INTEGRATED PEST MANAGEMENT:
A COMPREHENSIVE APPROACH TO MANAGING PESTS AND VECTORS

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INTEGRATED PEST MANAGEMENT (IPM)

HILGARDIA

A Journal of Agricultural Science Published by the California Agricultural Experiment Station

VOLUME 29 OCTOBER, 1959 NUMBER 2

THE INTEGRATION OF CHEMICAL AND BIOLOGICAL CONTROL OF THE SPOTTED ALFALFA APHID

The Integrated Control Concept

Vernon M. Stern, Ray F. Smith, Robert van den Bosch, and Kenneth S. Hagen

Field Experiments on the Effects of Insecticides

Vernon M. Stern and Robert van den Bosch

Impact of Commercial Insecticide Treatments

Ray F. Smith and Kenneth S. Hagen

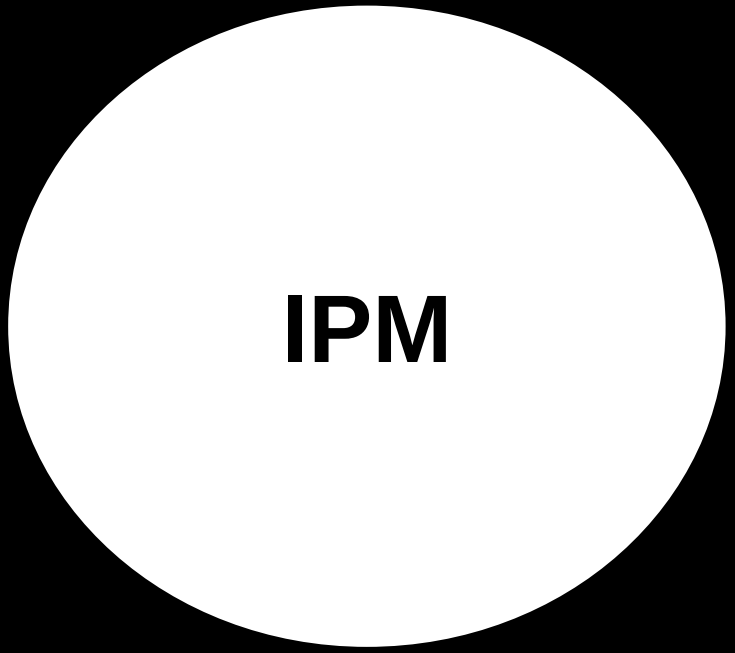
UNIVERSITY OF CALIFORNIA · BERKELEY, CALIFORNIA

INTEGRATED PEST MANAGEMENT (IPM)

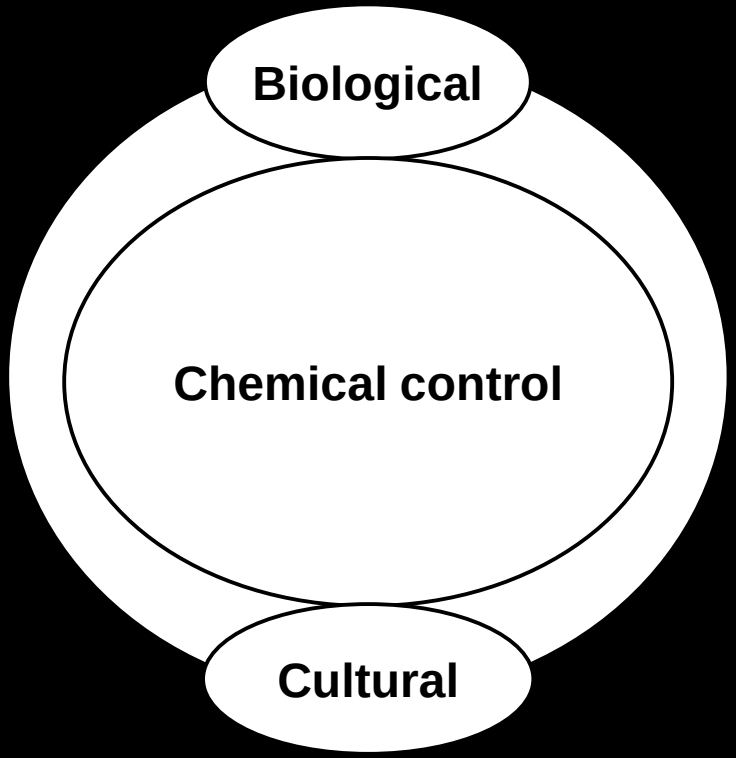
- ✓ Decision support system
- ✓ Management strategy
- ✓ Cost / benefit analysis
- ✓ Interests of all stakeholders
- ✓ Impacts on the environment

(Kogan 1998)

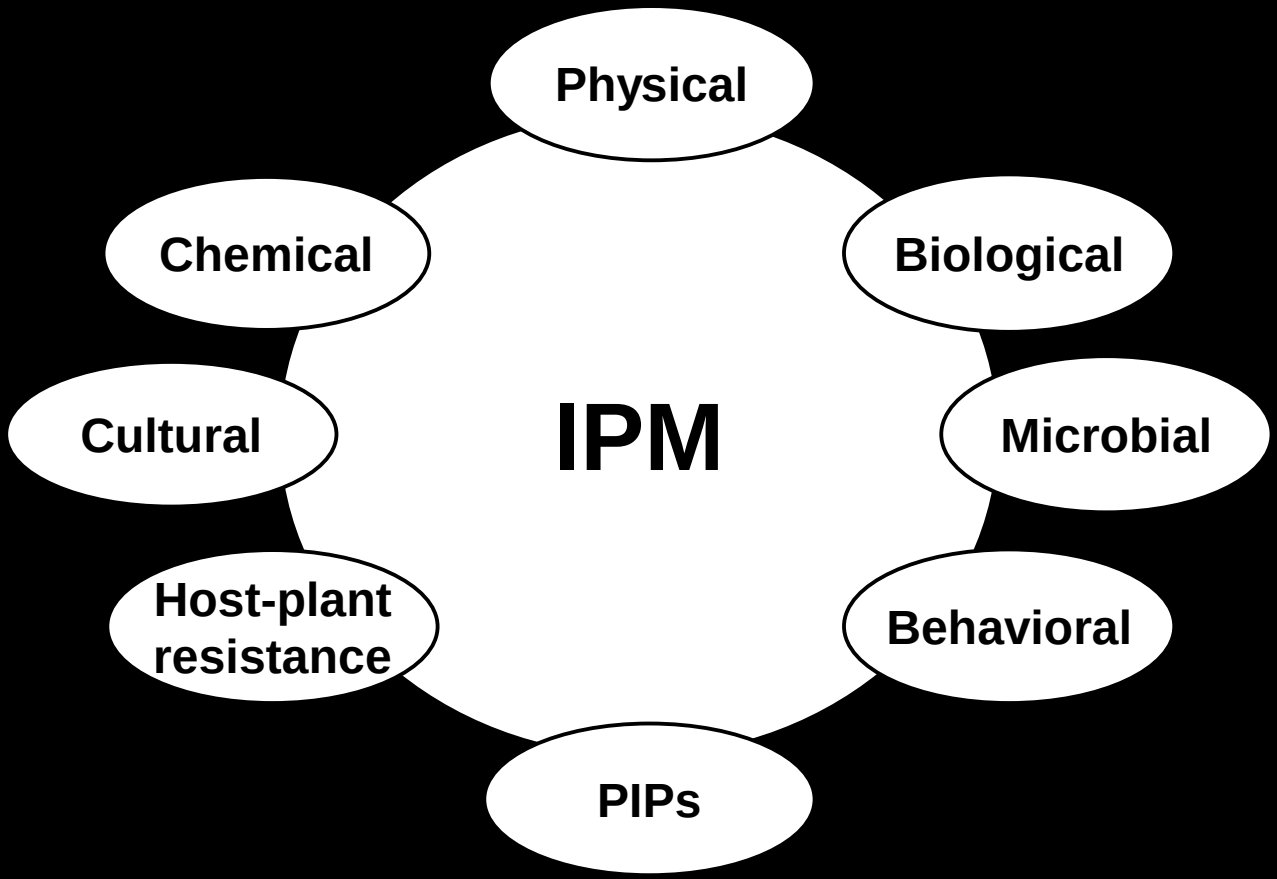
IPM



IPM



IPM


Physical
Chemical
Biological
Cultural
IPM
Microbial
Host-plant resistance
Behavioral
PIPs

(NRC 2010)

Mosquito IPM

Surveillance

Remove Mosquito Habitats

Use Structural Barriers

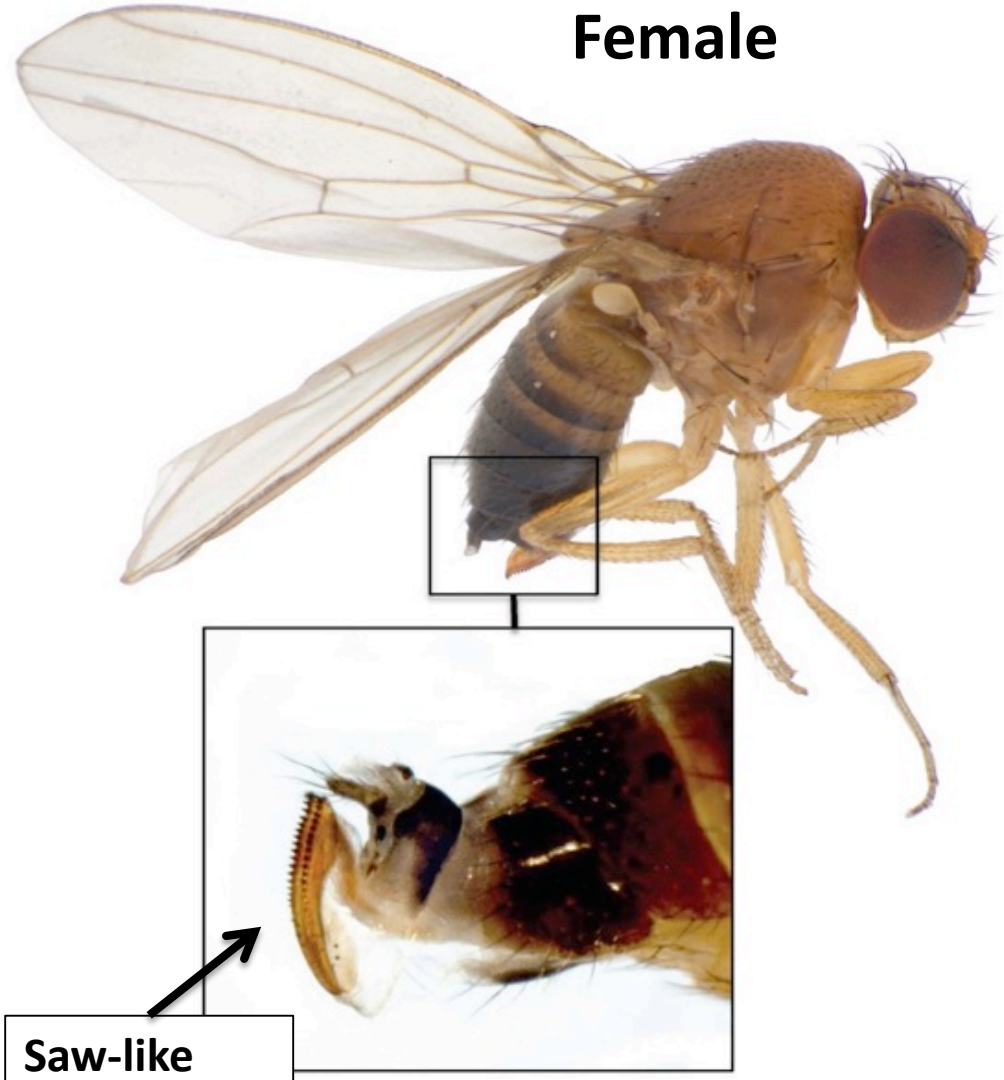
Larvicides Adulticides

Evaluation

Education & Communication

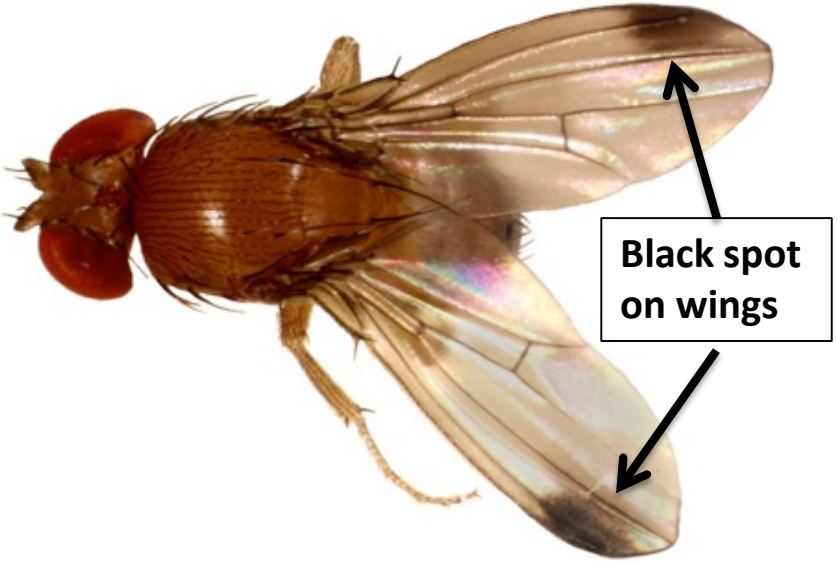
Spotted Wing Drosophila (SWD)

Female

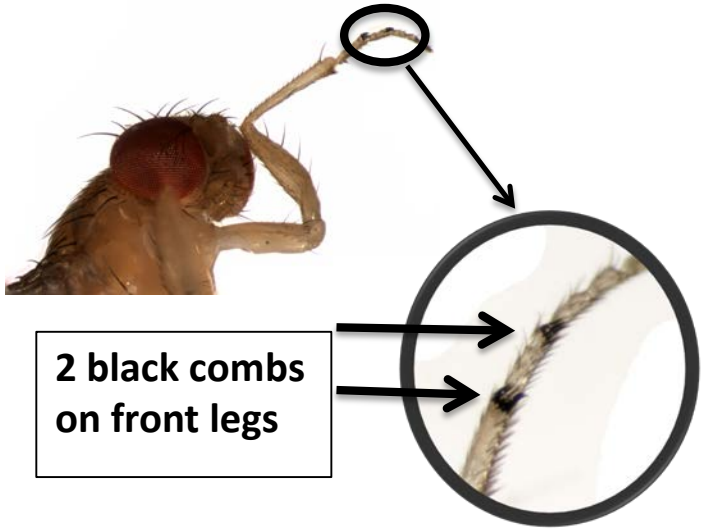


Saw-like ovipositor

Male



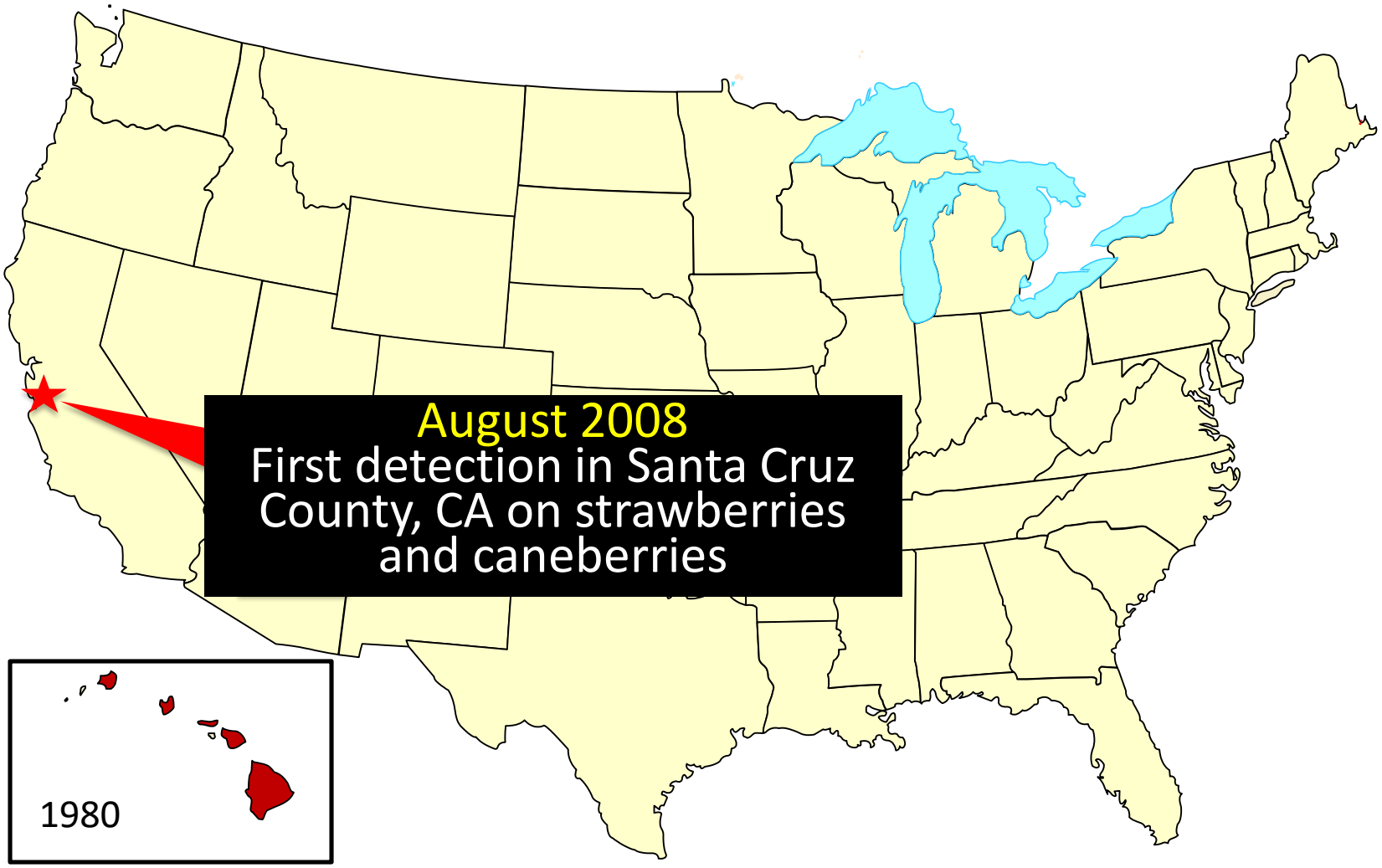
Black spot on wings



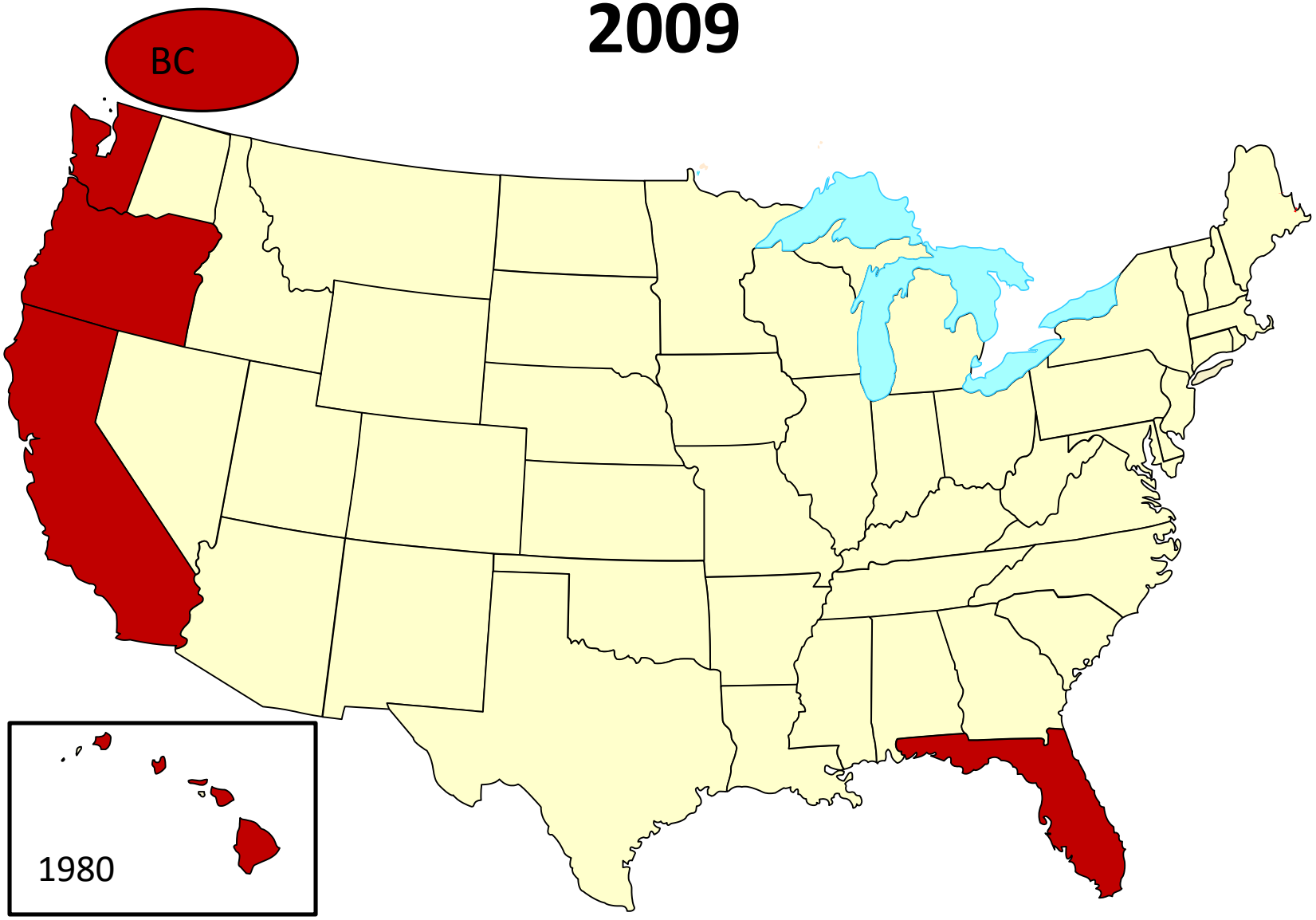
2 black combs on front legs

- **Described in Japan, Taiwan, Korea, China, the highlands of Southeast Asia and foothills of the Himalayas**
- **Known pest of cherries and non edible *Prunus* in Japan as early as 1916 (Cini et al. 2012, Kanzawa 1936)**

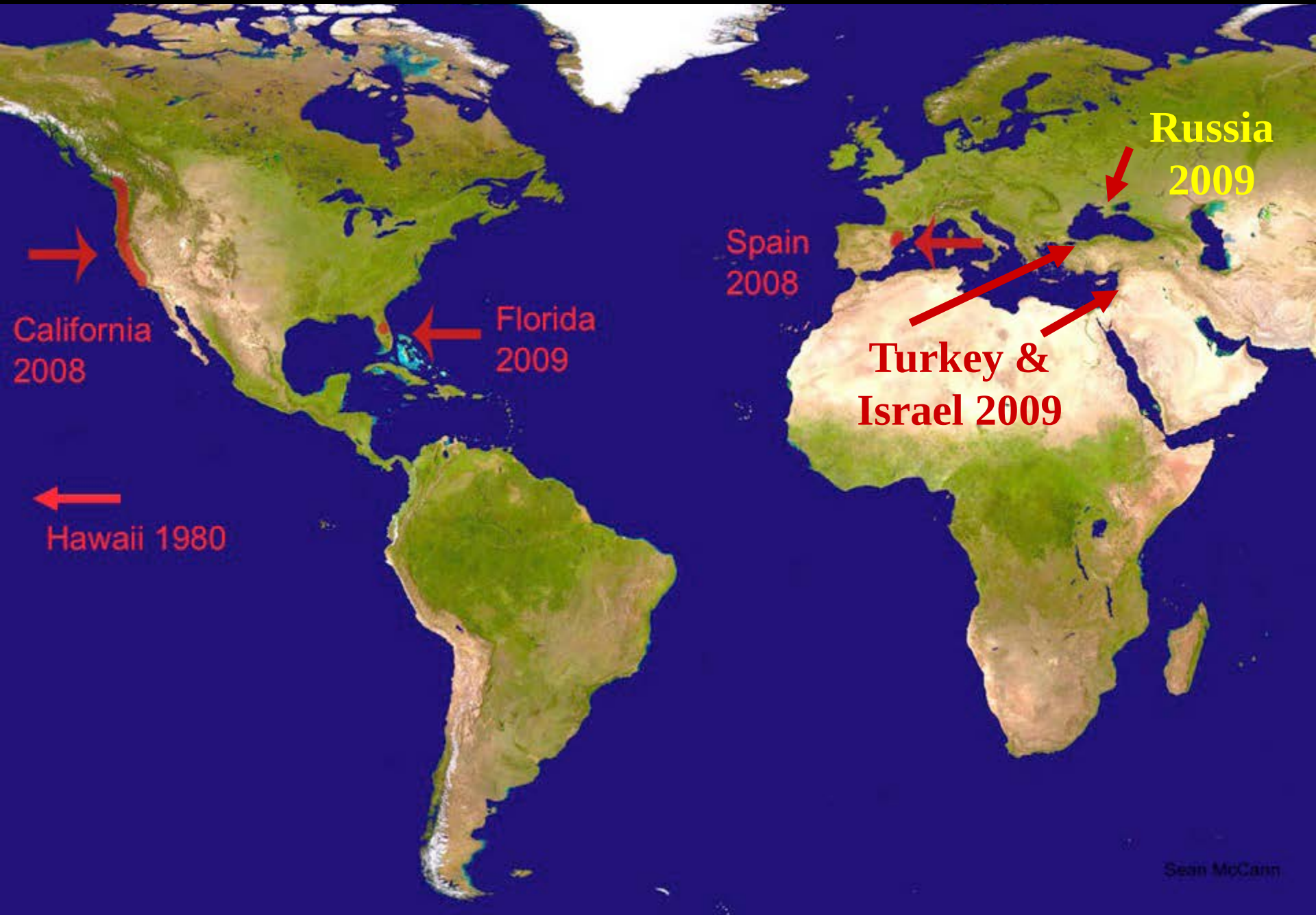
Distribution of SWD in the US



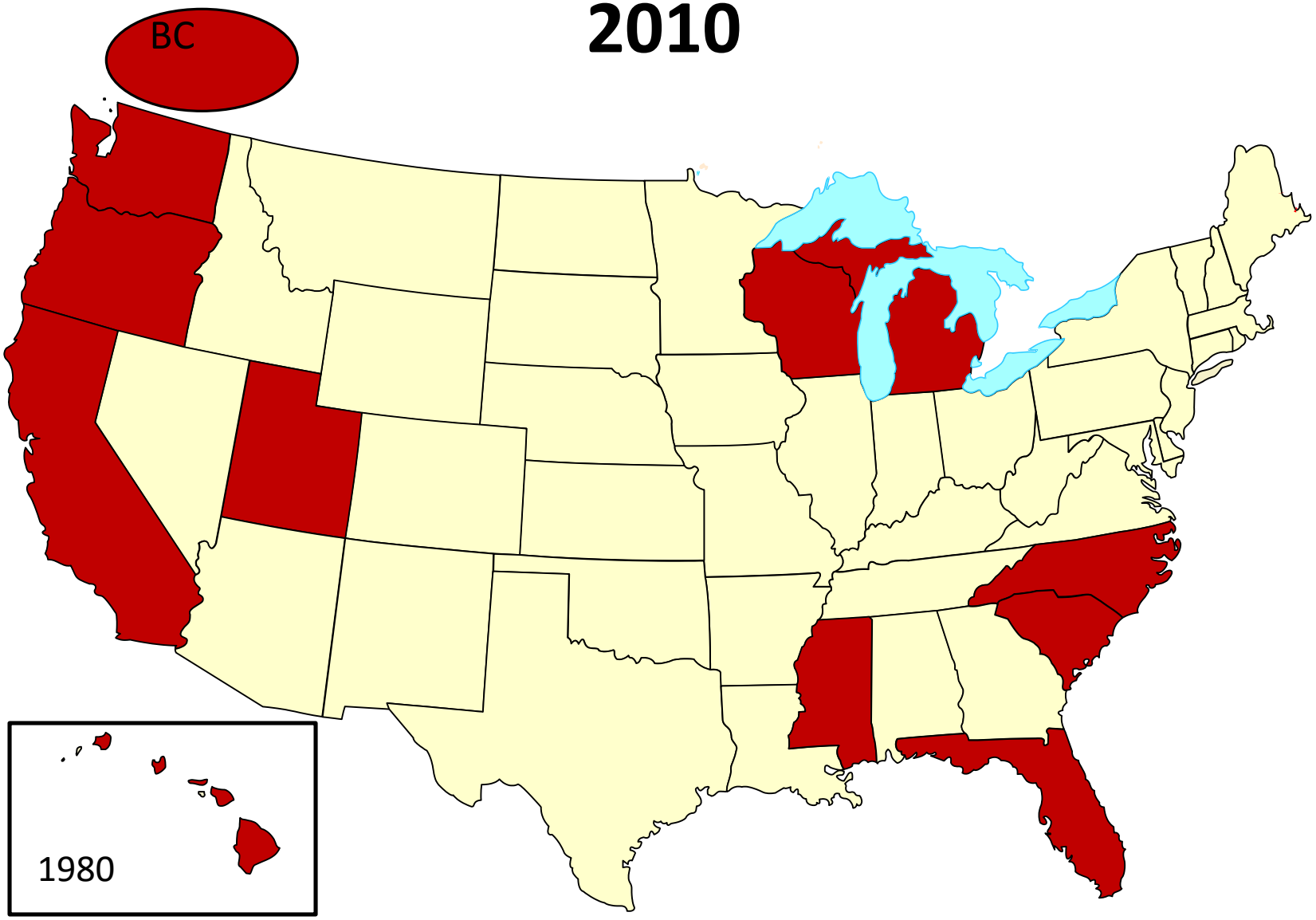
Distribution of SWD in the US 2009



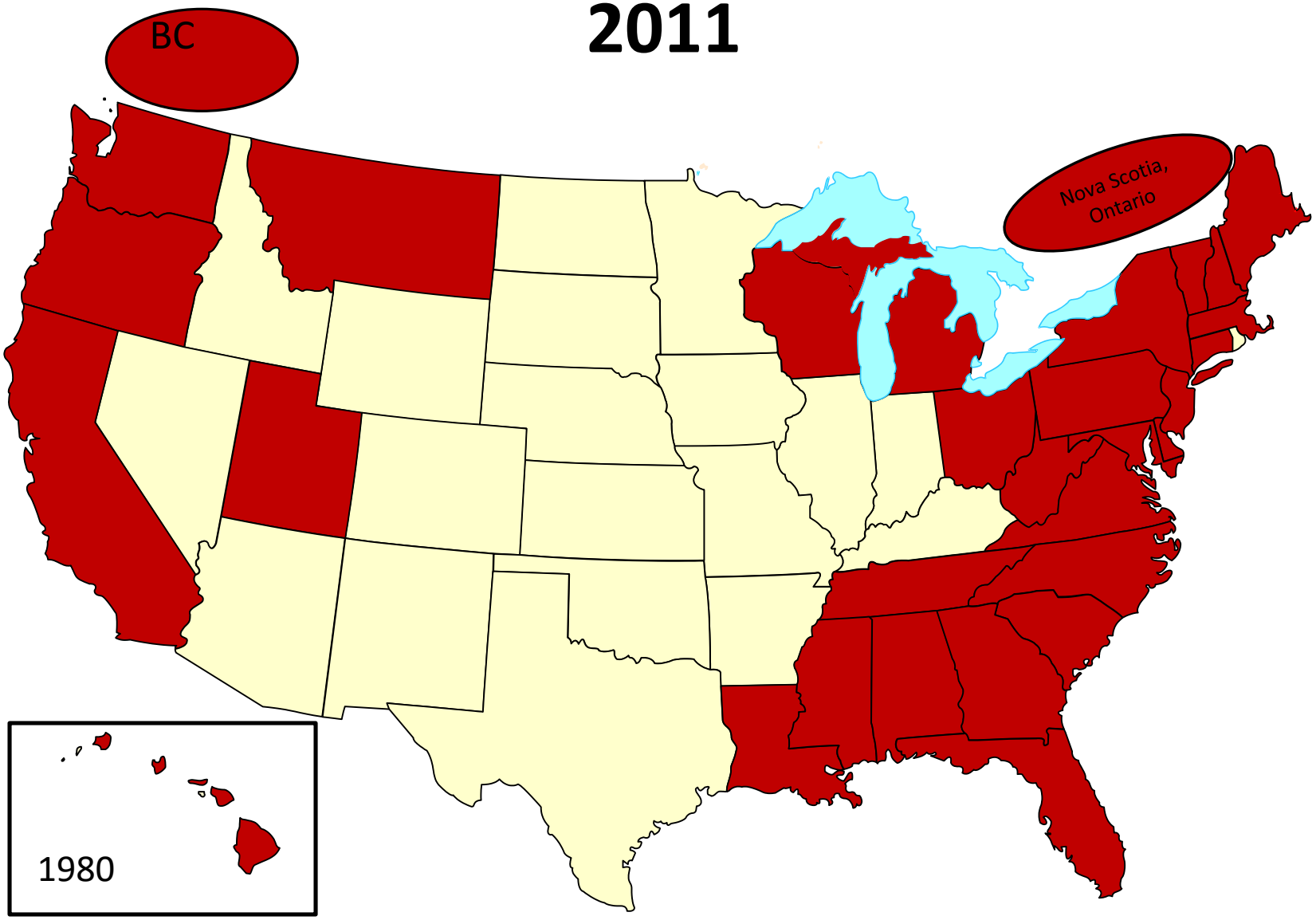
NOW DISTRIBUTED WORLDWIDE



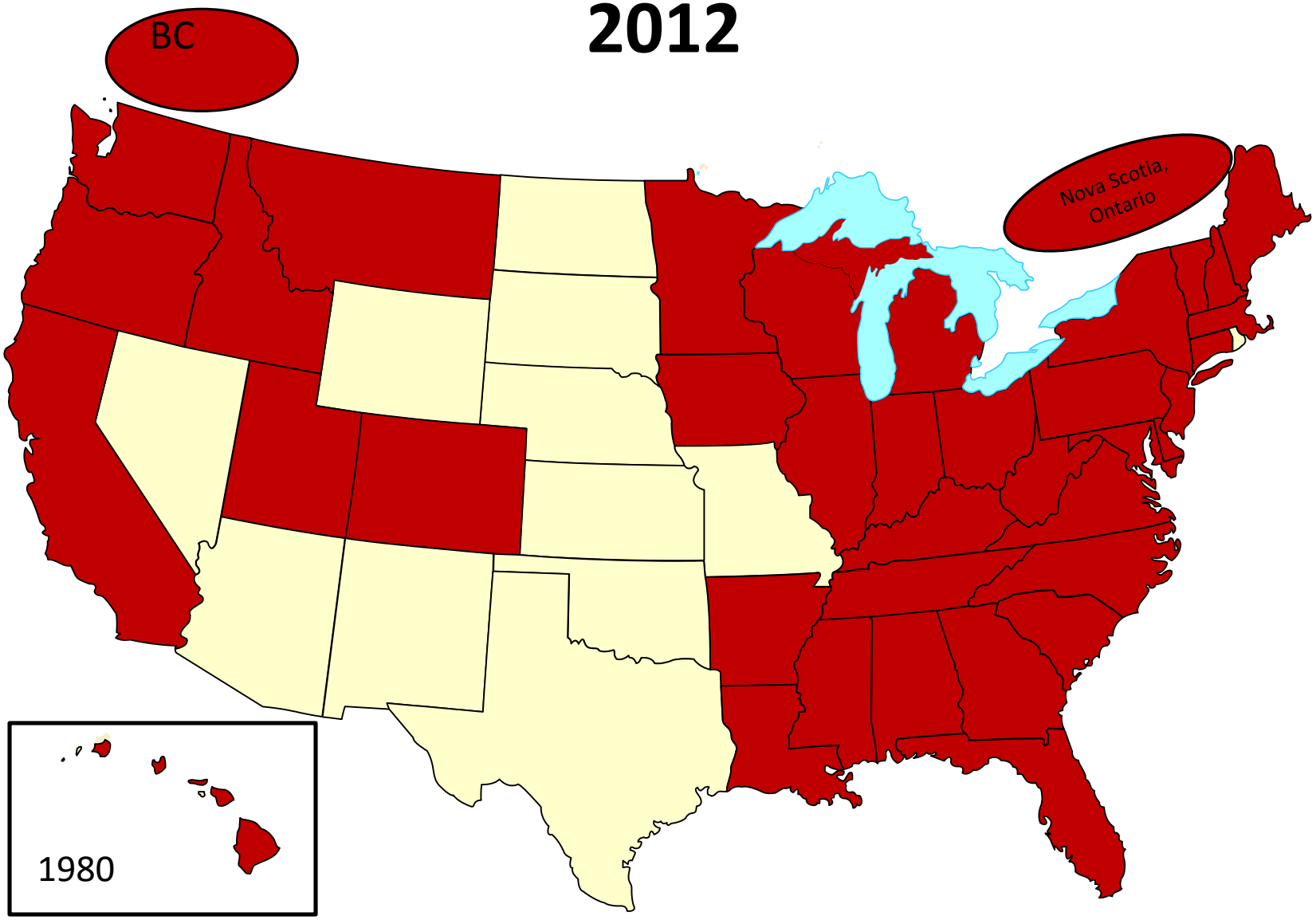
Distribution of SWD in the US 2010

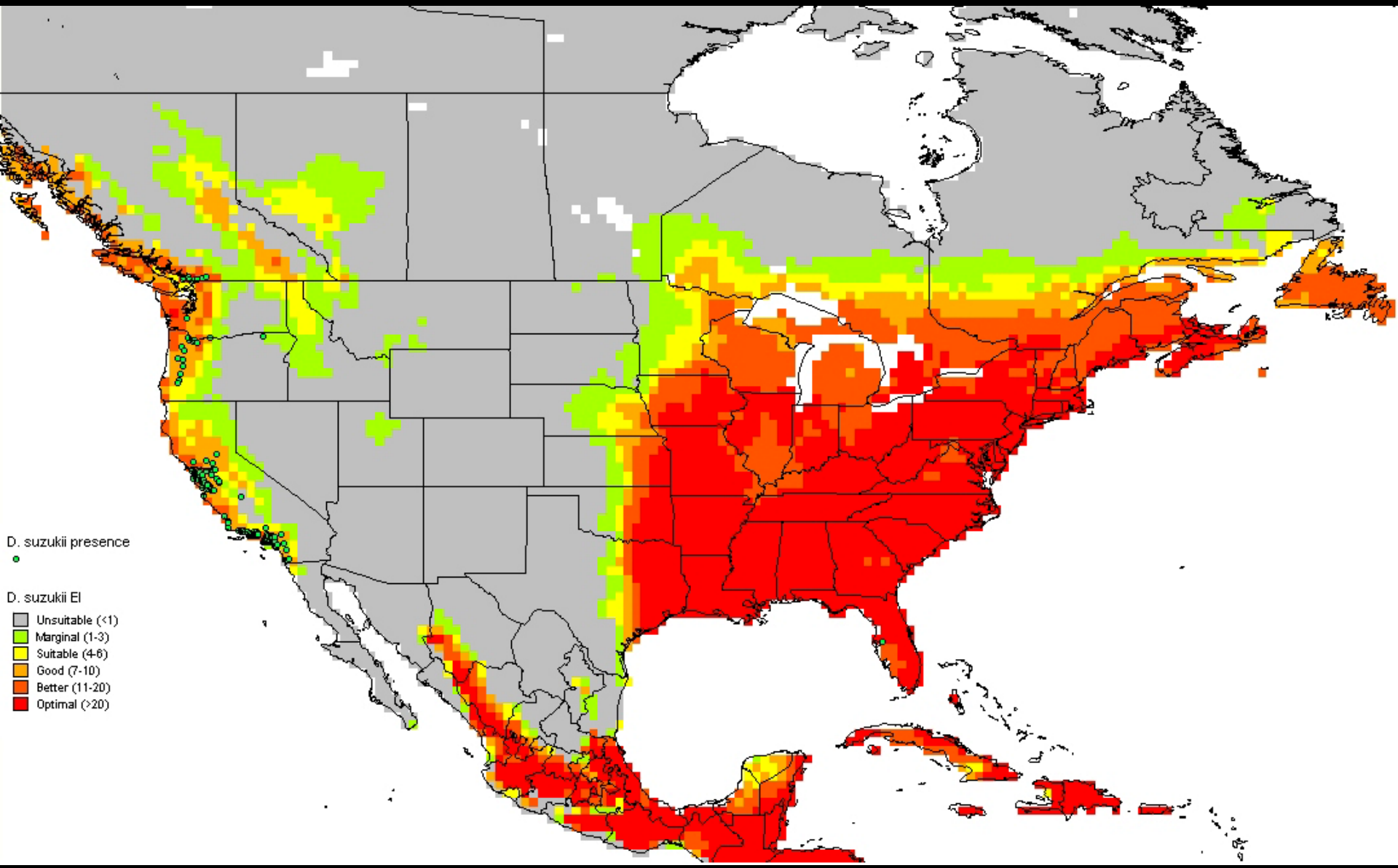


Distribution of SWD in the US 2011

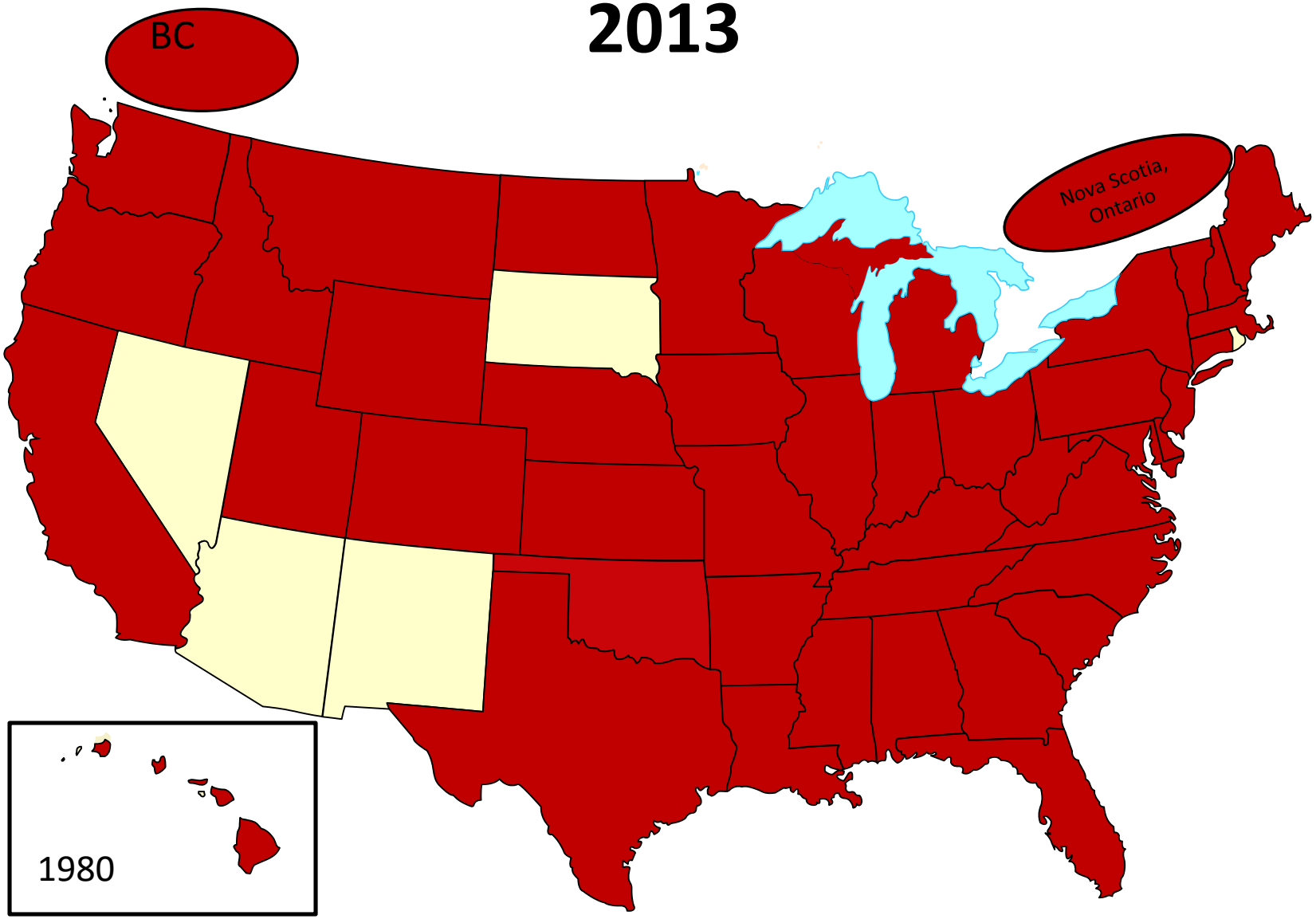


Distribution of SWD in the US 2012

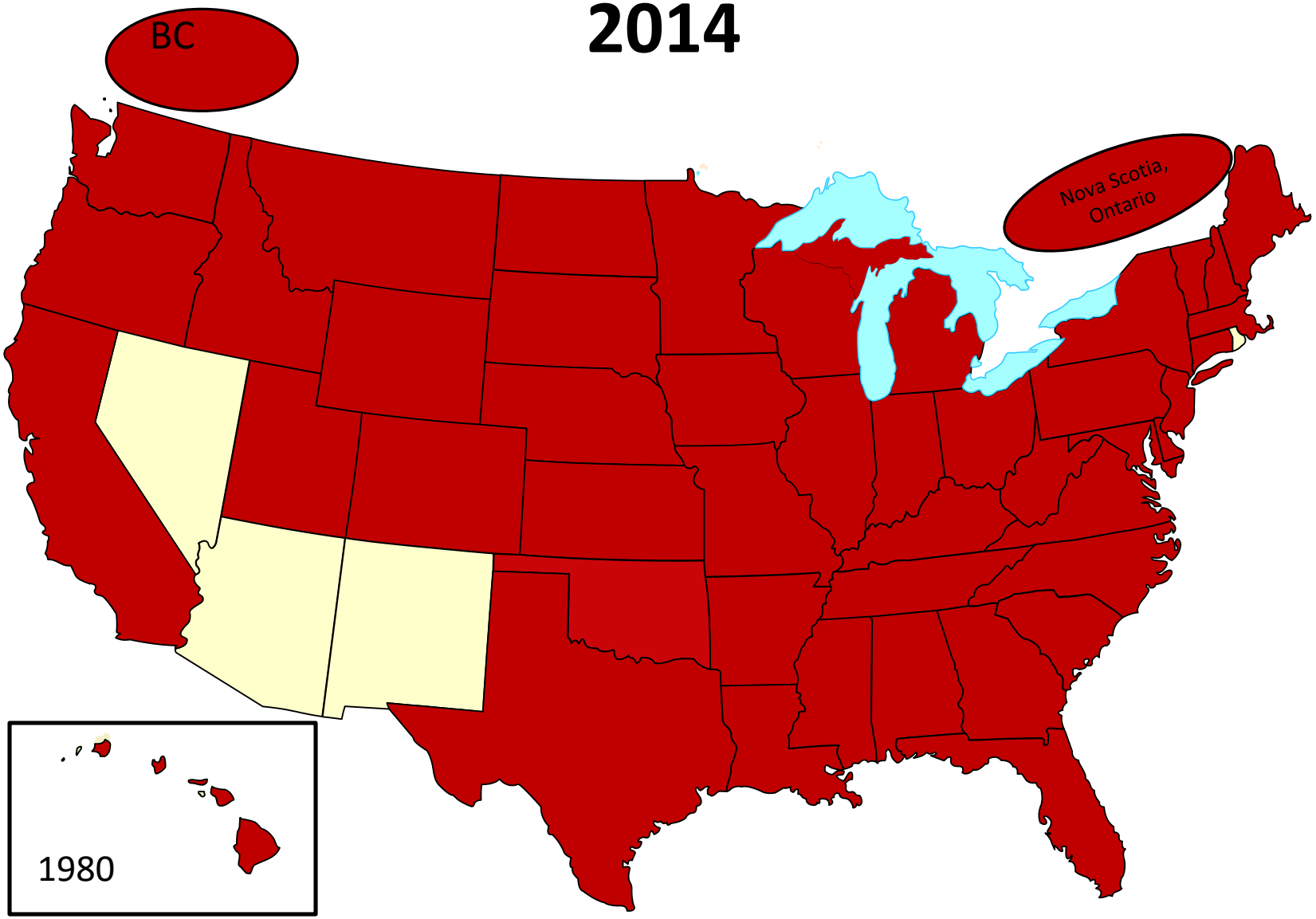



D. suzukii presence
D. suzukii EI
Unsuitable (<1)
Marginal (1-3)
Suitable (4-6)
Good (7-10)
Better (11-20)
Optimal (>20)

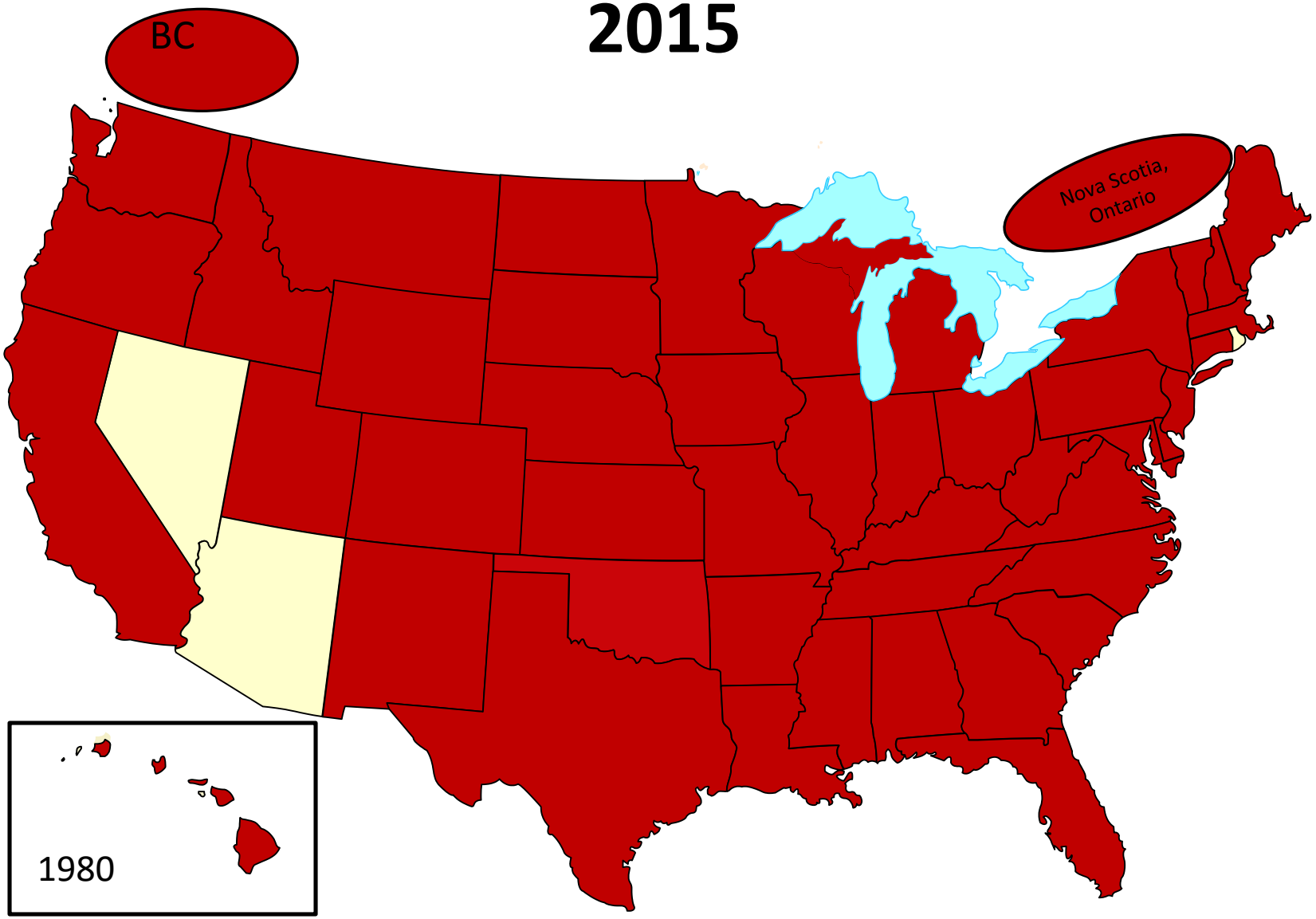
Distribution of SWD in the US 2013



Distribution of SWD in the US 2014

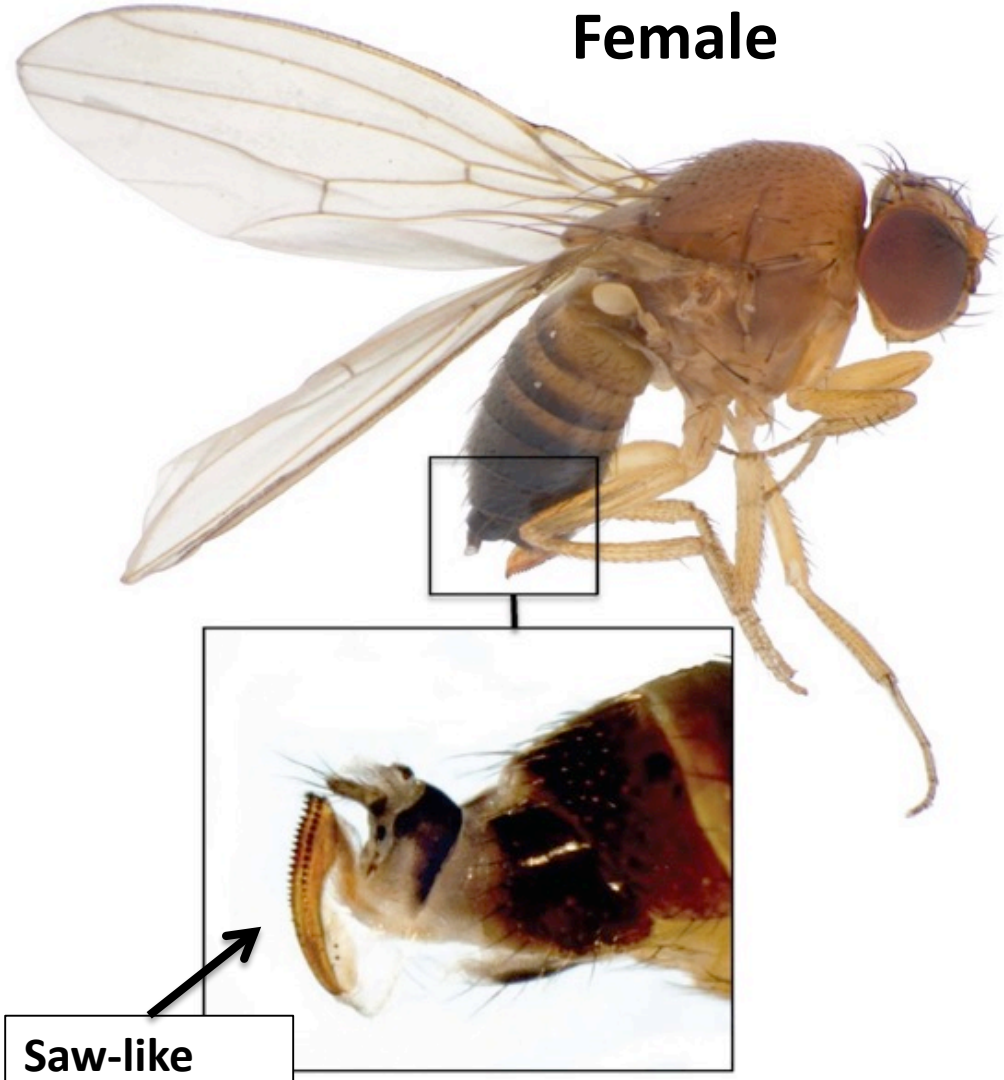


Distribution of SWD in the US 2015



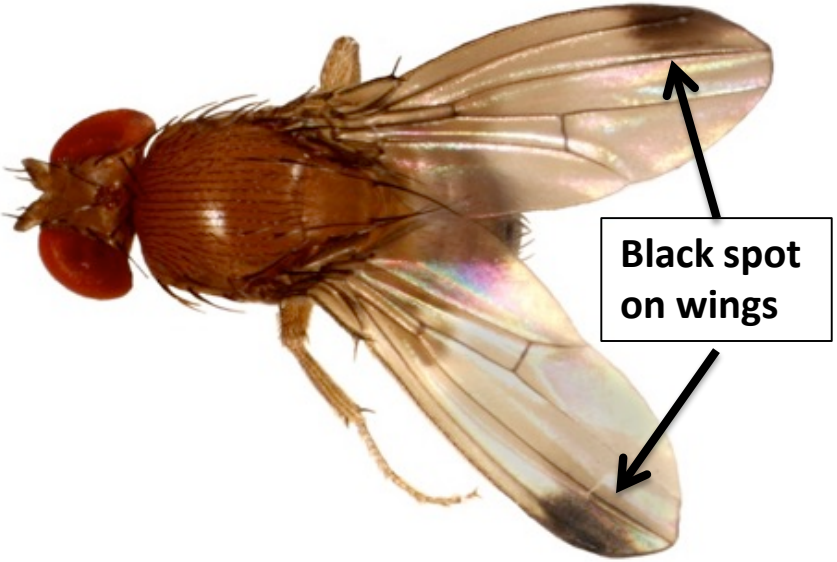
Spotted Wing Drosophila (SWD)

Female



Saw-like ovipositor

Male



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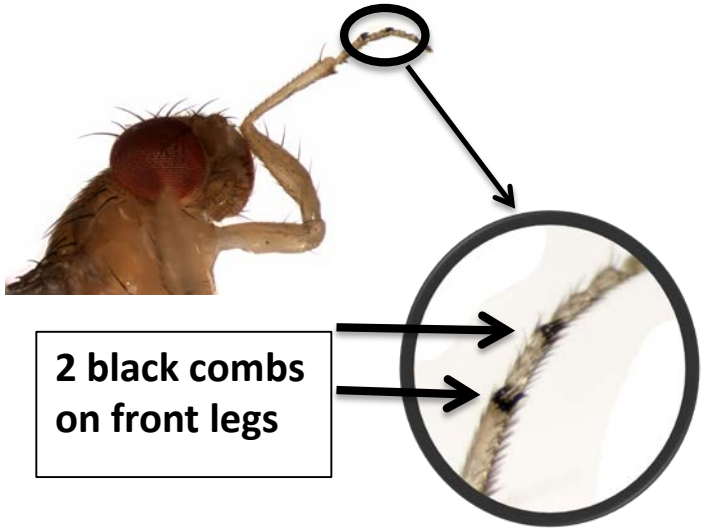


2 black combs on front legs

Day 0 – Uninfested blueberry

Sial & Wilson – UGA

Day 1

Sial & Wilson – UGA

Day 2

Sial & Wilson – UGA

Day 3

Sial & Wilson – UGA

Day 4

Sial & Wilson – UGA

Day 5

Sial & Wilson – UGA

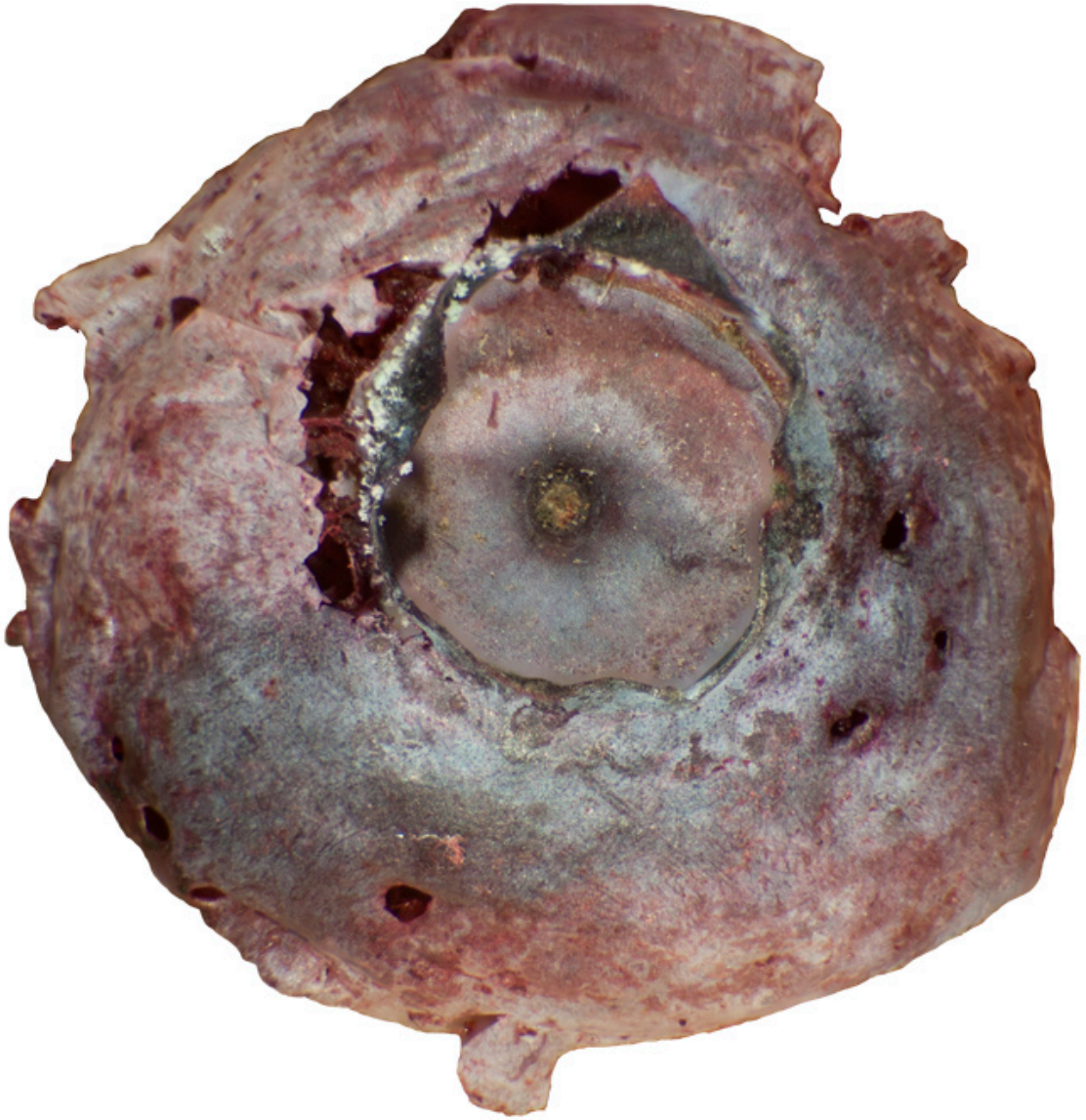
Day 6

Sial & Wilson – UGA

Day 7

Sial & Wilson – UGA

Day 8



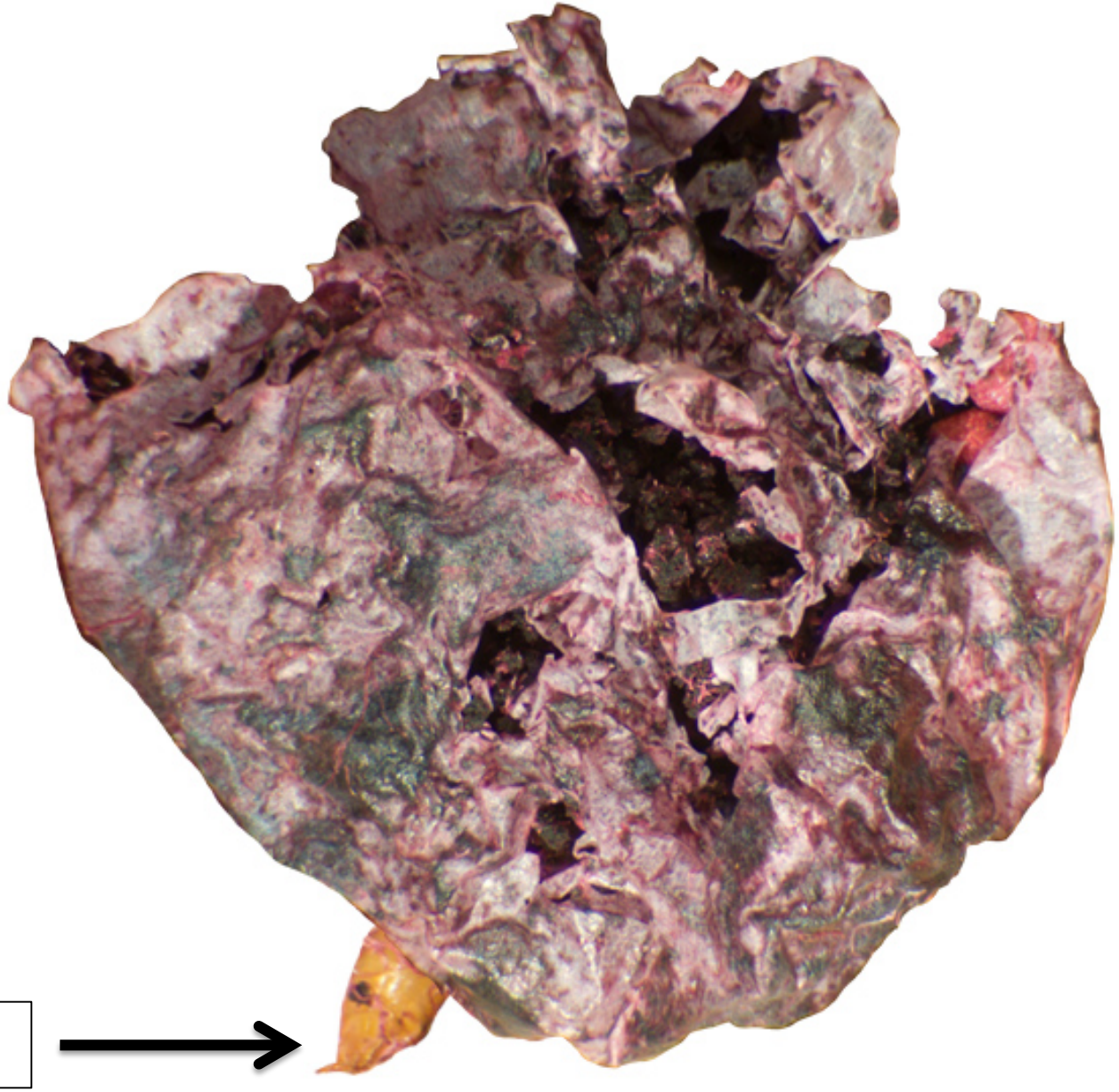
Sial & Wilson – UGA

Day 9

Sial & Wilson – UGA

Day 10

Sial & Wilson – UGA



Sial & Wilson – UGA

Pupae:
3-15 days

Adults:
59 days

Eggs:
12 hours - 3 days

Larvae:
3-13 days

<u>One generation</u> 8-10 days (25° C)

TEMPERATURE TOLERANCE

OPTIMUM ACTIVITY:

68F – 86° F (20° C – 30° C)

- Established at : - 4° C
- Male sterility at high temperatures

HOST RANGE

HIGHEST RISK

Raspberries
Blackberries
Blueberries
Strawberries
Sweet Cherries

MODERATE RISK

Peaches
Grapes
Pears
Tomato

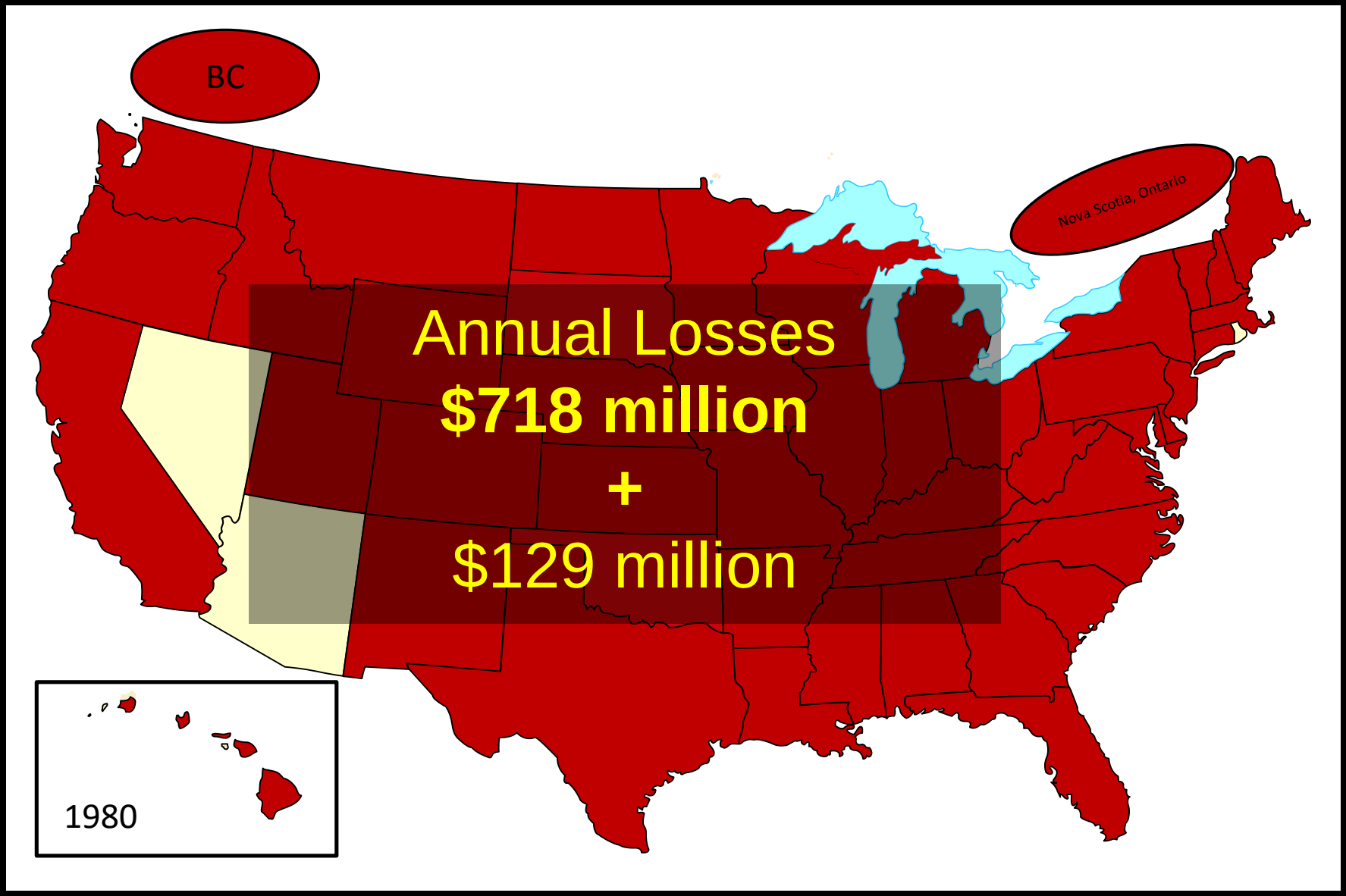
ALTERNATE HOSTS

Wild plants with berries, such as
Snowberries
Elderberries
Pokeweed
Dogwood



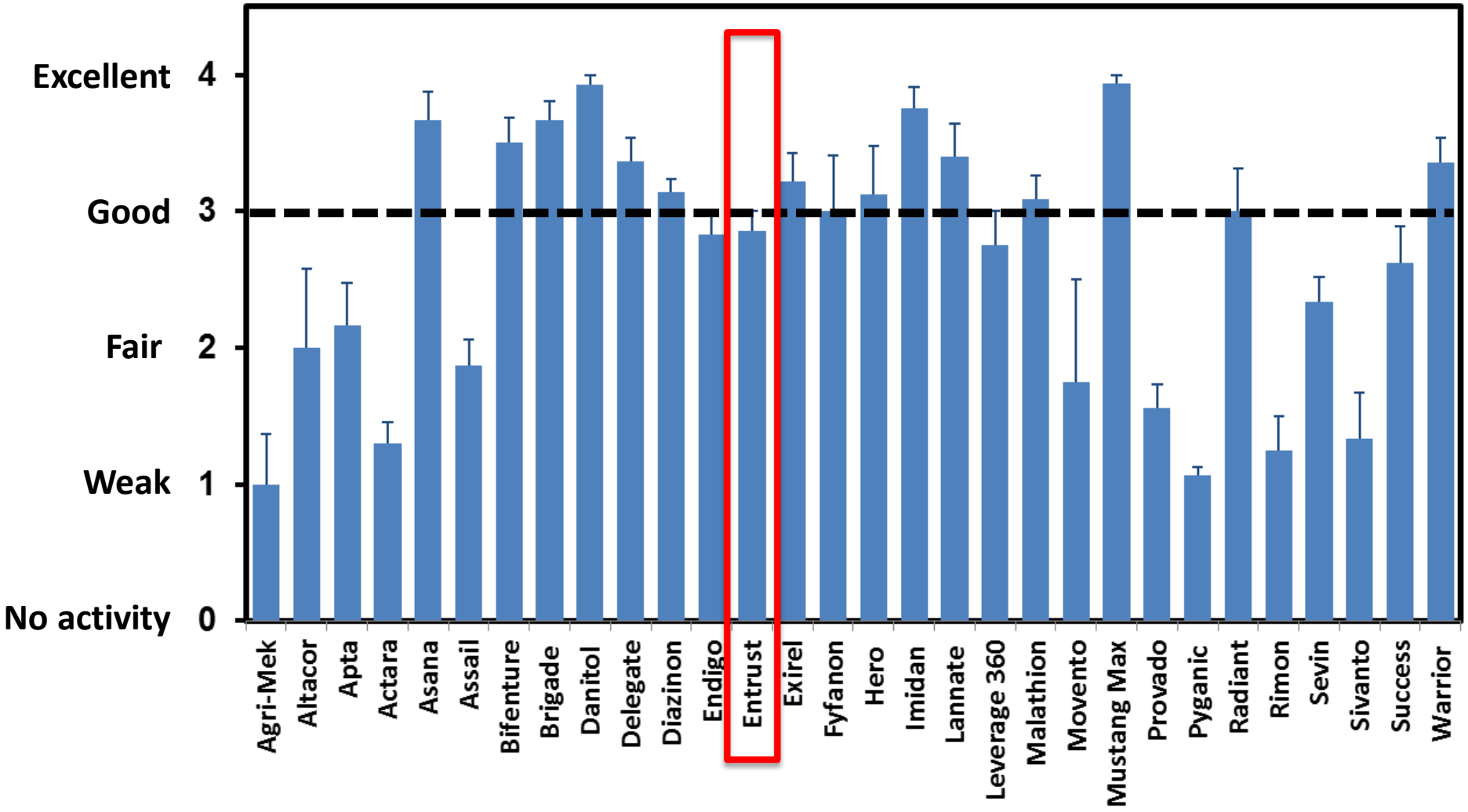


ECONOMIC IMPACT



CHEMICAL CONTROL

2014 summary rankings of insecticide efficacy against SWD
10 states, 20 state x crop combinations



Information provided by Michigan State University, North Carolina State University, Washington State University, University of Maine, University of California Berkeley, Rutgers University, Oregon State University, University of Georgia, Cornell University, and University of Florida.

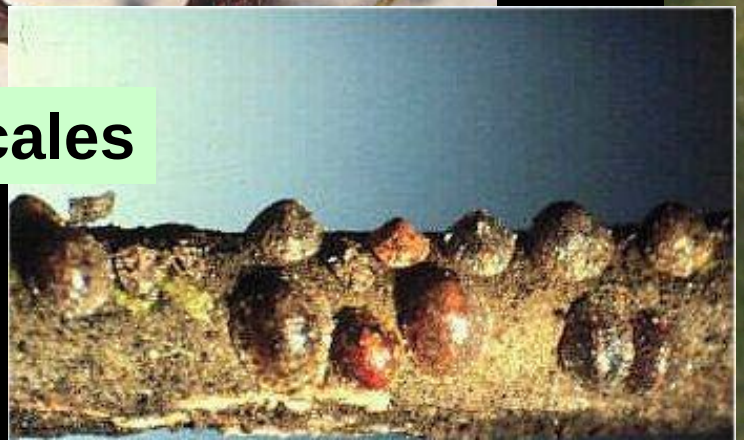
SWD Management Programs in GA Blueberries

Management Strategy	Weekly rotations
Export-friendly, maximum modes of action	Imidan (phosmet), Malathion 8F, Delegate (spinetoram), and Danitol (fenpropathrin)
Short preharvest interval (PHI)	Mustang Max (zeta-cypermethrin) and Malathion 8F
Reduced risk	Delegate and Exirel (cyantraniliprole)
Organic	Entrust and Pyganic

SECONDARY PESTS

Bearberry whitefly
(*Tetraleurodes ursorum* Cockerell)

Scales



False spider mite
(Brevipalpus sp.)


Scales


SECONDARY PESTS

SWD Activity in the Field

- Four sets of nine traps were used in this study
- One set of traps was deployed during each of the four 6hr windows of time:

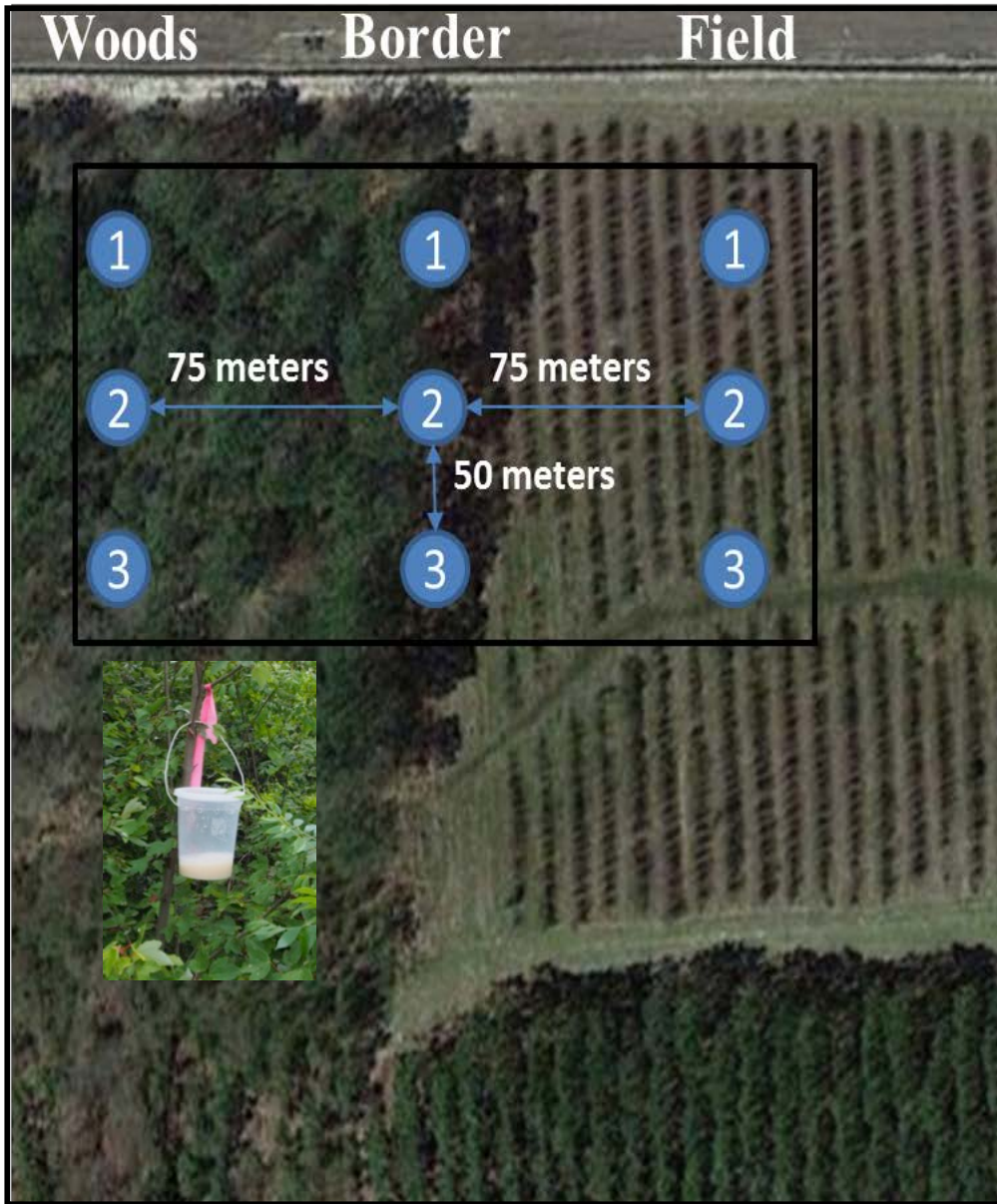
5:30am – 9:30am (Dawn)

9:30am – 3:30 pm (Day)

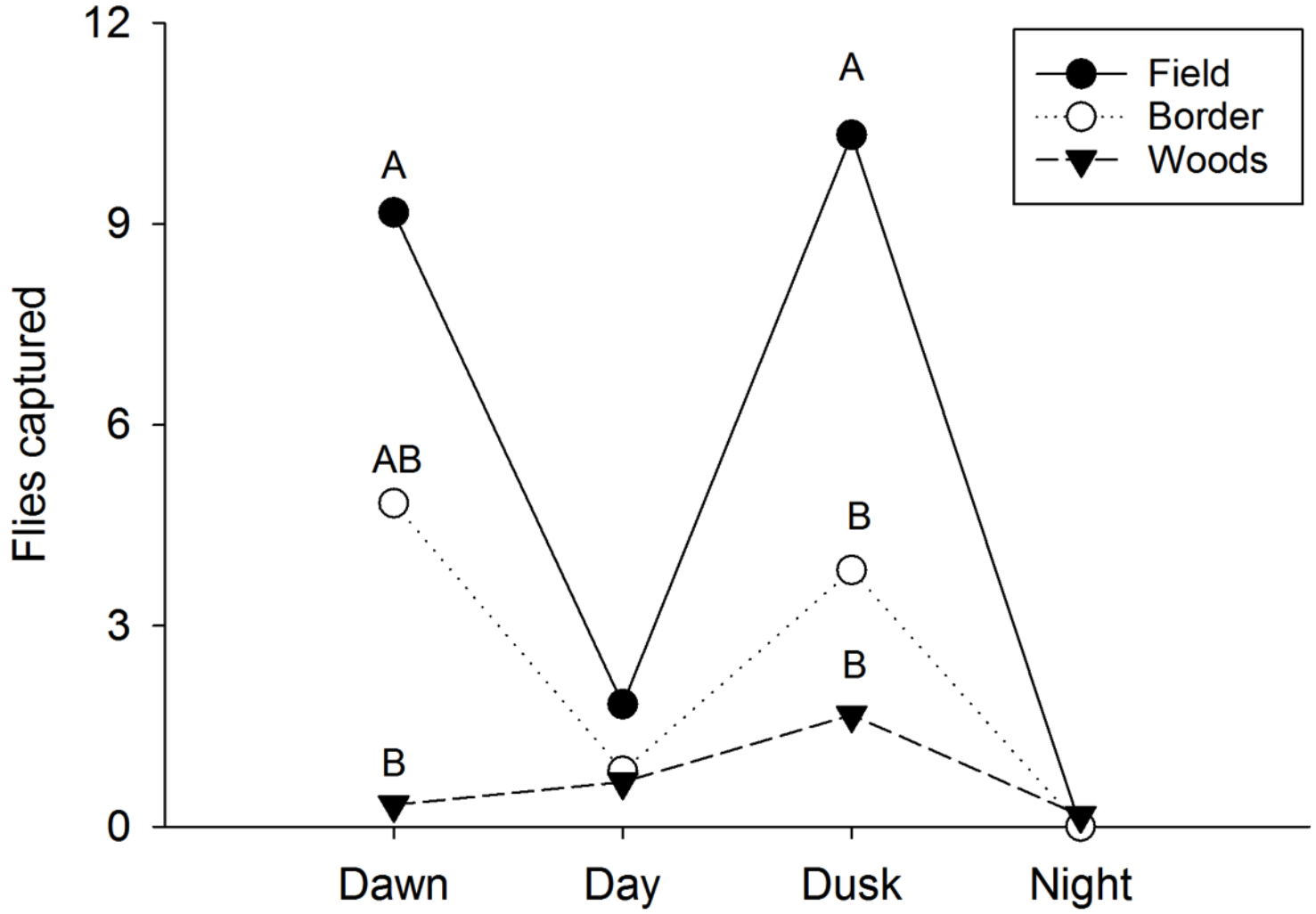
3:30pm – 9:30pm (Dusk)

9:30pm – 5:30am (Night)

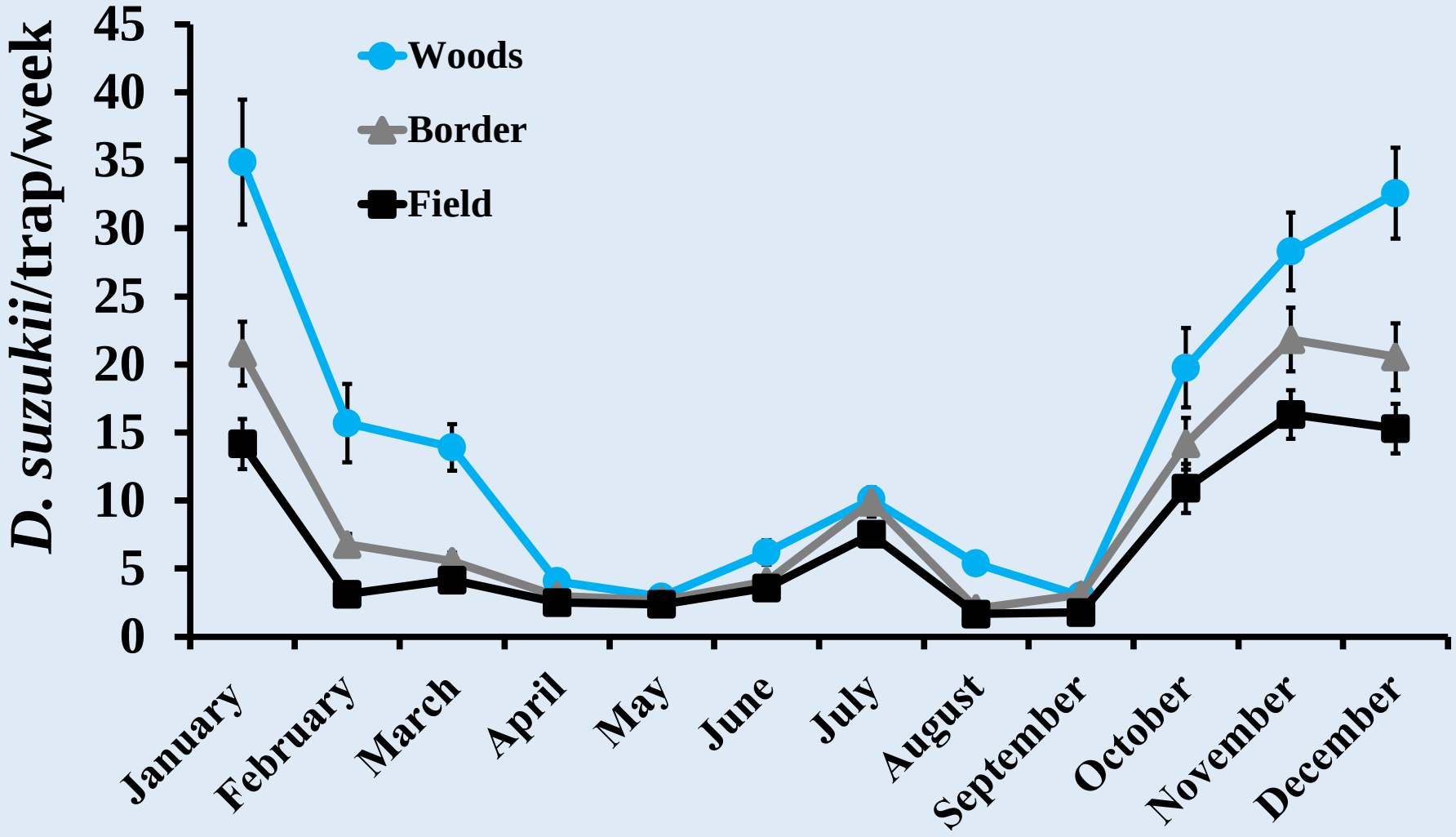
- SWD Trap counts were recorded after one week



SWD Activity in the Field

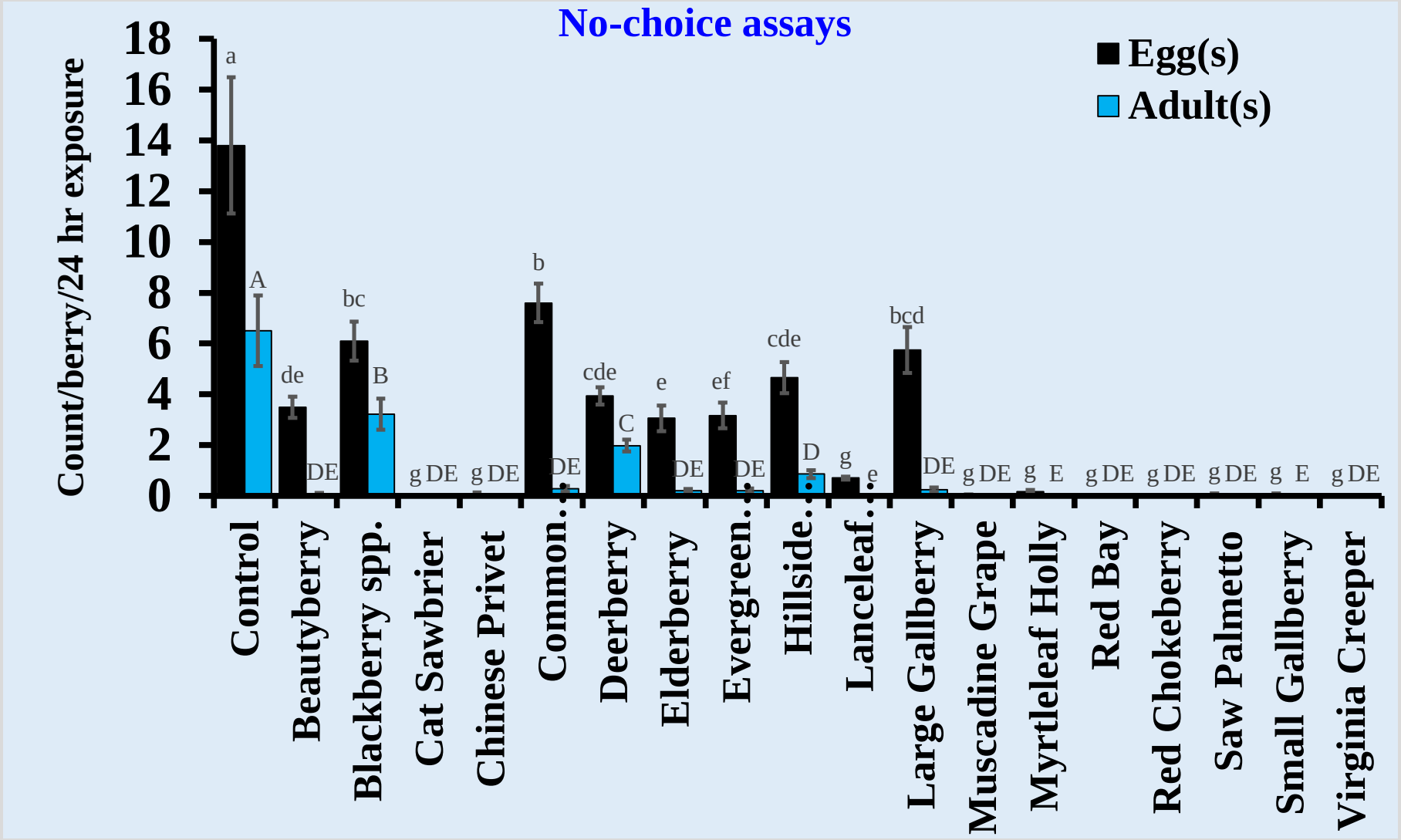


SWD Phenology



Average weekly adult SWD captures (Mean±SEM) per trap at each of the three trapping locations across all seven sites 2015-2016

Alternate Hosts



SWD oviposition and adult eclosion per berry (Mean ± SEM) in 2016

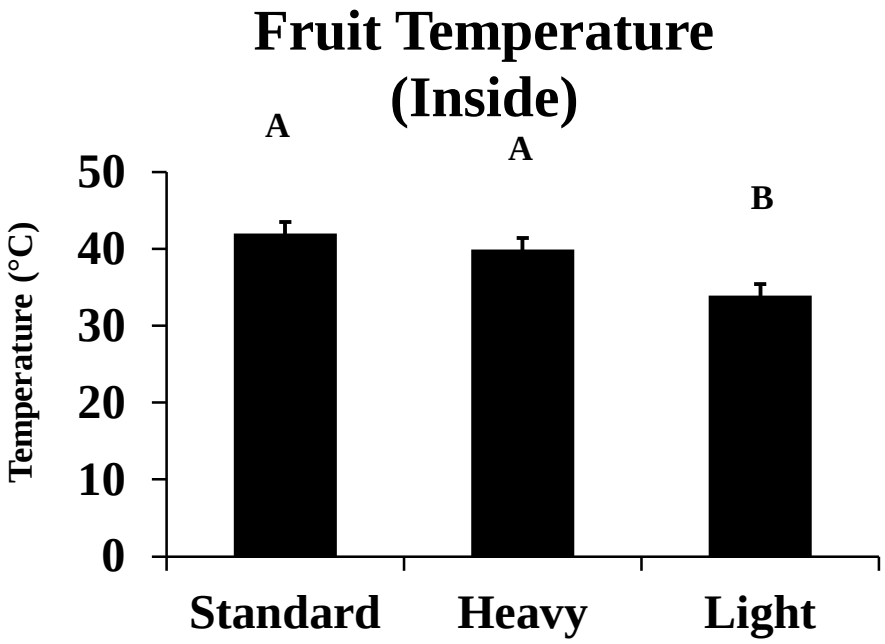
Cultural Control Strategies

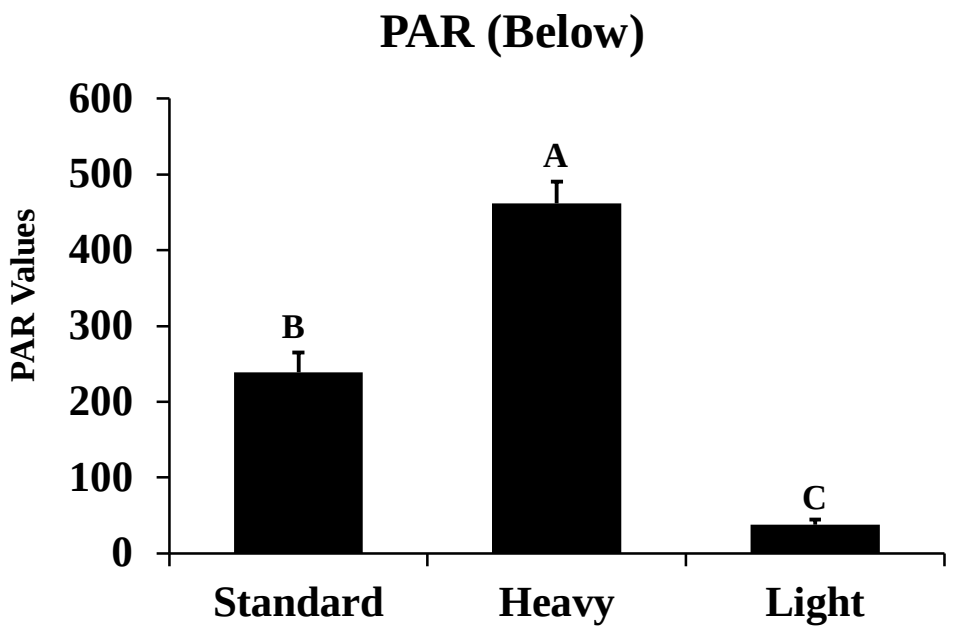
Canopy Management: Pruning

Light Pruning

Medium Pruning

Heavy Pruning

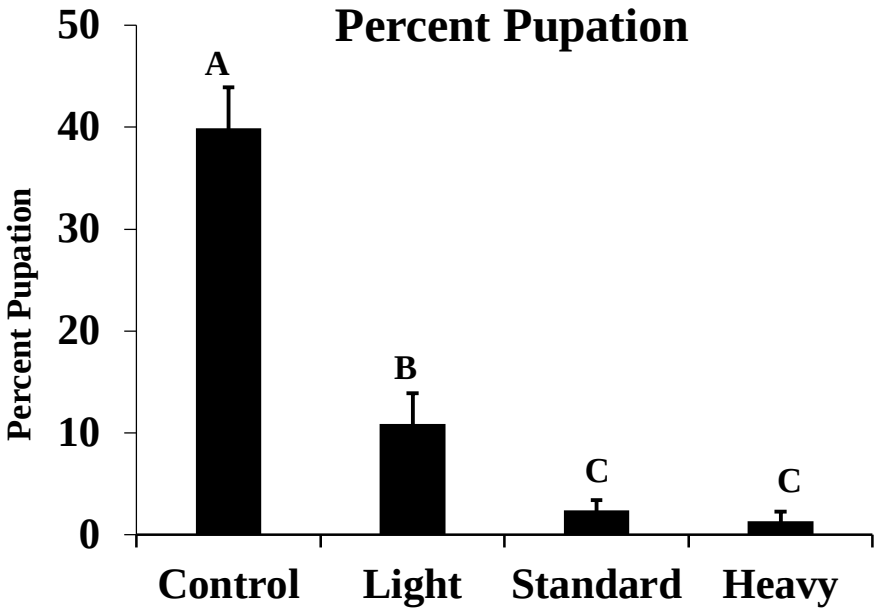


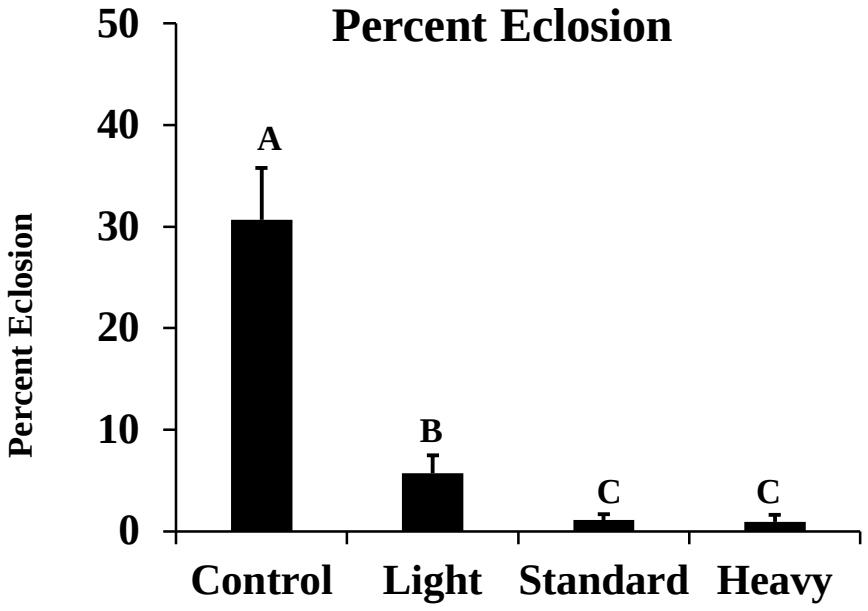


Pruning Treatment

Cultural Control Strategies

Canopy Management: Pruning

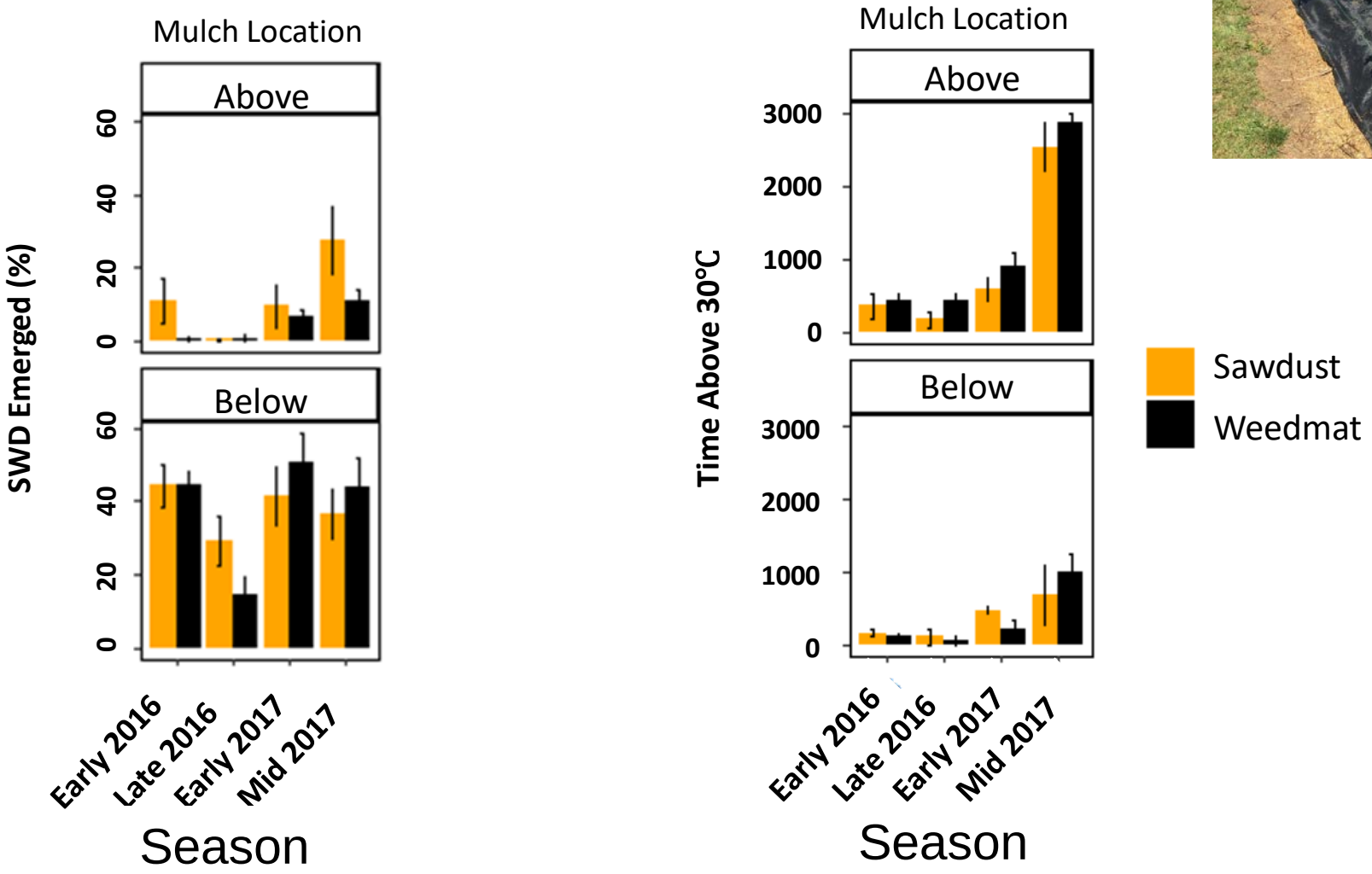




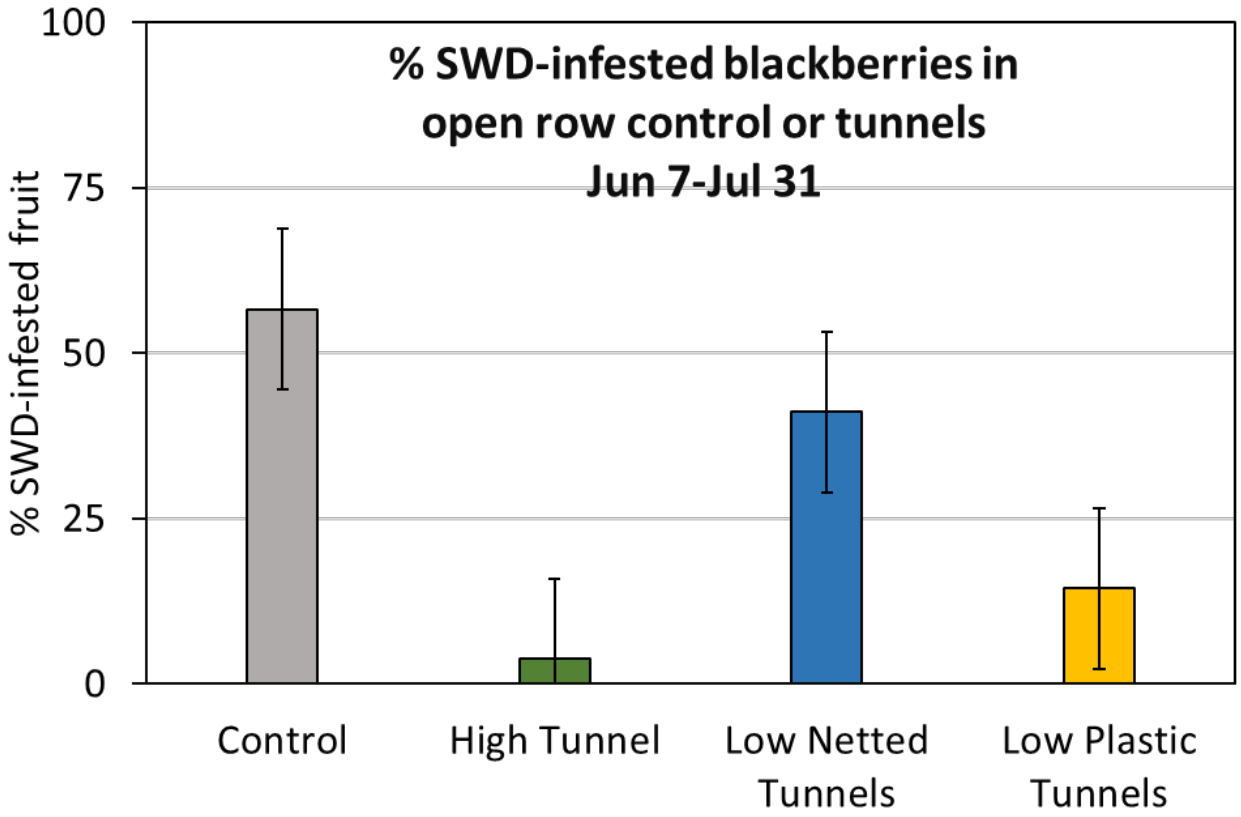
Pruning Treatment

Cultural Control Strategies

Floor Management: Mulching



Exclusion Tunnels
(Mosquito nets)



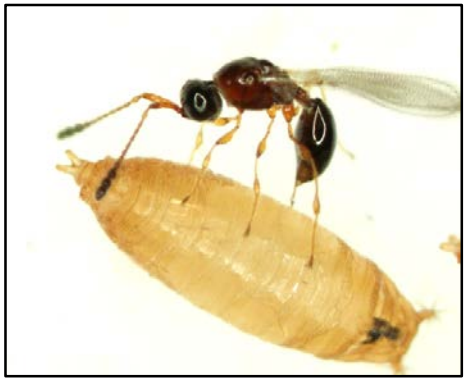
BIOLOGICAL CONTROL

Resident drosophila parasitoids in California

Pupal parasitoids:

Pachycrepoideus vindemiae
(Pteromalidae)

Trichopria drosophilae
(Diapriidae)



photos Xingeng Wang

Larval parasitoids:

Leptopilina heterotoma
Leptopilina boulardi
(Figitidae)

photos Alexander Wild

SUMMARY

IPM is a science-based, decision-making process that identifies and reduces risks from pests and pest management related strategies:

- IPM coordinates the use of pest biology, environmental information, and available technology to prevent unacceptable levels of pest damage/disease spread by the most economical means, while minimizing risk to people, property, resources, and the environment.
- IPM provides an effective strategy for managing pests in all arenas from developed agricultural, residential, and public lands to natural and wilderness areas.
- IPM provides an effective, all encompassing, low-risk approach to protect resources and people from pests."

(National Road Map for IPM, Revised October 1, 2013)

International IPM Symposium

- Started as a National IPM Symposium
- Grew into International IPM Symposium in 2006
- Held every three years
- The International IPM Symposium is the premier global event for sharing your expertise, networking with colleagues and leading scientists, and learning the latest technologies for effectively managing pests.

9th International IPM Symposium

March 19-22, 2018 in Baltimore, MD

IPM: Improving Health, Environment and Global Sustainability

- 514 participants, including 51 students and 50+ Sysco participants
- 202 oral presentations in 47 sessions
- 172 poster presentations
- 17 exhibitors
- 25 different countries represented

9th International IPM Symposium

March 19-22, 2018 in Baltimore, MD

IPM: Improving Health, Environment and Global Sustainability

Highlights include:

•Opening keynote presentation by Dr. Dini M. Miller, Professor, Virginia Tech University, and Urban Pest Management Specialist, State of Virginia, and an internationally recognized expert in the area of urban pest management, specializing in bed bug and German cockroach biology, behavior, and control

•Mini-symposia featuring experts addressing hot topics in the IPM field

•More than 40 concurrent sessions designed for practitioners, growers, educators, consultants, researchers, industry professionals, students, and employees of non-governmental organizations

•CCA credits available – 25 CCA CEUs in IPM category, 5 CCA CEUs in the professional development category

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March 19-22, 2018 in Baltimore, MD

IPM: Improving Health, Environment and Global Sustainability

Highlights include:

- Maryland Department of Agriculture pesticide recertification credits available - 8 credits in categories: private, CORE, 1A, 3A, 3B, 3C, 7A and 10
- A specialized day-long workshop, "Integrated Tick Management: Community-Wide Action to Address the Global Tick Problem"
- Presentation of the 2018 IPM Achievement Awards
- Over 170 poster presentations of research and best practices
- Field trips to see IPM in action in downtown Baltimore
- Exhibits from leading IPM suppliers
- Optional trip to visit policymakers on Capitol Hill to educate them on IPM needs and benefits for your sector and clientele

9th International IPM Symposium

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IPM: Improving Health, Environment and Global Sustainability

IPM Achievement Awards:

- **International IPM Lifetime Achievement Awards**
- **International IPM Awards of Excellence**
- **International IPM Awards of Recognition**
- **International IPM Awards for Graduate Students**

9th International IPM Symposium

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IPM: Improving Health, Environment and Global Sustainability

Annie Rich

International IPM Award for Graduate Students (Masters Student)

- 2 Bachelor of Science degrees
- MS in Veterinary Entomology from University of Georgia under Dr. Nancy Hinkle
- Conducted several project with IPM aspects
- Thesis project focused on malaria mosquito control including use of endectocide treated cattle for mosquito and biting midge control

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IPM: Improving Health, Environment and Global Sustainability

Annie Rich

International IPM Award for Graduate Students (Masters Student)

- Also involved in stable fly phenology and horn fly control project and use of standard alternatives to manage darkling beetles in poultry houses
- Annie truely exemplifies the next generation of IPM leaders as she would like to use her skills to begin closing the rift that seems to lie between the public and professional pest control.

9th International IPM Symposium

March 19-22, 2018 in Baltimore, MD

IPM: Improving Health, Environment and Global Sustainability

Annie Rich

International IPM Award for Graduate Students (Masters Student)

- Under the esteemed supervision of Dr. Nancy Hinkle, she has already begun advocating for the profession through talks at many conferences and with students about backyard mosquito control.
- Her experience with delusory parasitosis patients makes her truly unique and effective as a young IPM leader.

ACKNOWLEDGEMENTS

9TH International IPM Symposium

United States Department of Agriculture
National Institute of Food and Agriculture

OREI & SCRI

UNIVERSITY OF GEORGIA
EXTENSION
Integrated Pest Management Program