

Japanese Beetle: History, biology, and control

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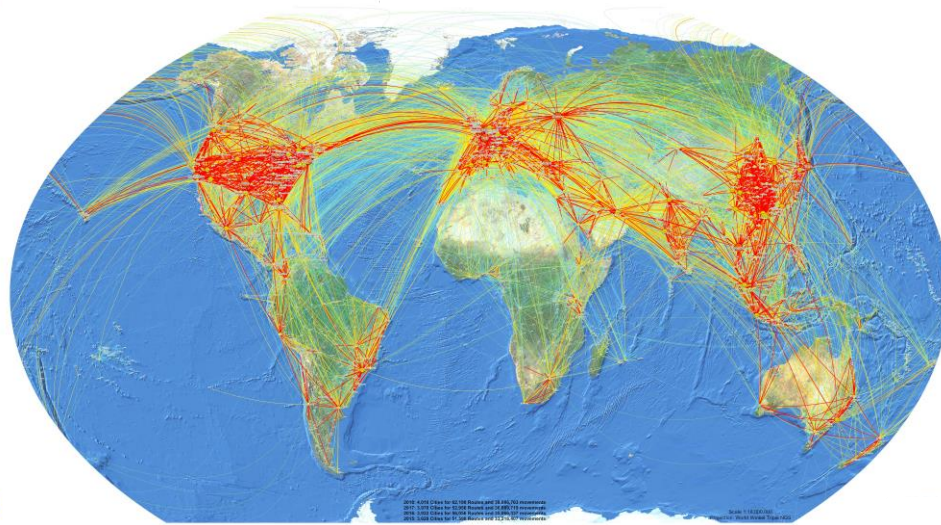
UNIVERSITY OF MISSOURI
 Extension

Invasive species

- Introduced range = higher populations
- Enemy free space
- Increased damage
- Arrivals-accelerating rates

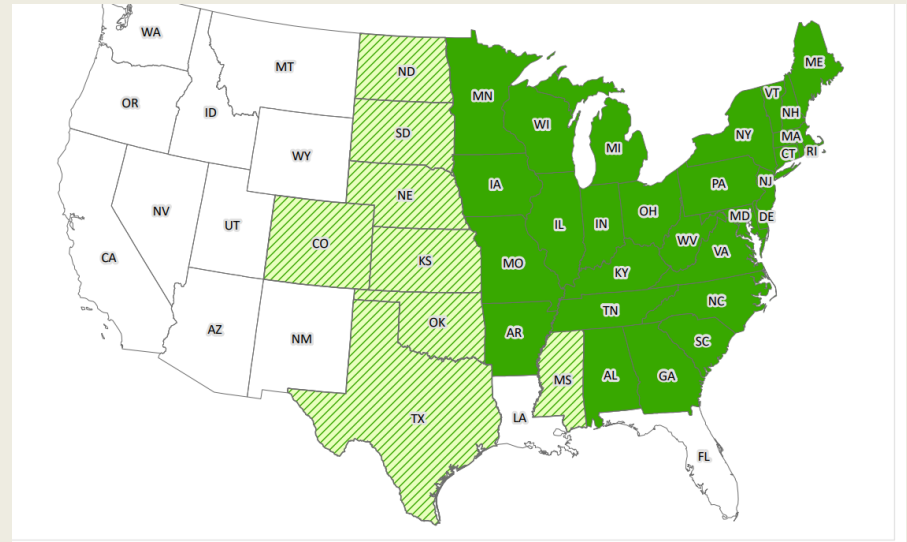
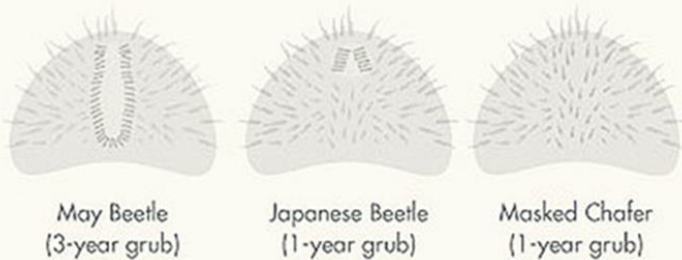


Global Air Traffic 2018



Japanese beetle

- Native to Asia
- Discovered NJ-1916



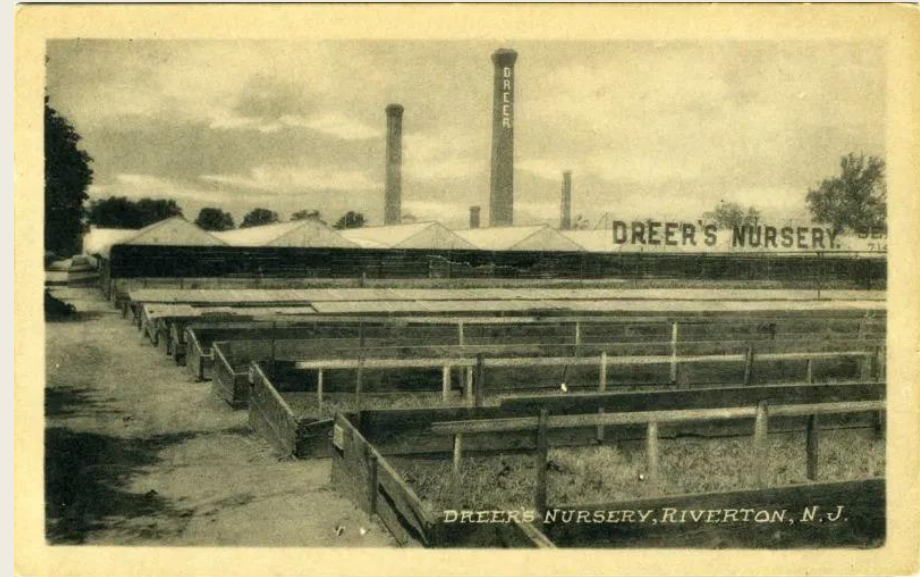
Initial eradication effort?

- Scientist aware of potential problem
- \$5,000
- 1 cart sprayer
- 1 barrel sprayer
- 2 dusters
- Tons of arsenic
- No labor support
- Abandoned 2 years



Initial management

- Dreer Nursery
 - Oppose eradication
 - “\$5 worth of damage”
 - Quarantine 1920
- Bounty
 - 80 cents/quart of beetles
- Roadside inspections
 - Fines
 - Convictions



Chemical control

- Estimated pop size = $\frac{1}{2}$ billion/square mile
- Burn fields with oil and fire
- Lead arsenate
 - 1,500 pounds/acre
 - Human sickness
 - *Silent spring*

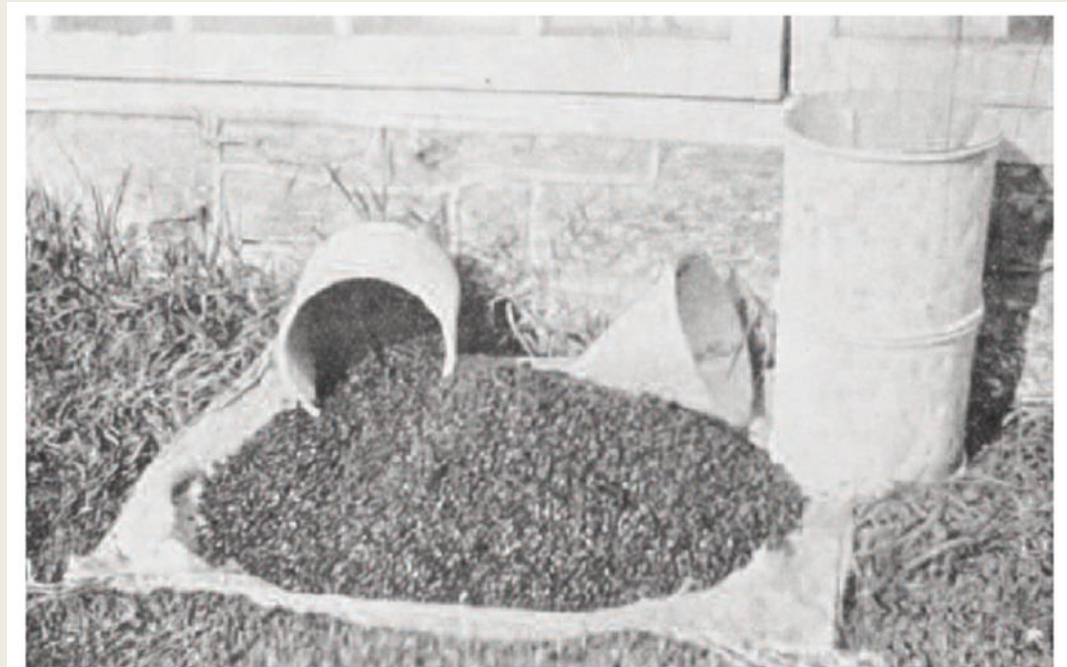


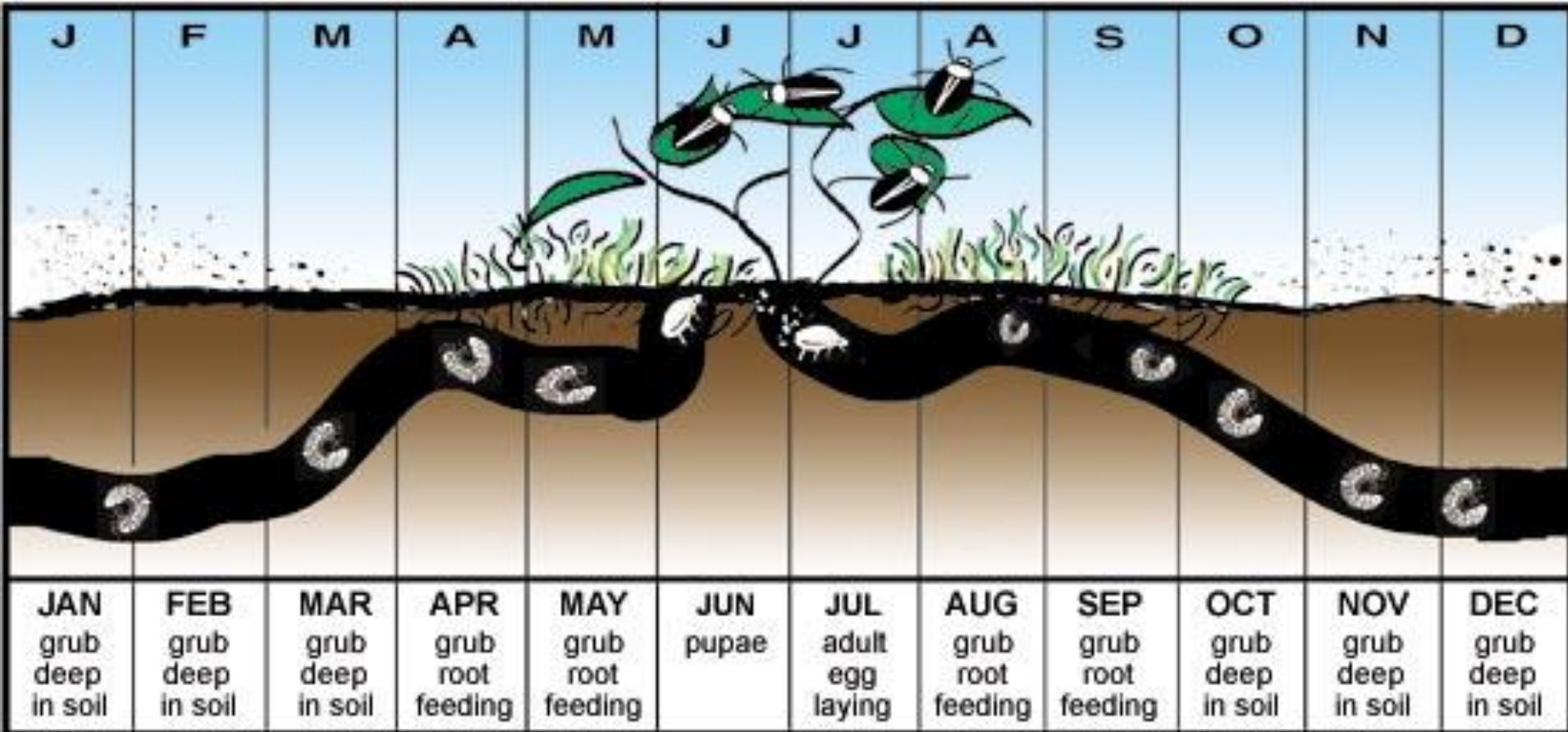
Fig. 3. "60 bushels caught in one day in August in one orchard." (Caption and photo from Britton, 1928.)

Host plant species

- Grubs = grass roots
- Adults = 300+ plant species
 - Field crops
 - Fruits
 - Ornamentals
 - Weeds
 - Shrubs
 - Hardwoods



Lifecycle



Immune to cold winters

Japanese beetle in Missouri

- Continues westward expansion
- Populations lower in years following droughts
- Adults emerge June-July (feed ~45 days)
 - 1 generation per year
 - Larvae host plant can determine emergence date



Grape feeding damage

- Primarily feed on upper foliage
 - Skeletonize or consume entire leaf
 - Clumped distribution
- July-sept



Management options

- Remove attractive non-crop host plants
- Preferred plants (including weeds)
 - Linden, Japanese/Norway maple, birch, pin oak, horse chestnut, rose, mountain ash, willow, elm, Rose of Sharon, Virginia creeper ornamental apple, plum, cherry
- Rarely attacked plants
 - Red/silver maple, tulip tree, magnolias, red mulberry, forsythia, privet, lilac, spruce, hydrangea, yew

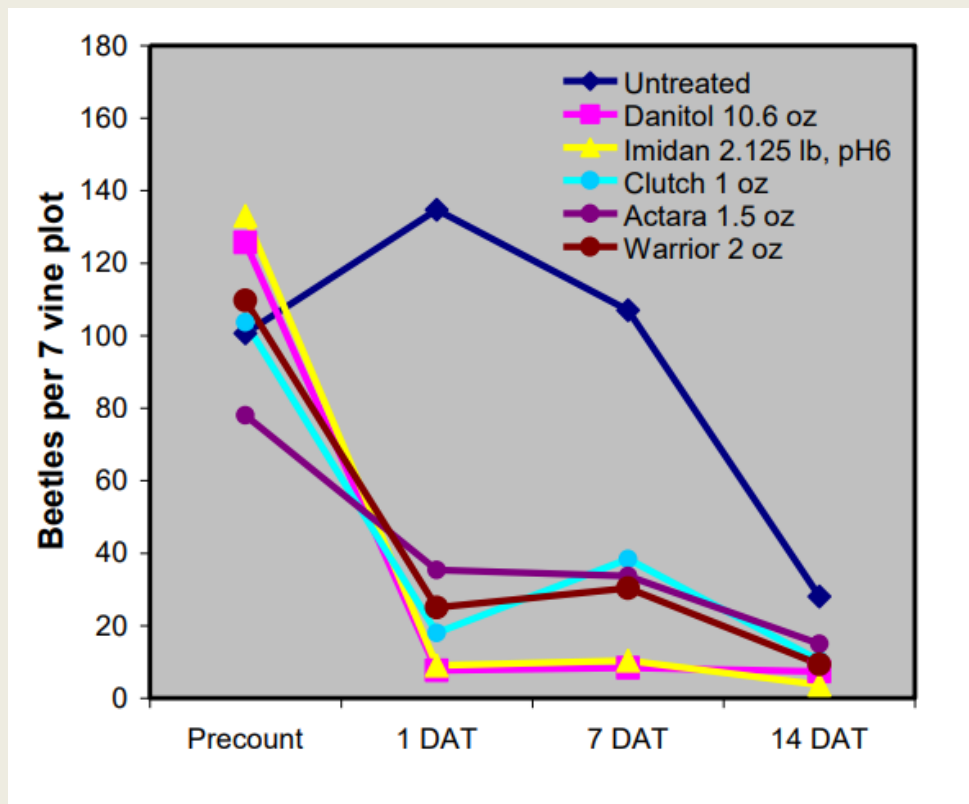
Chemical applications?

- No established thresholds (beetles or defoliation)
- 30% mechanical defoliation
 - Bloom = reduced growth (nodes pruning wts)
 - Veraison = no effect
 - Damage at bloom made vines less tolerant of damage at veraison



Insecticides efficacy

- Foliar sprays
- Early July
- Assessment 1, 7, 14 days after treatment



Japanese beetle management

- DO NOT use bucket traps
- Aggregation pheromones
- Not point specific
- Spill over



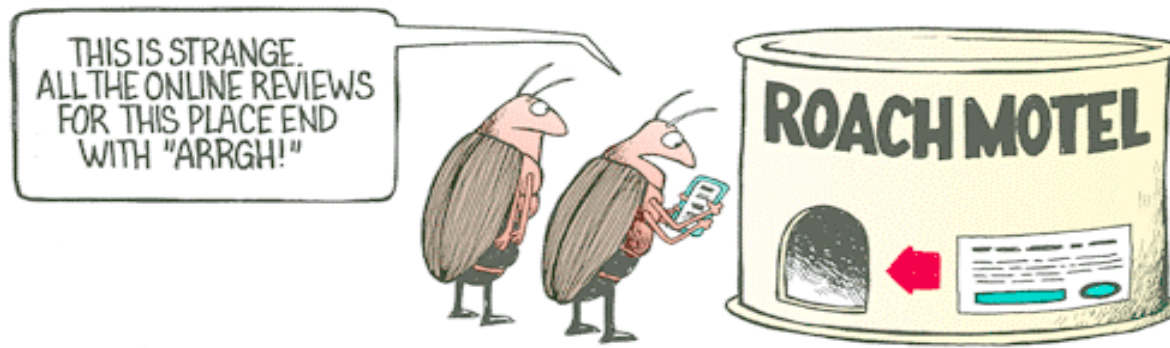
Milky spore disease = variable results



Biological control-*Tiphia vernalis*



Design an attract-and-kill strategy for Japanese beetles



Insecticidal nets

Pyrethroids
Dose: 4 g/kg

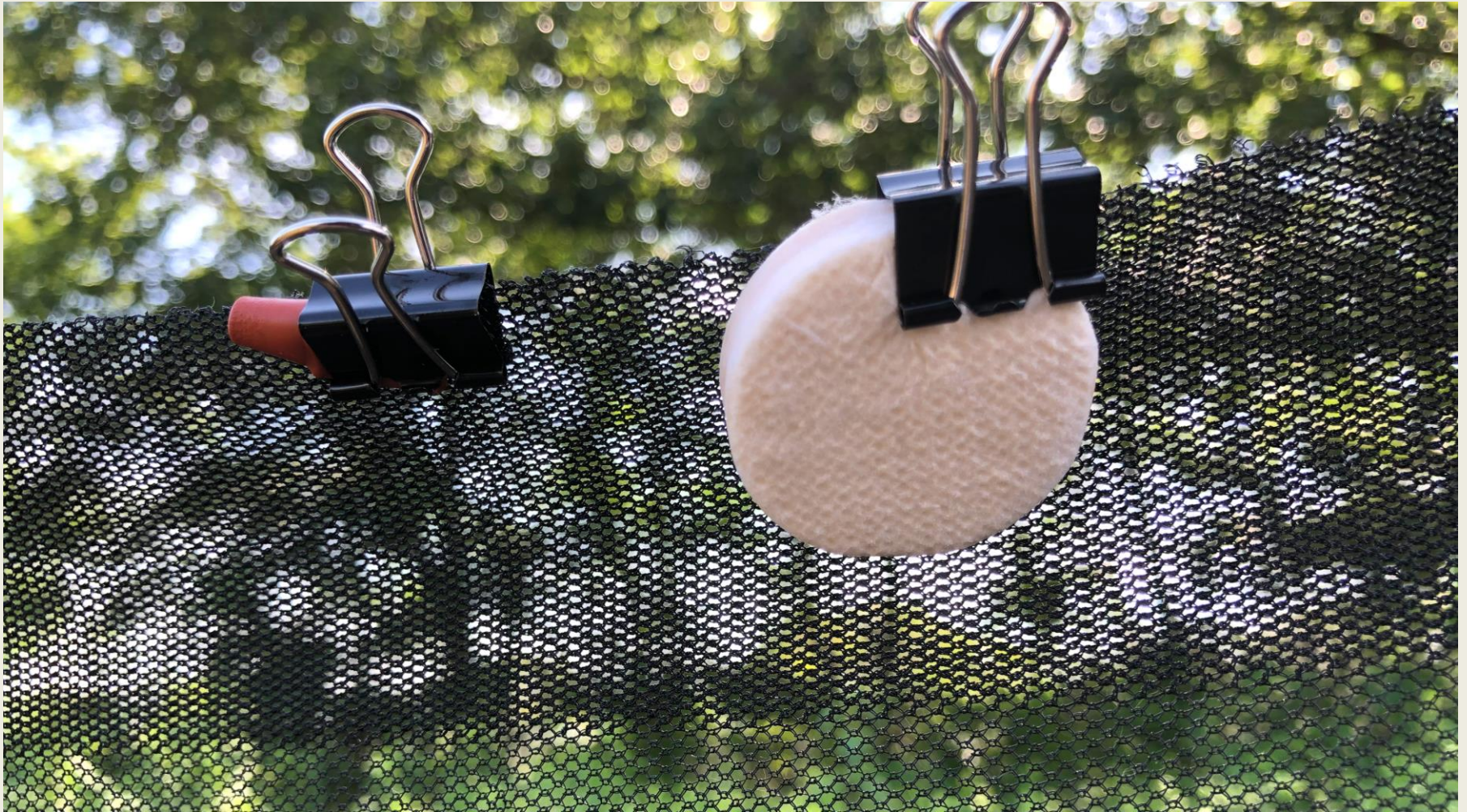


Rapid mortality

Toxic dose
in 3 sec



Two component lure



Aggregation pheromone = kills males and females

Treatments

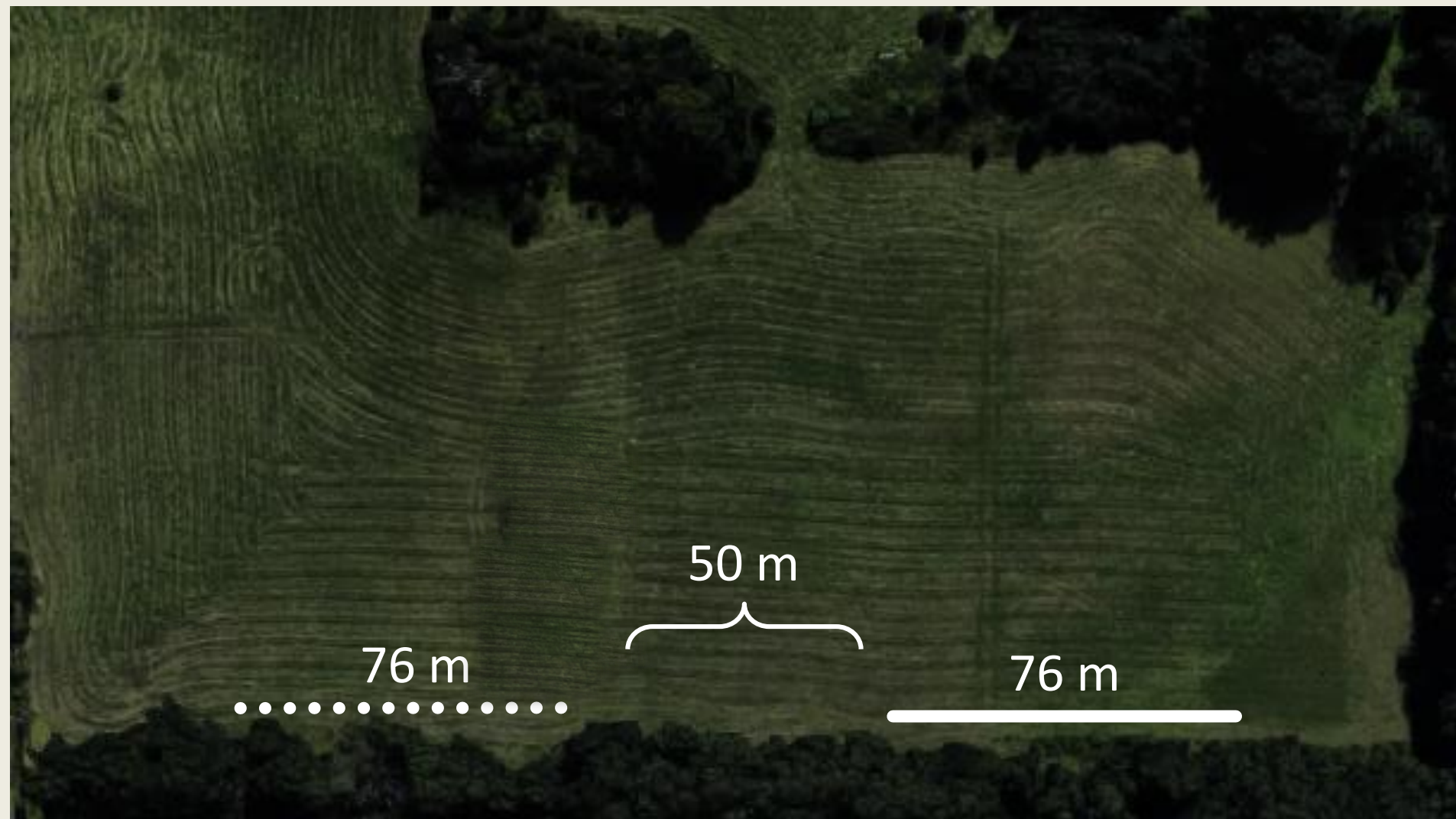
Attract-and-Kill



Control



Field design

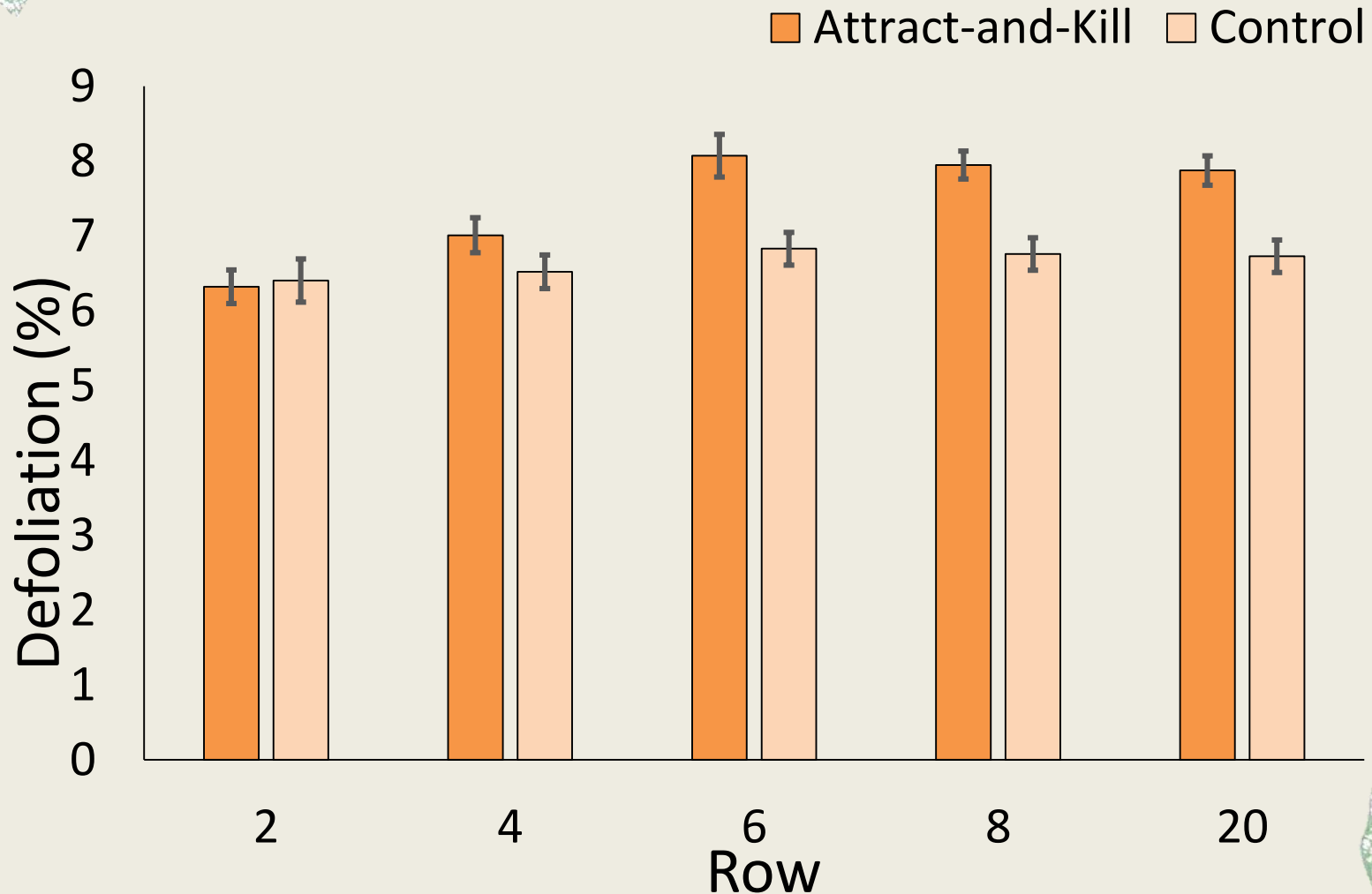


Methods

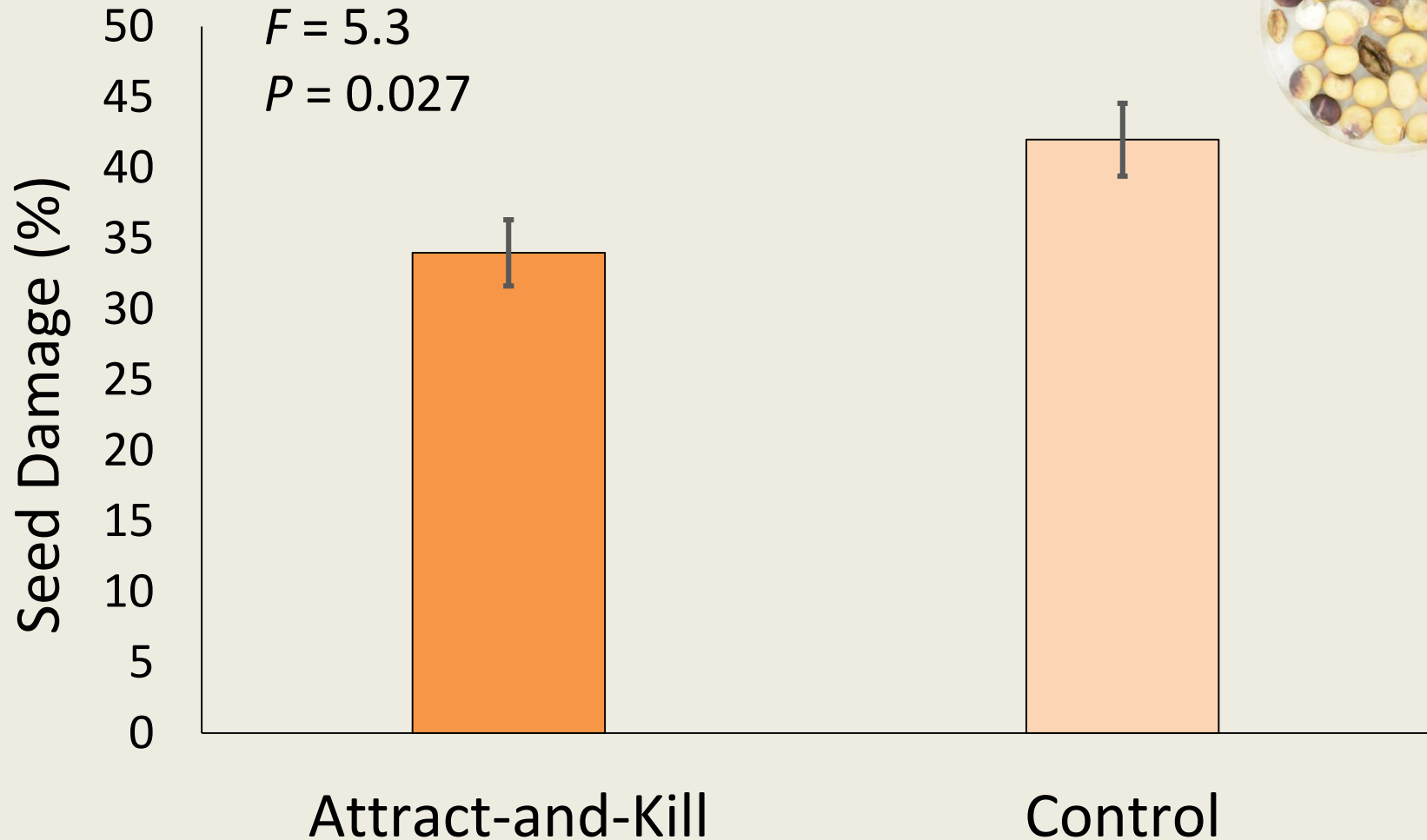
- June to October
- Sampled in rows
 - 2, 4, 6, 8, 20
- Weekly sampling
 - Defoliation 10 plants/row
 - 30 sweeps/row
 - Bee bowls (R1-R6)
- Quantify seed damage



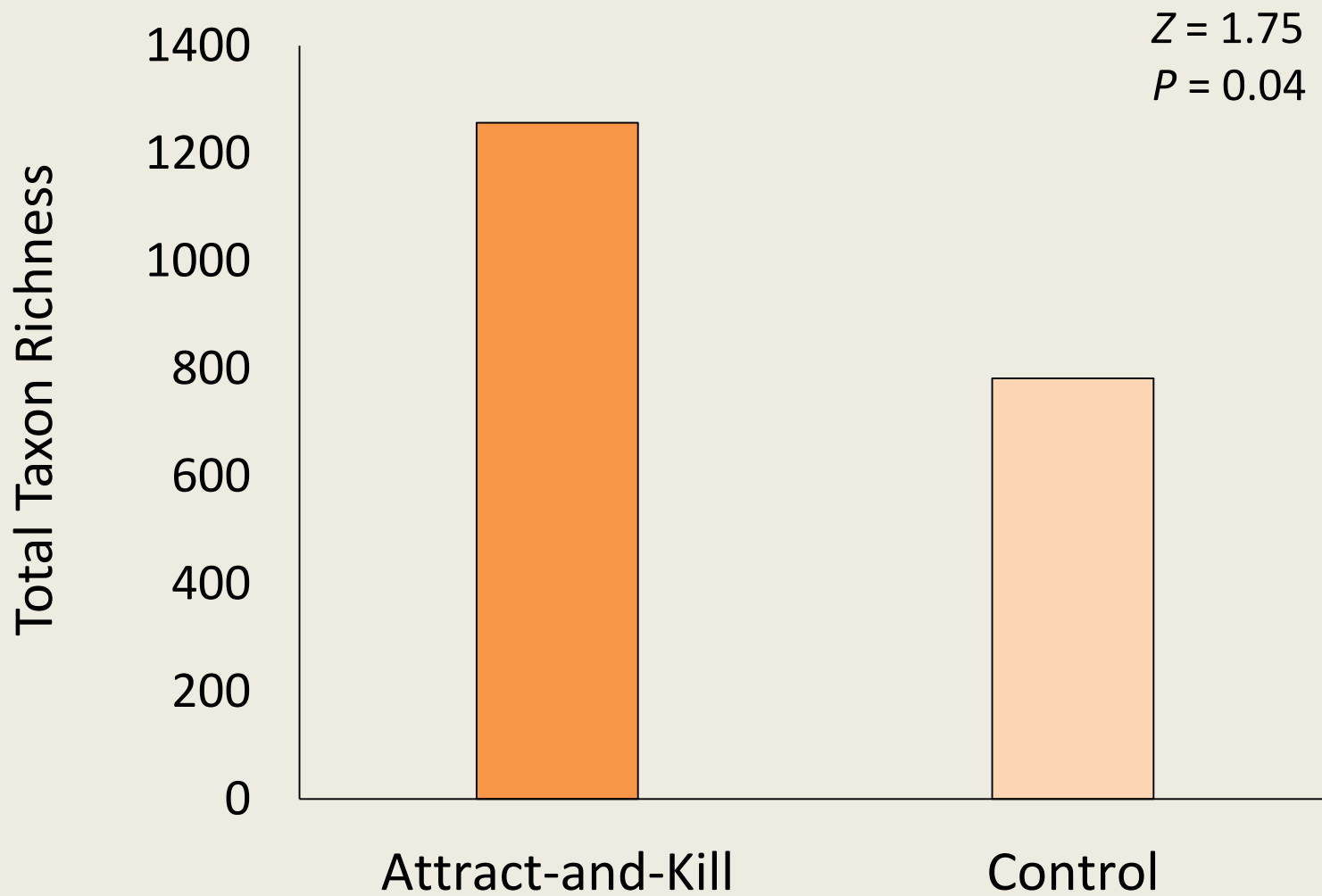
Nets provide equal protection



Attract-and-kill reduced seed damage



Increased biodiversity



Nets reduce seed damage

- Insecticide applications kill target insect
 - Also kill parasitoid wasps
 - Greater late season stink bug populations
 - Reduced seed quality
- Insecticidal nets
 - Maintain parasitoid populations
 - Lower stink bug populations
 - Higher seed quality



Insecticidal nets

- Provide equivalent control/defoliation
 - Low populations
- Reduce seed damage from stink bugs

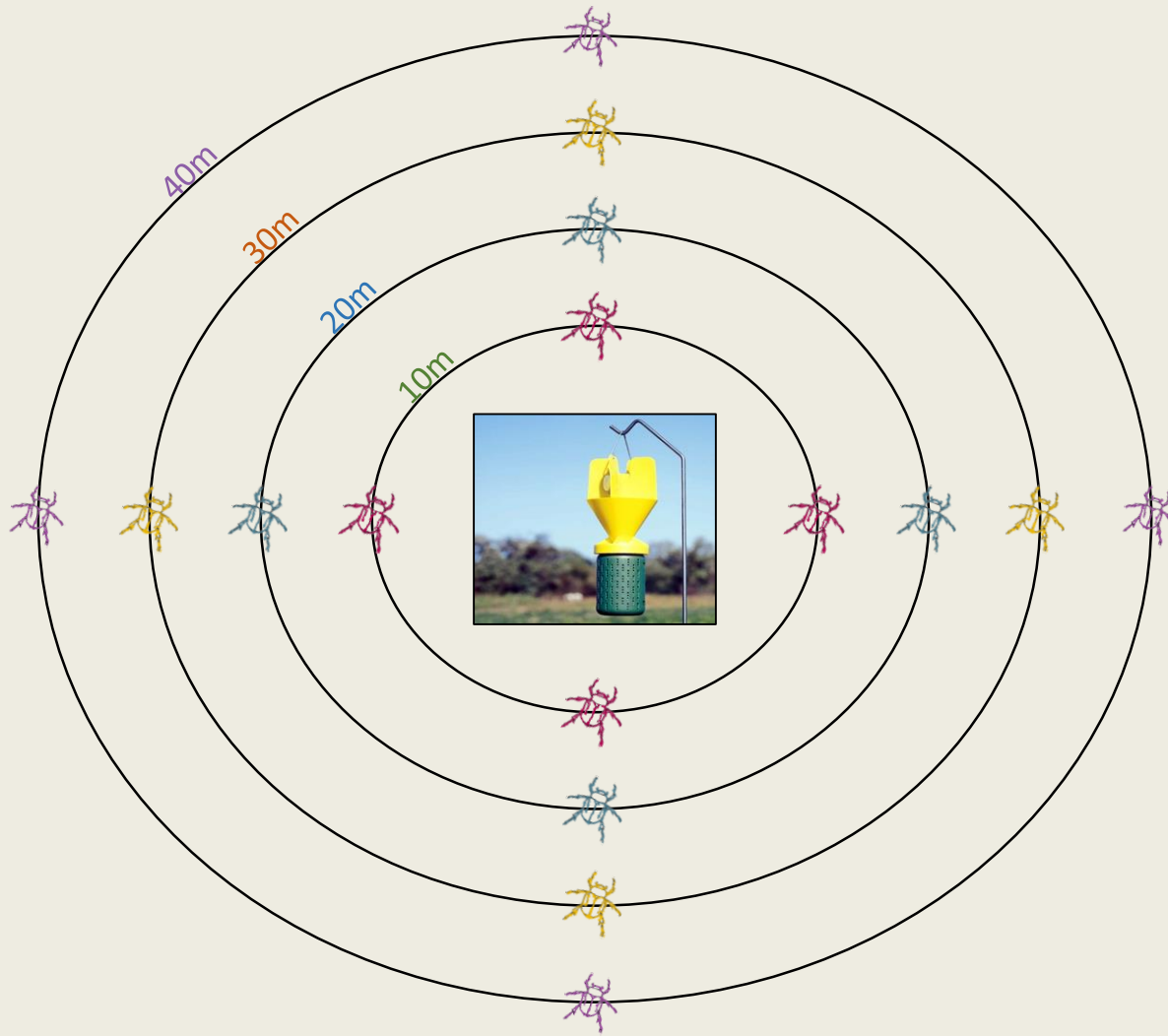


Current work

- Analyze movement
- Protein marking
 - Milk
 - Egg
- Pollinator diversity



Plume capacity



Plume capacity in vineyards???



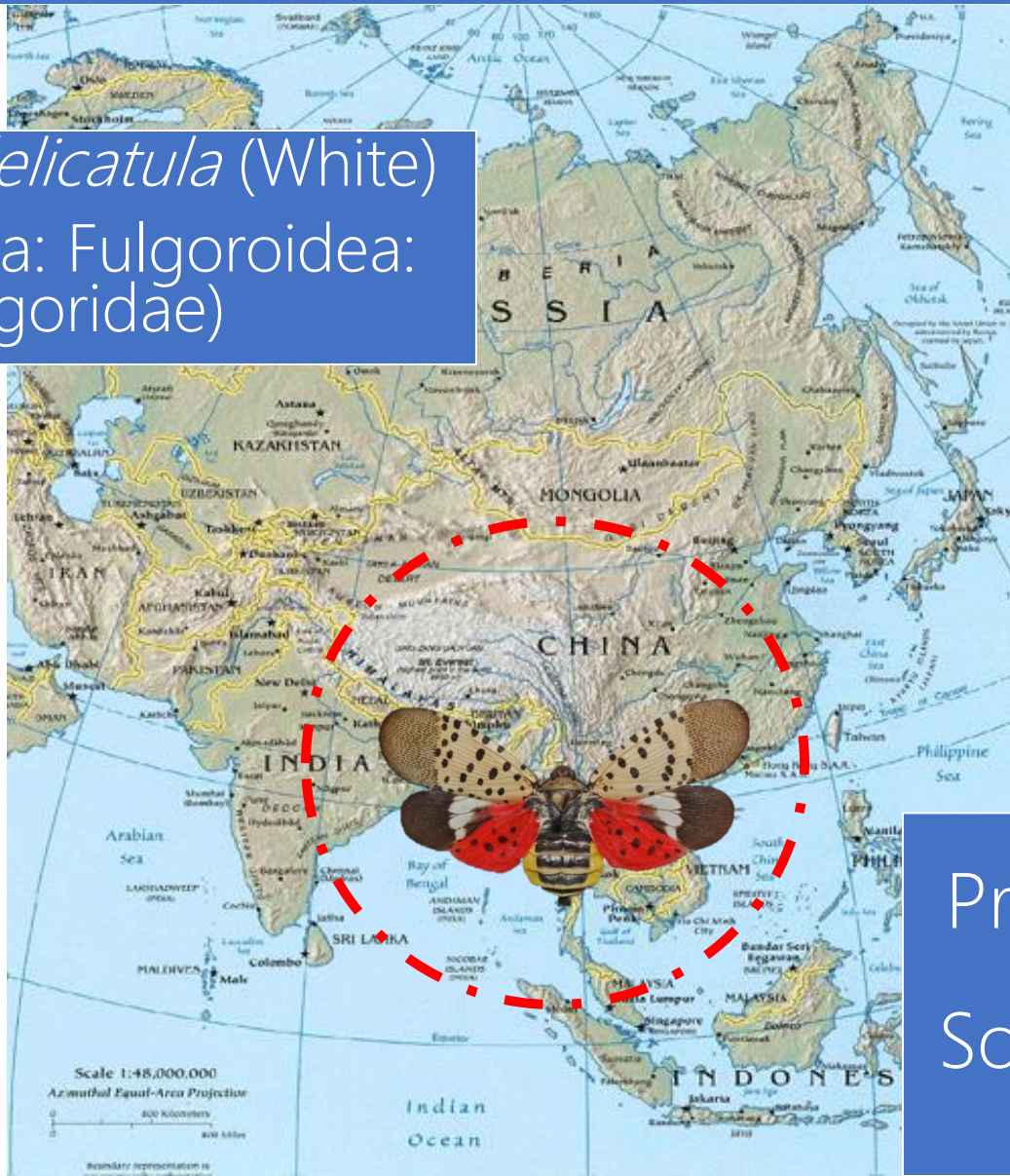
Spotted Lanternfly: a New Invasive



Danielle Kirkpatrick-Trece Inc.
Heather Leach- PSU

SLF is an Invasive Species in the USA

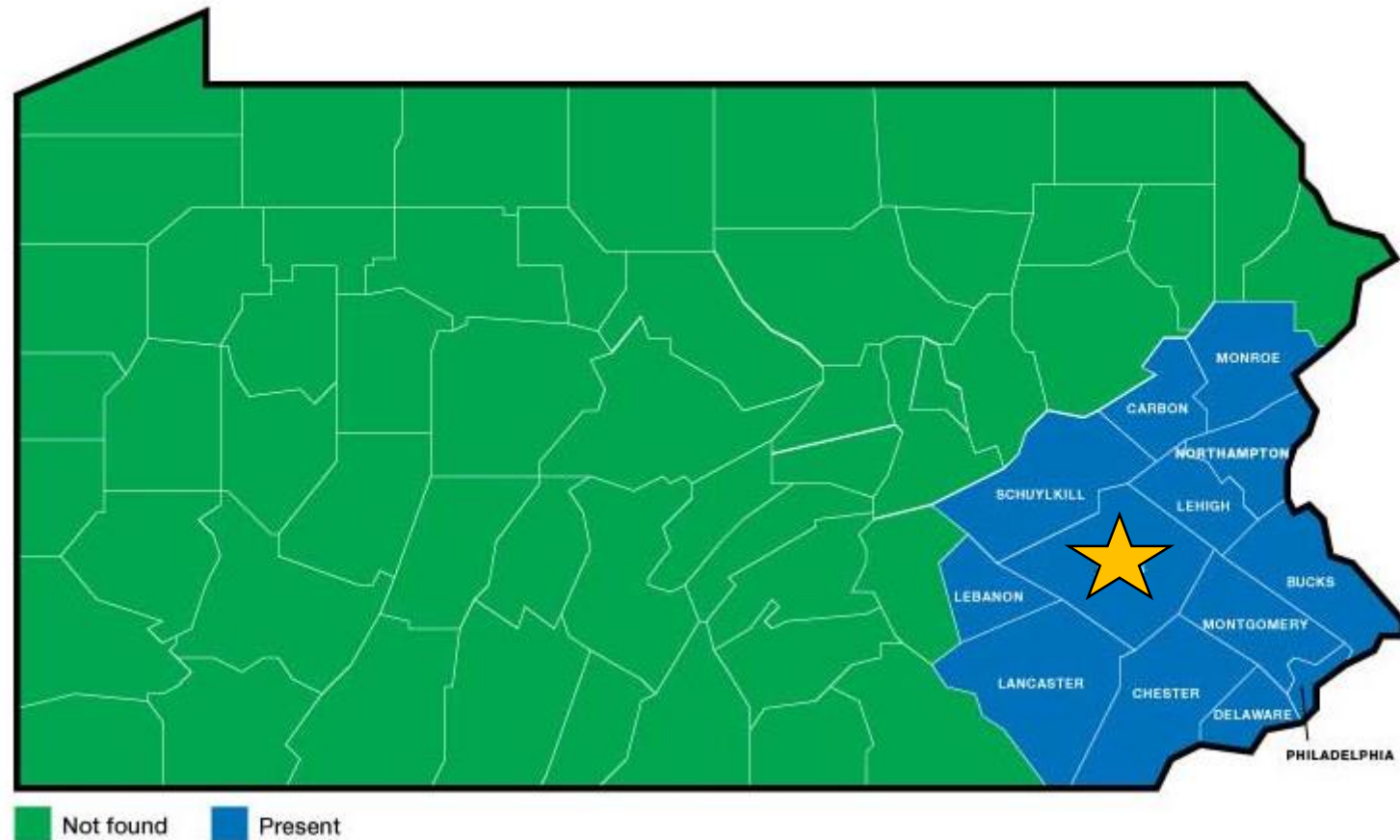
Lycorma delicatula (White)
(Hemiptera: Fulgoroidea:
Fulgoridae)



Present in China,
India, Japan,
South Korea, and
Vietnam

SLF first detection Berks Co. Pa

2018 quarantine counties

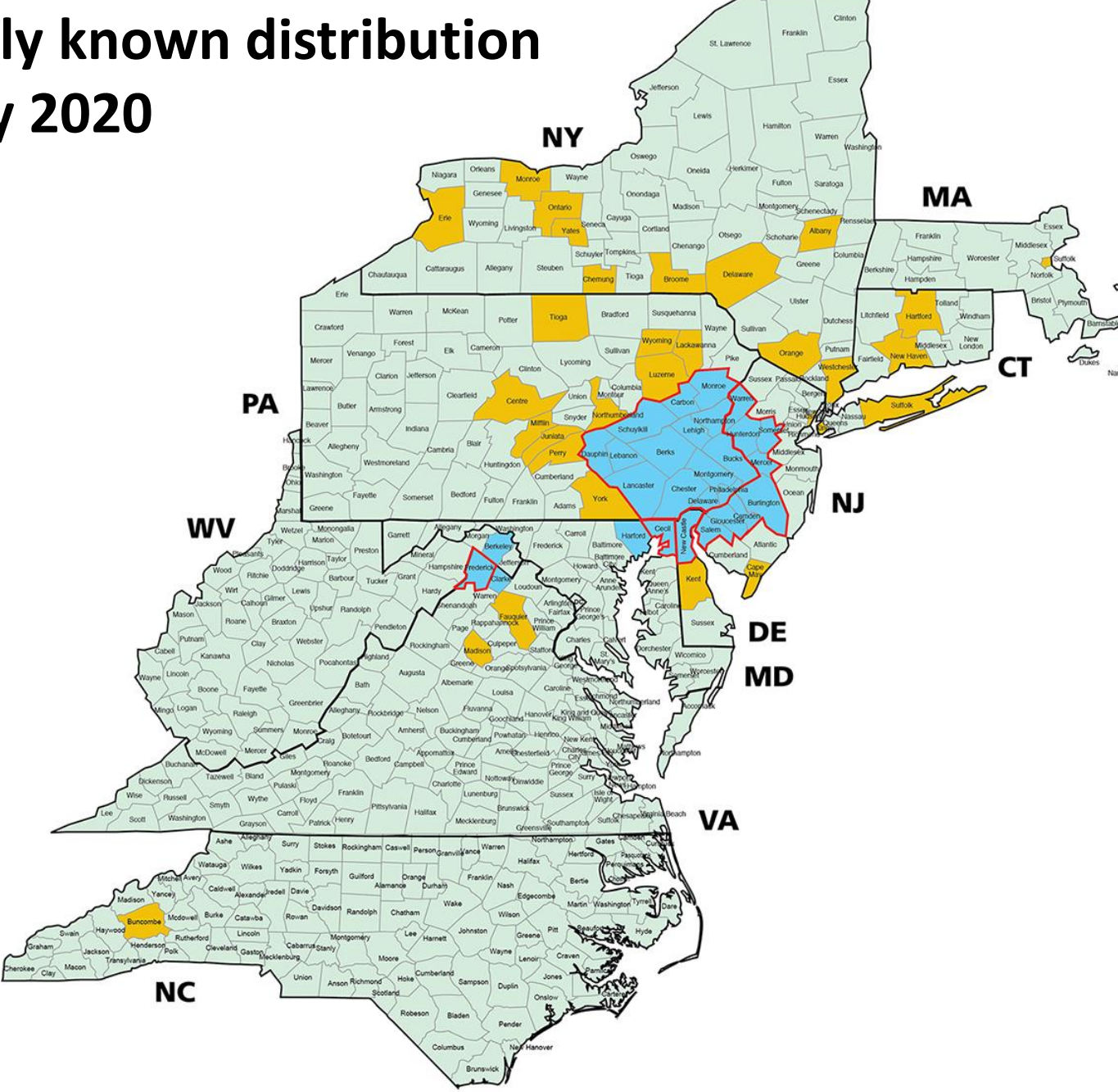


Eggs deposited on flat surfaces



Spotted lanternfly known distribution

Updated January 2020



NY external quarantine areas. Spotted lanternfly infestation found. Spotted lanternfly found, no infestation.

Internal state quarantine areas.

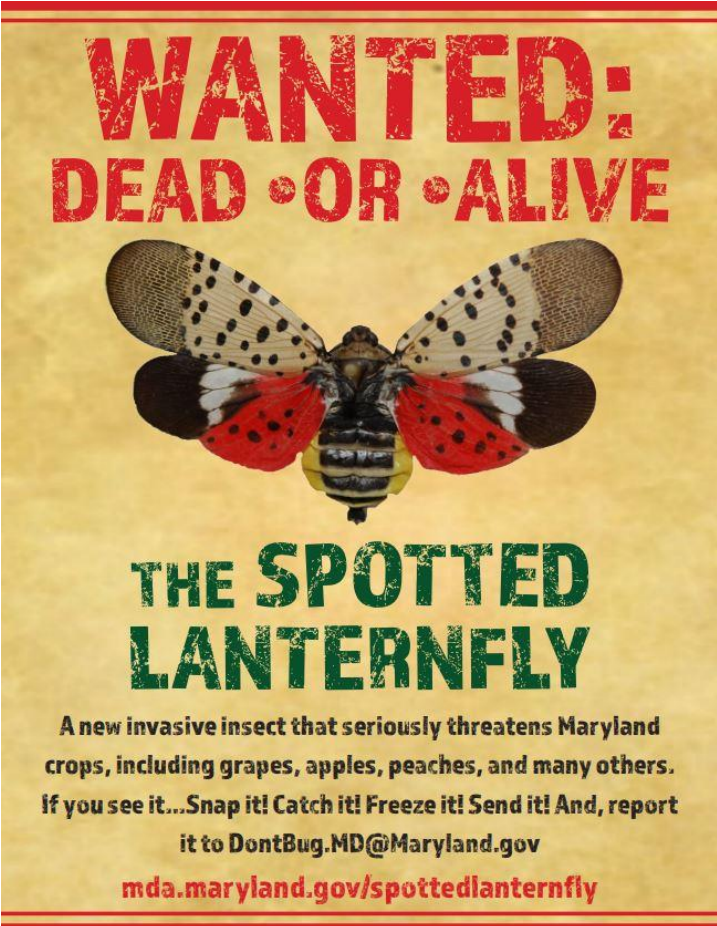
Adult hitchhikers

Spotted Lantern Fly Sparking California Concern

JUNE 17, 2019 [FRUITS & VEGETABLES](#), [INDUSTRY NEWS RELEASE](#), [NUTS & GRAPES](#)

Live, Adult Spotted Lanternfly Found in California

FEBRUARY 24, 2020 [PEST UPDATE](#)



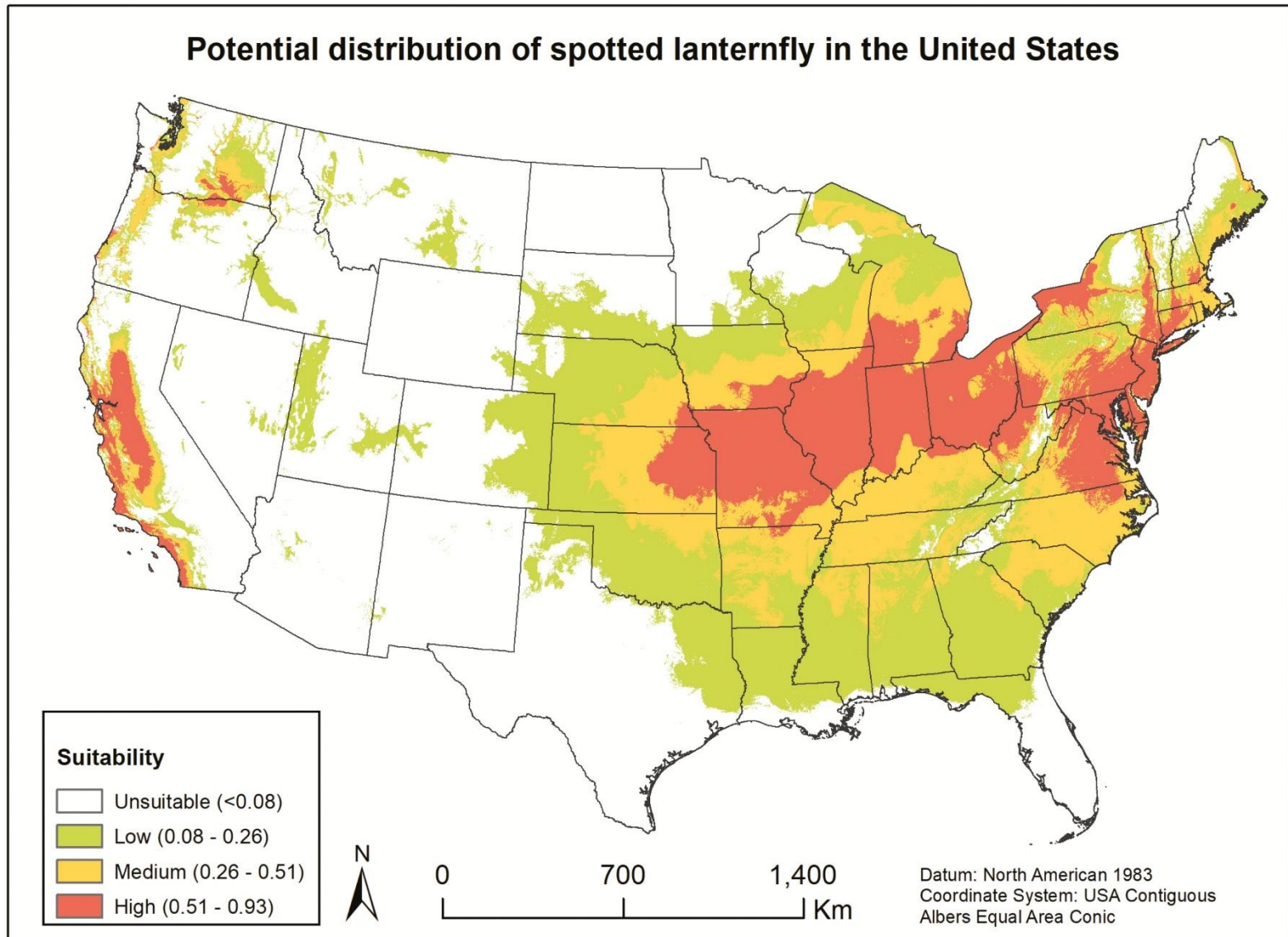
**WANTED:
DEAD • OR • ALIVE**

**THE SPOTTED
LANTERNFLY**

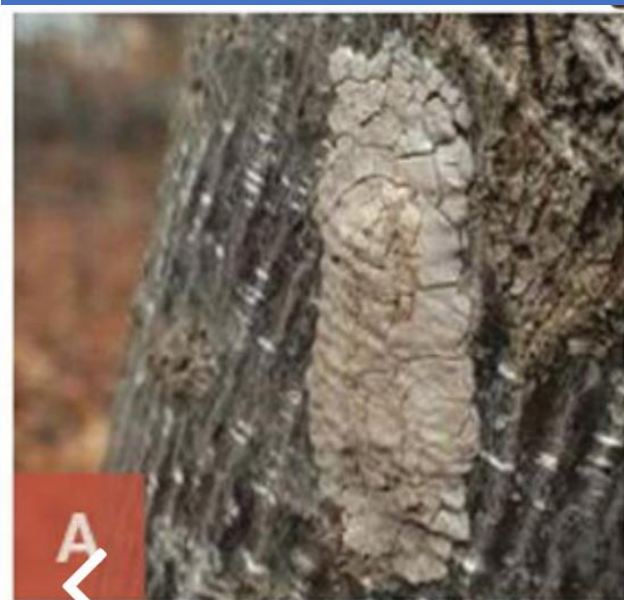
A new invasive insect that seriously threatens Maryland crops, including grapes, apples, peaches, and many others. If you see it...Snap it! Catch it! Freeze it! Send it! And, report it to DontBug.MD@Maryland.gov

mda.maryland.gov/spottedlanternfly

Where is SLF likely to spread to?



How to Identify the Invasive SLF



E. Swackhamer



PA Department of Agriculture



PA Department of Agriculture



PA Department of Agriculture



PA Department of Agriculture

- A. Egg masses
- B. Early nymph
- C. Late nymph
- D. Adult, wings closed
- E. Adult, wings open

Cryptic egg casing



Nymphal Stages of SLF



- Early stage nymphs (1st-3rd instars) have black bodies and legs with white spots
- Only a few centimeters long
- Strong jumpers; will jump when frightened
- Tend to feed on the new growth of a plant, such as stems and foliage

Nymphal Stages of SLF



- Late stage nymphs (4th instars) have bright red bodies with black stripes and white spots
- Last nymphal stage before becoming adults
- About ½ inch long
- Strong jumpers; will jump when frightened

Adult SLF



- Adults are about 1" long

Adult SLF



- Early season (left) vs. late season (right) female SLF
- Females build up fat bodies towards end of summer to prepare for egg laying

Potential to Cause Economic Damage

Direct effects

Phloem feeders; reported to feed on over 65 species of plants
Knowledge gaps in host range in the US

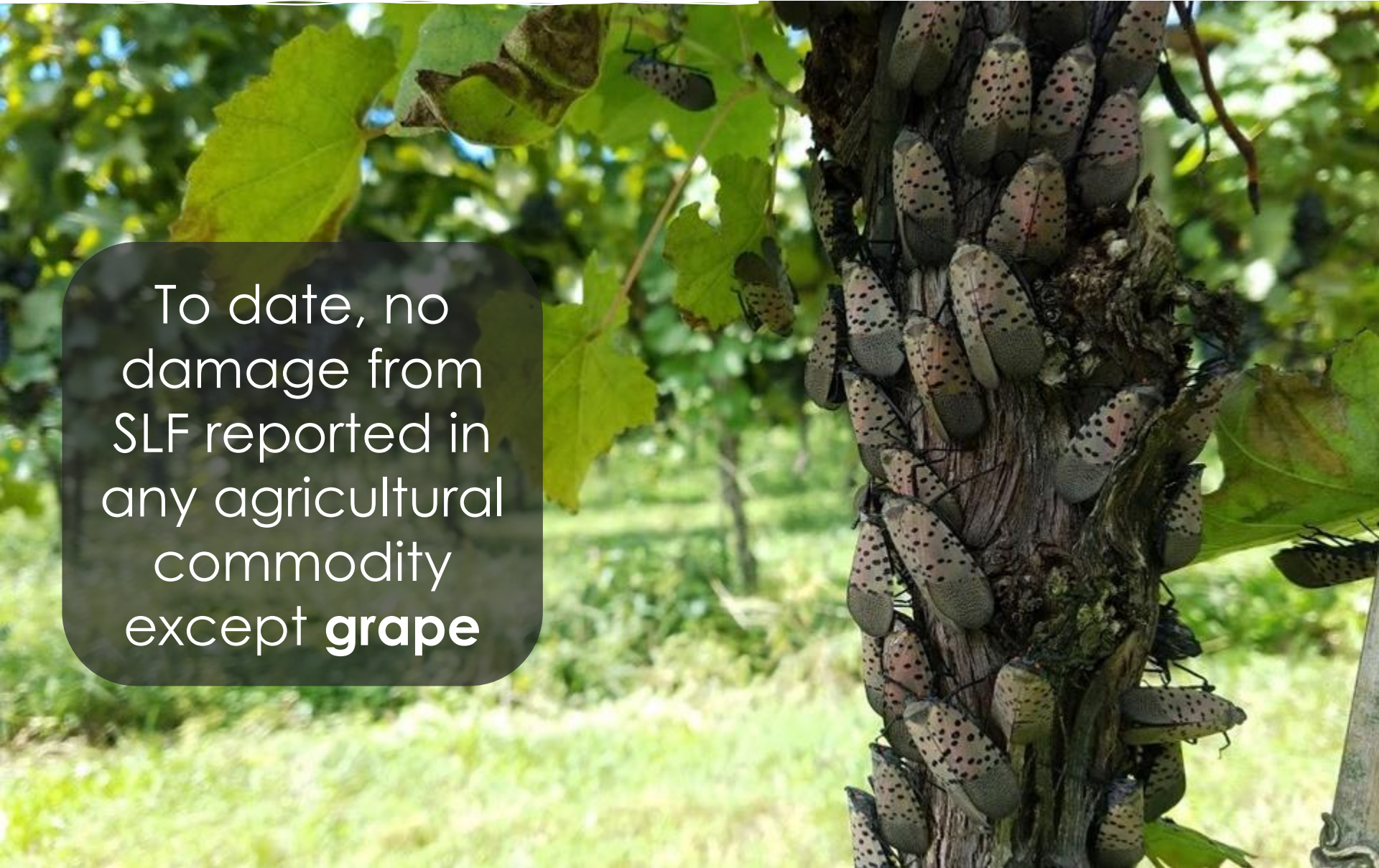
Projected to become a serious pest of timber, ornamental trees, tree fruit, stone fruit, grapes, hops and small fruit such as blueberries

Feeding could potentially shock trees and cause decline



SLF in vineyards

To date, no damage from SLF reported in any agricultural commodity except **grape**



SLF pressure in vineyards



SLF pressure in vineyards



SLF damage to vineyards

13 vineyards reporting yield losses and vine death from SLF

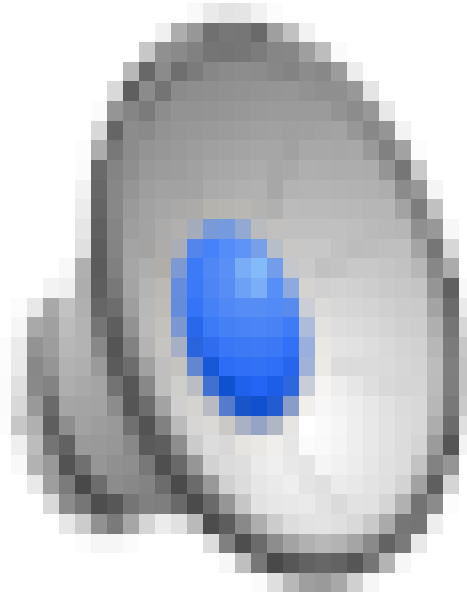
Average number of insecticide applications went from **4 to 14** in response to SLF in just two years (2016 to 2018)

Average insecticide costs per acre went from **\$54 to \$147** (J. Harper et al.)

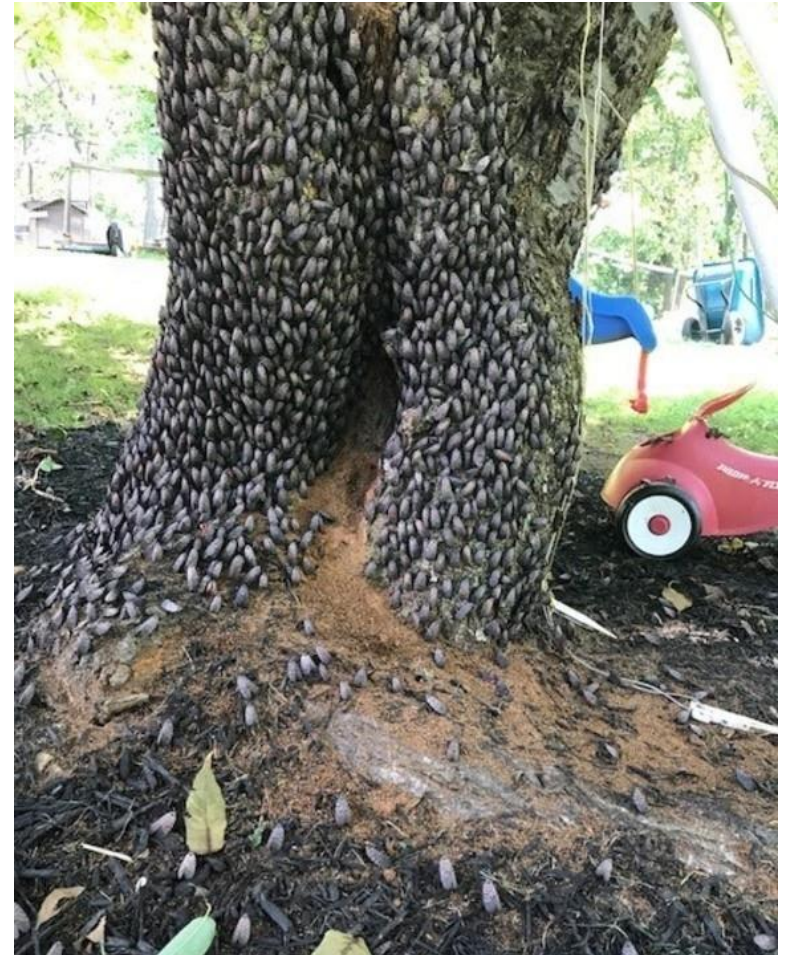


Adult SLF Feeding on Grapevine

Video: Erica Smyers, PSU

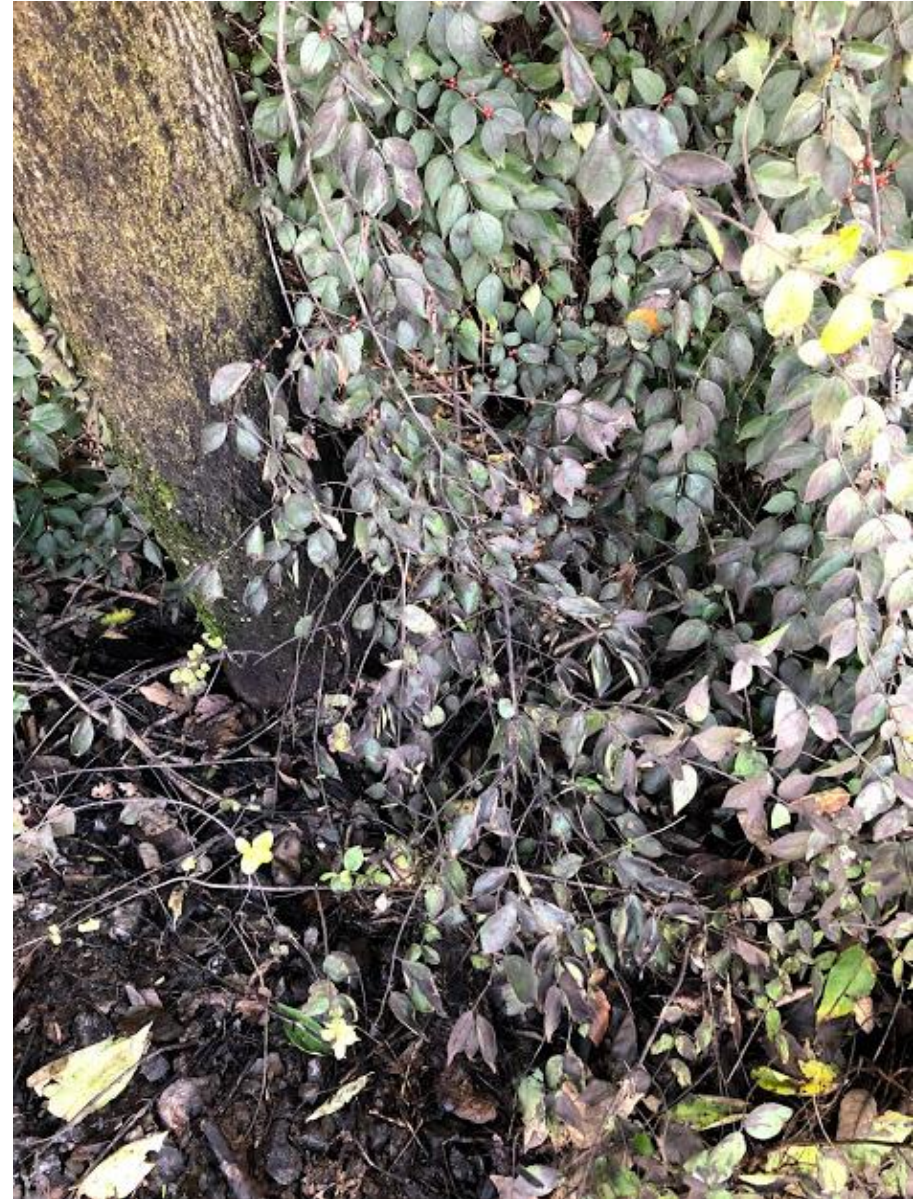


SLF on hardwood trees



Potential to Cause Economic Damage

- Indirect effects of feeding
 - Excrete large amounts of honeydew
 - Sooty mold on leaves/fruit
 - May exacerbate yellow jacket problems
 - jacket problems



Preliminary Trapping Study



Sticky Band Trap



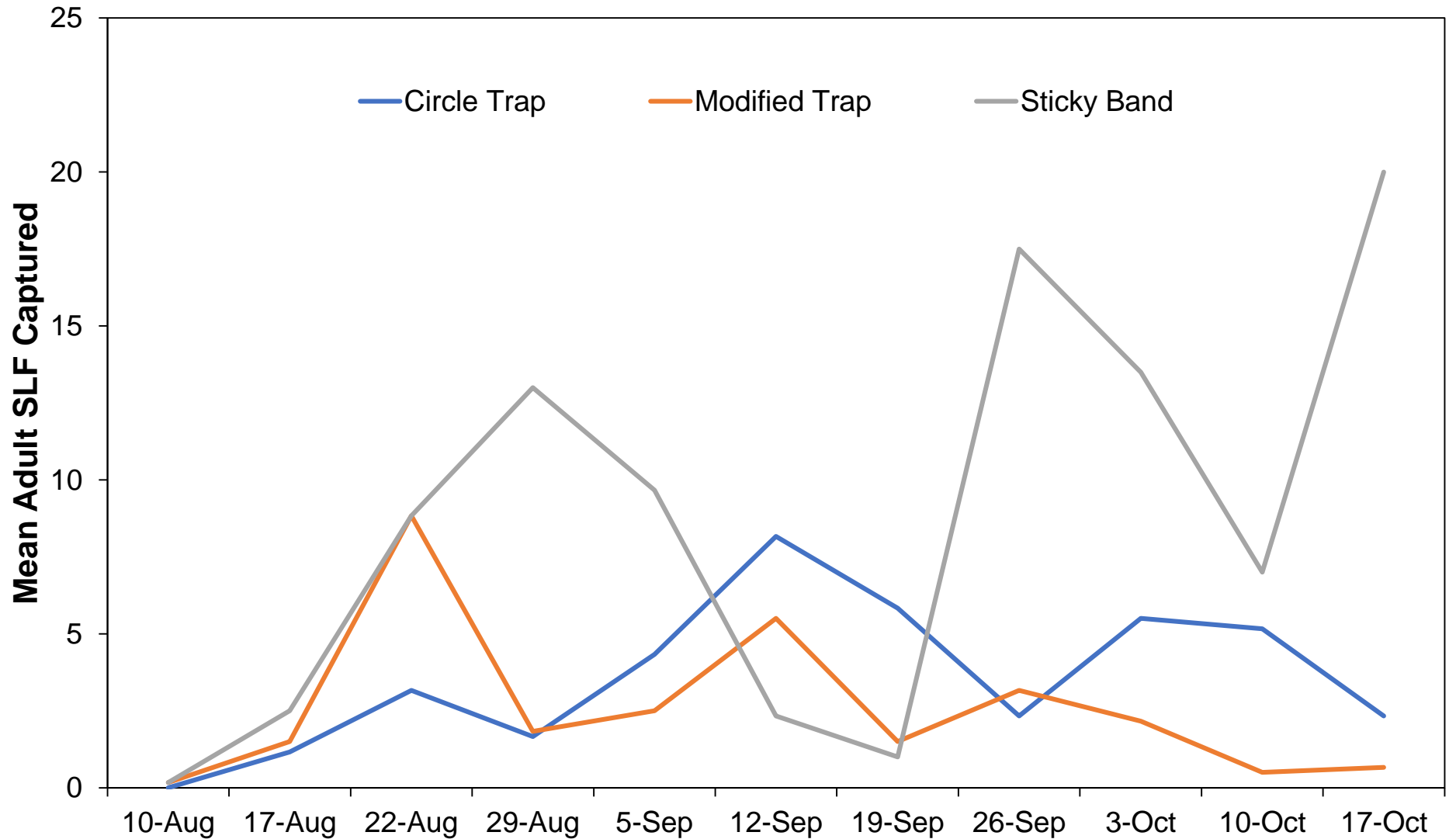
Modified Trap

- 2 sites – Winchester, VA (lower population) and Reading, PA (higher population density)
- 3 trap types, baited and unbaited
- Traps checked weekly and captures recorded
- Sticky bands and lures replaced weekly

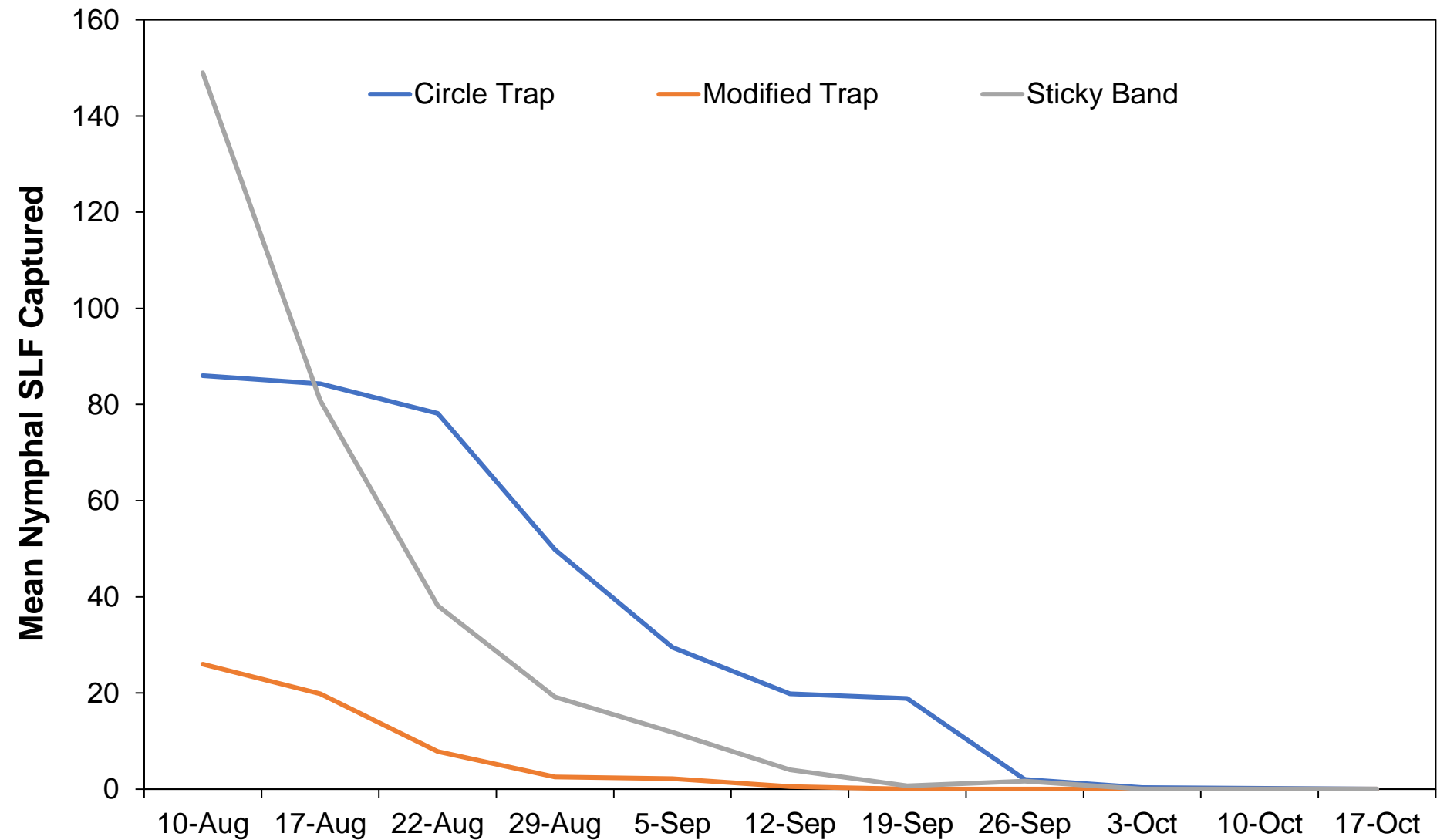


Circle Trap

Adult Captures



Nymph Captures – Reading, PA



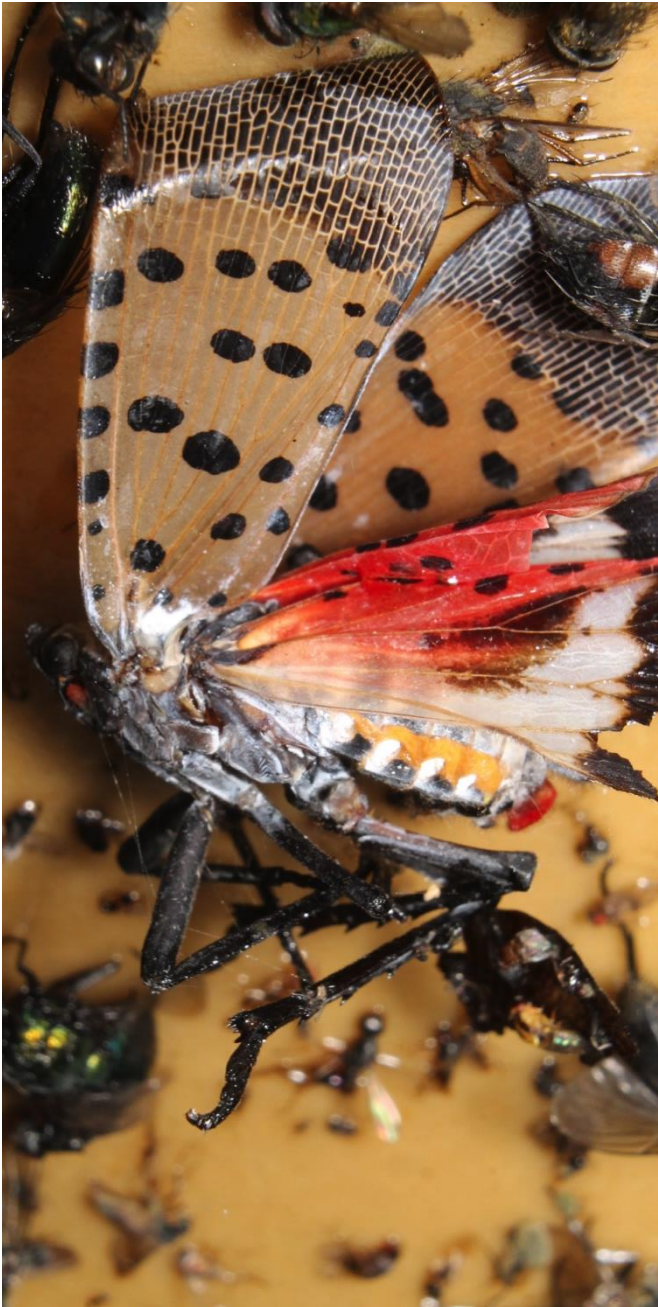


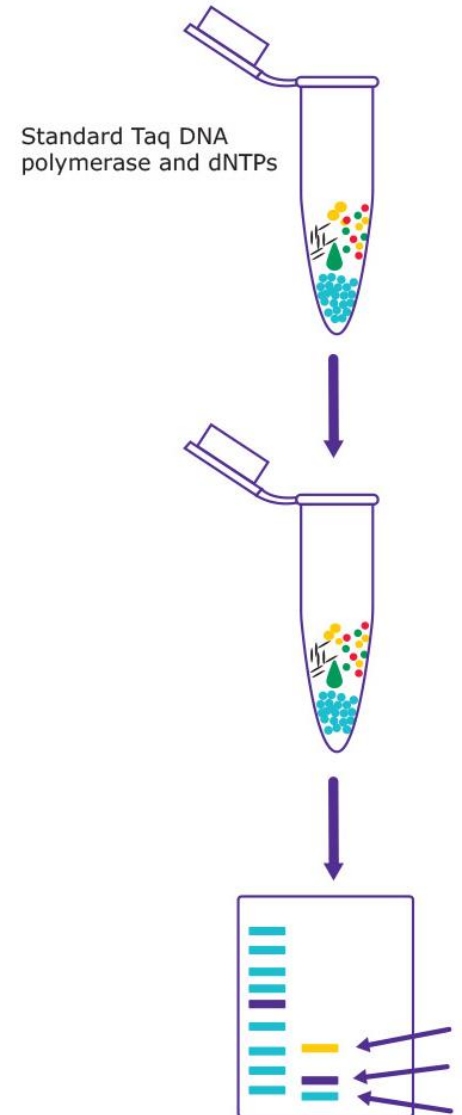
Photo: H. Leach, PSU

Sticky band traps:
effective for capturing
nymphs and adults
throughout season



Non-target captures of vertebrates and invertebrates creates a potential problem with using sticky bands

Environmental DNA



eDNA for Biosurveillance

- Highly sensitive/specific
 - 7x more likely to detect SLF
 - Follow with traps/visual scouting
- Collect from entire vineyard!



SLF insecticide trials

Most commonly used

Trade Name	Active Ingredient	Control Method	PHI (days)	REI (hours)	Labeled for SLF on Grape in PA?	Life Stage Tested	Longevity	SLF Activity
Brigade 10WSB	bifenthrin	C, I	30	12	Yes, 2(ee)	Nymphs, adults	****	++++
Actara 25WDG	thiamethoxam	S, C, I	5	12	Yes, 2(ee)	Nymphs, adults	****	++++
Scorpion 35SL	dinotefuran	S, C, I	1	12	Yes, 2(ee)	Nymphs, adults	***	++++
Carbaryl 4L	carbaryl	C, I	7	12	No Note: Sevin XLR has 2(ee)	Nymphs, adults	***	++++
Danitol 2.4EC	fenpropathrin	C, I	21	24	No	Nymphs	**	++++
Malathion 8F	malathion	C, I	3	12	Yes, 2(ee)	Nymphs, adults	**	++++
Mustang Maxx 0.8EC	zeta-cypermethrin	C, I	1	12	Yes, 2(ee)	Nymphs, adults	**	+++
Avaunt 30DG	indoxacarb	C, I	7	12	Yes, 2(ee)	Nymphs, adults	*	++
Imidan 70WP	phosmet	C, I	14	336	Yes, 2(ee)	Nymphs, adults	*	++ for nymphs; 0 for adults
Assail 30SG	acetamiprid	S, C, I	3	48	Yes, 2(ee) on nymphs only	Nymphs, adults	*	+
JMS Stylet Oil	Paraffinic oil	C	14	4	No	Egg masses	Unknown	++
Lorsban Advanced	chlorpyrifos	C	35	24	No	Egg masses	Unknown	++++

SLF insecticide trials

SLF are fairly **easy to kill** with many broad-spectrum insecticides

Most effective chemicals include:

dinotefuran

carbaryl

thiamethoxam

zeta-cypermethrin

malathion

bifenthrin

fenpropathrin

beta-cyfluthrin



Natural predators killing SLF



Generalist predators are attacking SLF in the U.S.

This is unlikely to control the SLF population

Fungal pathogens killing SLF

Two fungal pathogens in PA found attacking SLF

One identified as *Beauveria* sp., the other as *Batkoa major*

Too early to determine species or use as a control method



Searching for natural enemies



FOREIGN EXPLORATION

Two parasitoid species found: *Anastatus orientalis* and *Dryinus stantoni*

Both are currently in U.S. quarantine facility



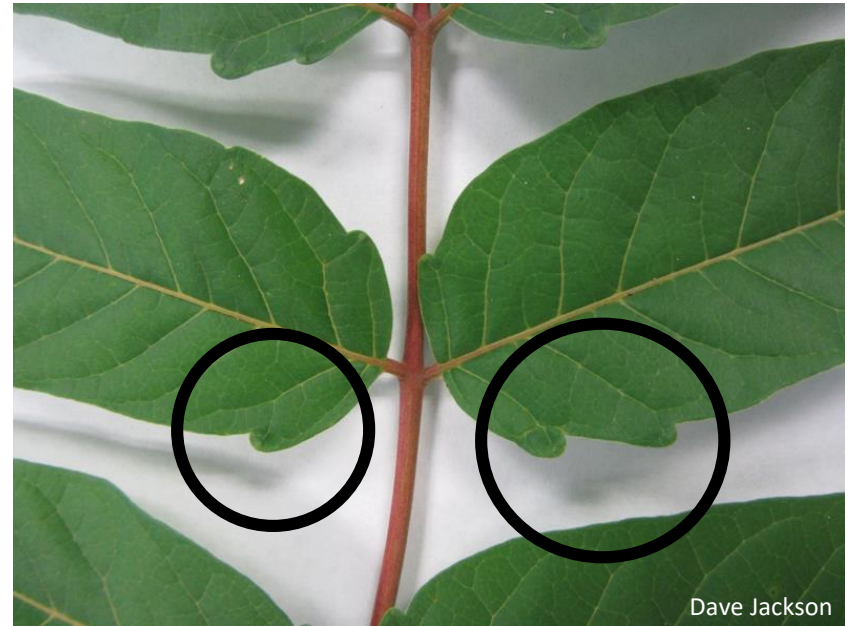
How to prepare for SLF

Scout for **tree-of-heaven** on your property

Monitor your wood edge for spotted lanternfly

If you think you find a spotted lanternfly, kill it, take a picture, and report it to:

Your department of agriculture



Dave Jackson



Dave Jackson

SLF invaded Korea-2004

- Severe economic damage
- Recent rapid decline in pop.
- *Anastatus orientalis*?
 - Non-targets in USA
- Additional BC agents?



Questions?

