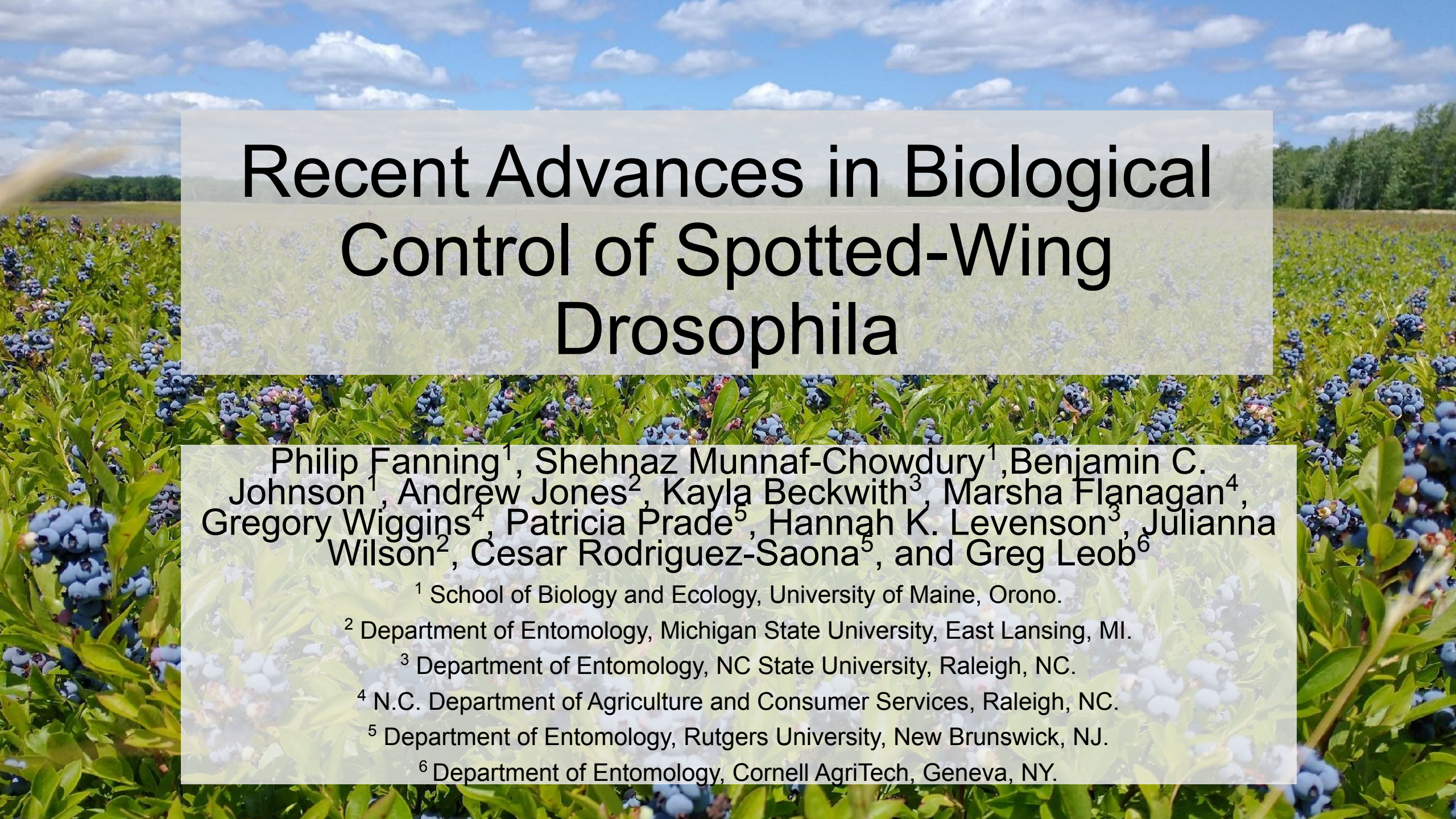


# Recent Advances in Biological Control of Spotted-Wing Drosophila

Philip Fanning[1], Shehnaz Munnaf-Chowdury[1],Benjamin C. Johnson[1], Andrew Jones[2], Kayla Beckwith[3], Marsha Flanagan[4], Gregory Wiggins[4], Patricia Prade[5], Hannah K. Levenson[3], Julianna Wilson[2], Cesar Rodriguez-Saona[5], and Greg Leob[6]

[1] School of Biology and Ecology, University of Maine, Orono.

[2] Department of Entomology, Michigan State University, East Lansing, MI.

[3] Department of Entomology, NC State University, Raleigh, NC.

[4] N.C. Department of Agriculture and Consumer Services, Raleigh, NC.

[5] Department of Entomology, Rutgers University, New Brunswick, NJ.

[6] Department of Entomology, Cornell AgriTech, Geneva, NY.

# Recent Advances in Biological Control of Spotted-wing Drosophila


USDA National Institute for Food and Agriculture (NIFA)-

Organic Agriculture Research and Extension Initiative (OREI)
*Award number 2022-51300-37890*

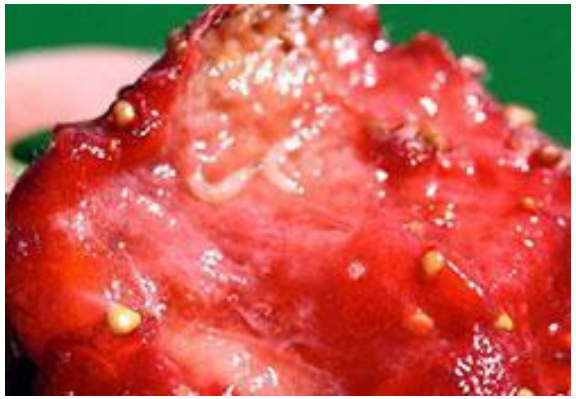
Crop Protection and Pest Management (CPPM) program
*Award number 2021-70006-35312*

Specialty Crop Research Initiative (SCRI) program
*Award number 2020-5118-32140*

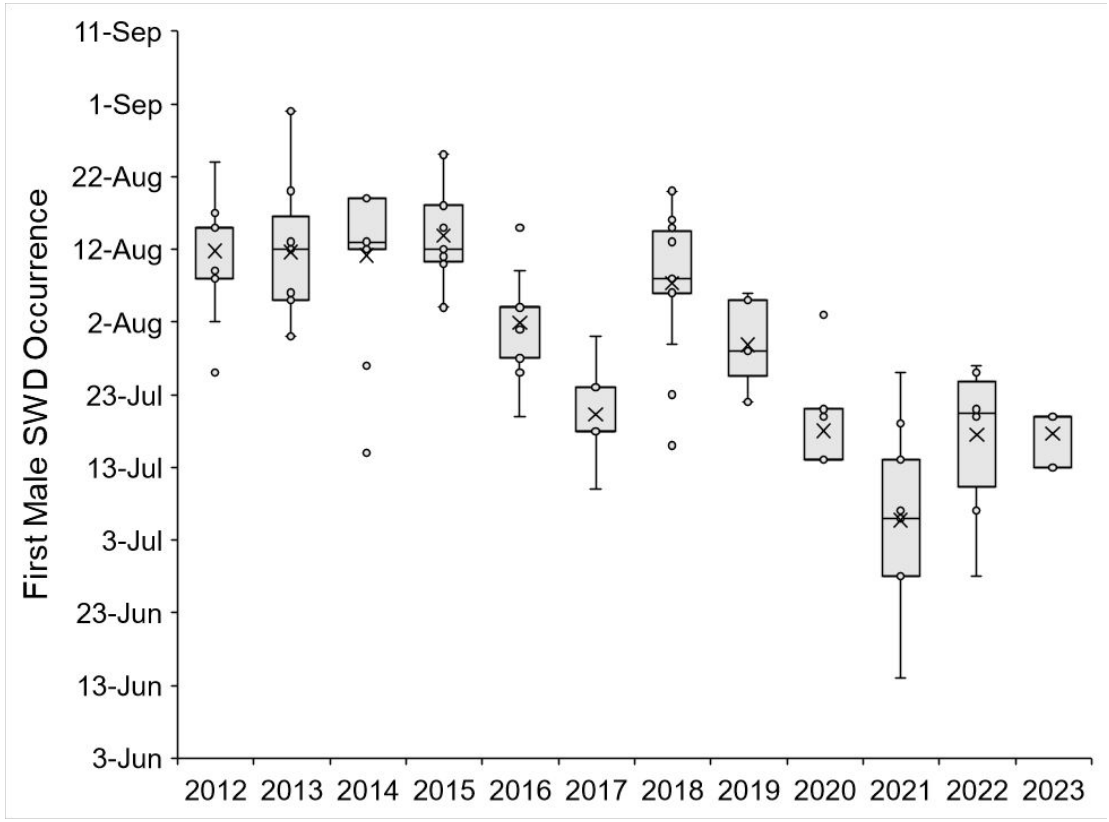
United States Department of Agriculture
National Institute of Food and Agriculture

# Spotted-wing Drosophila

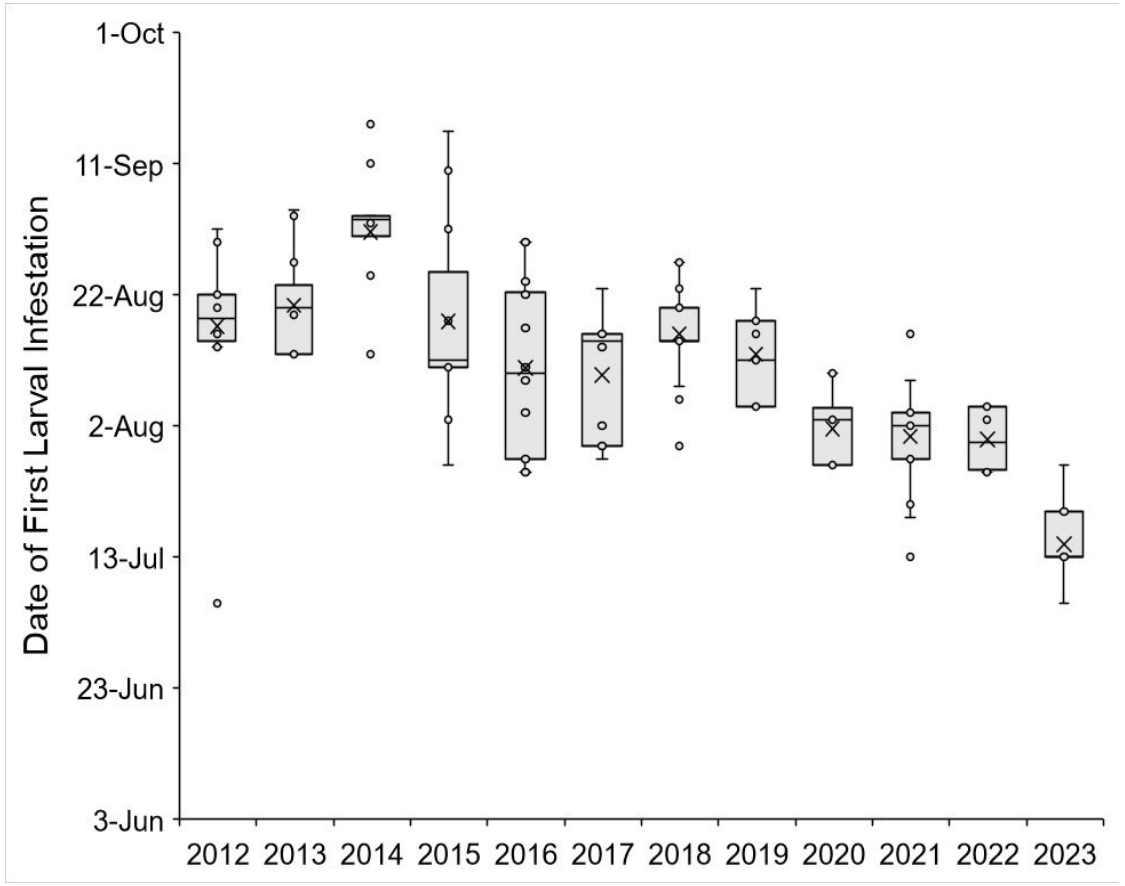
- Native to SE Asia
- Males have dark wing spots
- Females have serrated ovipositors
- Frugivore of berry crops



# Earlier SWD Occurrences in Maine!




First adult male encounter




First larval infestation found

# Tiny Insect Causing Huge Losses

**Blueberries**
*$859 million*
*Average 13% crop loss*

**Blackberries**
*$38 million*
*Average 27% crop loss*

**Raspberries**
*$582 million*
*Average 41% crop loss*

**Cherries**
*$846 million*
*Average 9% crop loss*

***Crop loss statistics: https://swd.ces.ncsu.edu/swd-impacts-2014/***

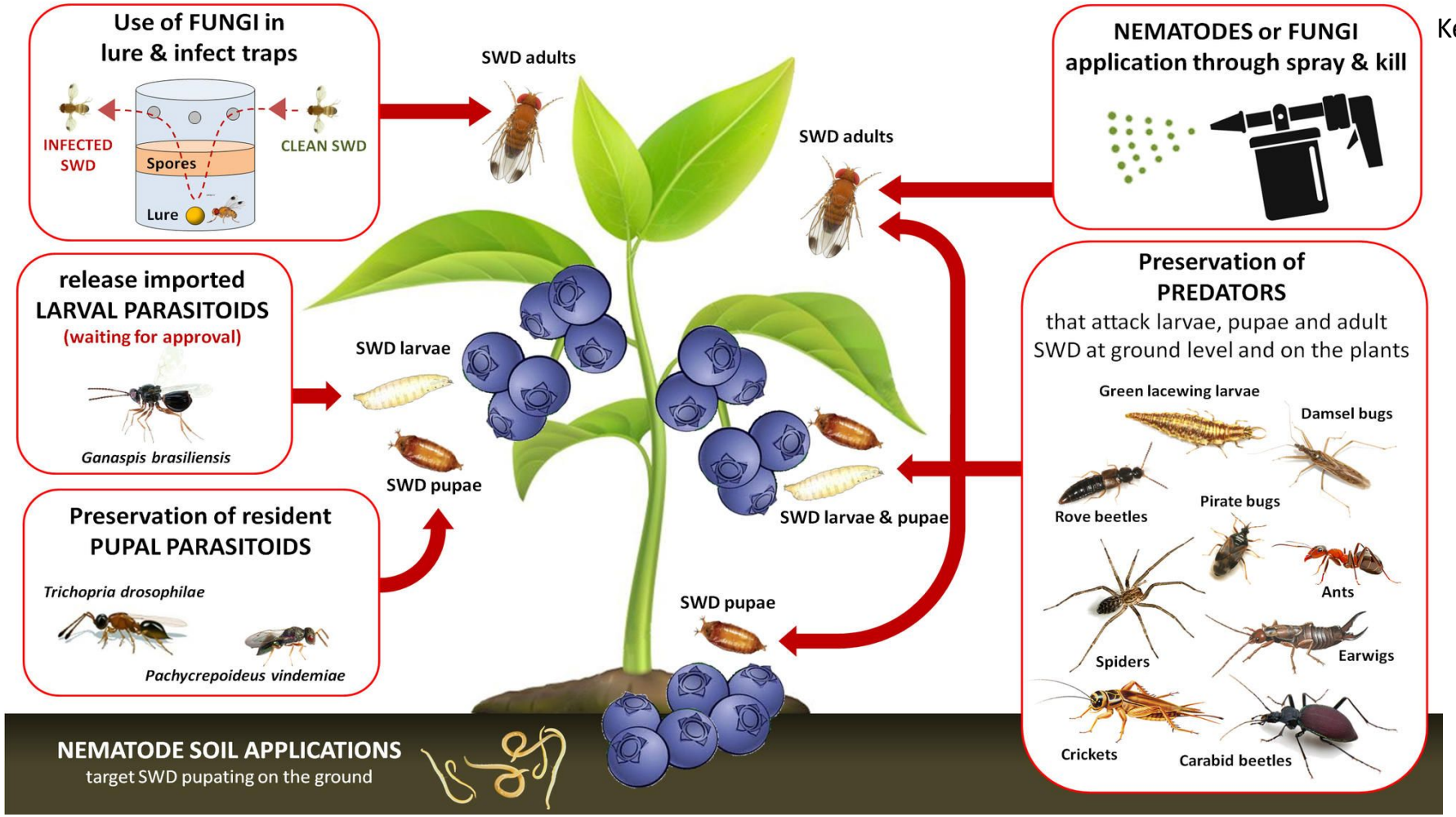
# Overview of SWD Biological Controls

Kent Daane

## Bio-Controls

Rossi-Stacconi et al. 2019 OSU Extension.

Bacteria
Fungi
Nematodes
Insect predators
Insect parasitoids



# Bio-Controls are Present, But Need Improvement

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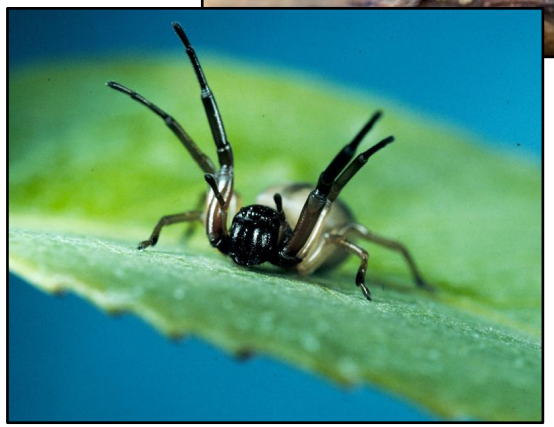
| Fruit | % pupae in soil |
|---|---|
| Raspberry | 83-90% |
| Blueberry | 83% |

About 80% of SWD pupate outside of fruit in soil, where they are attacked by generalist predators.
Ballman et al. 2017, J. Econ. Entomol.




Predator exclusion trials showed a 19-49% reduction of SWD larvae and a 61-91% reduction of pupae by generalist predators, such as ants and spiders!
Woltz and Lee, Biol. Control

# More was Needed – Started Classical Bio-Control Program

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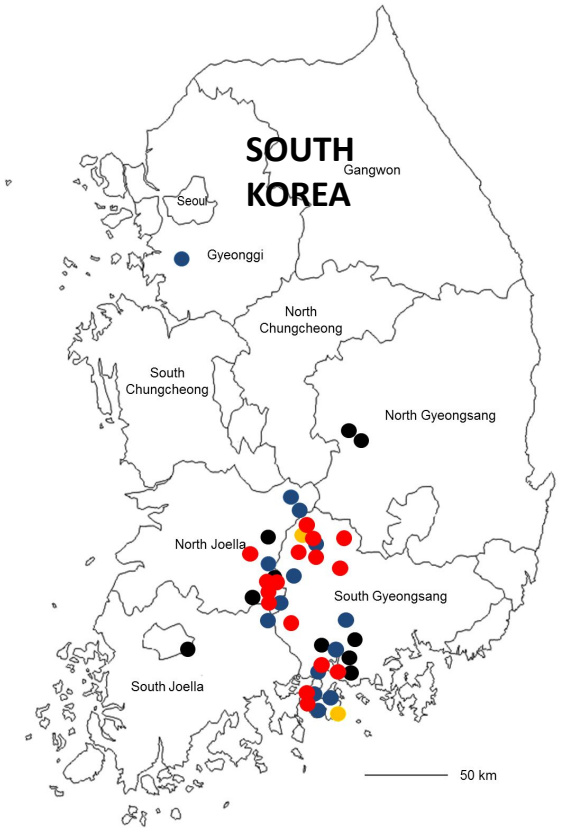
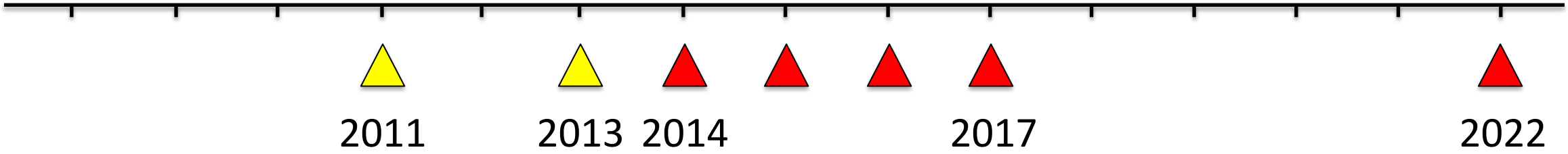
Exploration in So. Korea (2011, 2013, 2014, 2016, 2017, 2022) and China (2013-2016) for novel parasitoids.

*Asobara japonica,*
*Leptopilina japonica,*
*Ganaspis brasiliensis*





Kim Hoelmer
Massimo Giorgini
Emilio Guerrieri
Xingeng Wang
Betsey Miller
Fu-Shou Chen
Yoohan Song
Hong-Yin Chen
Kent Daane

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# Foreign Exploration in Asia – Discovered many SWD Parasitoids

Braconidae – larval parasitoids

*Asobara japonica*, *A. leveri*, *A. mesocauda*, *A. unicolorata*, *A. brevicauda*, *A. elongata*, *A. triangulata*, *A. pleuralis*, *A. sp.*, *Tanycarpa chors*, *Areotetes striatiferus*

Figitidae – larval parasitoids

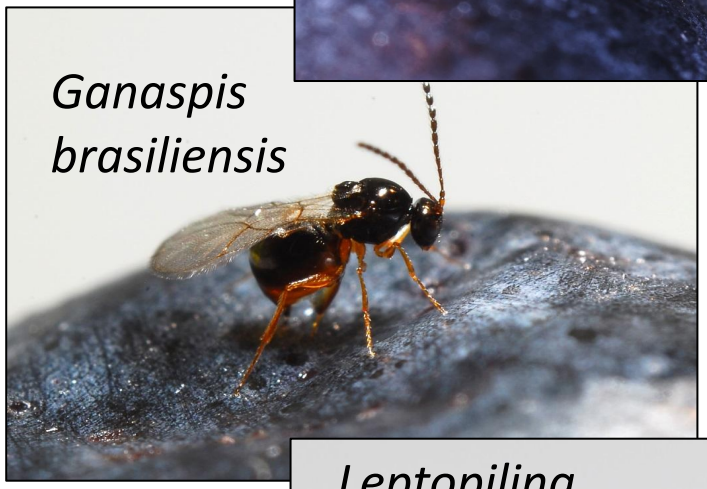
*Ganaspis sp 1 and sp 2*, *G. xanthopoda*, *Leptolamina sp.*, *Leptopilina j. japonica*, *L. decemflagella*, *L. sp. 1*

Pteromalidae – pupal parasitoids

*Pachycrepoideus vindemiae*

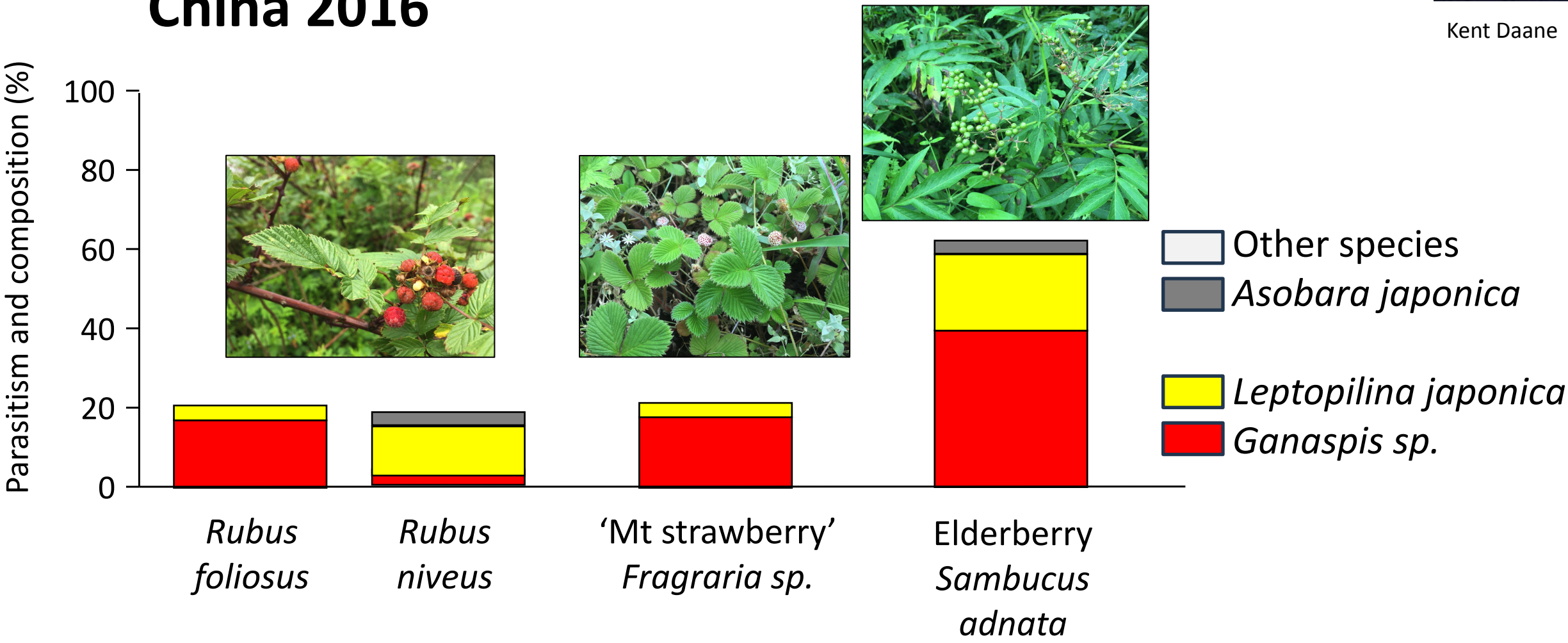
Diapriidae – pupal parasitoids

*Trichopria drosophilae*

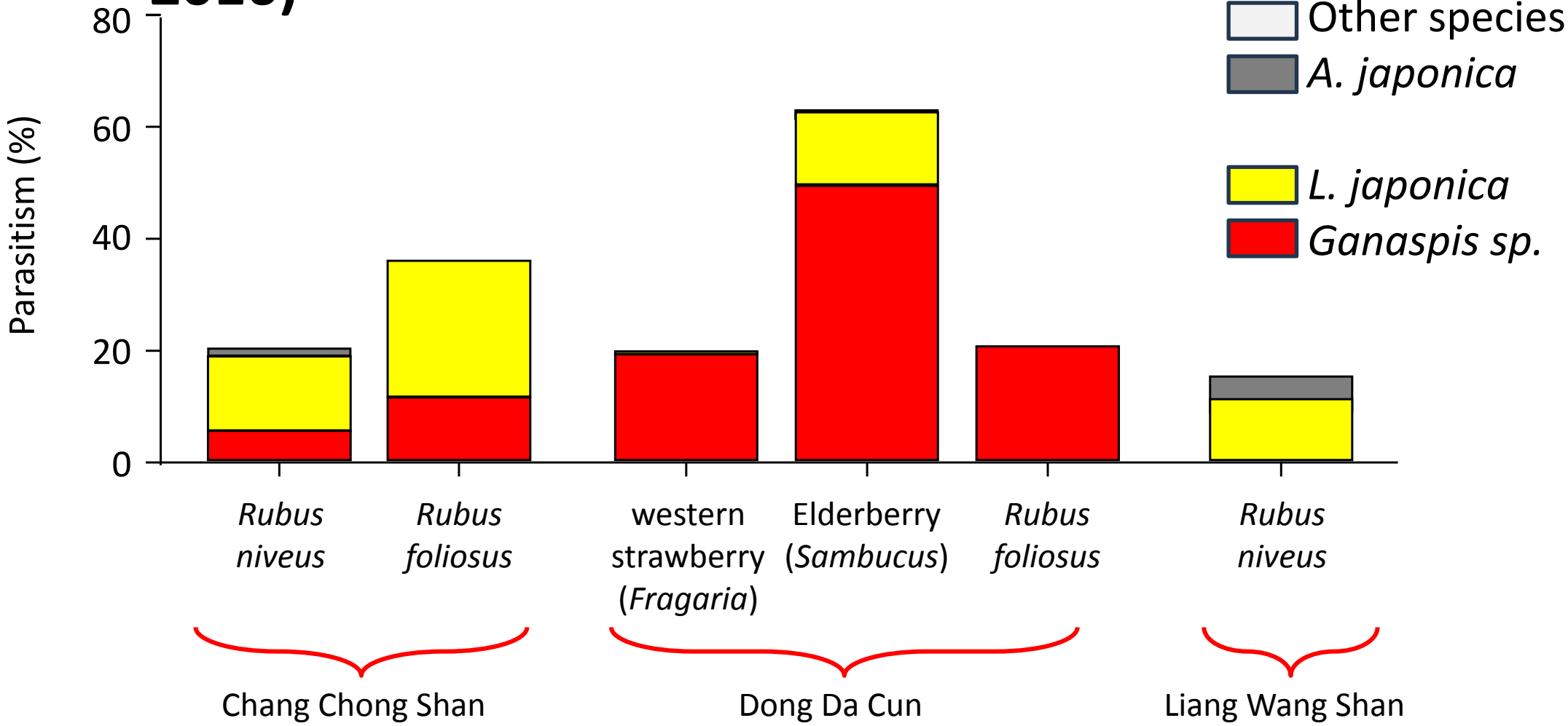

# What can be expected in US? Parasitism Levels & Species Composition in China 2016

Kent Daane

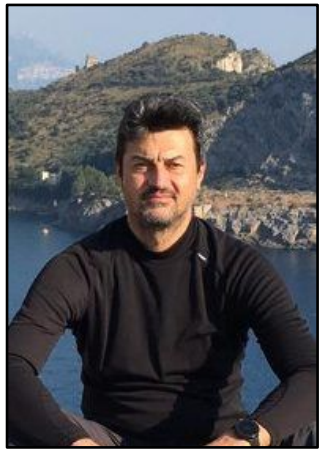


# Expect some variation in parasitoid impact – Variation among location as well as host plant (China 2016)

Kent Daane



# For USDA Permits to Release – 5 years (2014-2019) of Quarantine work – Biology and Taxonomy



International team

Antonio Biondi
Xingeng Wang
Evelyne Hougardy
Matthew Buffington
Emilio Guerrieri
Massimo Giorgini

CABI group in Switzerland

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# “non-target” impact (kills only SWD)

Kent Daane

***Drosophila suzukii***

*Scaptodrosophilia lebanonensis*

*Samoaia leonensis*

*Drosophila elmoi*

*Hirtodrosophila duncani*

*Gitona americana*

*Drosophila robusta*

*Drosophila melanogaster*

*Drosophila tripunctata*

*Drosophila subobscura*

*Drosophila sturtevanti*

*Drosophila pseudoobscura*

*Drosophila putrida*

*Drosophila simulans*

*Drosophila persimilis*

*Drosophila paramelanica*

*Drosophila montana*

*Drosophila willistoni*

*Drosophila immigrans*

*Drosophila hydei*

*Drosophila guttifera*

*Drosophila funebris*

*Drosophila cardini*

*Drosophila busckii*

*Chymomyza amoena*

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Kent Daane

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***Drosophila simulans***

***Drosophila persimilis***

***Drosophila montana***

***Drosophila funebris***

***Drosophila busckii***

Kent Daane

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# “non-target” impact (kills only SWD)


***Drosophila suzukii***

***Drosophila melanogaster***

***Drosophila simulans***

*Drosophila persimilis*

Kent Daane

# APHIS Environmental Compliance Process (2-4 yrs for insects)

**(A) Petition to release a novel agent is a "federal action" that triggers the compliance with two Acts:**

**(1) The Endangered Species Act (ESA) (specifically "Section 7" consultation… addresses Risk!)**
**(2) National Environmental Policy Act (NEPA… addresses Risk!)**

**(B) Petition will include/address at least seven components:**

**(1) Proposed Action (including statement of need), (2) Target Pest Information,**
**(3) Bio-Control Agent Information, (4) Host Specificity Testing, (5) Environ. & Economic Impacts of Proposed Release (6) Pre–Release Clearance, and (7) Post Release Monitoring**

**(C) Steps in the "Environmental Compliance Process" after a Petition is developed:**

**(1) Petition is submitted to ad hoc review panel (full NAPPO representation)**
**(2) Decision by APHIS to move forward with the process (No Endangered Species Act concerns)**
**(3) APHIS proceeds to NEPA review – Environmental Assessment:**
**(i) Tribal Consultation, (ii) Publication in Federal Register for Public Comment**
**(4) APHIS makes Environmental Finding**
**(5) Finding of No Significant Impact (FONSI)**
**(6) Publish Final Environmental Assessment and FONSI in Federal Register**

Based on a seven-slide review
courtesy: Dr. Robert Pfannenstiel

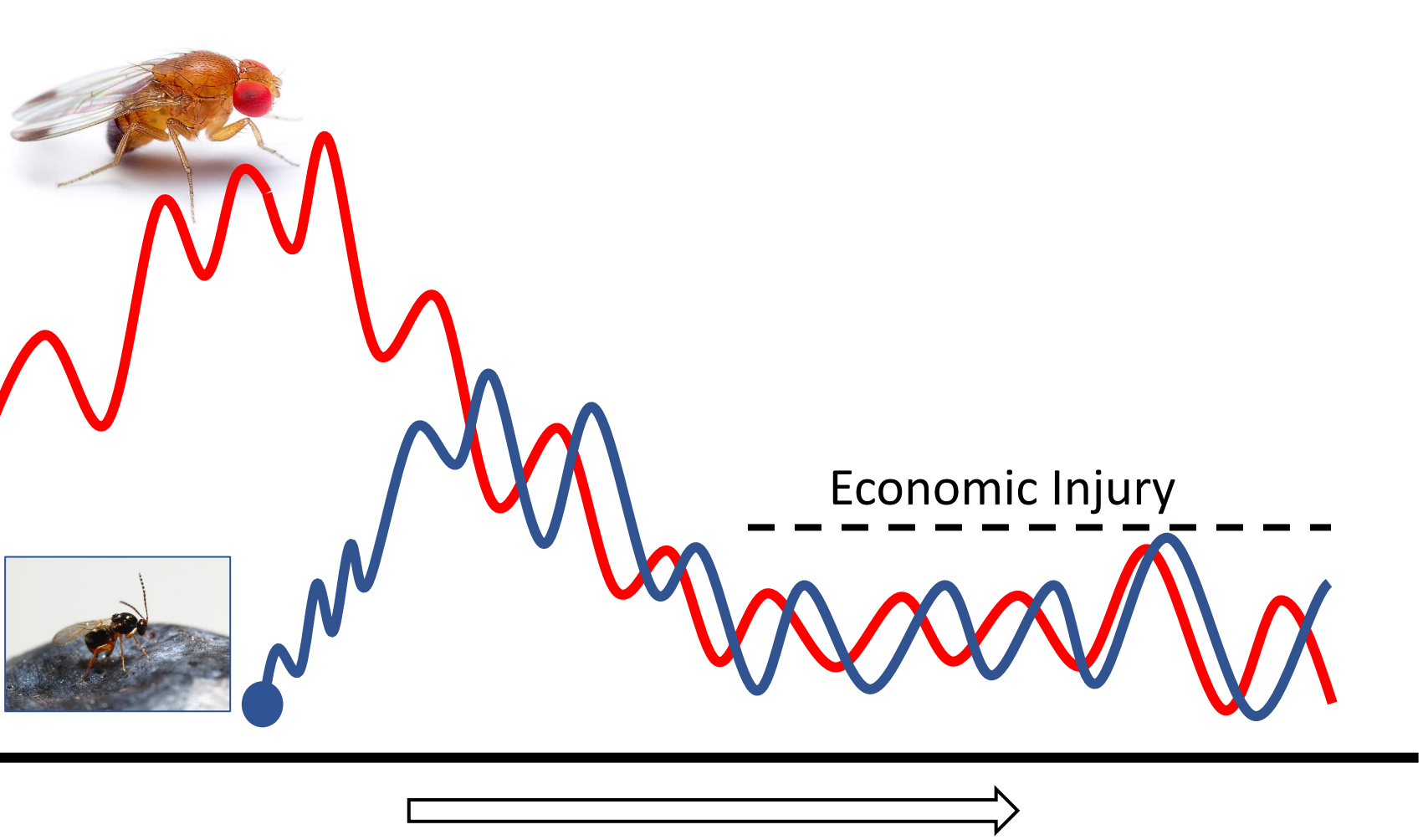
# Progress on Classical Biocontrol

A petition to release *Ganaspis brasiliensis* as a classical biocontrol from Quarantine was reviewed with USDA APHIS, and a release permit was issued in the Fall of 2021.

A state level release permit was granted by Maine Department of Inland Fisheries and Wildlife in November 2021

# Classical BioControl – Introduction of Exotic Natural Enemy

Kent Daane

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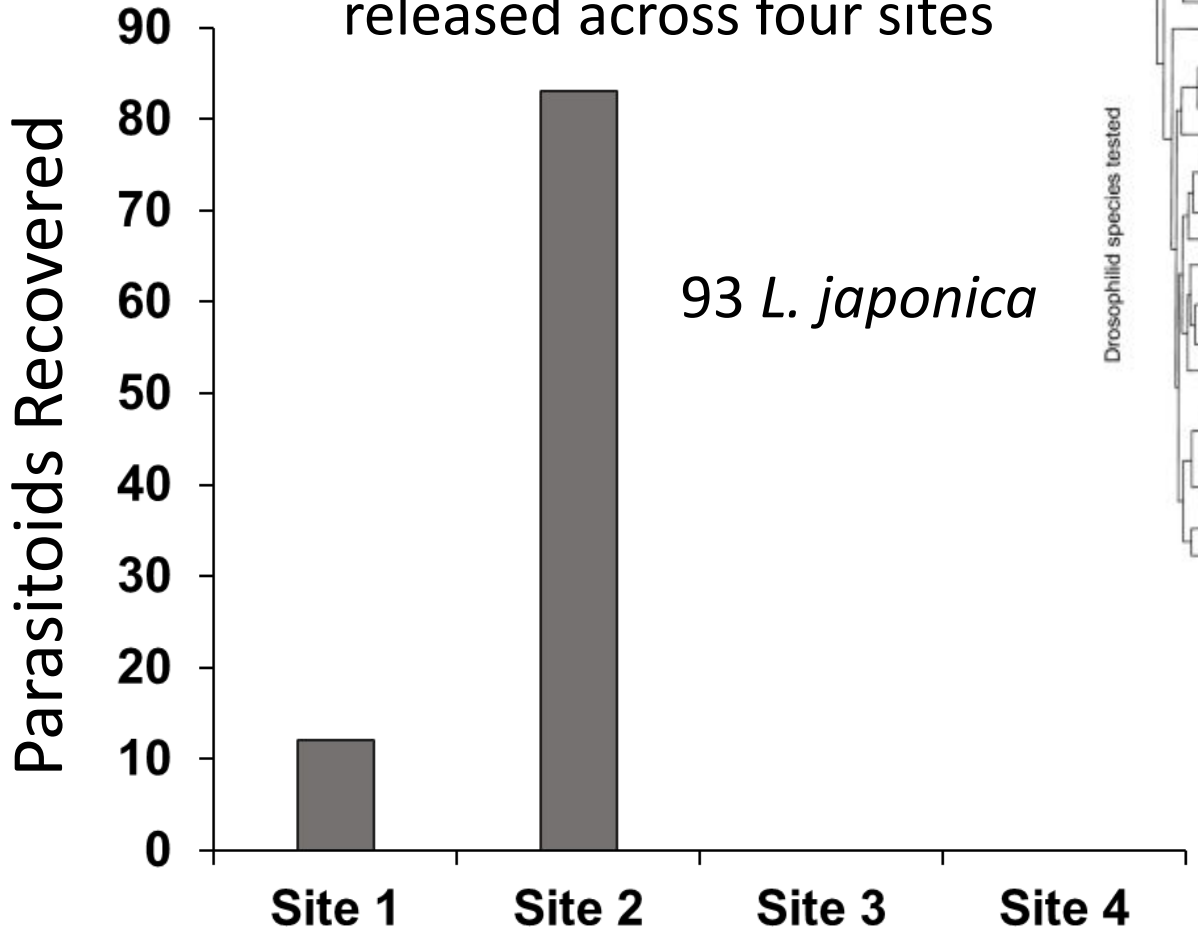
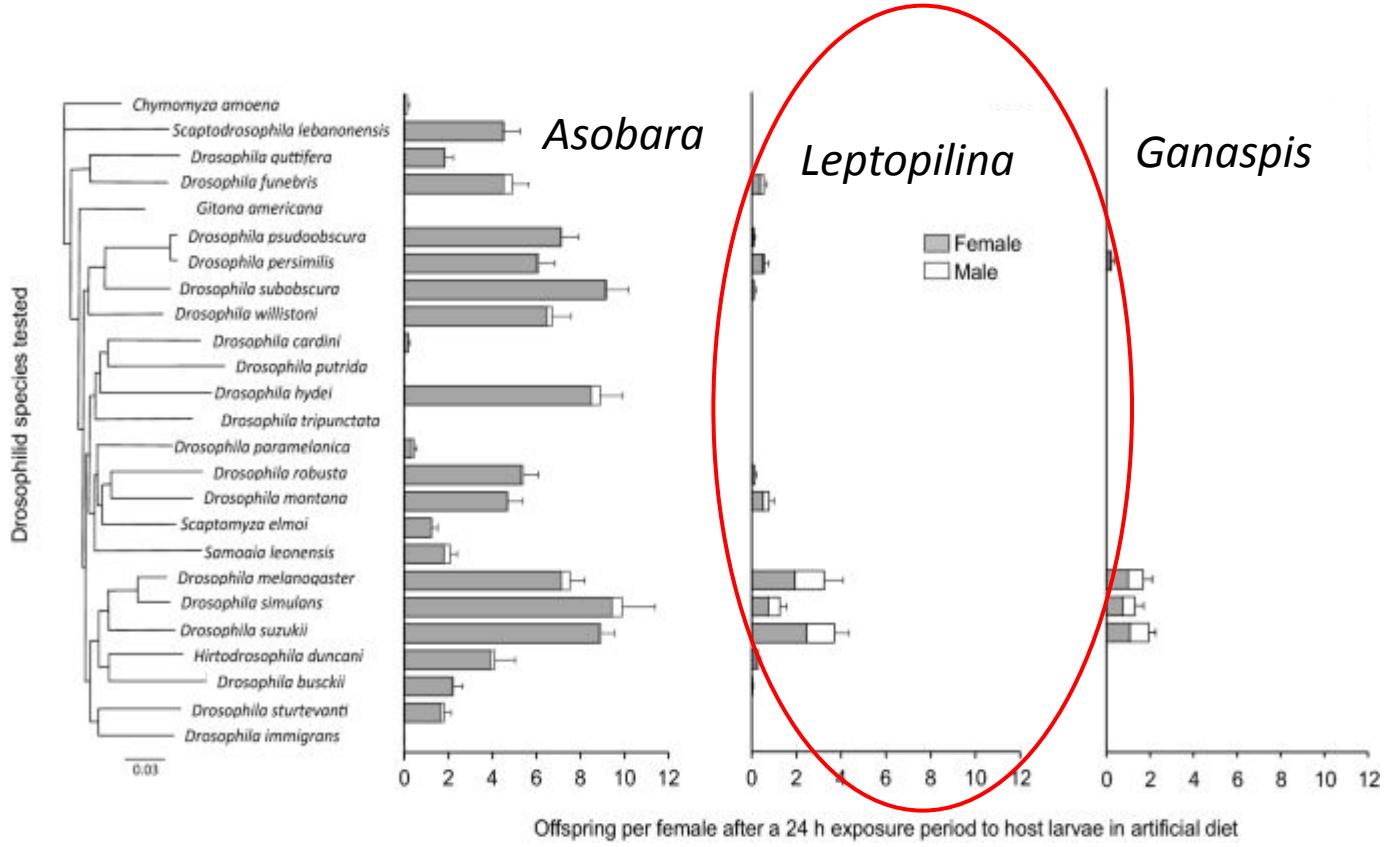
# Progress on Classical Biocontrol

**Summer 2022**

4800 total *G. brasiliensis* released across four sites




93 *L. japonica*



JHR 91: 11–25 (2022)
doi: 10.3897/jhr.91.82812
https://jhr.pensoft.net

RESEARCH ARTICLE

JOURNAL OF Hymenoptera RESEARCH

# First records of adventive populations of the parasitoids *Ganaspis brasiliensis* and *Leptopilina japonica* in the United States

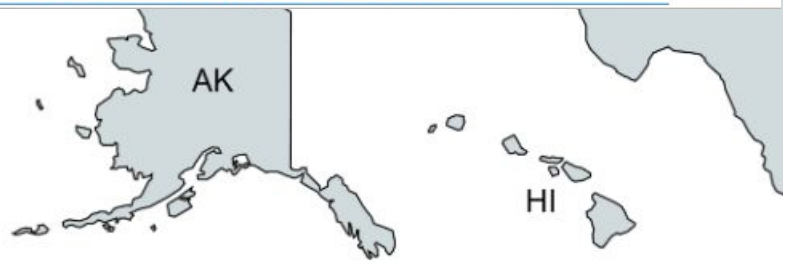
Elizabeth H. Beers[1], Dylan Beal[1], Peter Smytheman[1], Paul K. Abram[2], Rebecca Schmidt-Jeffris[3], Erica Moretti[3], Kent M. Daane[4], Chris Looney[5], Chia-Hua Lue[6], Matthew Buffington[7]

**1** *Washington State University, Tree Fruit Research and Extension Center, Wenatchee, Washington, USA* **2** *Agriculture and Agri-Food Canada, Agassiz Research and Development Centre, Agassiz, British Columbia, Canada* **3** *USDA-ARS Wapato Research Laboratory, Wapato, Washington, USA* **4** *University of California Berkeley, Berkeley, California, USA* **5** *Washington State Department of Agriculture, Olympia, Washington, USA* **6** *Department of Biology, Brooklyn College, City University of New York (CUNY), Brooklyn, USA* **7** *Systematic Entomology Laboratory, USDA-ARS, c/o National Museum of Natural History, Smithsonian Institution, Washington DC, USA*

Corresponding author: Elizabeth H. Beers (ebeers@wsu.edu)

Academic editor: Elijah Talamas | Received 1 March 2022 | Accepted 21 April 2022 | Published 30 June 2022

*http://zoobank.org/0F1430EB-3E66-4FDC-9BE3-BCB7EC31540F*

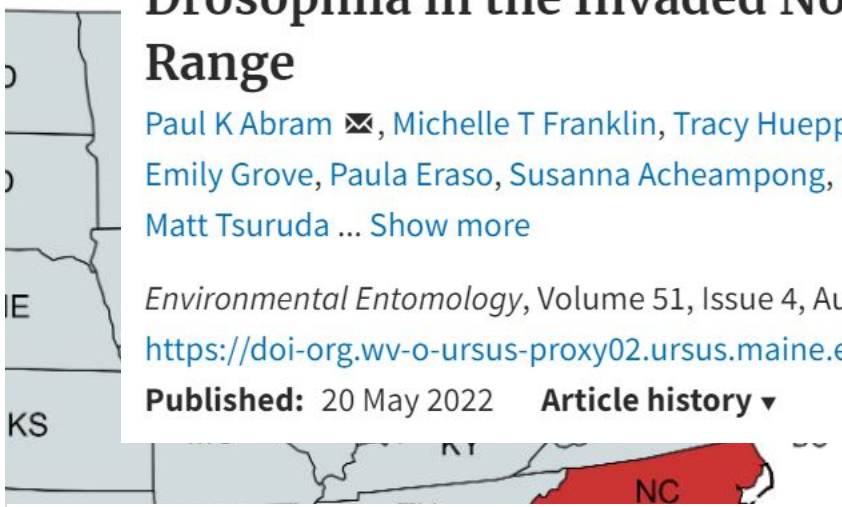



JOURNAL ARTICLE

# Adventive Larval Parasitoids Reconstruct Their Close Association with Spotted-Wing Drosophila in the Invaded North American Range

Paul K Abram ✉, Michelle T Franklin, Tracy Hueppelsheuser, Juli Carrillo, Emily Grove, Paula Eraso, Susanna Acheampong, Laura Keery, Pierre Girod, Matt Tsuruda ... Show more

*Environmental Entomology*, Volume 51, Issue 4, August 2022, Pages 670–678,
https://doi-org.wv-o-ursus-proxy02.ursus.maine.edu/10.1093/ee/nvac019
**Published:** 20 May 2022 **Article history** ▾




# First Report of *Leptopilina japonica* in Europe

by Simone Puppato [1,2] ✉, Alberto Grassi [1] ✉, Federico Pedrazzoli [1] ✉, Antonio De Cristofaro [2] ✉ and Claudio Ioriatti [1,*] ✉

1 Technology Transfer Centre, Fondazione Edmund Mach, Via Edmund Mach 1, 38010 San Michele all'Adige, Trento, Italy

2 Department of Agricultural, Environmental and Food Sciences, University of Molise, Via Francesco De Sanctis, 86100 Campobasso, Italy

* Author to whom correspondence should be addressed.

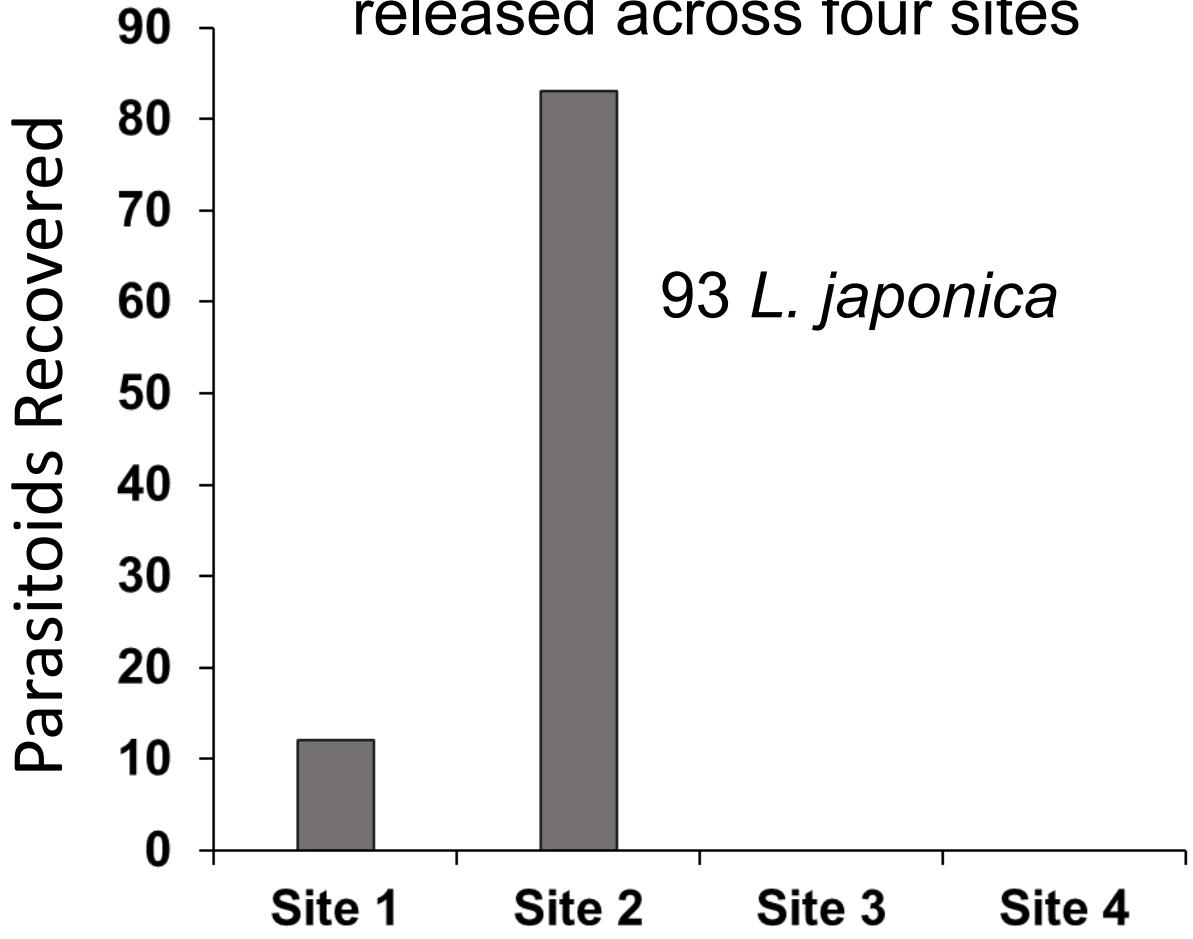
*Insects* **2020**, *11*(9), 611; **https://doi-org.wv-o-ursus-proxy02.ursus.maine.edu/10.3390/insects11090611**

**Received: 6 August 2020 / Revised: 1 September 2020 / Accepted: 7 September 2020 / Published: 8 September 2020**

# Progress on Classical Biocontrol

**Summer 2022**

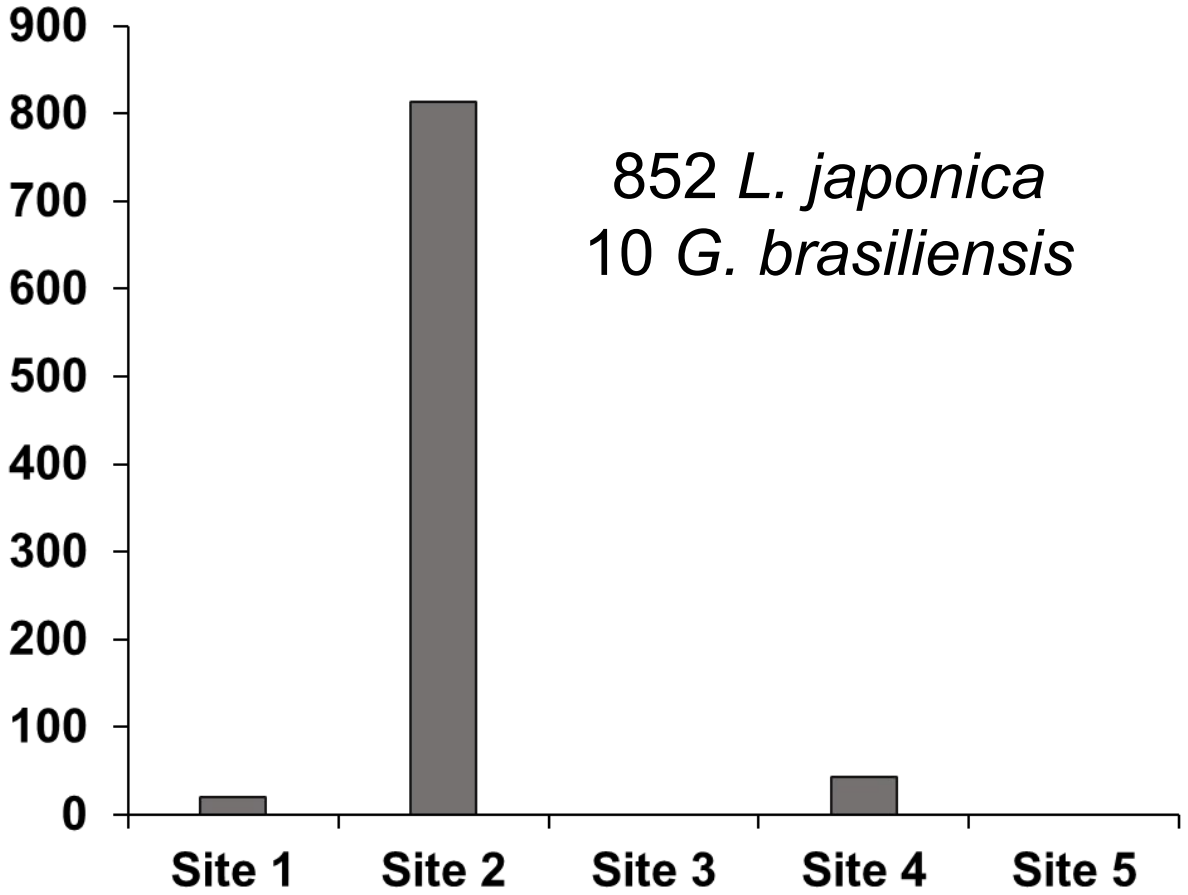
4800 total *G. brasiliensis* released across four sites




93 *L. japonica*

**Summer 2023**

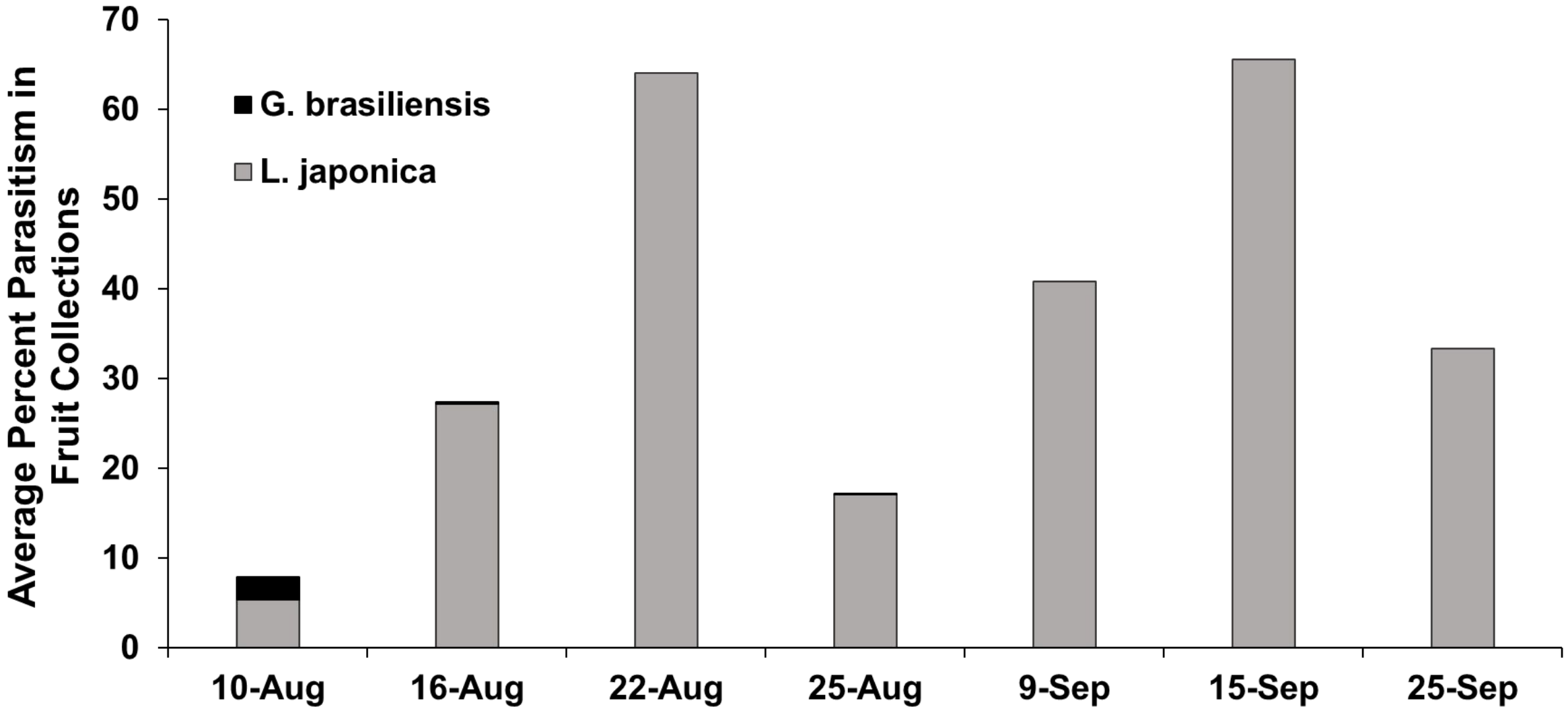
1500 total *G. brasiliensis* released across five sites



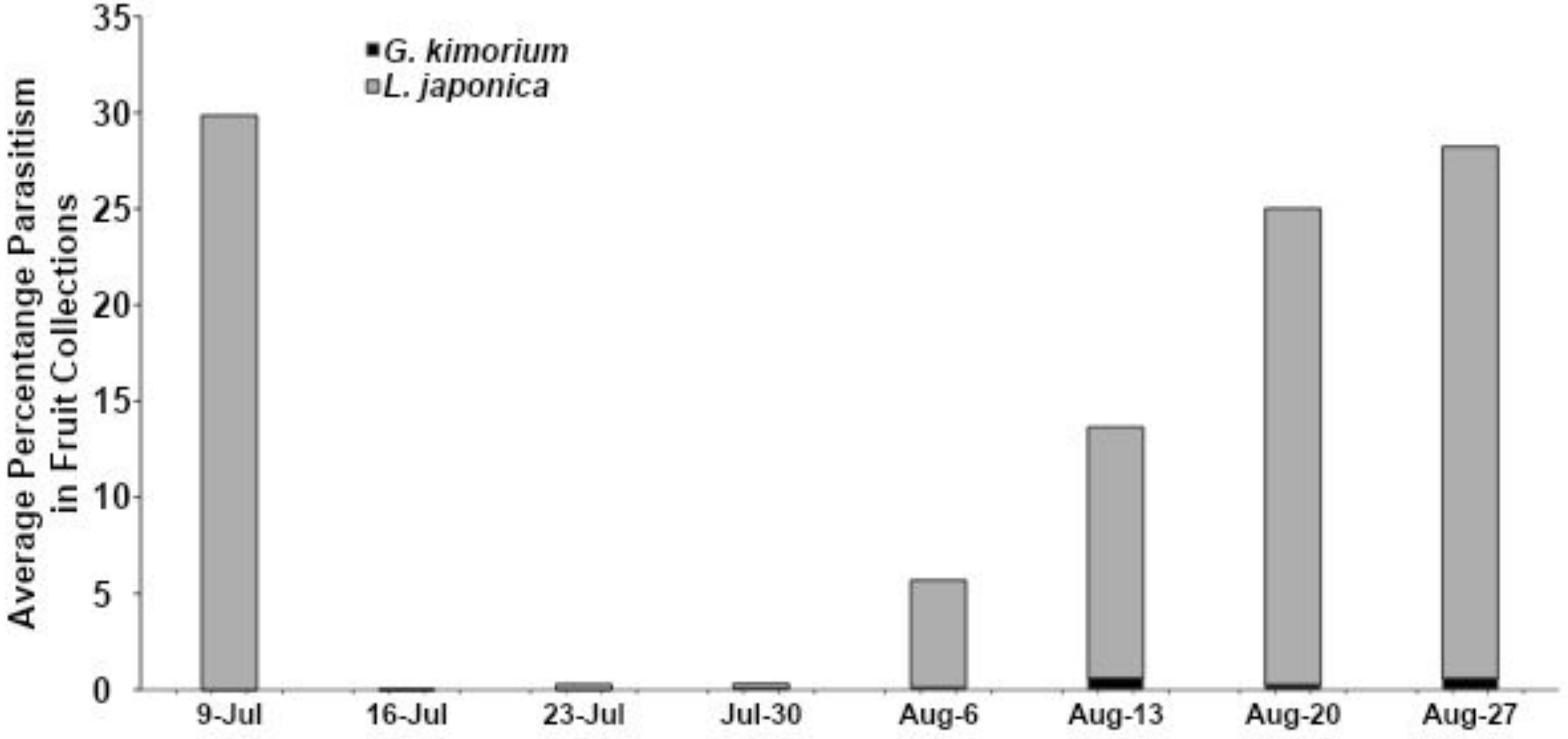

852 *L. japonica*

10 *G. brasiliensis*

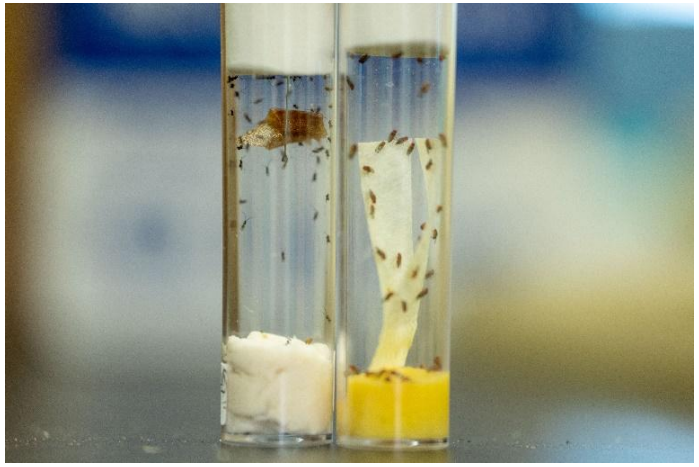
# 2023 Field Parasitism Rates

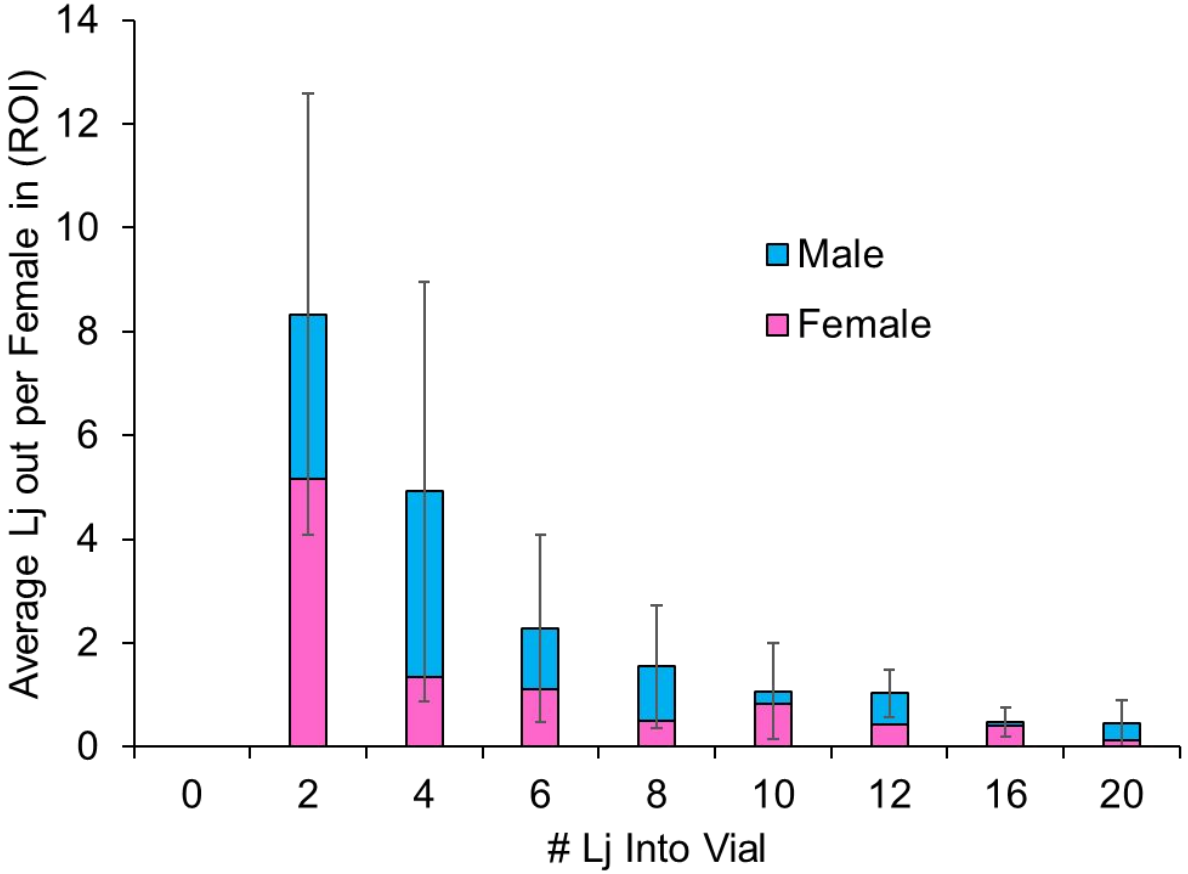


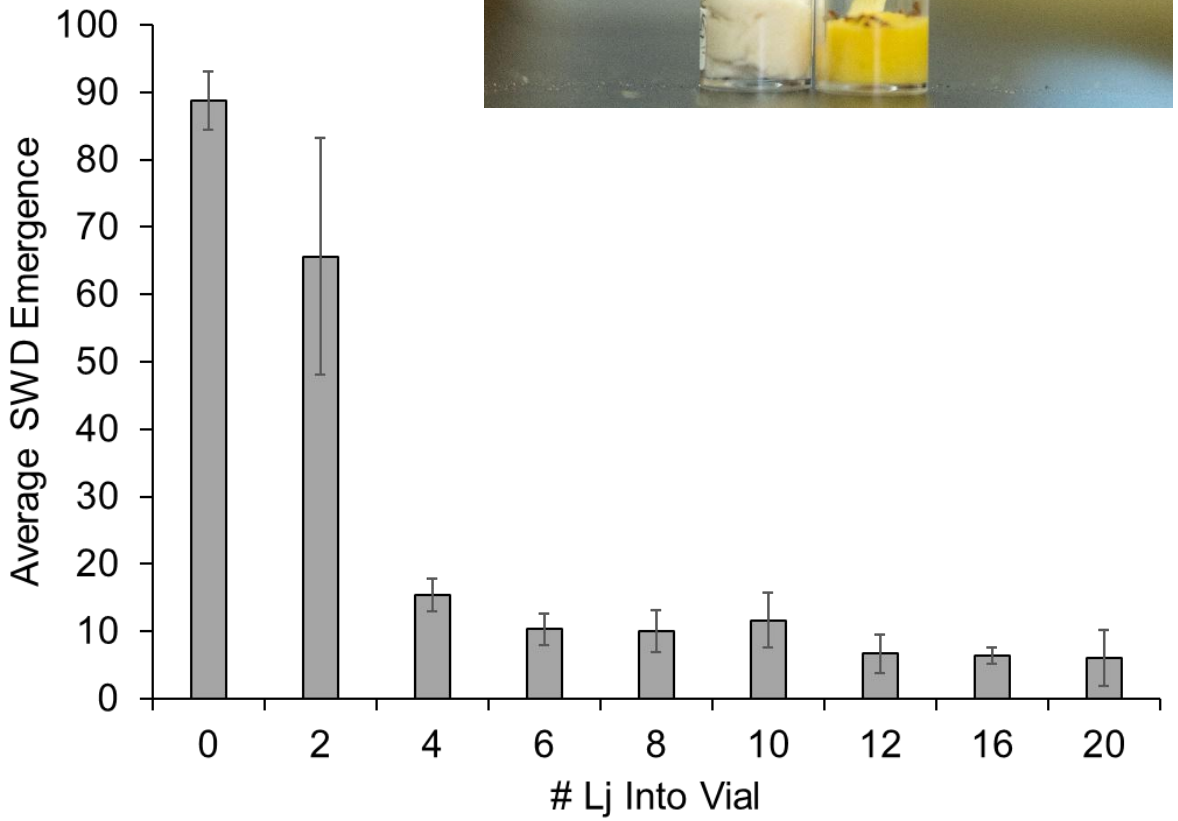
# 2024 Field Parasitism Rates



# Direct Physical Impacts

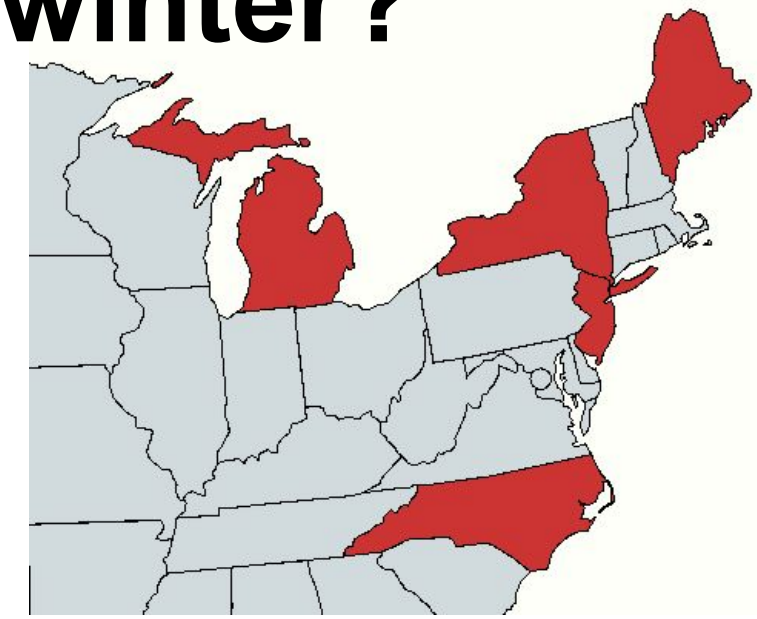


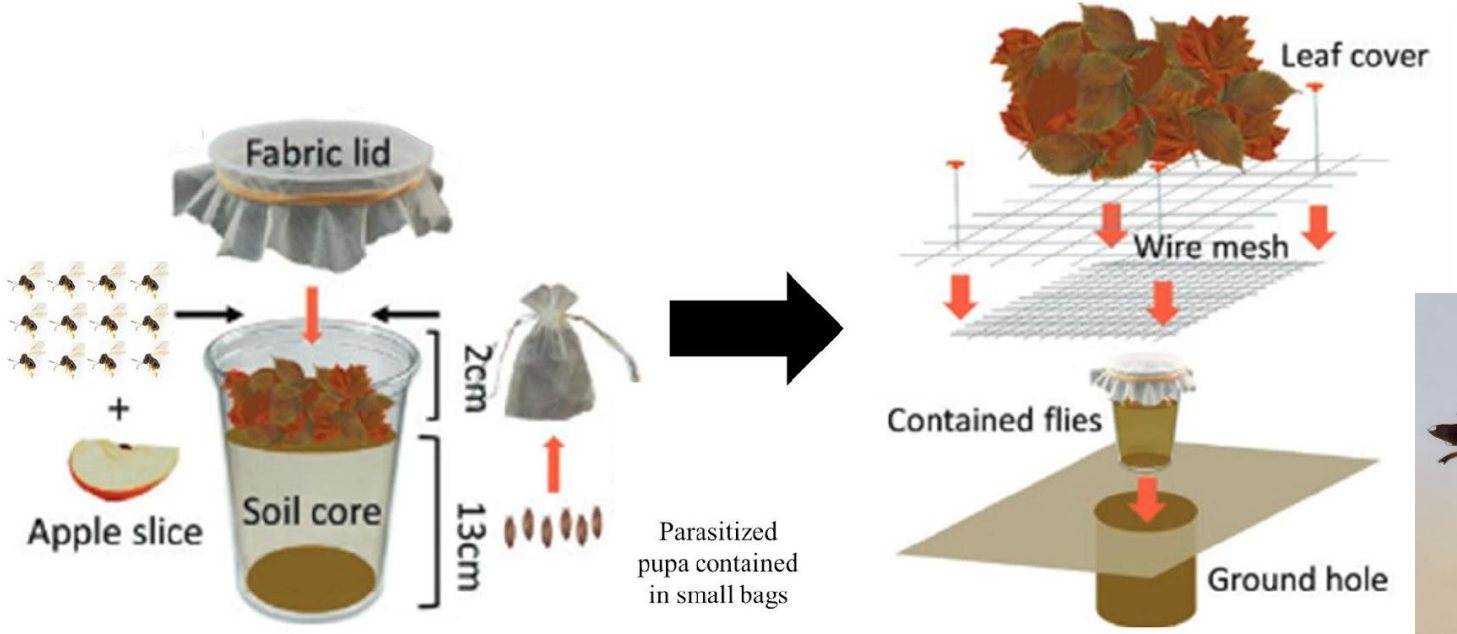


# Can *Ganaspis kimorum* overwinter?

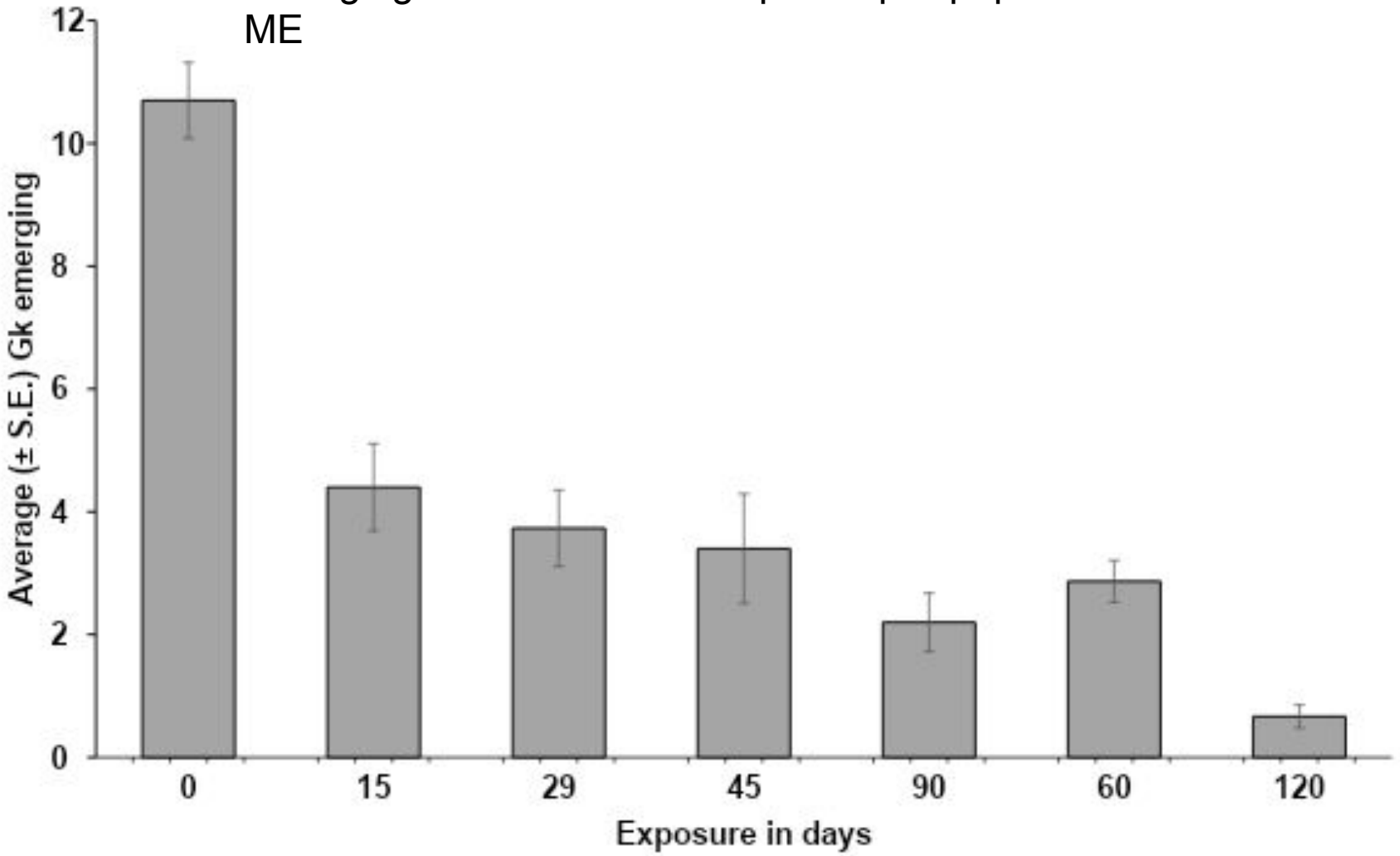
- Overwintering of diapausing *Gk* pre-pupa in NC (1), NY(2), NJ(1), ME(1) and MI(4) in 2022/3 and in NY(3), NJ(3), ME(3) in 2023/4

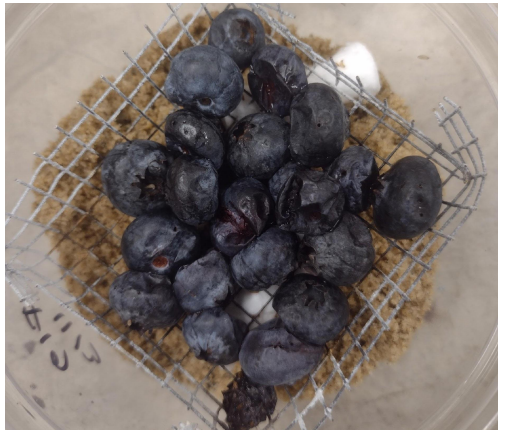





# Diapausing Pre-Pupa survival

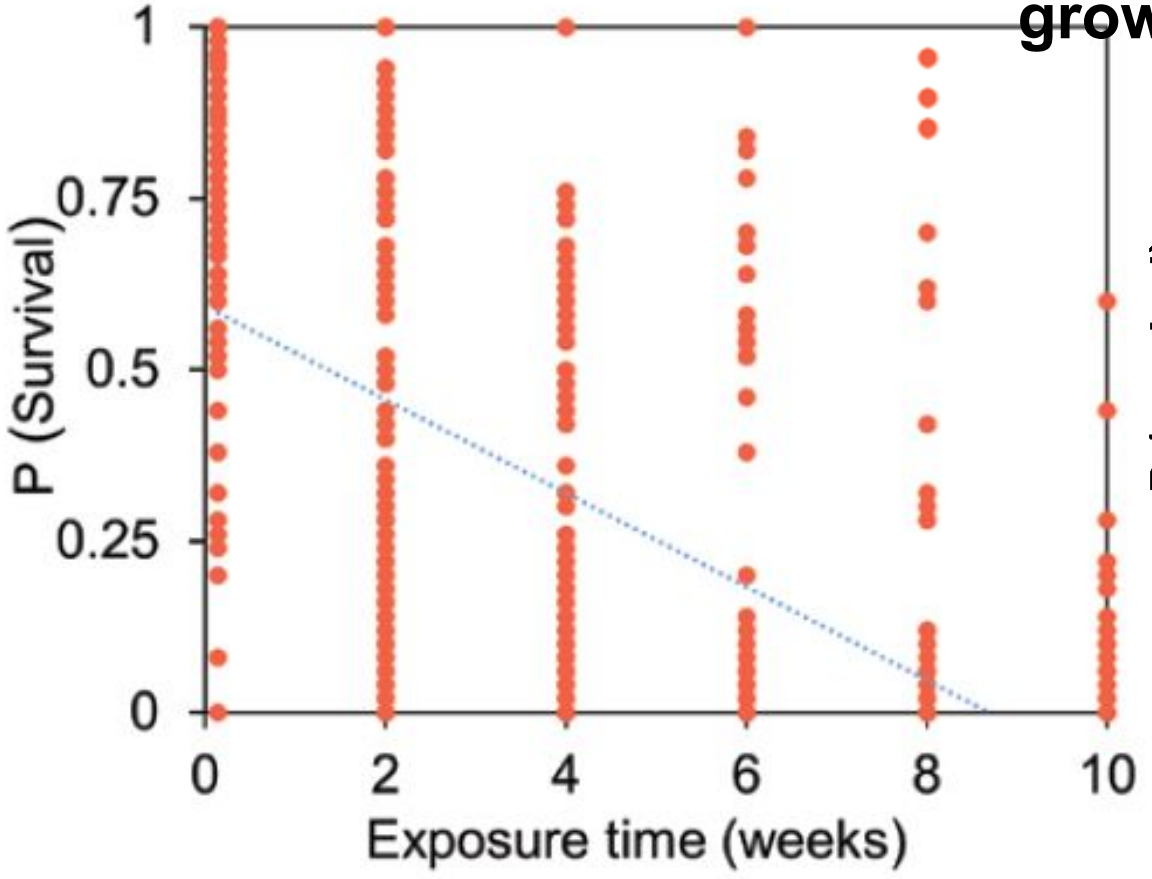
Emerging adults from field exposed pre-pupa in ME

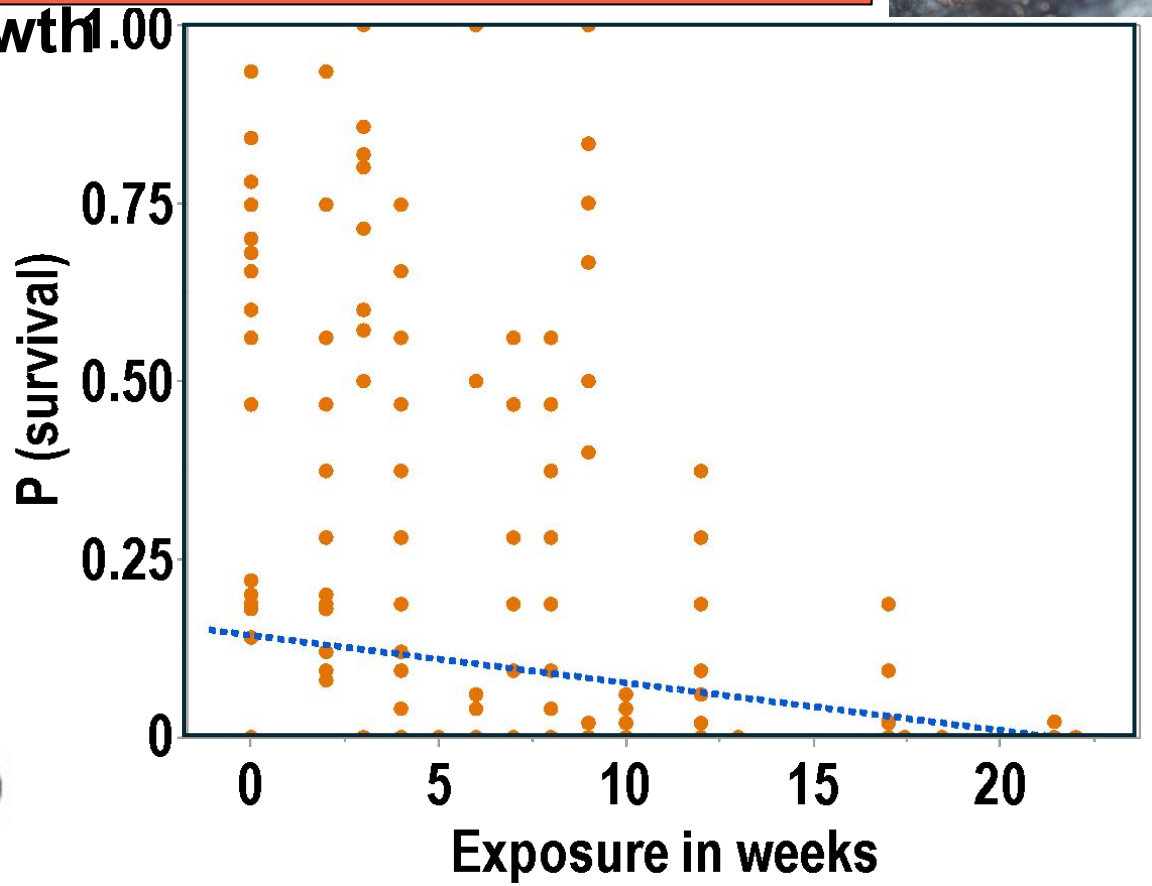


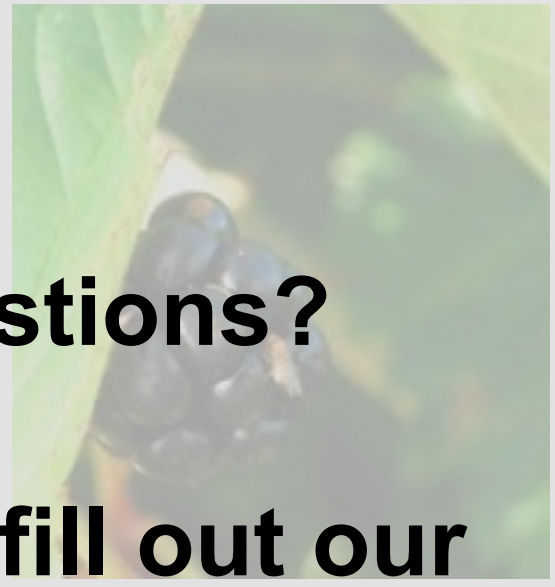
# *G. kimorum* overwintering survival low but persistent

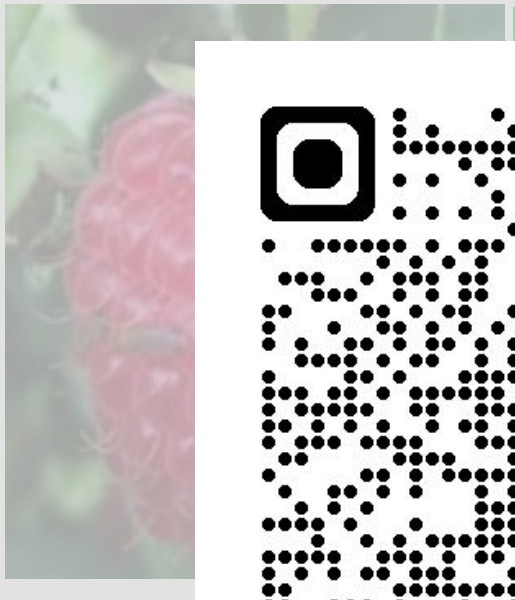
**Survival of SWD was observed to be low (particularly in northern states). *G. kimorum* survival looks similarly low. Collectively might impact early season populations growth**



# Tiny Insect Causing Huge Losses





**Questions?**

**Please fill out our survey!**

Blueberries
*$859 million*
*Average 13% crop loss*

kberries
*$38 million*
*Average 27% crop loss*

Ras
*$58*
*Averag*
*loss*

*loss*

***Crop loss statistics: https://swd.ces.ncsu.edu/swd-impacts-2014/***