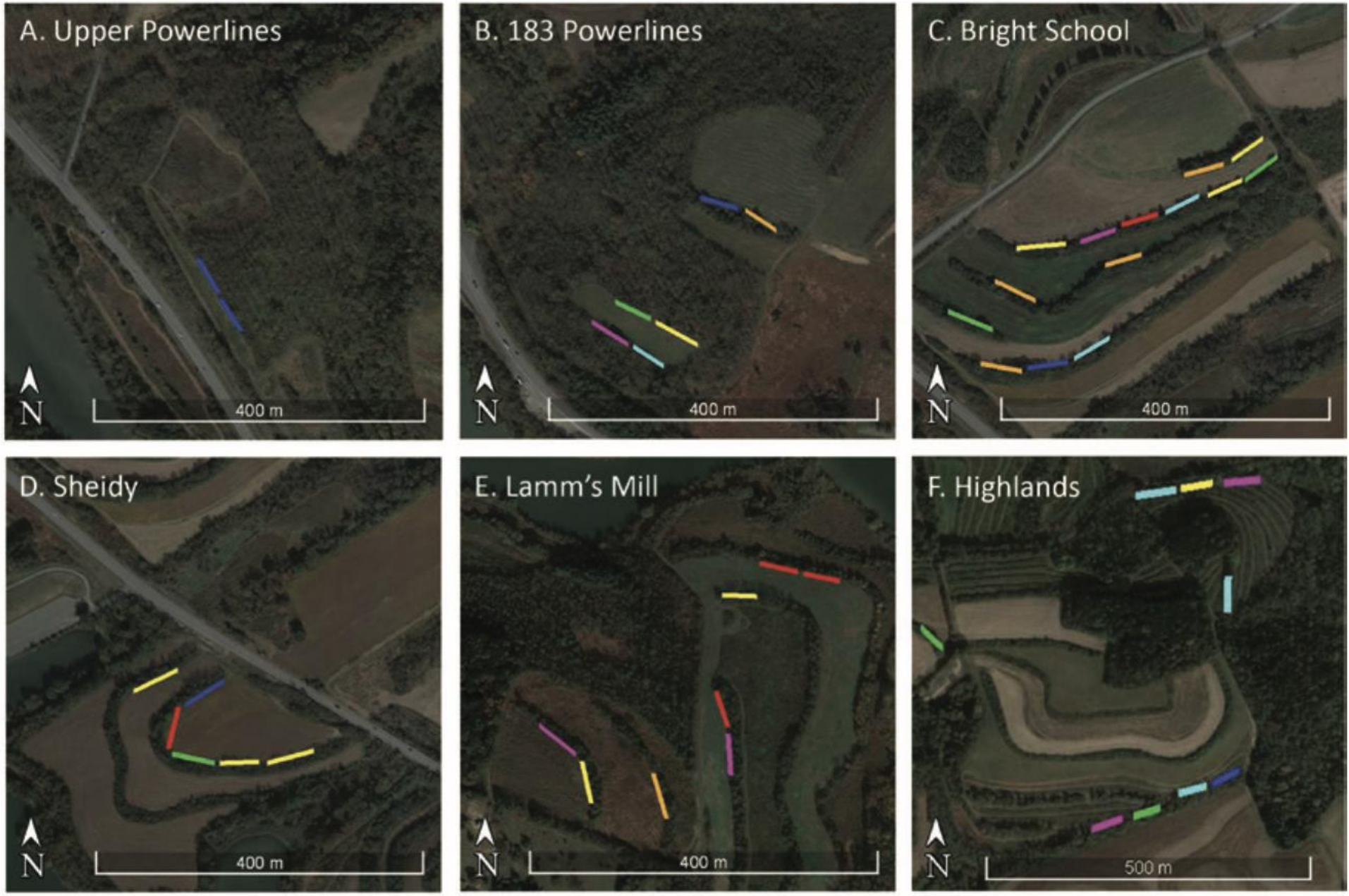
Application method:

-- Aerial application: helicopter

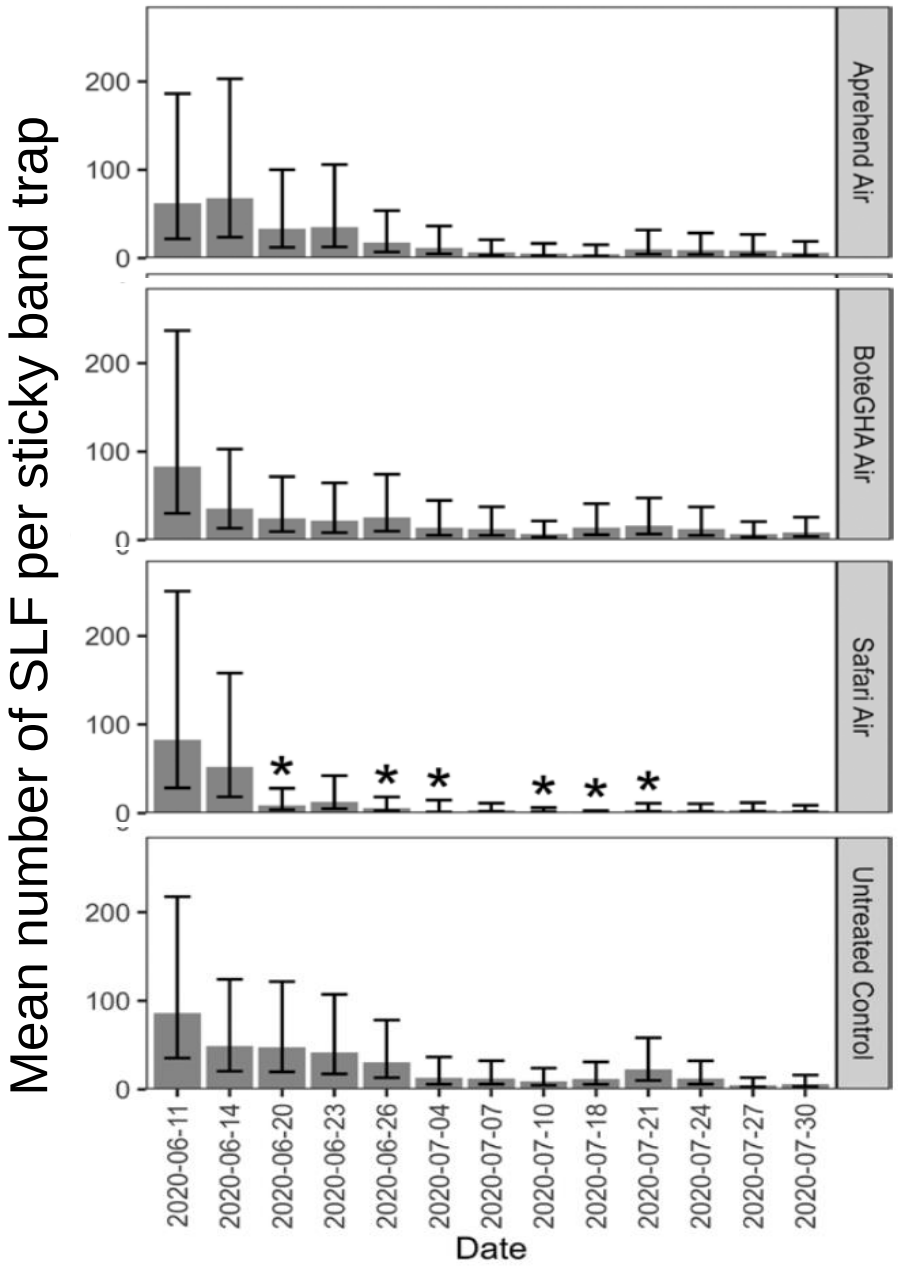
-- Ground application: backpack sprayer

Timing:

-- Applications made to target each of first 3 instars based on phenology model (Safari single treatment, made in application targeting first instars)


A. Upper Powerlines
B. 183 Powerlines
C. Bright School
D. Sheidy
E. Lamm's Mill
F. Highlands
N
400 m
500 m
Untreated Control
Aprehend Air
Aprehend Ground
BoteGHA Air
BoteGHA Ground
Safari Air
Safari Ground

Results: *Beauveria bassiana* was not effective in controlling SLF populations



- Safari (dinotefuran) did show significant effect in reducing SLF
- Non-target impacts were not observed in blue-vane, San Jose scale or flight-intercept traps

Similar results shown in woodlot next to vineyard (Leach, unpublished)

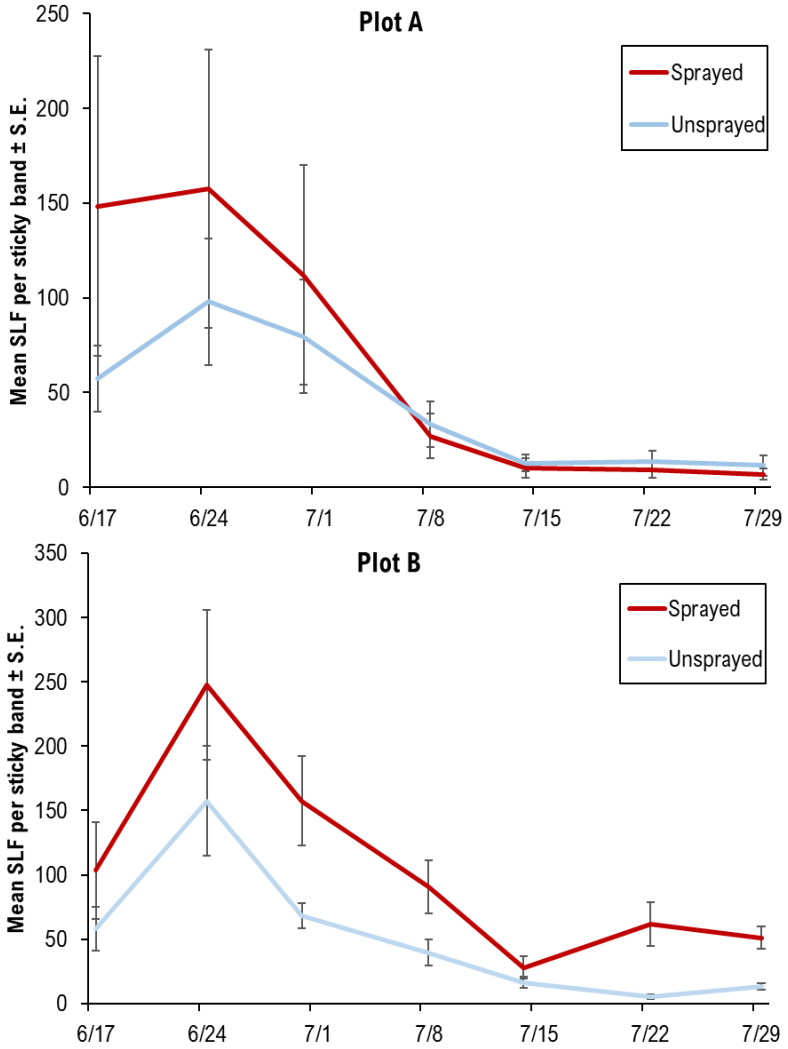
Efficacy of *Beauveria bassiana* (available as a biorational insecticide) not shown to provide effective control of SLF populations in vineyards

3rd – 4th Nymphal Instars

Two wooded areas, each adjacent a vineyard, were split in half. **Half received *Beauveria bassiana* (BoteGHA), half received no treatment.**

Treatments applied on: 6/17, 6/30, 7/14

Coverage:
up to 50 ft. into woodlot
up to 38+ meters high



Targeting Egg Masses

- Efficacy of ovicides is variable: kills up to ~75% of treated eggs
- Registered insecticidal oils most effective if applied between Feb. and April in high enough volumes to provide very good coverage
- Mechanical removal: scraping

Dispersion Patterns and Sample Size Estimates for Egg Masses of Spotted Lanternfly (Hemiptera: Fulgoridae)

J. Keller,[1] J. Rost,[2] K. Hoover,[1] J. Urban,[1] H. Leach,[1] M. Porras,[1] B. Walsh,[3] M. Bosold,[4] and D. Calvin[5,6]

Environmental Entomology, 49(6), 2020, 1462–1472
doi: 10.1093/ee/nvaa107

Most egg masses over 6m above ground

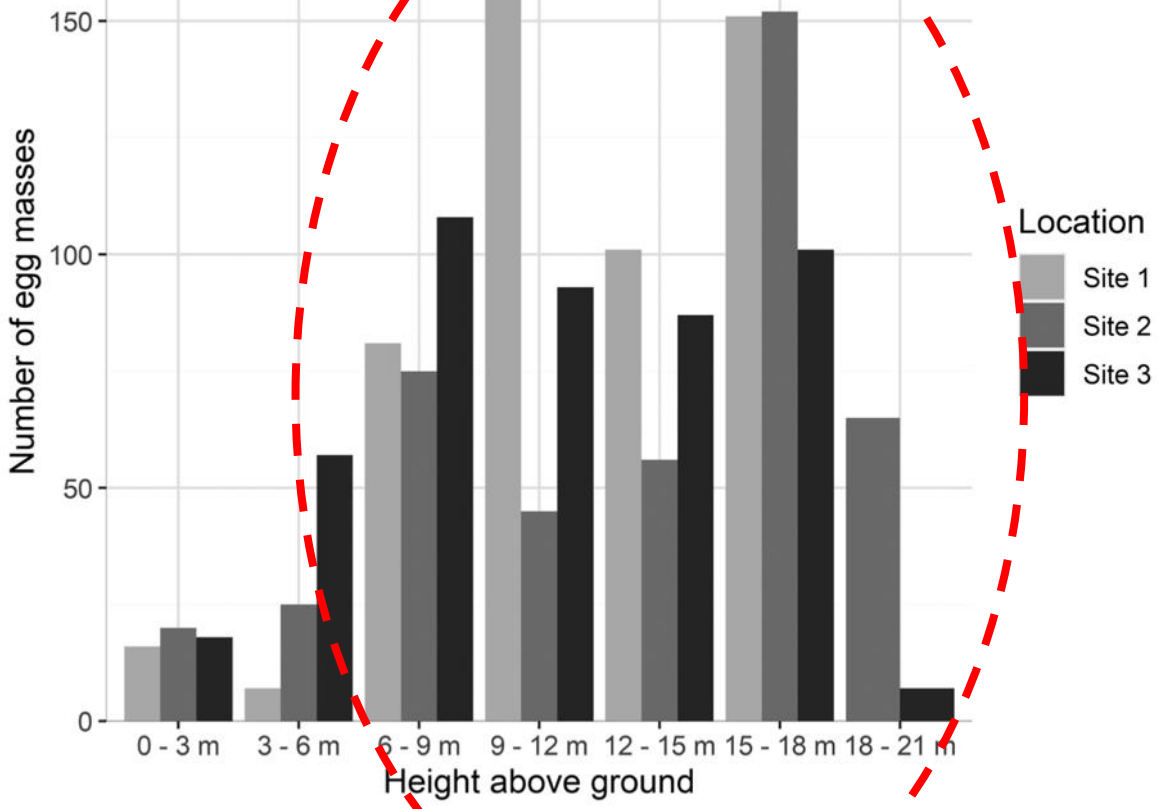


Fig. 4. Vertical height distribution of spotted lanternfly egg masses (in 3 m vertical sections) on *Ailanthus altissima* trees felled at three locations in Pennsylvania during 2019.

SLF Monitoring and Trapping

- Sticky bands (can be modified to reduce bycatch)

SLF Monitoring and Trapping

- Sticky bands can be modified to reduce bycatch
  https://extension.psu.edu/spotted-lanternfly-management-guide

SLF Monitoring and Trapping

Development of Behaviorally Based Monitoring and Biosurveillance Tools for the Invasive Spotted Lanternfly (Hemiptera: Fulgoridae)

Laura J. Nixon,[1,6] Heather Leach,[2] Caitlin Barnes,[3] Julie Urban,[2] Danielle M. Kirkpatrick,[1,4] Dalton C. Ludwick,[1] Brent Short,[1,4] Douglas G. Pfeiffer,[5] and Tracy C. Leskey[1]

Environmental Entomology, 49(5), 2020, 1117–1126
doi: 10.1093/ee/nvaa084

- Results: Circle trap (cone trap) is comparable to sticky band traps AND reduces bycatch dramatically
- Effective in areas with high SLF populations; not as effective in low density sites

Sticky band | Small circle trap | Modified circle trap | TR 290 trap

SLF Monitoring and Trapping

Development of Behaviorally Based Monitoring and Biosurveillance Tools for the Invasive Spotted Lanternfly (Hemiptera: Fulgoridae)

Laura J. Nixon,[1,6] Heather Leach,[2] Caitlin Barnes,[3] Julie Urban,[2] Danielle M. Kirkpatrick,[1,4] Dalton C. Ludwick,[1] Brent Short,[1,4] Douglas G. Pfeiffer,[5] and Tracy C. Leskey[1]

Environmental Entomology, 49(5), 2020, 1117–1126
doi: 10.1093/ee/nvaa084

- Results: No difference in capture rates in unbaited traps vs. those with methyl salicylate bait

Baited

Unbaited

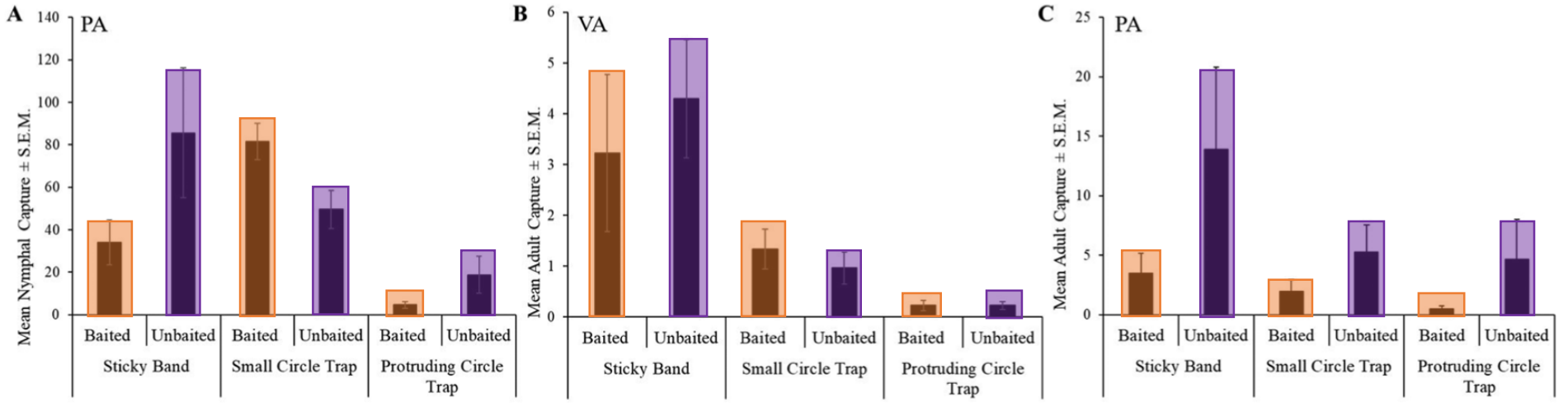


Fig. 4. Mean number of *Lycorma delicatula* ± SEM (A) nymphs in Reading, PA, and adults in (B) Winchester, VA, and (C) Reading, PA captured per trap per week.

SLF Monitoring and Trapping

Host	Nymphs			Adults		
	May	June	July	August	September	October
Rose	■	■				
Grape	■	■	■	■	■	■
Tree-of-heaven	■	■	■	■	■	■
Black walnut		■	■			
River birch			■	■	■	■
Willow			■	■	■	■
Sumac			■	■	■	■
Sycamore				■	■	■
Silver/red maple				■	■	■

Table 1. Key Plant Hosts of SLF and the Times They Can Be Found on These Hosts

Cultural Control

- Removing preferred hosts: Tree of heaven (*Ailanthus altissima*)
  - Efficacy has not been formally evaluated
  - Information on removal: https://extension.psu.edu/tree-of-heaven

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  - Idea: to remove or reduce SLF "Source"
  - Where is the "Source" of SLF for this vineyard?

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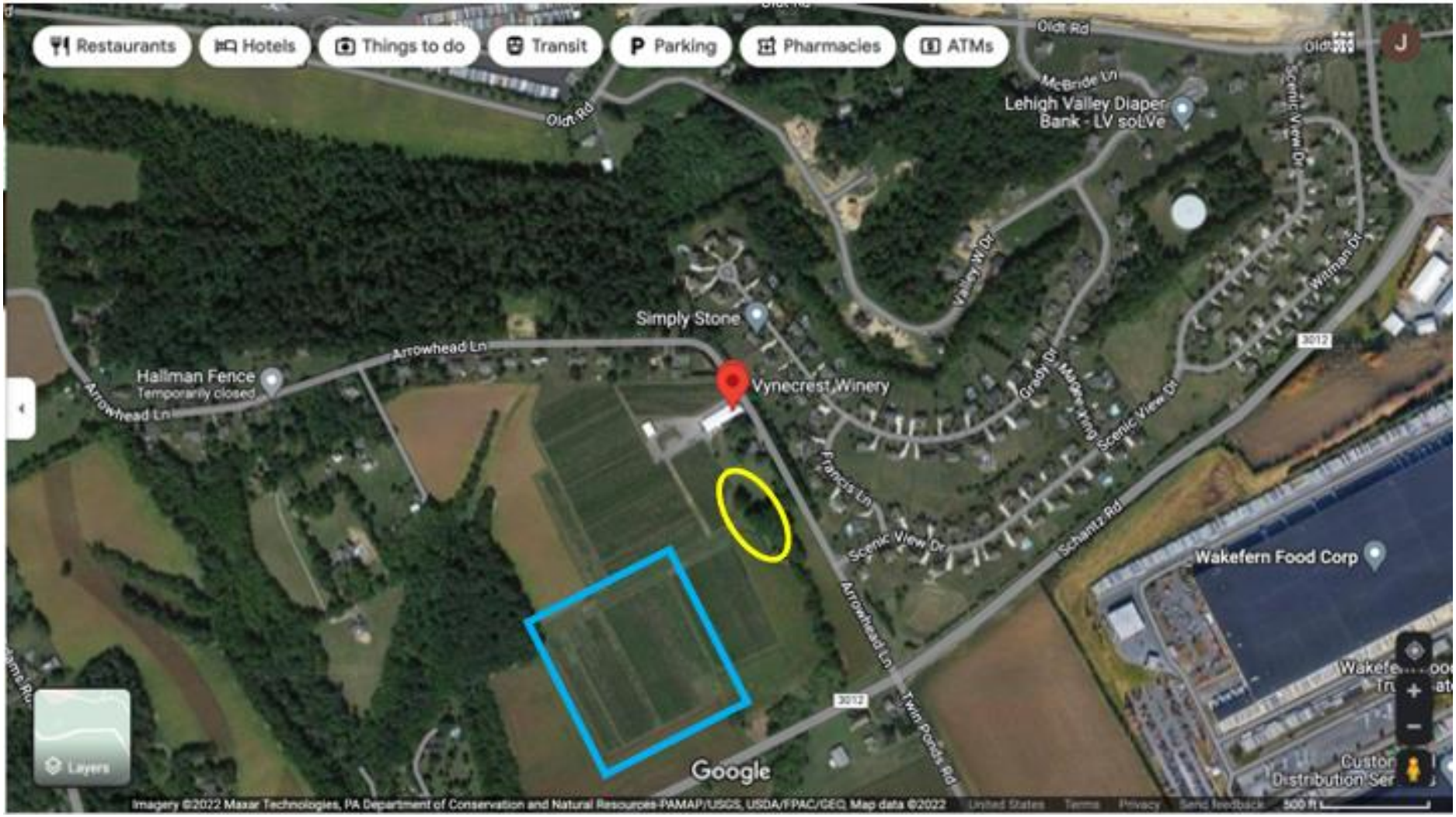
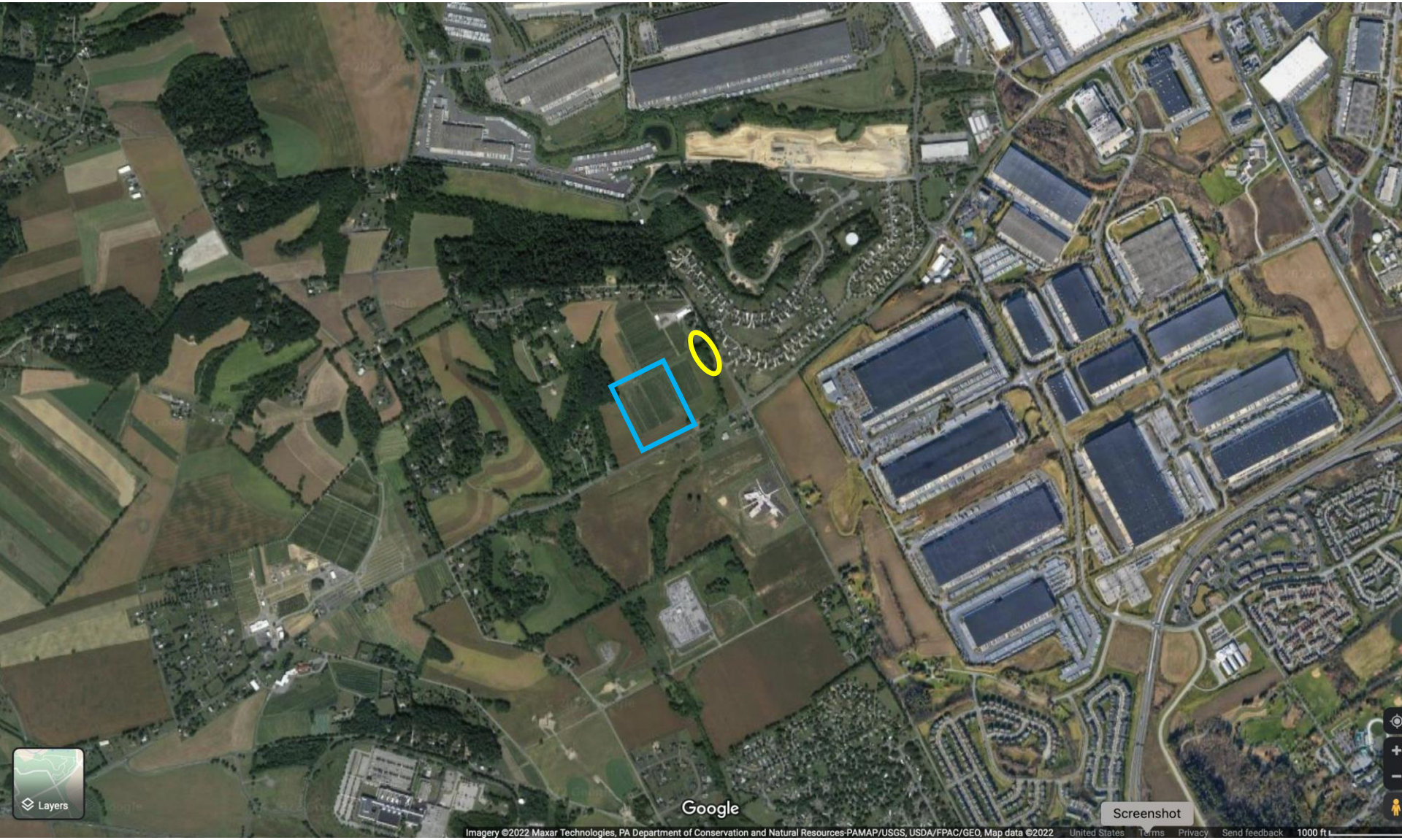


Cultural Control



Yearly Variation in Infestations

Heavy Infestation and Damage 2018-2020

2021 SLF Populations Extremely Low!

End of Sept.; Oct. 15, 2021 saw high SLF flight into vineyard

Within last 3-4 weeks of 2022 season, SLF back in solid numbers throughout vineyard

SLF Economic Impacts

Quarantine Compliance:
Movement on Conveyances or with Products being Shipped

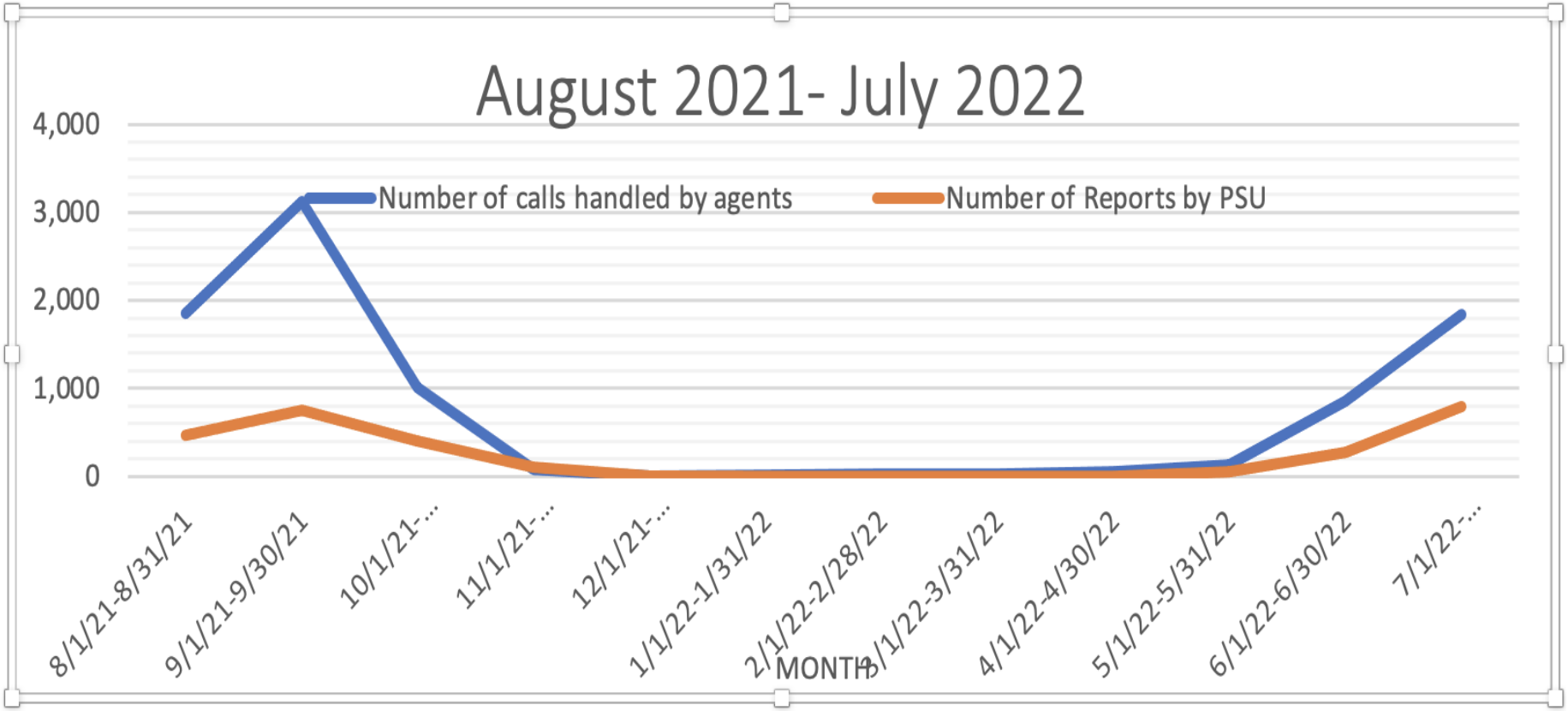
SLF Permit

- Issued by State of PA (and other states also issuing permits)
- 33,000 business permits issued to date (Oct. 2023)
- > 1.3M people received permit training
- Penn State provides training
  - Some in-person training
  - Mostly on-line training
  - Penn State has to pay for ”subscription” fee for service that administers web-based training (charge based on # of users)

Responding to the Need for SLF Outreach

What are the types of Outreach and Education Penn State has been providing?

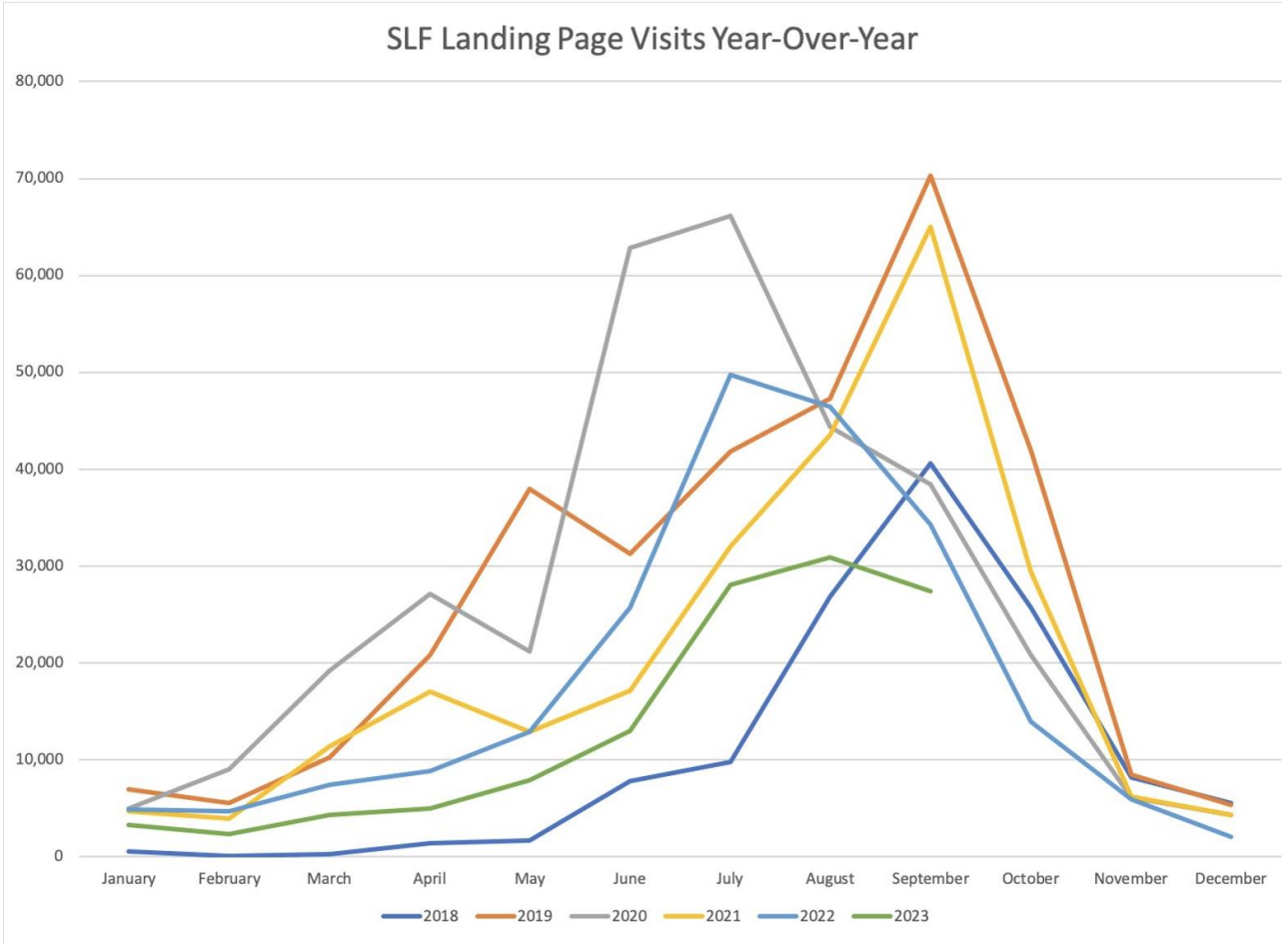
- SLF Call Center



Responding to the Need for SLF Outreach

What are the types of Outreach and Education Penn State has been providing?

- Penn State Extension SLF Website



Responding to the Need for SLF Outreach

What are the types of Outreach and Education Penn State has been providing?

- SLF materials distributed (physically) from July 1, 2022 – June 30, 2023

Product Name ↑	SKU ↑	Sum of Quantity Shipped
How You Can Comply with the Spotted Lanternfly Quarantine Regulations	EE0232	5422
Spotted Lanternfly: Tips for Handling Yard Waste in Quarantined Areas	EE0233	4150
Spotted Lanternfly Management Guide	EE0524	20517
Spotted Lanternfly Management in Vineyards	EE0226	336
Spotted Lanternfly Tattoo (Pack of 200)	MISC035	86
Spotted Lanternfly Waterproof Poster	EE0231	1858
Stop this Invader! Spotted Lanternfly Brochure	EE0228	18690
Stop This Invader! Spotted Lanternfly Scraper Card	MISC037	33896
Tree-of-Heaven	EE0218	8281
Total		93236

Responding to the Need for SLF Outreach

What are the types of Outreach and Education Penn State has been providing?

- Advertising: radio, billboards, social media

Next Steps to Improve SLF Management in Vineyards

Test New IPM Methods:

- Exclusion netting
- Perimeter sprays
- Biopesticides targeting specific life stages

Biological Control:

- Classical biological control with parasitoid wasps
- Verticillium nonalfalfae for control of Tree of Heaven

Feeding Behavior with EPG: Compare SLF feeding on different grape varieties – are some more resistant to SLF feeding?

Exclusion Netting: Wall

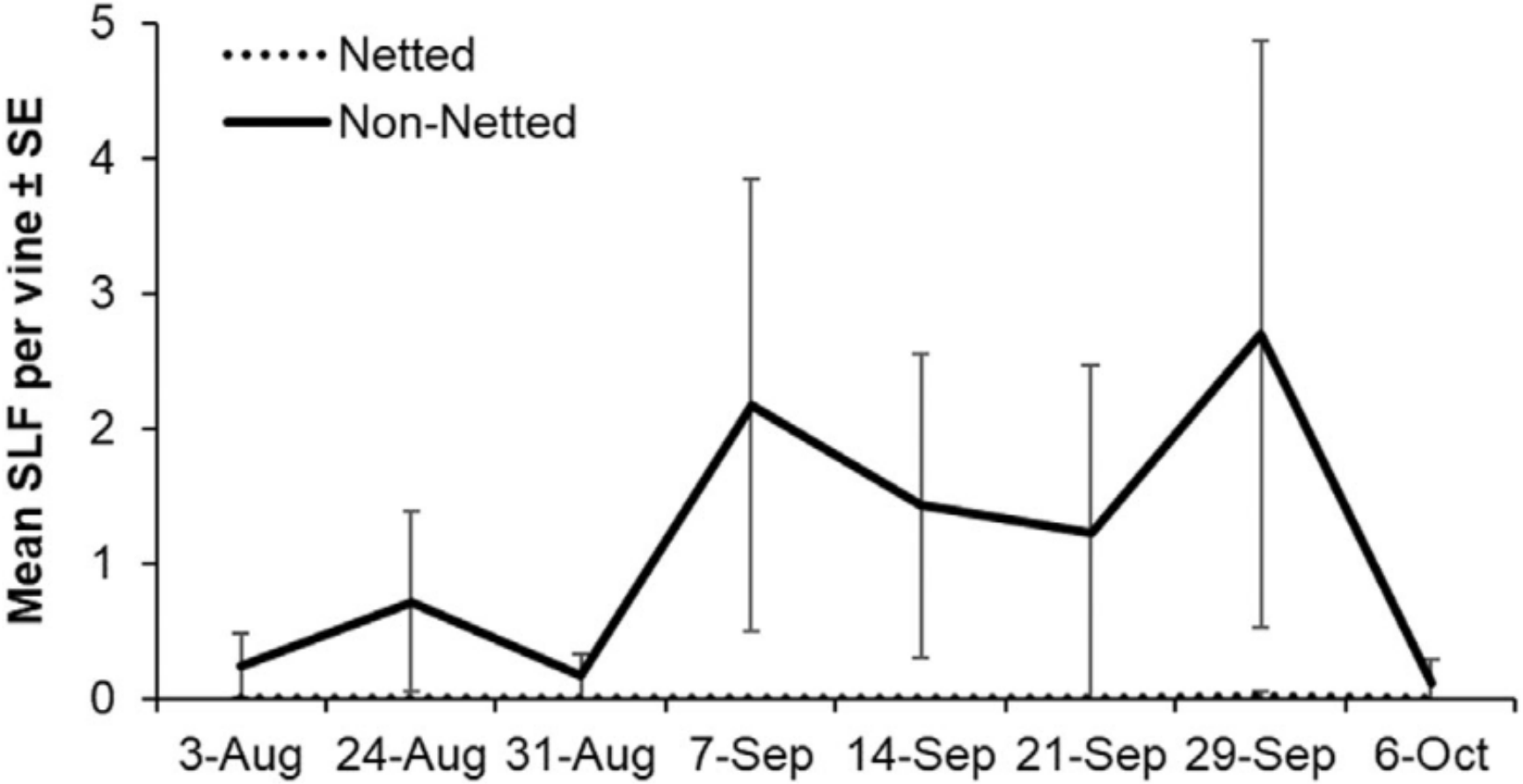
(treated vs. untreated netting; now being tested)

Exclusion Netting: Grapevine Trellis

- Hail netting with 6 x 1.8mm mesh
- Installed in Aug. – Oct. 2020 in 5 vineyards
- Growers continued sprays as needed

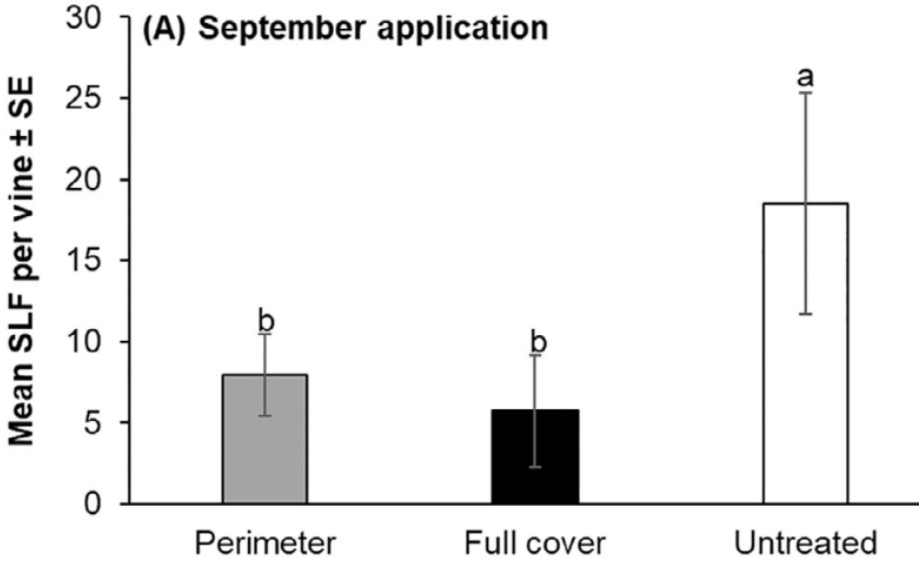
Exclusion Netting: Grapevine Trellis

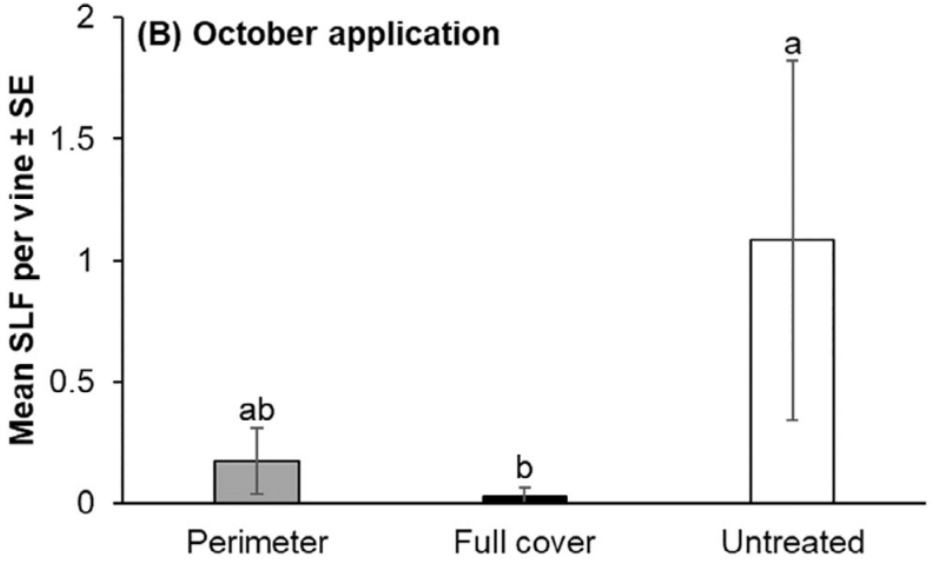
- Netting reduced SLF on vines by 99.8%
- Had no effect on air temp., humidity, fruit quality, or fungal disease



Perimeter Sprays

- Perimeter vs. full-cover insecticide applications compared
- Residual efficacy declined after 8m into vineyard w/ perimeter spray
- No difference in control gained w/ full-cover vs perimeter spray
- Perimeter spray: 31% reduction in area sprayed; 66% less time to spray





Classical Biological Control

Nymphal parasitoid: *Dryinus sinicus*

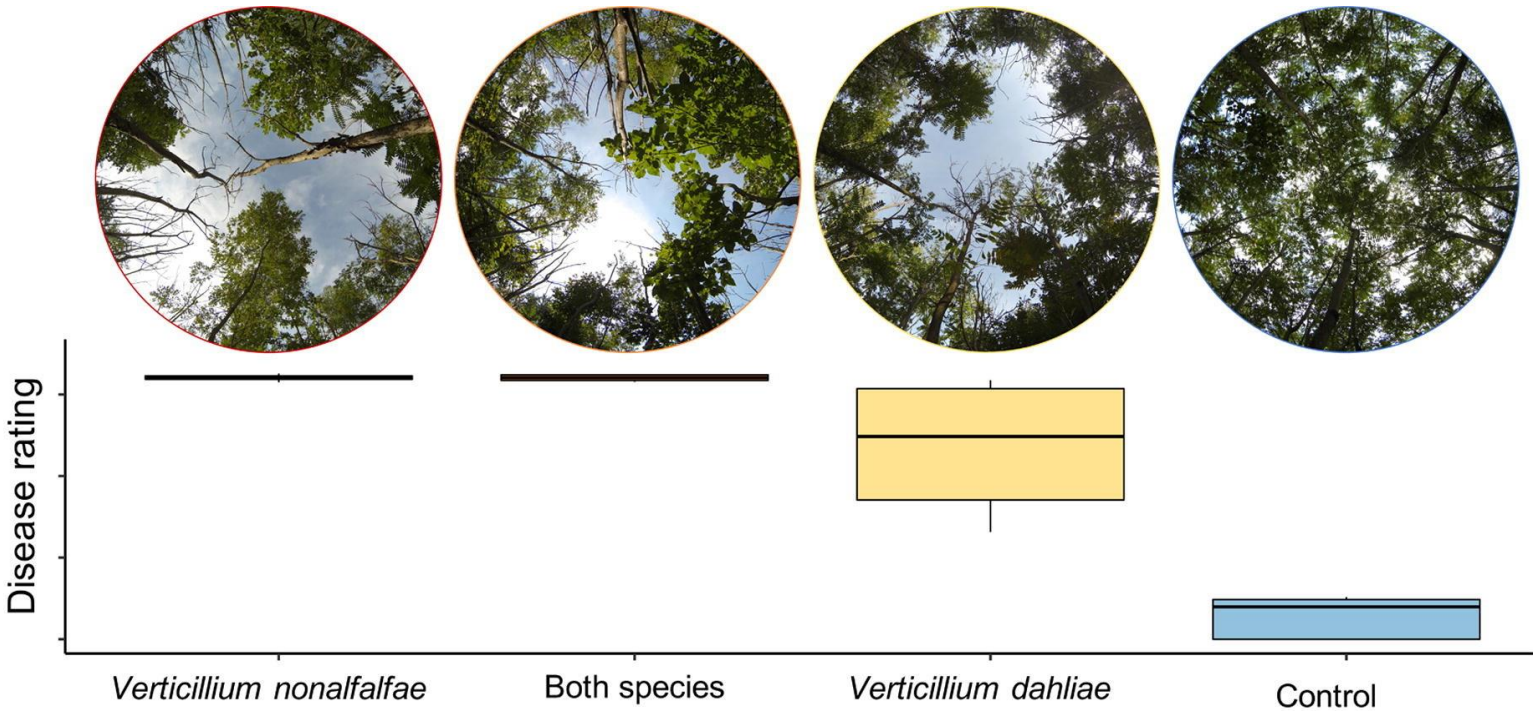
Biological Control of Tree of Heaven

Biological Control
Volume 148, September 2020, 104298

Field-inoculated *Ailanthus altissima* stands reveal the biological control potential of *Verticillium nonalfalfae* in the mid-Atlantic region of the United States

Rachel K. Brooks [a], Kristen L. Wickert [b], Anton Baudoin [a], Matt T. Kasson [b], Scott Salom [c]

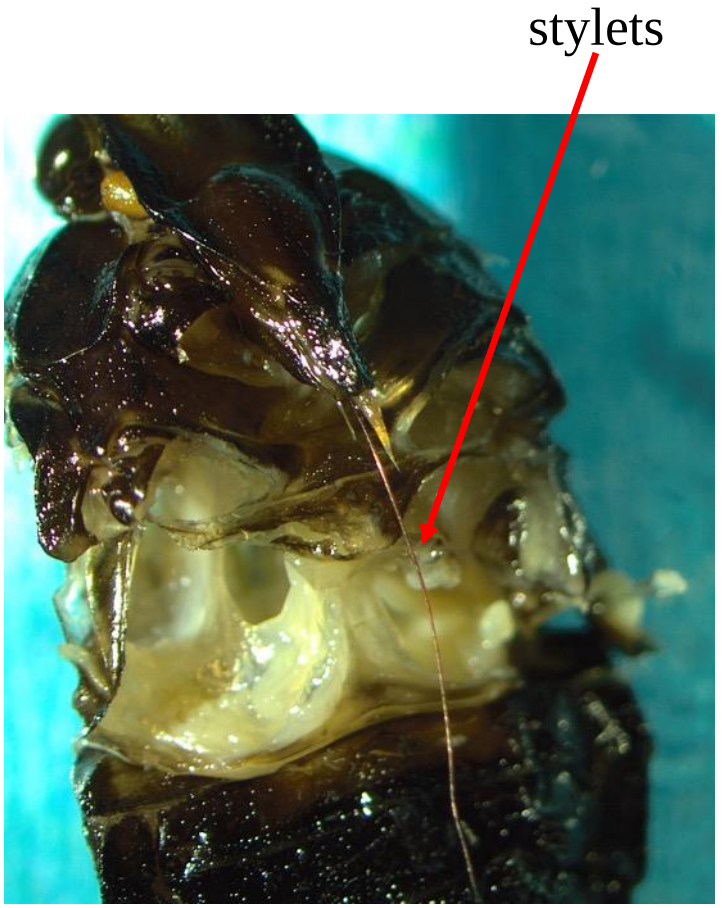
Invasive *Ailanthus altissima* stands 27 months after biological control applications



Spotted Lanternfly is a Planthopper

Phloem feeders: piercing-sucking mouthparts

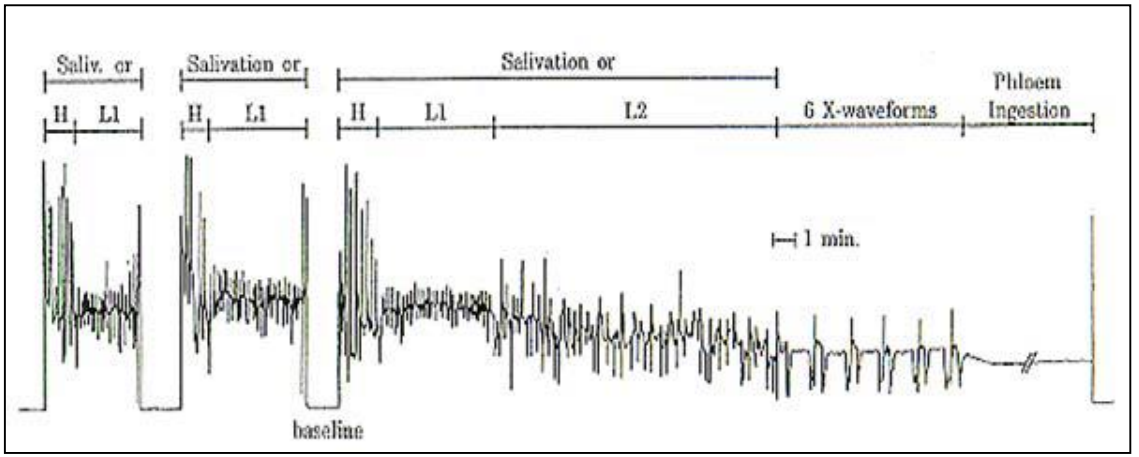
- Studies of SLF Feeding Behavior: Dr. Holly Shugart, postdoc, Urban lab
- Collaboration with Manoharie Sandanayaka and Jacqui Todd, New Zealand Institute for Plant and Food Research; Elaine Backus USDA ARS



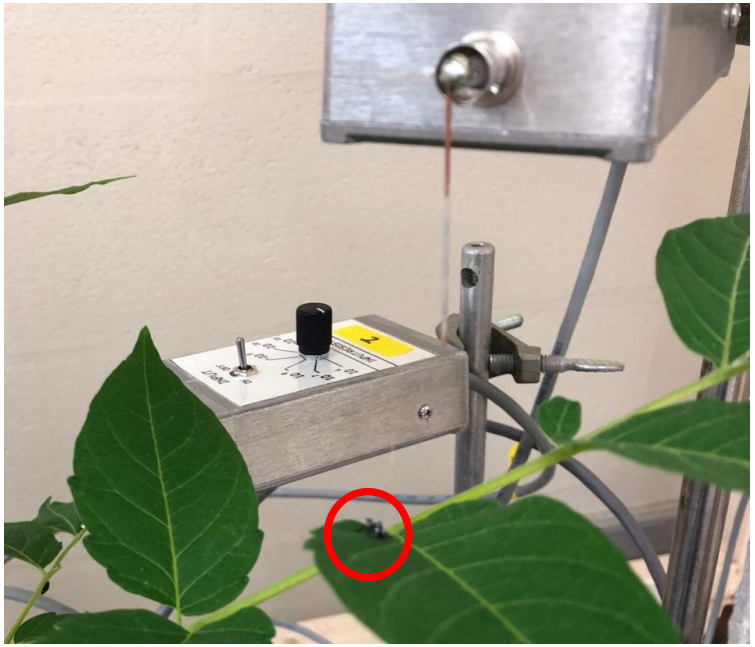
Electropenetrography- A Tool To Study Invisible Feeding Behavior

- Electrical Penetration Graph technique (EPG) was invented in the early 1960's to study aphid probing behavior
- Dozens of papers have been published on aphid probing

McLean, D.L. & M.G. Kinsey. 1964. Nature: 202: 1358-1359.

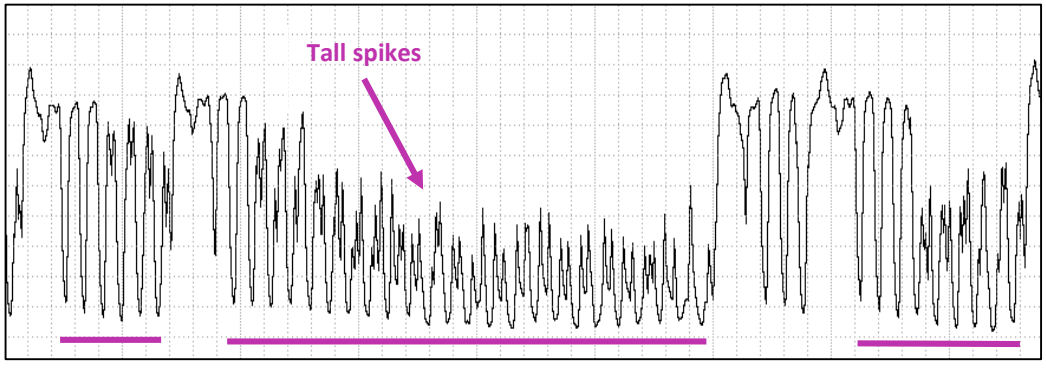


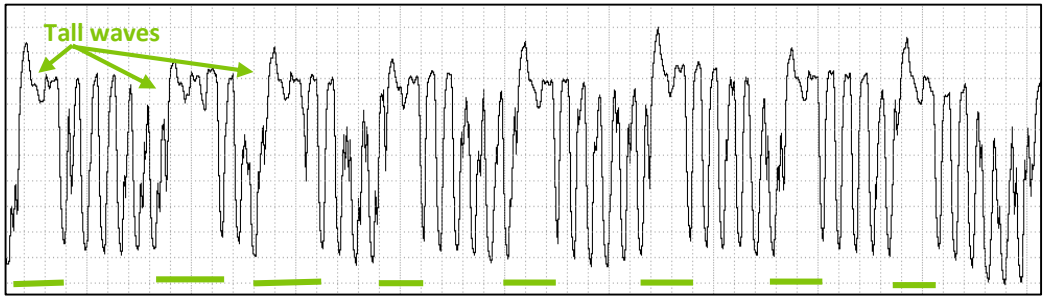
Using EPG to Develop Better Understanding of Host Preference and varietal differences in susceptibility to SLF feeding



Feeding Behavior with EPG: Compare SLF feeding on different grape varieties – are some more resistant to SLF feeding?

- The excerpted waveforms below represent ingestion behaviors.
- Have SLF waveforms from all life stages
- Next steps: more recordings and “decode” based on histology of plant tissues





Acknowledgements

Thank You!

SLF SCRI CAP Project

Project website:

StopSLF.org

For latest recommendations visit:

Penn State SLF Extension Website

https://extension.psu.edu/spotted-lanternfly

Urban Lab

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