

# Flatheaded Borer & Spotted Lanternfly Update



Cindy Kron  
North Coast IPM Advisor  
Sonoma, Napa, Mendocino  
and Lake Counties



# Flatheaded borer attacking pear fruit in Lake County



Cindy R. Kron<sup>1</sup>, Clebson G. Gonçalves<sup>2</sup>, Broc Zoller<sup>3</sup>, Axel David Gonzalez Murillo<sup>4</sup>, J. Kevin Moulton<sup>4</sup>, Karla Adesso<sup>5</sup>, William E. Klingeman<sup>4</sup>

<sup>1</sup>University of California Agriculture and Natural Resources, Santa Rosa, CA; <sup>2</sup>UCANR, Lakeport, CA; <sup>3</sup>The Pear Doctor, Inc., Kelseyville, CA; <sup>4</sup>University of Tennessee, Knoxville, TN; <sup>5</sup>Tennessee State University, McMinnville, TN



August 2023



Photos: Broc Zoller



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Agriculture and Natural Resources

Integrated Pest Management Program

# Flatheaded borer infested fruit in the orchard







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# Flatheaded borer infested fruit in the orchard

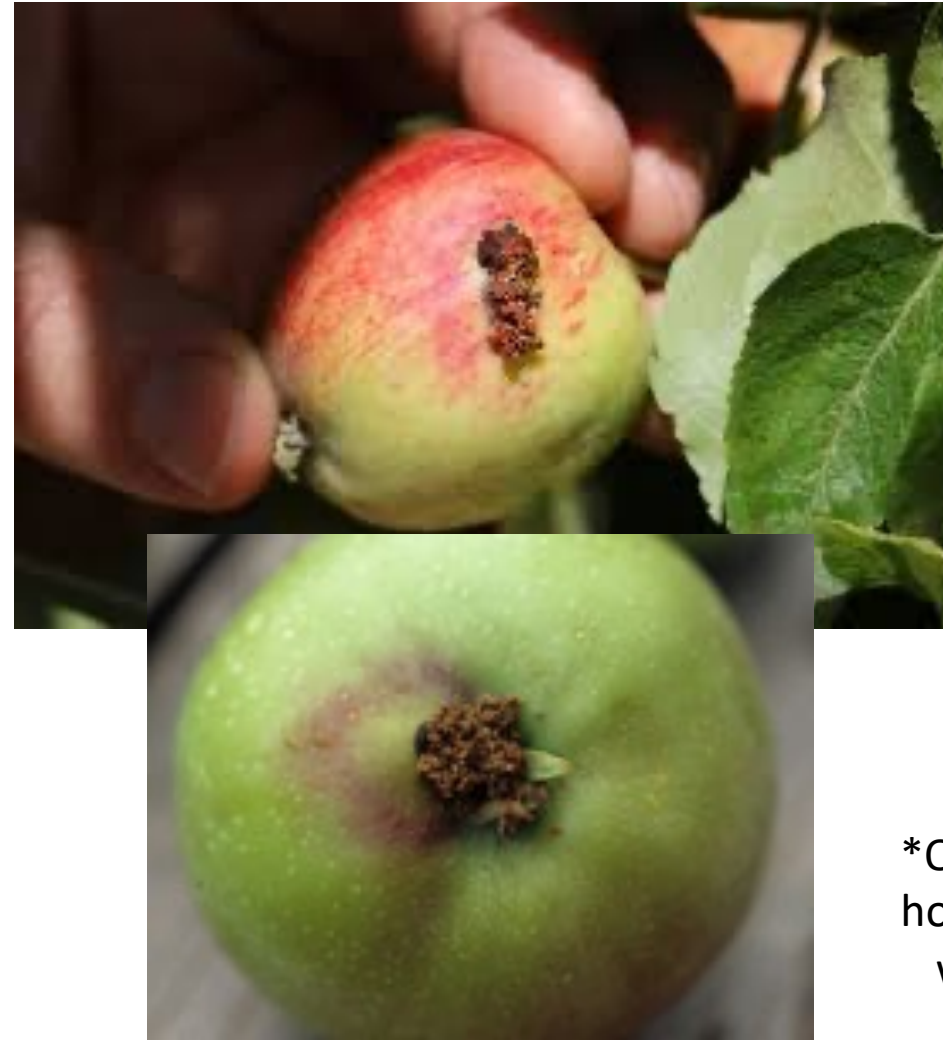


Flatheaded borer damage



\*No frass at entrance hole\*

Codling Moth damage



\*One or more holes plugged with frass\*

# Where we have found flatheaded borers in Pear fruit

❖ Four Pear orchards in Lake County



# Where we have found flatheaded borers in Pear fruit

❖ Four Pear orchards in Lake County

But, this discovery was late in the season and areawide scouting to determine the extent of the flatheaded borer distribution was not conducted before harvest



# Entomologist: Flatheaded borer in fruit?!?!







**Phylum:** Arthropoda

**Class:** Insecta (Insects)

**Order:** Coleoptera (Beetles)  
(400,000+ species)

**Family:** Buprestidae (Metallic wood-boring beetles)  
(15,500+ species)(larvae called flatheaded borers)

**Genus:** *Chrysobothris* (CDFA Identified)  
(690+ species – at least 69 species in California)

**Species:** ?



# Rearing on artificial diet

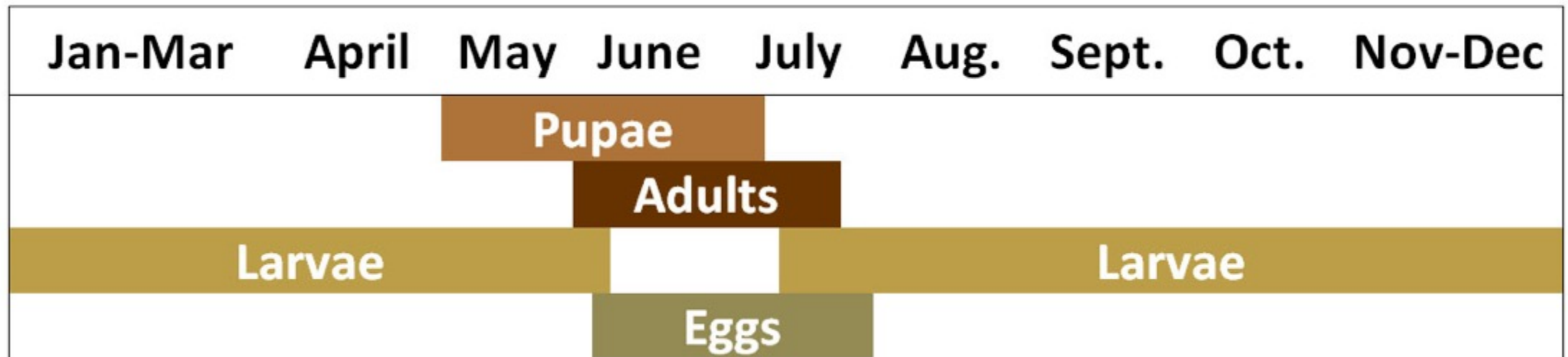
- Spoke with Jhalendra Rijal, Area IPM Advisor working with flatheaded borer on walnut
- Received an artificial diet recipe from Karla Adesso, Associate Professor at Tennessee State University
- Sent sample to CDFA and received a *Chrysobothris* spp. ID
- Sent samples for DNA analysis to William Klingeman, Professor at University of Tennessee

*The process could take 5+ months to get an adult*



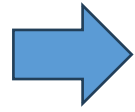


# Flatheaded Borer Life Cycle

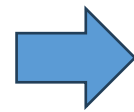




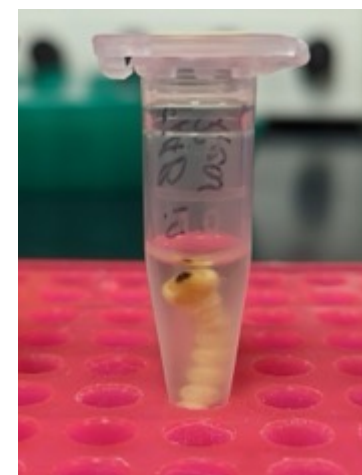
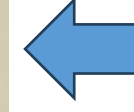
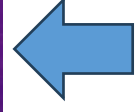
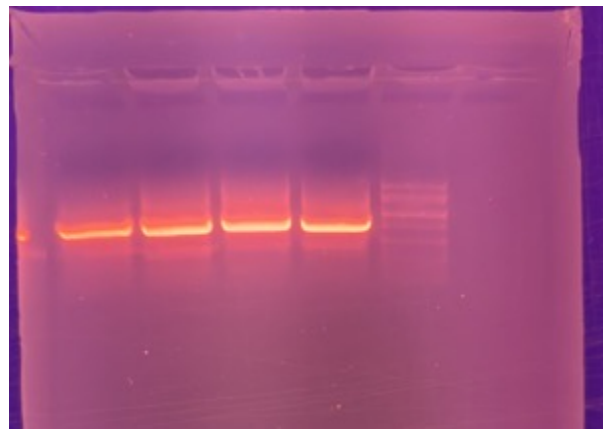
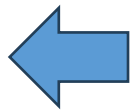
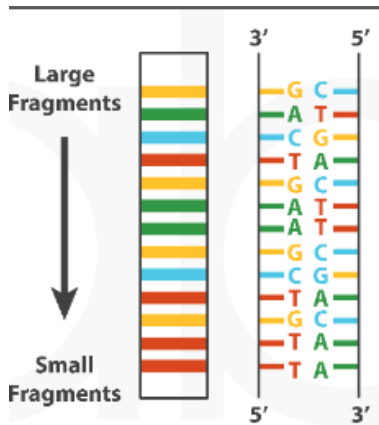
Larvae were found in infested pear fruits that were collected in Kelseyville, CA



A subsample of larvae were preserved in molecular-grade, non-denatured ethanol



The last larval segment was removed & then a hole was made in the second thoracic segment to give access to soft tissue for better DNA extraction



The whole larvae was exposed to lysis buffer & proteinase K for 4 hrs, and then placed in a heat block at ~52C°.

DNA was obtained using an extraction protocol designed by Dr. Kevin Moulton (University of Tennessee)

PCR was completed using a customized (730 bp) COX I primer that amplifies coding regions of *Chrysobothris* species. Finally, DNA samples were sent for DNA sanger sequencing



Assemble Interactively

Candidates	Matches	Mismatch	Overlap	Mismatch	Gaps	New Contig Len
B17.fasta	B17.fasta	100	29	0	0	1,462
B1.fasta	E05_371_F#287416#_B...	99	726	3	0	726
B11.fasta	C05_370_F#287414#_B...	99	726	3	0	726
B12.fasta	B52.fasta	98	727	8	1	1,522
B13.fasta	B72.fasta	98	727	9	1	870
B14.fasta	G04_368_F#287410#_...	98	726	13	0	726
B15.fasta	B33.fasta	96	336	12	0	1,466
B17.fasta	B24.fasta	94	110	6	0	1,466
B19.fasta	B67.fasta	92	727	58	1	1,004
B2.fasta	B66.fasta	92	727	52	1	1,522

Assembly Parameters

Overlap of 727 bases.  
8 bases mismatch.  
Inserted 1 Gaps.  
98.76% of Overlap matches.  
Contig Length of 1522 bases.

Candidate  
Match

Assemble

Done

Analysis of returned Sanger Sequencing data were completed using Sequencher v.5.4



Annotated sequences were blasted against the National Institute of Health's NCBI GenBank database

Based on database resources, we determined that DNA extracted from the larva from pear fruit is 98.75% similar to (homologous with) the COX I mitochondrial region for *Chrysobothris mali* (658 bp match)



*Chrysobothris mali* ♂

Distance tree of results MSA viewer ?

Descriptions Graphic Summary Alignments Taxonomy

Sequences producing significant alignments Download Select columns Show 100 ?

select all 100 sequences selected GenBank Graphics Distance tree of results MSA Viewer

Description	Scientific Name	Max Score	Total Score	Query Cover	E value	Per. Ident	Acc. Len	Accession
<input checked="" type="checkbox"/> <a href="#">Chrysobothris mali</a> voucher RGF16610 cytochrome oxidase subunit 1 (COI) gene, partial c...	<i>Chrysobothris...</i>	1133	1133	87%	0.0	98.75%	658	<a href="#">KX283168.1</a>
<input checked="" type="checkbox"/> <a href="#">Chrysobothris inaequalis</a> voucher BUP0166 cytochrome oxidase subunit 1 (COI) gene, par...	<i>Chrysobothris...</i>	992	992	100%	0.0	91.33%	1233	<a href="#">KM364358.1</a>
<input checked="" type="checkbox"/> <a href="#">Ectophasia rotundiventris</a> voucher YSUW180401074 cytochrome c oxidase subunit I (COX...	<i>Ectophasia ro...</i>	902	902	98%	0.0	89.51%	806	<a href="#">MW392928.1</a>
<input checked="" type="checkbox"/> <a href="#">Ectophasia rotundiventris</a> voucher YSUW180401073 cytochrome c oxidase subunit I (COX...	<i>Ectophasia ro...</i>	902	902	98%	0.0	89.51%	806	<a href="#">MW392927.1</a>
<input checked="" type="checkbox"/> <a href="#">Iotarphia australis</a> voucher CNUIC856 cytochrome c oxidase subunit I (COX1) gene, partia...	<i>Iotarphia aust...</i>	900	900	99%	0.0	89.10%	1492	<a href="#">MT188367.1</a>
<input checked="" type="checkbox"/> <a href="#">Pterostichus fasciatopunctatus</a> voucher he907 cytochrome c oxidase subunit I (COI) gene...	<i>Pterostichus f...</i>	898	898	99%	0.0	89.18%	1444	<a href="#">JX535633.1</a>
<input checked="" type="checkbox"/> <a href="#">Ectophasia rotundiventris</a> mitochondrion, complete genome	<i>Ectophasia ro...</i>	896	896	98%	0.0	89.37%	15792	<a href="#">NC_050938.1</a>
<input checked="" type="checkbox"/> <a href="#">Iotarphia australis</a> isolate CNUIC0329 cytochrome oxidase subunit I (CO1) gene, partial cd...	<i>Iotarphia aust...</i>	885	885	98%	0.0	89.06%	1458	<a href="#">MK234522.1</a>
<input checked="" type="checkbox"/> <a href="#">Ochthebius uniformis</a> voucher IBE<ESP>:AN437 mitochondrion, complete genome	<i>Ochthebius y...</i>	883	883	99%	0.0	88.71%	16212	<a href="#">NC_052905.1</a>
<input checked="" type="checkbox"/> <a href="#">Maoraxia auroimpressa</a> voucher BUP0017 cytochrome oxidase subunit 1 (COI) gene, partl...	<i>Maoraxia aur...</i>	881	881	100%	0.0	88.61%	1257	<a href="#">KM364366.1</a>

# Isn't pear fruit a dead-end host?





# Isn't pear fruit a dead-end host?



# We've got a pupa!!!



February 29<sup>th</sup>, 2024



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Agriculture and Natural Resources

■ Integrated Pest Management Program



# Pupal development



Feb 29: 9:00 am



March 4: 1:14 pm



March 5: 12:28 pm



March 5: 3:31 pm



March 6: 10:02 am





March 7



**Pacific Flatheaded Borer**  
*Chrysobothris mali*

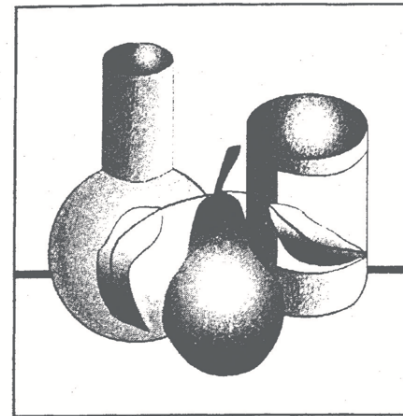


March 18

# Funding provided by the Pear Pest Management Research Fund



CALIFORNIA  
PEARS



Pear Pest Management  
Research Fund



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Integrated Pest Management Program

# The invasive Spotted Lanternfly

*Why we need to remain vigilant*



Cindy Kron, PhD

North Coast IPM Advisor

Serving Sonoma, Napa, Lake and Mendocino Counties



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# SPOTTED LANTERNFLY (SLF) (*Lycorma delicatula*)

- Planthopper (~1" x 0.5") native to northern China
- Egg masses thought to have arrived on a stone shipment in 2012
- First found in the United States (Pennsylvania) in 2014
- Has since been documented in 14 states: Pennsylvania, New York, Delaware, New Jersey, Maryland, Virginia, West Virginia, Connecticut, Massachusetts, Rhode Island, North Carolina, Ohio, Michigan, Indiana,



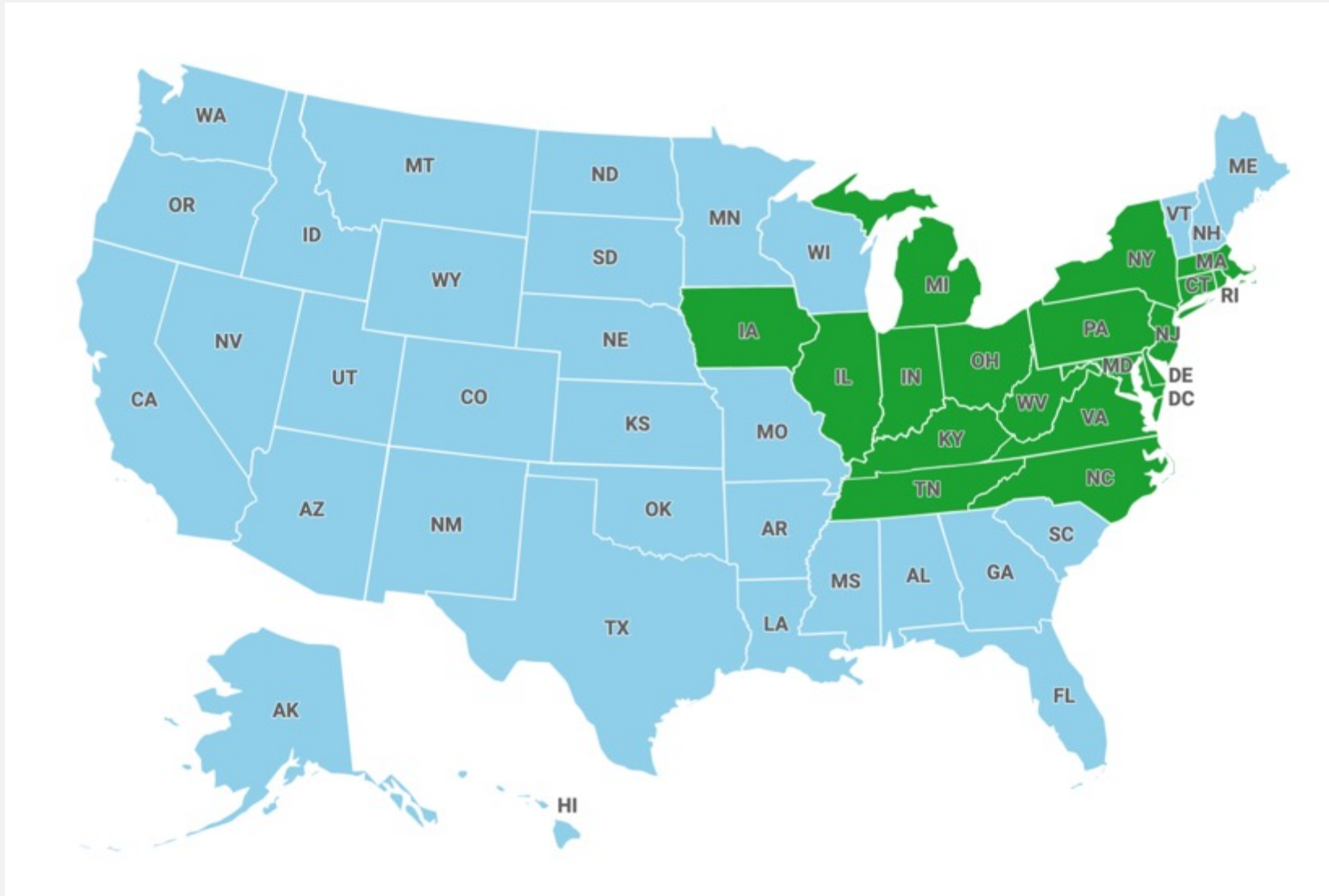
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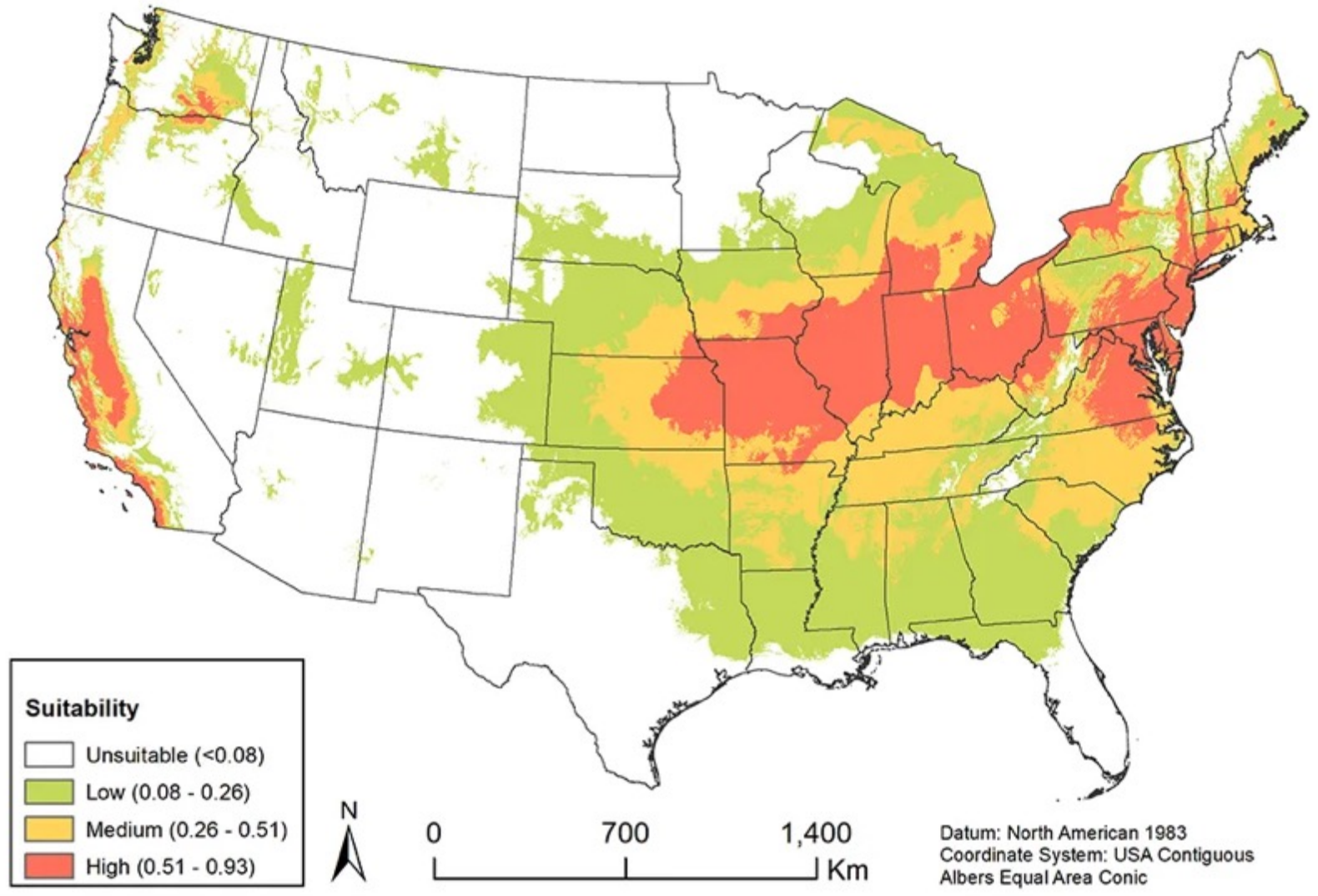
December 13<sup>th</sup>, 2023







## Potential distribution of spotted lanternfly in the United States



## News Release

**CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE**


**Media Contacts:** Steve Lyle (CDFA), 916-654-0462 , [officeofpublicaffairs@cdfa.ca.gov](mailto:officeofpublicaffairs@cdfa.ca.gov)



# CALIFORNIA ESTABLISHES QUARANTINE TO PROHIBIT THE INTRODUCTION OF THE SPOTTED LANTERNFLY INTO CALIFORNIA



Release #21-077

 [Print This Release](#)

July of 2021 - prohibits the entry into California of SLF, its host plants, and a variety of articles, including conveyances, originating from any area where an SLF infestation exists.





## SPOTTED LANTERNFLY EGGS

- Each female lays one to two egg masses of 30 to 50 eggs each
- Eggs are laid in multiple successive rows and covered with a yellowish-brown waxy deposit





## SPOTTED LANTERNFLY EGGS

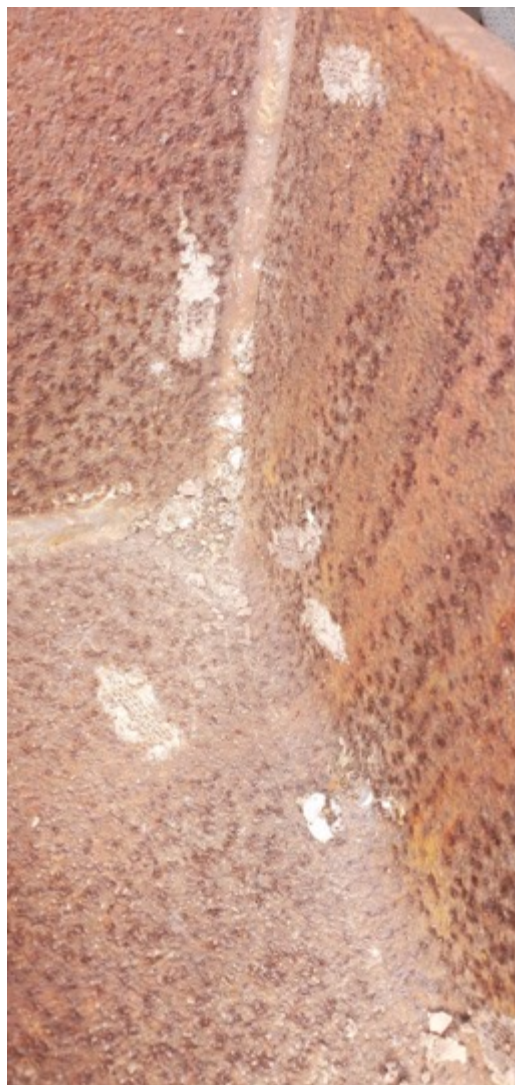
- Eggs are laid on smooth tree surfaces and inanimate objects such as telephone poles, stones, pallets, outdoor furniture, railway cars, firewood, vehicles, etc.
- **Laying eggs on non-plant items contributes to SLFs wide dispersal ability and likelihood of unintentional introduction into new areas**



- Art structure stopped at Truckee CDFA station – [March 27<sup>th</sup>, 2024](#)
- Suspected SLF egg masses found
- Eggs sampled and were viable
- Entry was denied and truck returned to Sparks where ~30 SLF egg masses removed and destroyed, structure was powerwashed with soap and water, and cleared inspection by Nevada Department of Agriculture – [April 2<sup>nd</sup>, 2024](#)
- Allowed entry into California
- Instructions were not to offload until inspection by Sonoma Ag Commissioner's office, but structure was offloaded anyway
- Sonoma Ag Commissioner's office arrived, inspected structure and found 3 more egg masses



Egg masses are ~30 - 50 eggs each meaning the structure had between 990– 1,650 SLF eggs!!!





# SPOTTED LANTERNFLY (SLF) (*Lycorma delicatula*)

- Host range of 103+ plant species with at least 40 occurring in North America
- Preferred host is tree of heaven (*Ailanthus altissima*), grapevines, black walnut, maple
- Other hosts include stone fruits, apple, cherry, blueberry, fig, hops, oak, birch, sycamore, ash, beech, hickory, poplar, black cherry, willows and woody ornamentals





**SPOTTED LANTERNFLY  
(SLF)**  
*(Lycorma delicatula)*

- Found in agricultural, wooded and urban areas and moves between different environments to feed
- Potential to severely harm grape, orchard and logging industries
- Can aggregate in large numbers



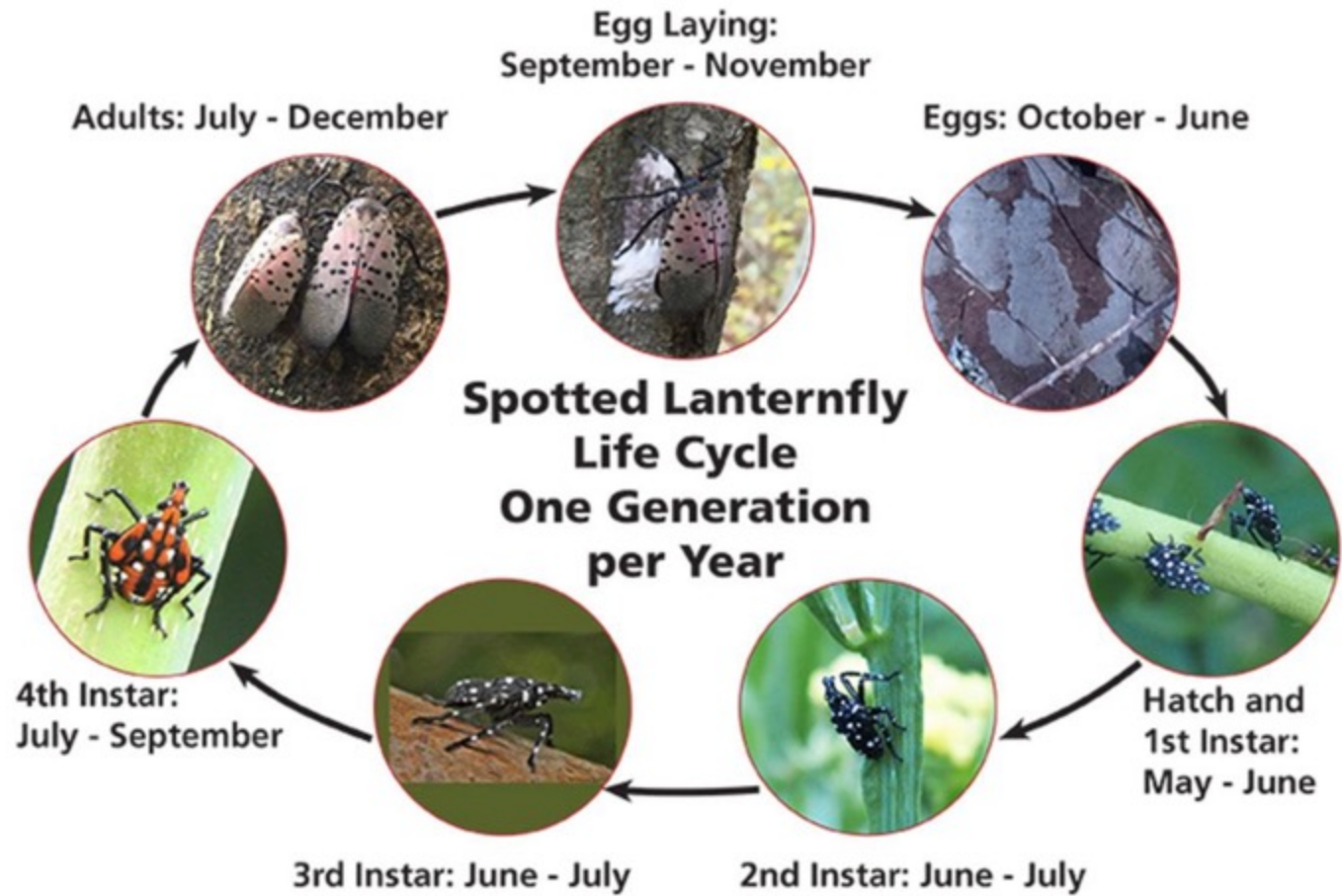


**SPOTTED  
LANTERNFLY  
(SLF)**  
*(LYCORMA DELICATULA)*

- May lower crop yields, increase production costs, lower cold hardiness, reduced or no return bloom or crop, cause vine death, and cause trade disruptions
- Produces large amounts of honeydew → sooty mold







## Spotted Lanternfly nymphs



1<sup>st</sup> through 3<sup>rd</sup> instars



4<sup>th</sup> instar





**Spotted lanternfly nymphs**



# Spotted Lanternfly nymphs and adults



4<sup>th</sup> instars and adults



Adult with wings spread

UCANR.EDU/NCIPM

UCANR.EDU/SLF

The screenshot shows the UCCE Sonoma County website. At the top, there is a dark blue navigation bar with the University of California Agriculture and Natural Resources logo, a search bar, and a 'Give' button. Below this is the UCCE Sonoma County logo and a secondary navigation bar with links for Home, About Us, Calendars, UC ANR Links, Apps, and Subscribe. A large banner image of a bridge over a river is displayed. The main content area is divided into two columns. The left column, titled 'Integrated Pest Management', lists several topics: North Coast IPM Seminar, Spotted Lanternfly (highlighted with a red arrow), Tree-of-Heaven (also highlighted with a red arrow), Bagrada bug, Ant Identification, Grape Pest Notes, European Grapevine Moth & Leafrollers, and Mealybugs in Vineyards. The right column features a yellow background with the title 'Spotted Lanternfly' and a sub-header 'Spotted Lanternfly (*Lycorma delicatula*)'. The text below describes the species as a new invasive pest and provides information on early detection and identification.

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Integrated Pest Management

- North Coast IPM Seminar
- Spotted Lanternfly**
- Tree-of-Heaven**
- Bagrada bug
- Ant Identification
- Grape Pest Notes
- European Grapevine Moth & Leafrollers
- Mealybugs in Vineyards

## Spotted Lanternfly

### Spotted Lanternfly (*Lycorma delicatula*)

New invasive species in the United States to be on the lookout for. Early detection is key to keeping the Spotted Lanternfly out of California. See the attached [newsletter](#) (pdf) [en español](#) for photos of the different life stages, species details and identification.

Invasive species have the potential to cause high levels of economic damage when introduced into new environments that lack the predators that normally suppress their population in their native environments. International and national travel and commerce are ideal avenues for the introduction of exotic pests into the United States and California. Therefore, the identification and early detection of exotic pests are key to preventing their establishment in California. Everyone, including growers, PCA's, field workers, and home gardeners, can play an important role in keeping exotic pests out of your county by being the eyes and ears needed for early detection of the next exotic pest.



UCANR.EDU/NCIPM

UCANR.EDU/TOH

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**Integrated Pest Management**

- North Coast IPM Seminar
- California Statewide Olive Seminar
- North Coast Olive Field Day
- Sonoma County Pest Control District
- Blue-green sharpshooter data
- Threecornered

**Invasive tree-of-heaven is a preferred host for two invasive insect pests that cause economic damage in California agricultural crops**

It is not uncommon for commercial agriculture to share a common boundary with riparian, forested or urban areas in California. Some pest species thrive in these border areas and serve as a source of insect pest pressure on neighboring commercial crops. Invasive species that find preferred hosts in these border areas can be especially problematic in that their new environment lacks the predators from their native habitat that would normally suppress and keep their population





## ***Report any sightings***

If you find what you believe to be any of these insects, collect it in a sealed container and document the location and date when found before taking it to your local county agricultural commissioner or UC Cooperative Extension office. Together with your help, we can help keep the spotted lanternfly out of California.



# Flatheaded Borer & Spotted Lanternfly Update



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