RUTGERS
School of Environmental and Biological Sciences
DEPARTMENT OF ENTOMOLOGY

NEVF
New England Vegetable and Fruit Conference

BEETLES, APHIDS, AND FLIES IN BLUEBERRIES

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Entomology

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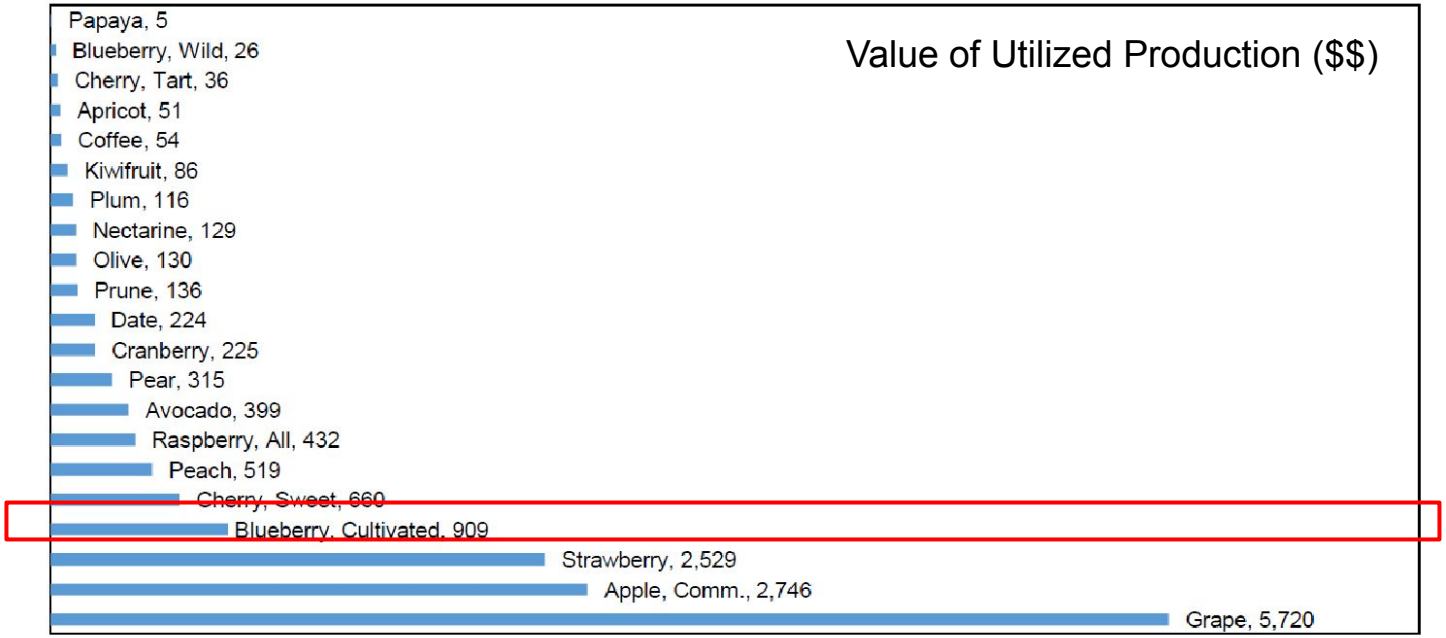
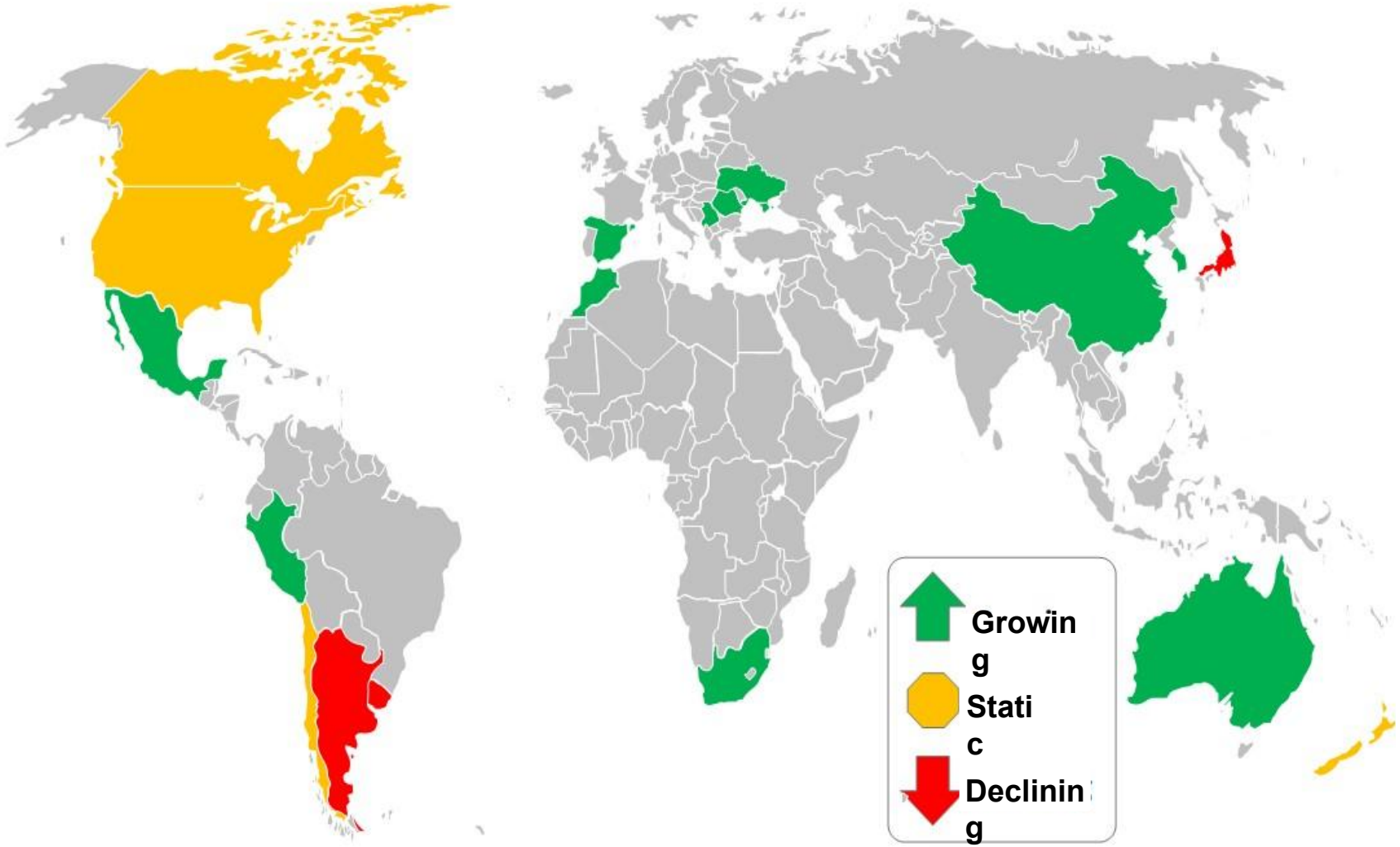
New England Veg & Fruit Conference
Dec. 2024

BLUEBERRY – AN IMPORTANT CROP

- The United States is the world's largest producer of blueberries.
- Blueberries are the 2nd most important commercial berry in the U.S.
- The value of the industry is approx. $900 million.
- Healthy small fruit.



WORLD BLUEBERRY PRODUCTION



International Blueberry Organization

Rodriguez-Saona et al. 2019

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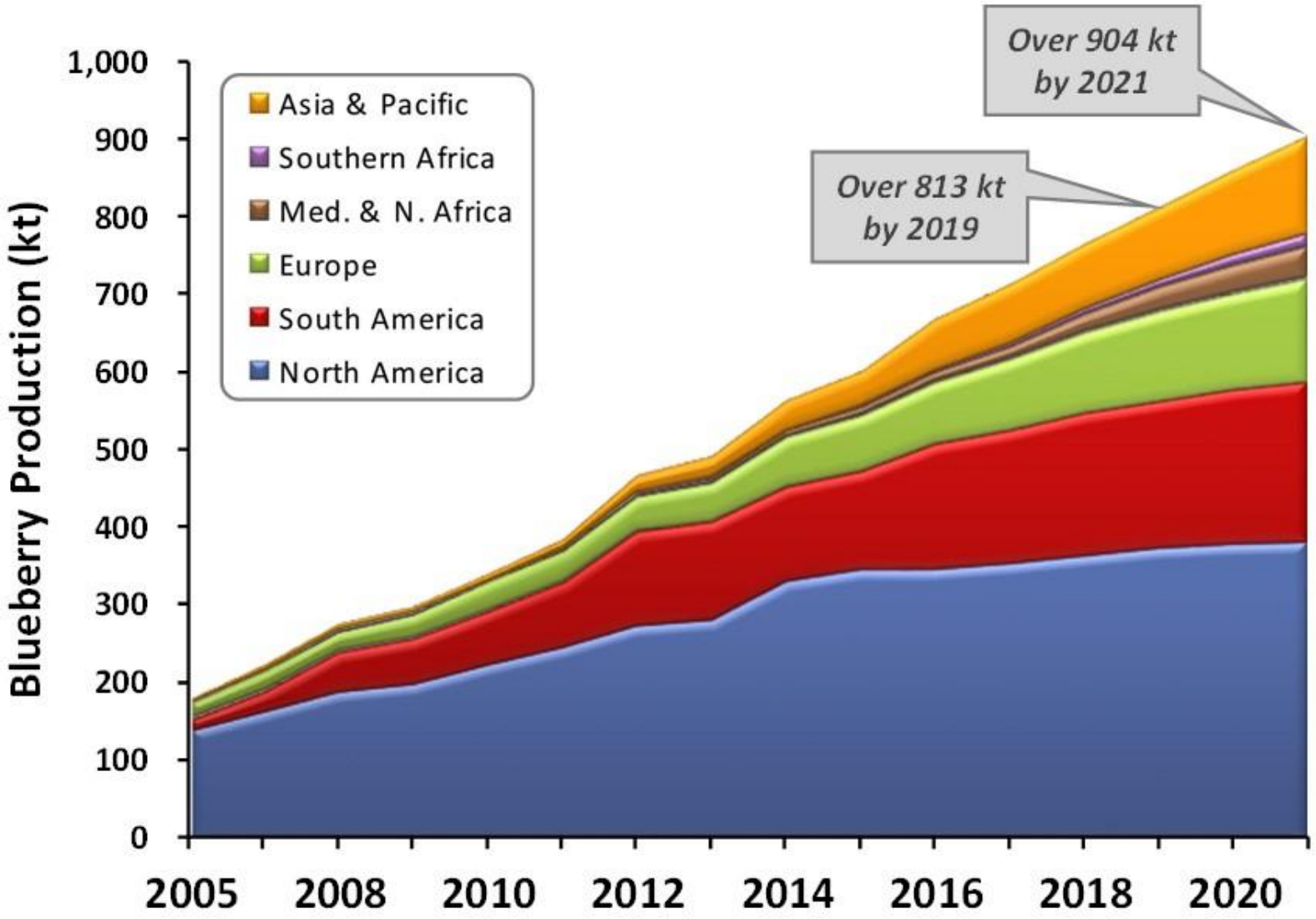

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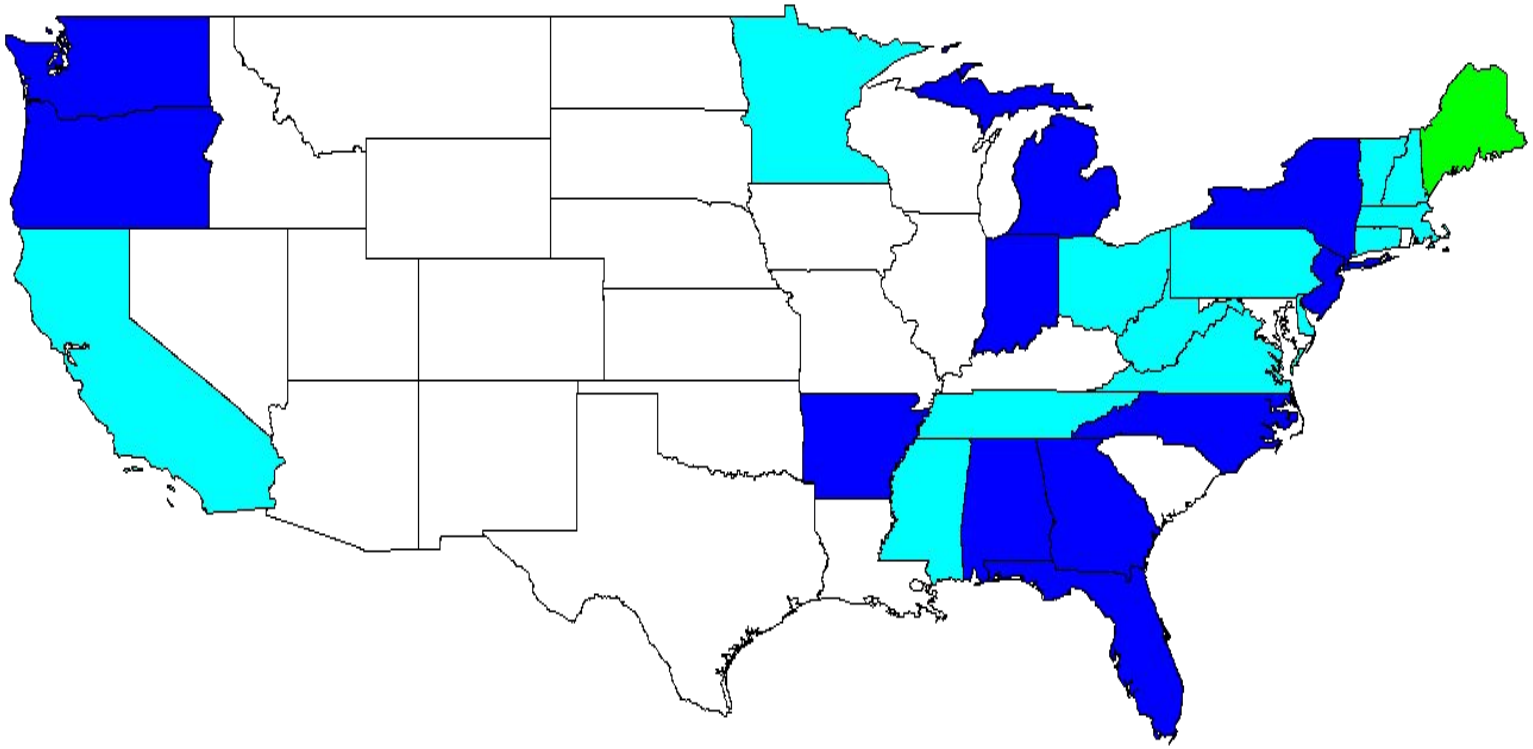
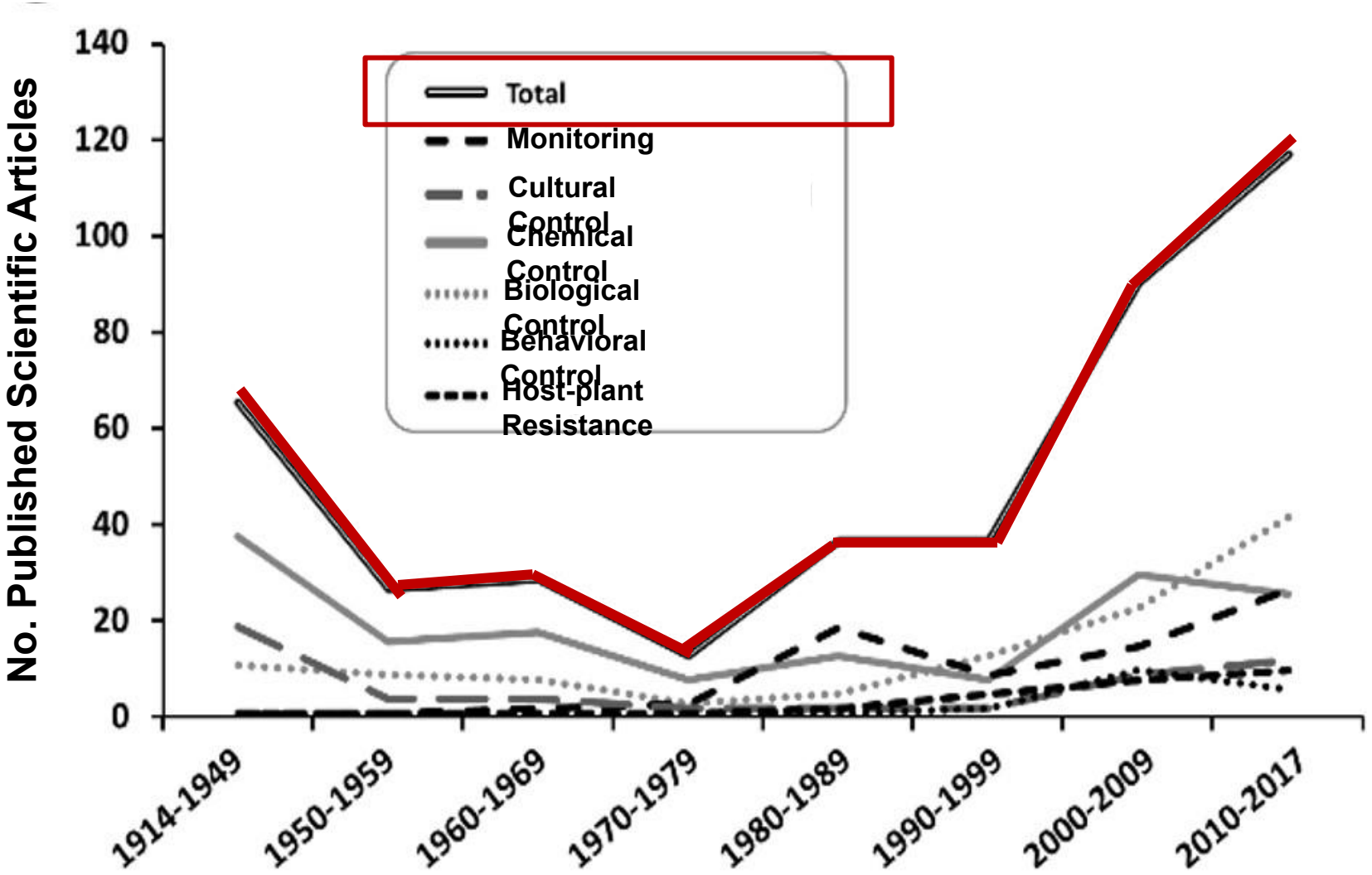
BLUEBERRY PRODUCTION IN USA



2019	NJ	NC	OR	MI	WA	GA	CA	FL
Yield (lbs/acre)	5,090	4,160	11,700	4,120	9,760	4,420	10,100	4,740
Total Yield (lbs x 10^3)	46,070	35,770	154,100	84,900	162,830	93,980	71,780	23,620
Total Value ($ x 10^6)	85.3	60.8	134.3	75.3	153.2	133.1	204.5	62.3

ADVANCES IN IPM



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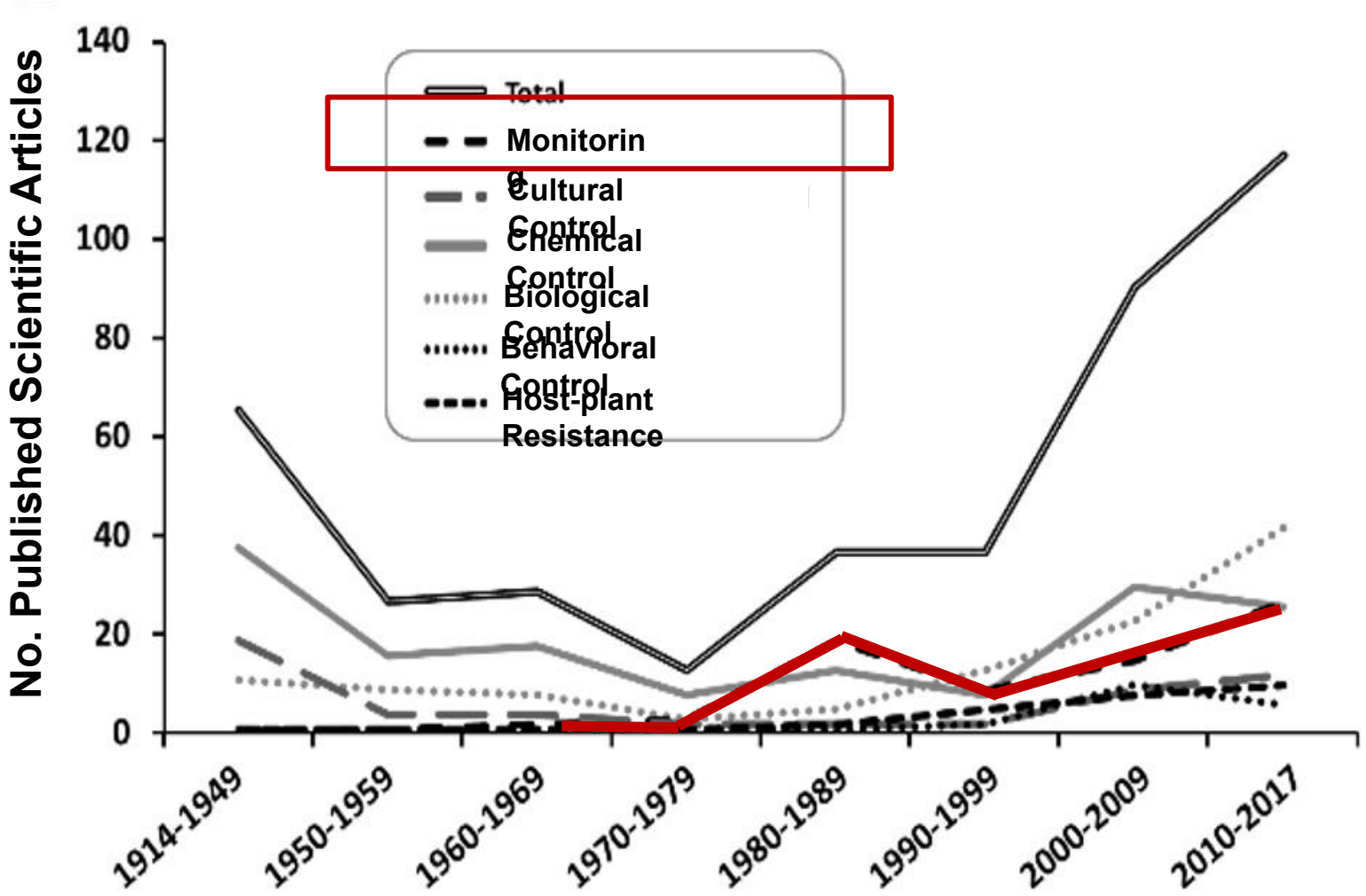

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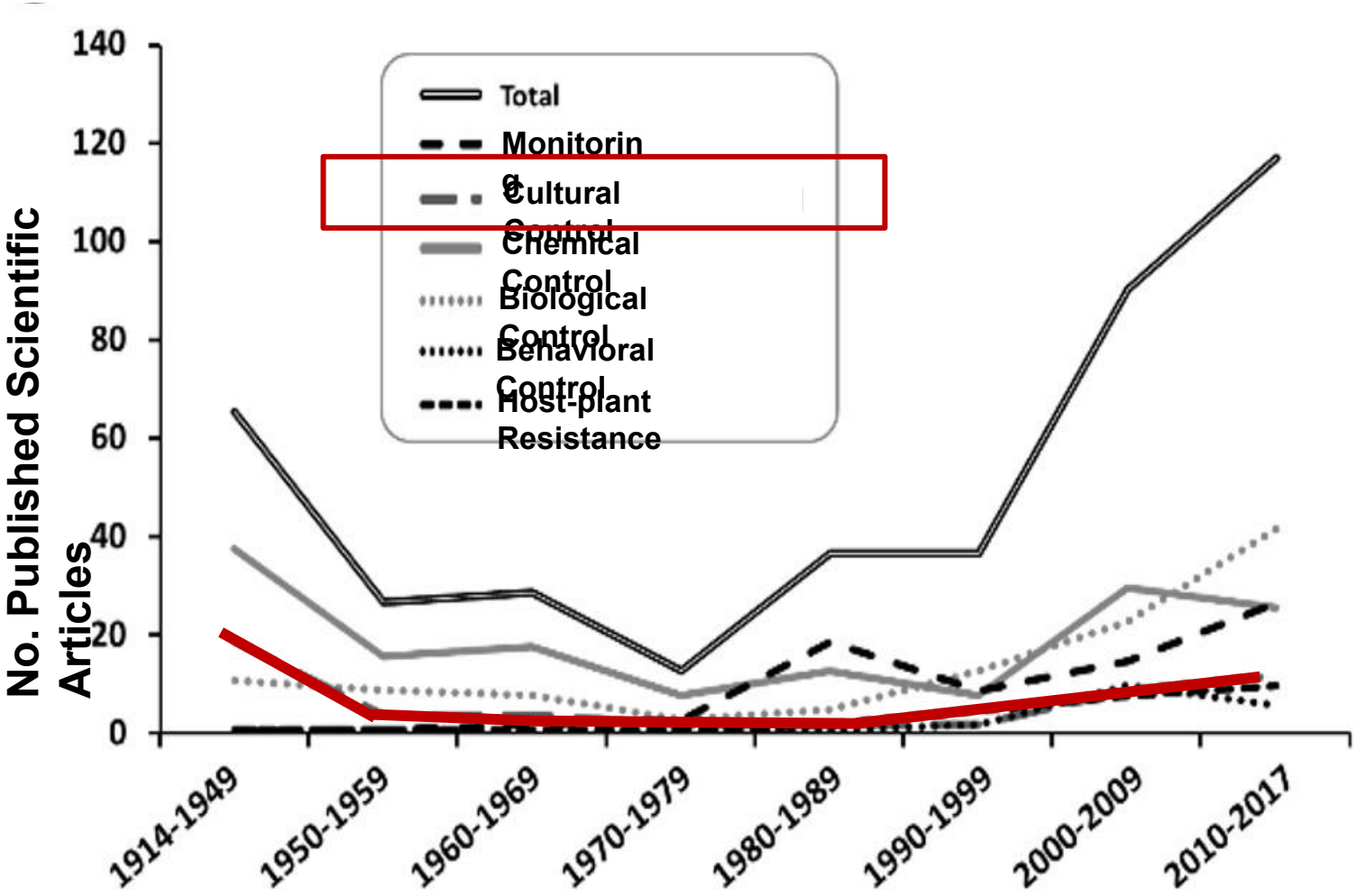

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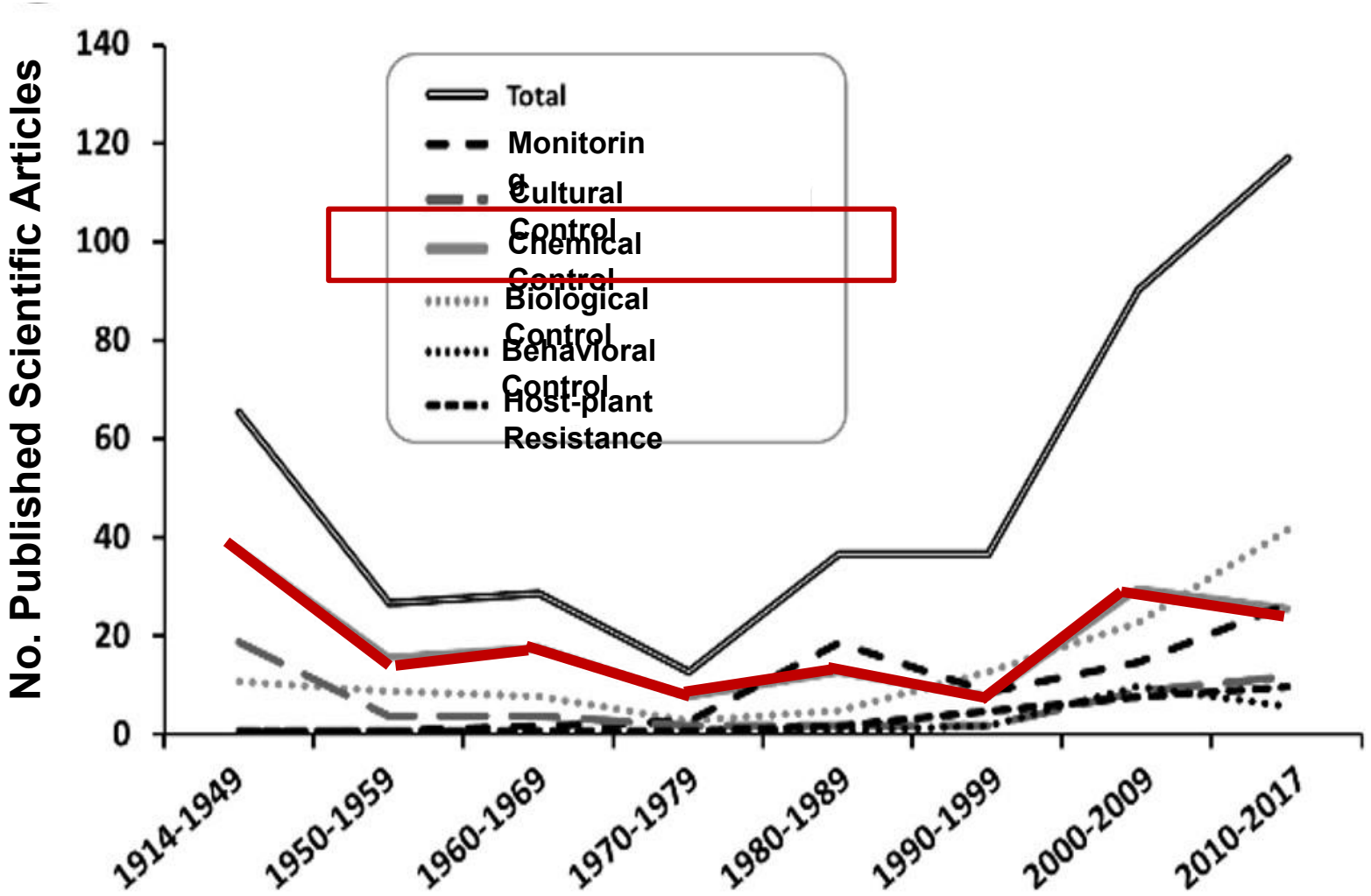

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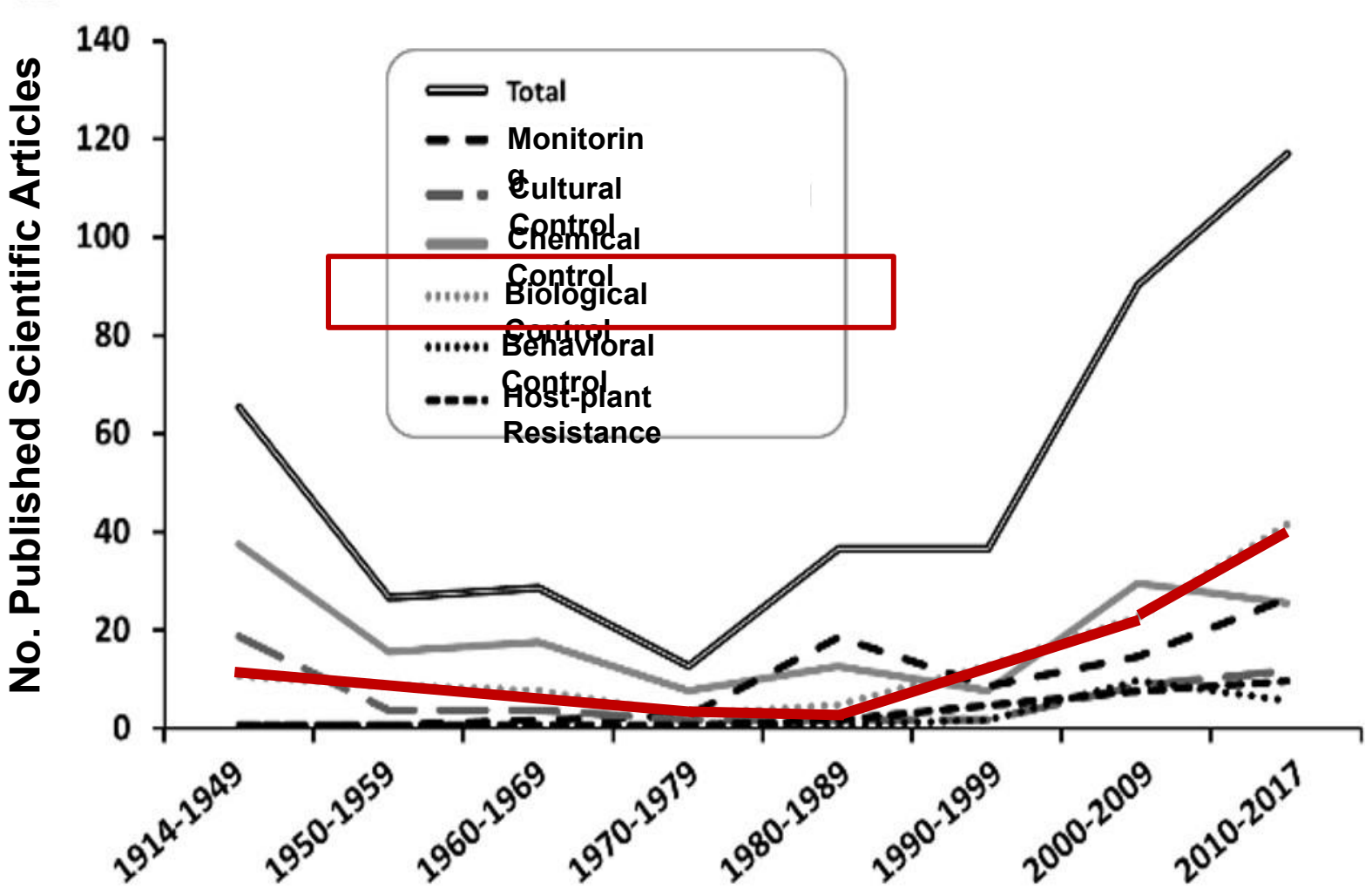

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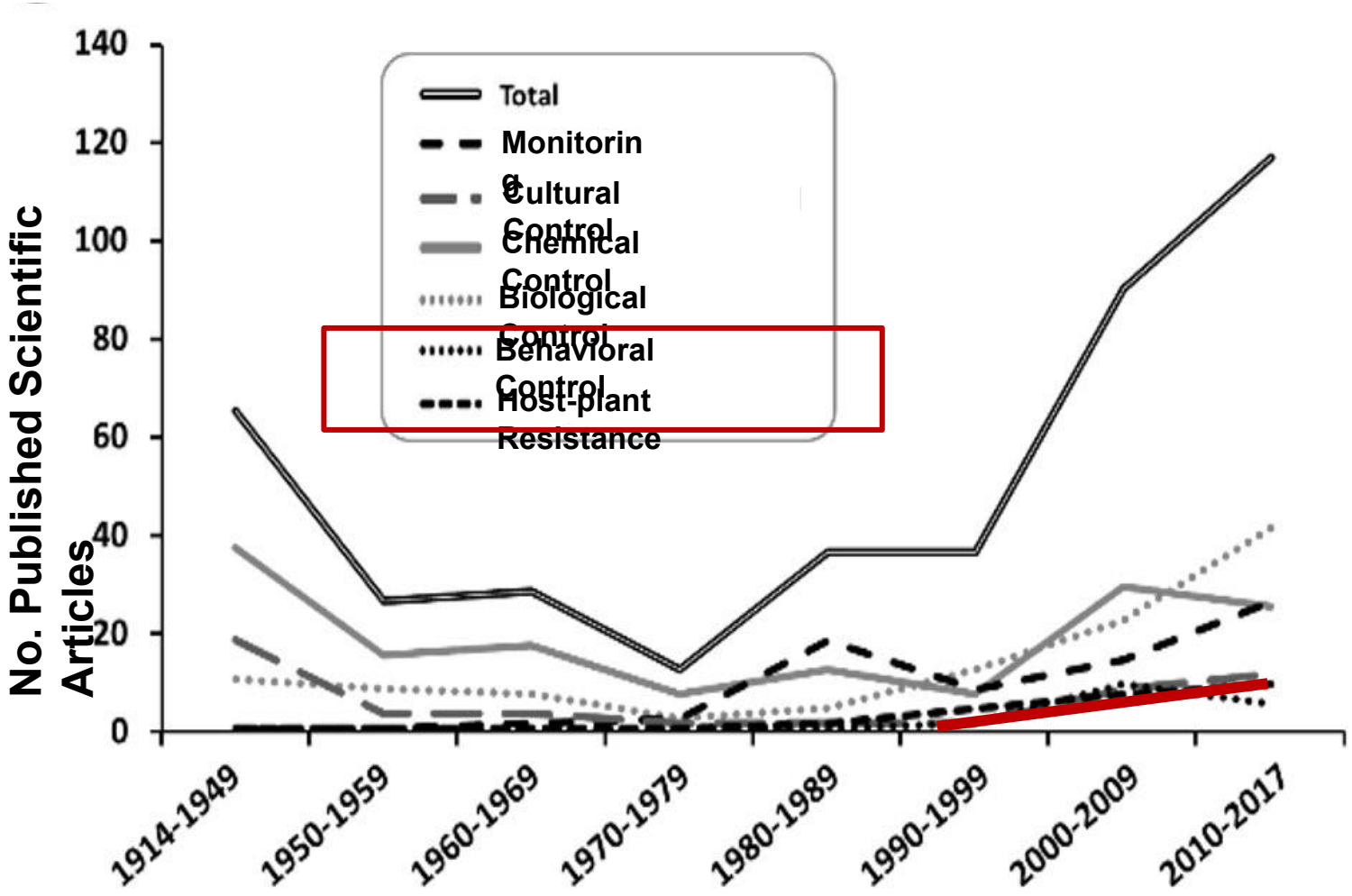

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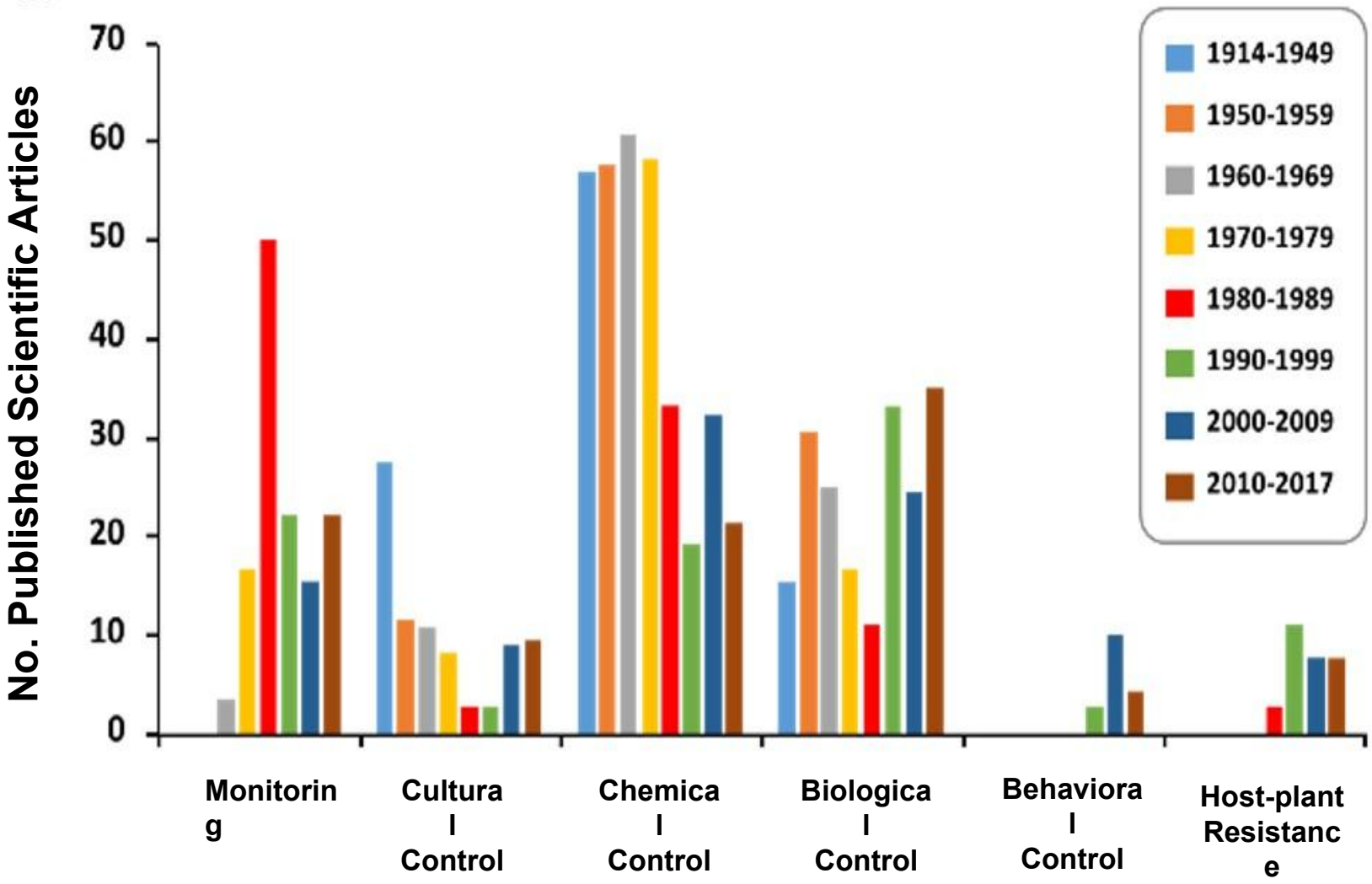

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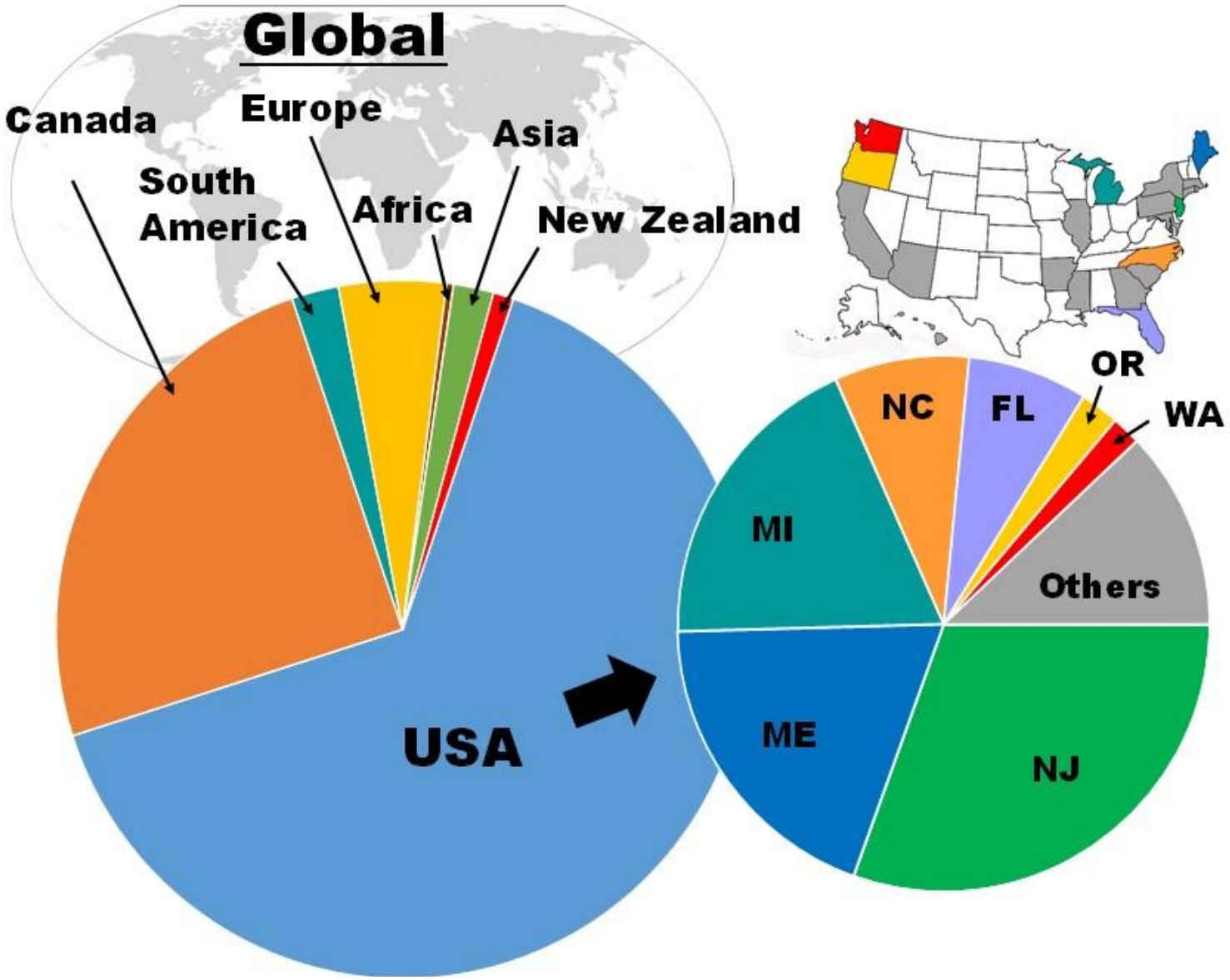

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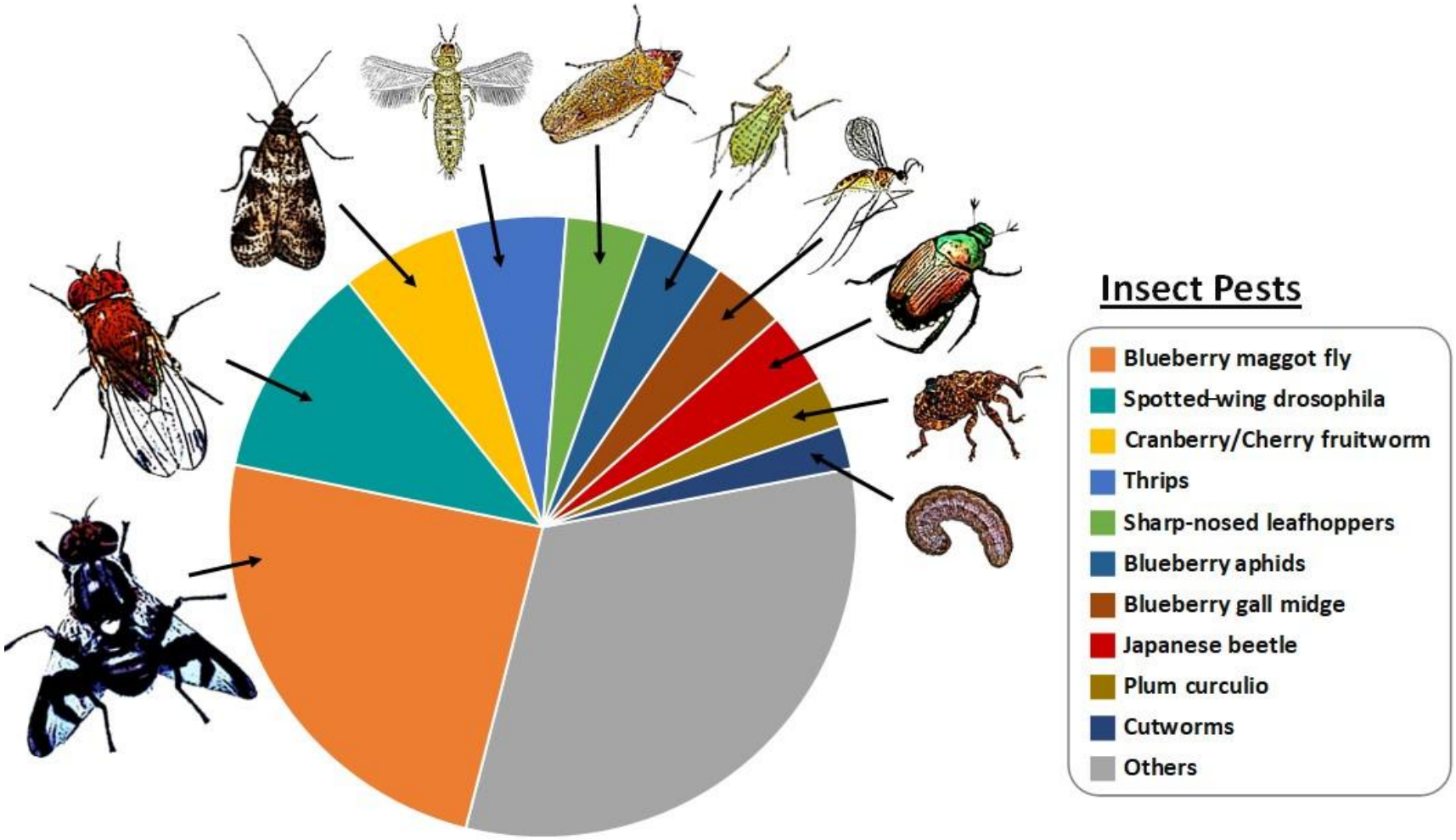

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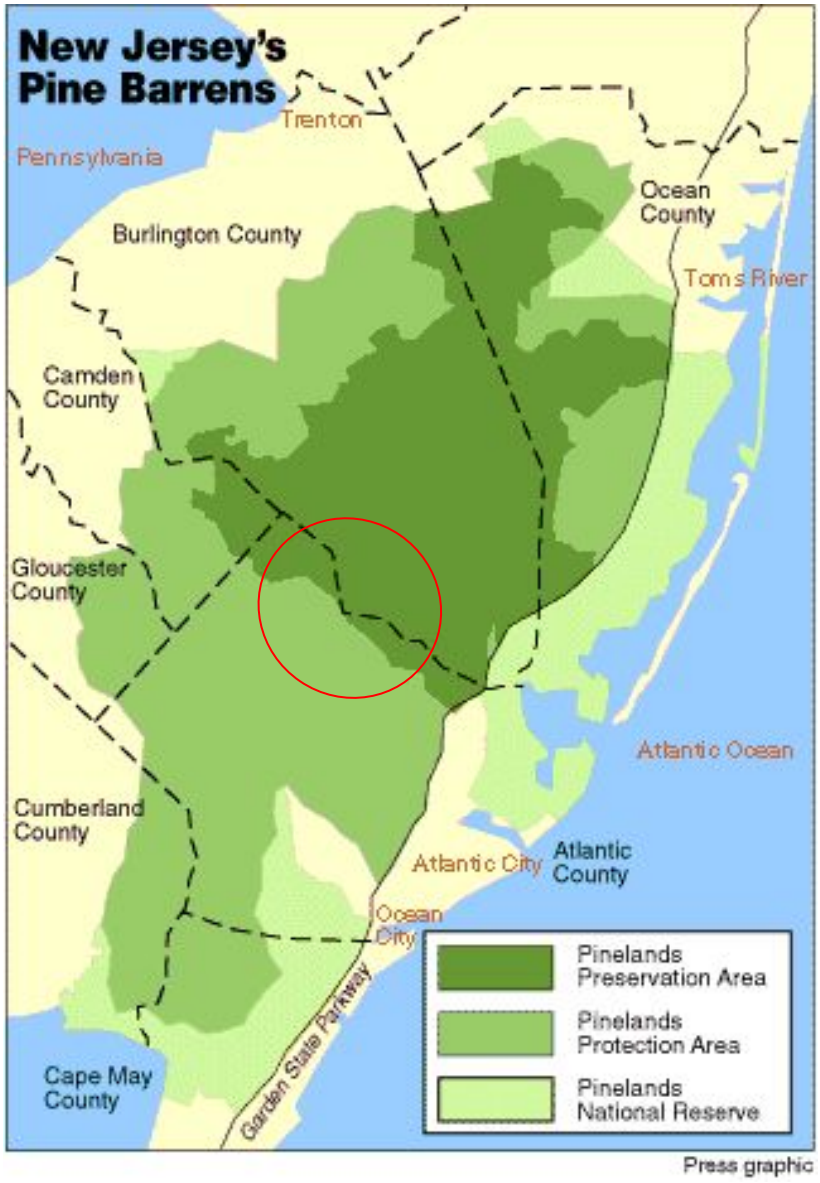
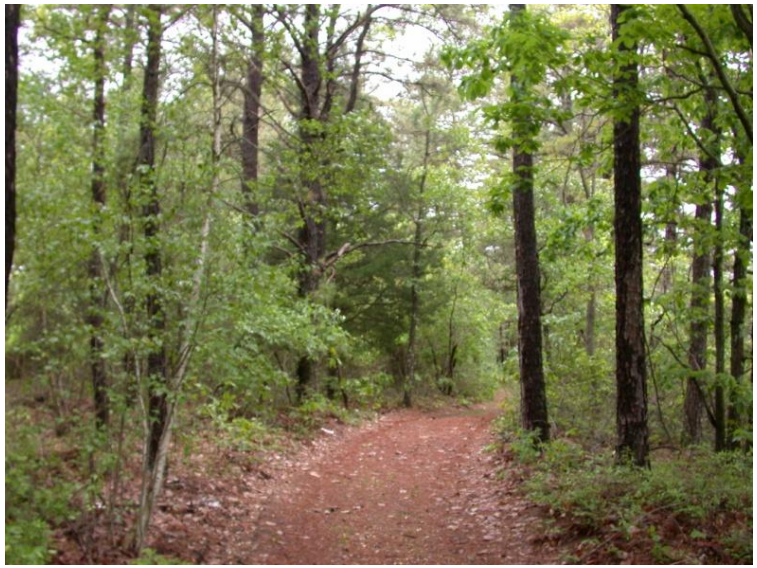
BLUEBERRY PRODUCTION IN NJ





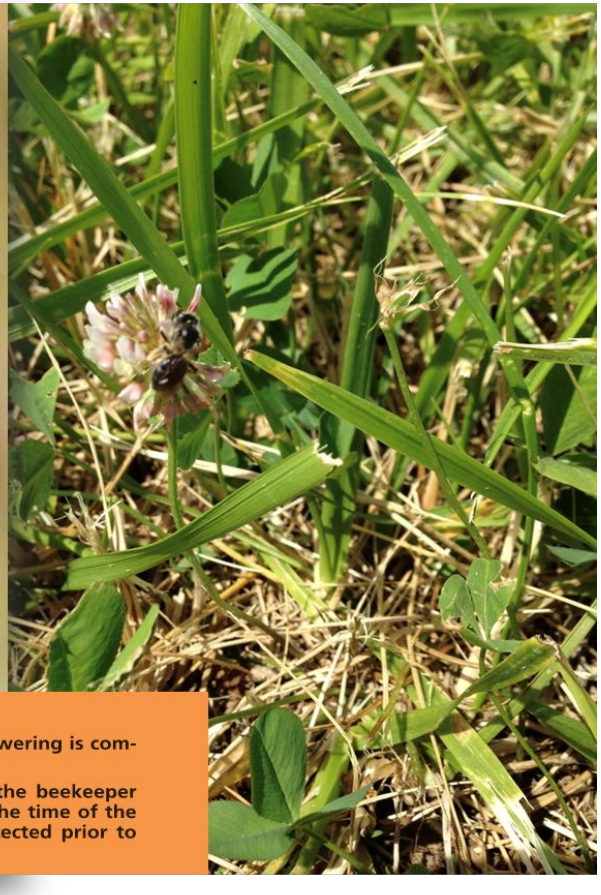
BLUEBERRY PRODUCTION IN NJ

- Only highbush blueberries are grown in NJ
- US$ 65 million industry in NJ, predominantly in Atlantic & Burlington Counties grown in 9,300 acres
- NJ is the sixth largest producer in US; WA, OR, MI, GA, and CA are the other major highbush blueberry producing states
- More than 75% of NJ production for fresh market

MAJOR PEST MANAGEMENT ISSUES

- Specialty crop.
- Food Quality Protection Act of 1996.
- Maximum Residue Limits (MRLs) for export.
- Invasive pests.

MAJOR PEST MANAGEMENT ISSUES



FOR CROPS UNDER CONTRACTED POLLINATION SERVICES

Do not apply this product while bees are foraging. Do not apply this product until flowering is complete and all petals have fallen unless the following condition has been met:

If an application must be made when managed bees are at the treatment site, the beekeeper providing the pollination services must be notified no less than 48-hours prior to the time of the planned application so that the bees can be removed, covered or otherwise protected prior to spraying.

ACTIVITY PERIODS OF ARTHROPOD PESTS

Insect Pest	dormant	budbreak-prebloom	bloom	1st post-pollination	fruit maturation	post-harvest
Scale	■					
Cranberry weevil		■				
Leafrollers			■		■	
Spanworms			■	■		
Spongy moth			■			
Cranberry Fruitworm				■		
Thrips			■			
Gall midge			■			
Leafminers					■	
Plum curculio						
Aphids				■		
Leafhoppers						■
Blueberry maggot					■	
Oriental beetle				■		
Spotted-wing drosophila				■		
Japanese beetle						
Bud mite						

PLUM CURCULIO

Conotrachelus nenuphar

- Snout weevil that overwinters as an adult in leaf litter.
- Single generation per year.
- Feeds on young fruit just after bloom, causing **feeding scar**.
- Lays eggs in fruit causing crescent-shaped **oviposition scar**.

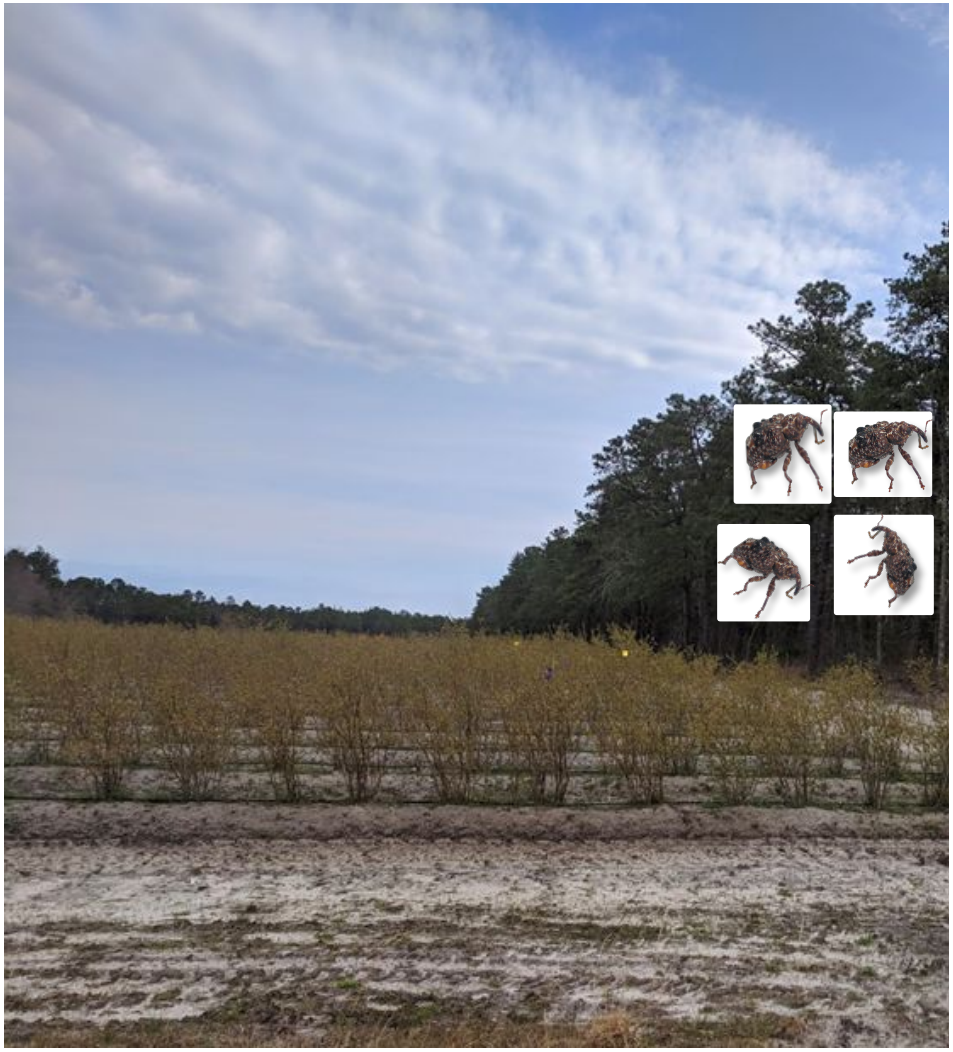
PLUM CURCULIO

- Fruit may color prematurely and fall off bush.
- White maggot-like larva develops inside fruit.
- Mature larva exits fruit to pupate in the ground and becomes adult in July and August.

<u>Chemical Control</u>

Avaunt eVo
Brigade
Danitol
Diazinon
Imidan

PLUM CURCULIO



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Adults continue to move from forest and into blueberry fields throughout April-May.

At fruit set, insecticides are applied to control the adults.

PLUM CURCULIO

Still, some adults could be able to lay eggs and infest fruit (early-season varieties).

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Insects will pupate in the soil by early-mid July.

In August, new adults emerge and move to the forest to overwinter.

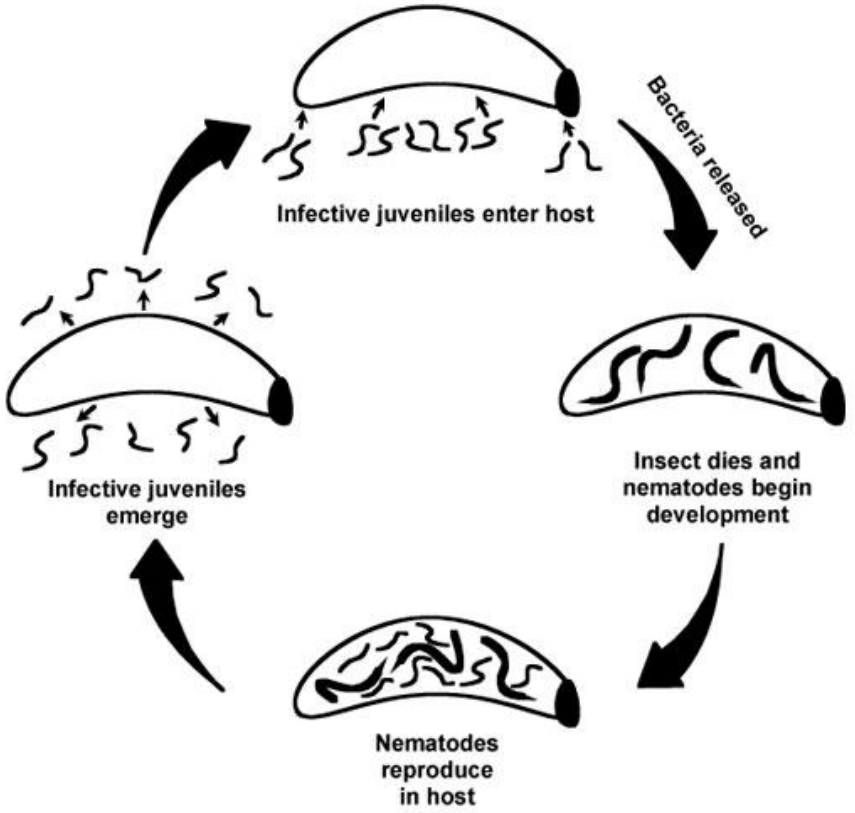
PLUM CURCULIO

Entomopathogenic Nematodes (EPNs)

- A group of nematodes (thread worms) that cause death to insects.
- EPNs infect many different types of insects living in the soil.
- EPNs found in all over the world and a range of ecologically diverse habitats.

PLUM CURCULIO

- Biological control organisms.
- Application is best at dusk or dawn.
- Application with weed boom.
- Applied at the timing for larval emergence into the soil (June).



PLUM CURCULIO

Four commercial EPNs:

Steinernema feltiae (Sf)

S. carpocapsae (Sc)

S. riobrave (Sr)

S. scarabaei (Ss)

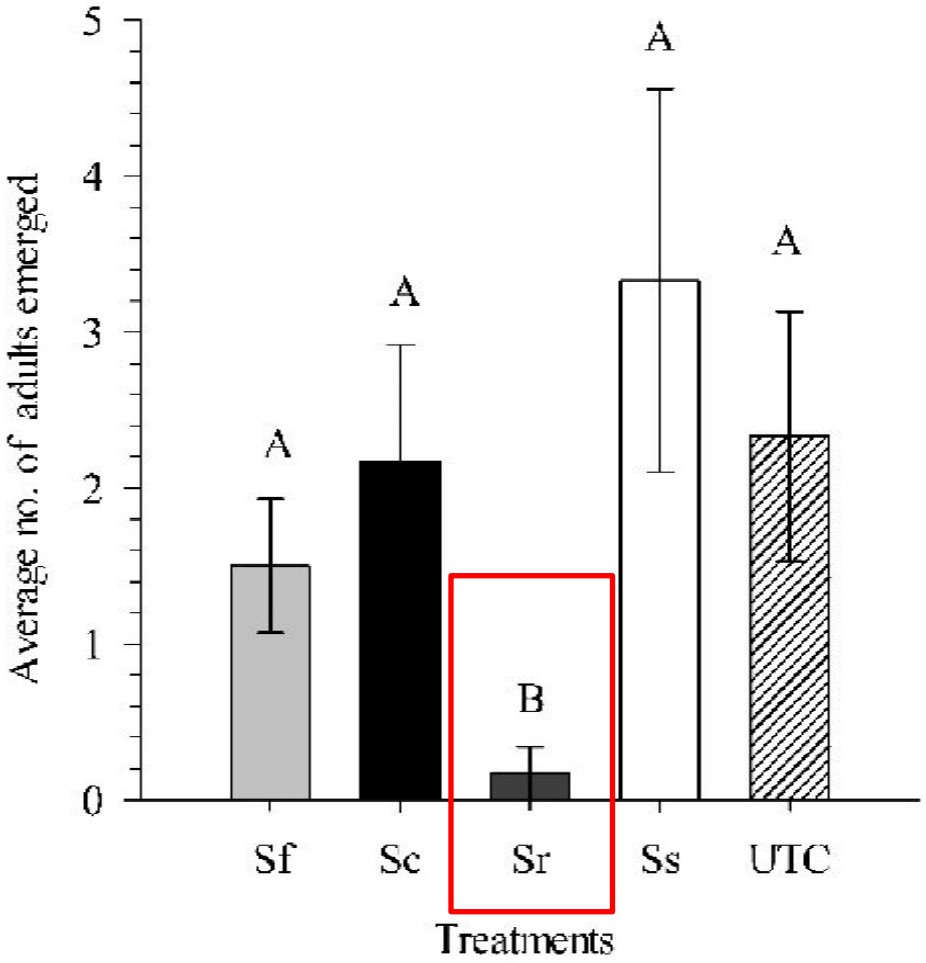
Field site at the Marucci Center

- Control had no EPNs.
- EPN rate = 50 IJs/cm^2
- PC-infested berries collected from commercial fields.
- Infested fruit placed under emergence traps (*N* = 6 per treatment).
- Number of adults emerged counted.
- Treated soil sampled for persistence assays.

Adult emergence trap

PLUM CURCULIO

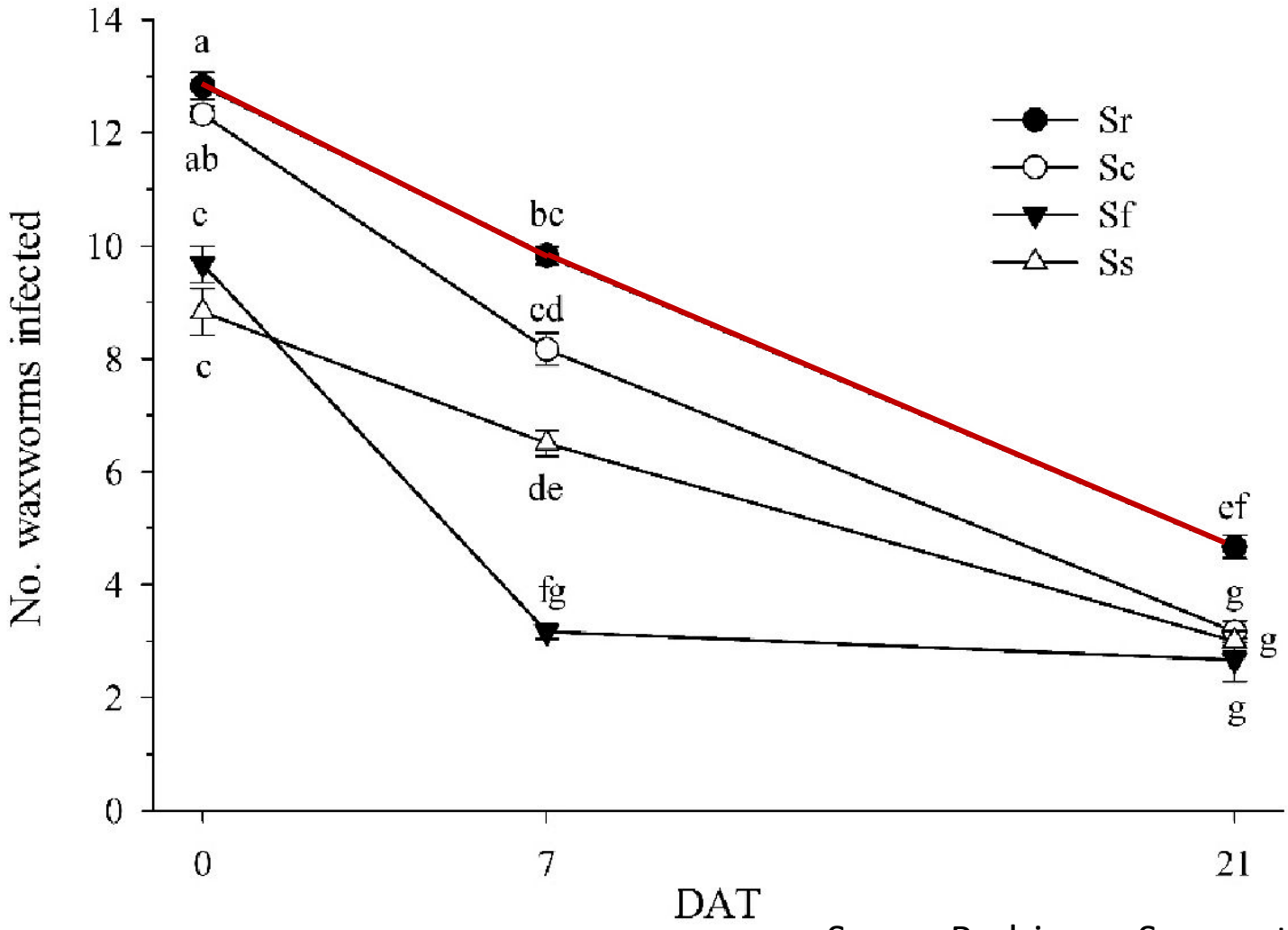
Steinernema riobrave was the best of all EPNs at reducing adult emergence



Sousa, Rodriguez-Saona et al. 2021

PLUM CURCULIO

Steinernema riobrave persisted in soil for ~21 days (3 weeks)



Sousa, Rodriguez-Saona et al. 2021

PLUM CURCULIO

Two *S. riobrave* rates:

25 IJs/cm^2

50 IJs/cm^2

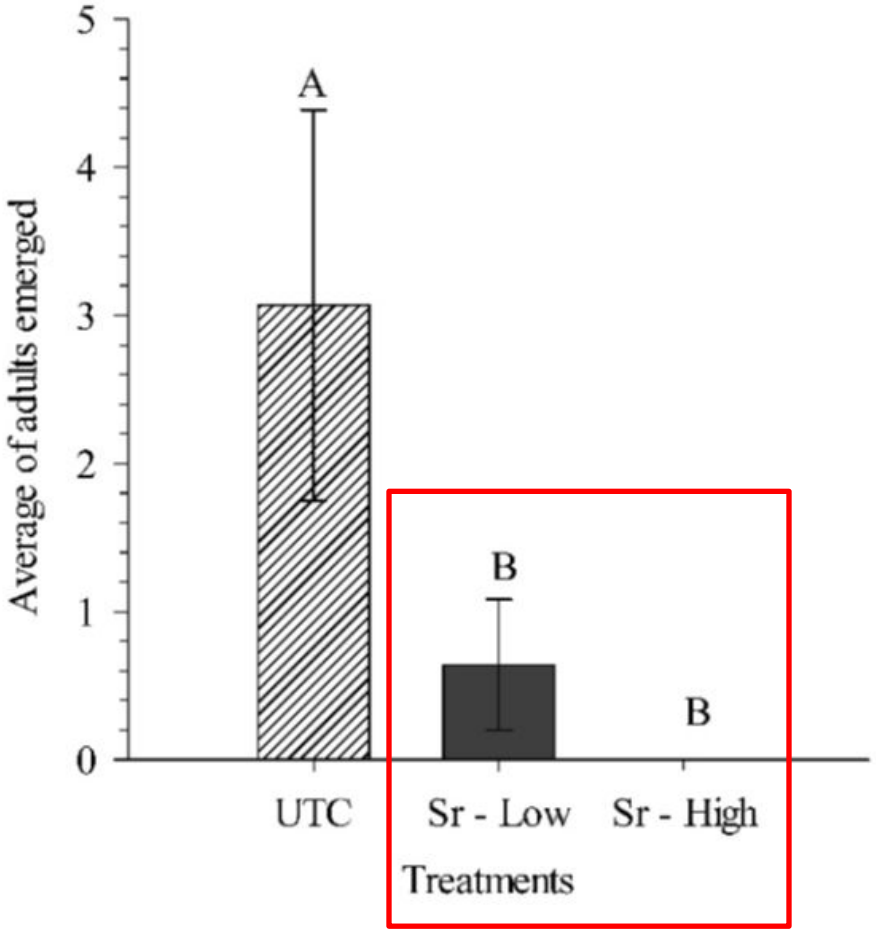
- Control had no EPNs.
- PC-infested berries collected from commercial fields.
- PC larvae placed under emergence traps (*N* = 14 per treatment).
- Number of adults emerged counted.
- Treated soil sampled for persistence assays.

Field site at the Marucci Center

Adult emergence trap

PLUM CURCULIO

Steinernema riobrave at both rates reduced adult emergence



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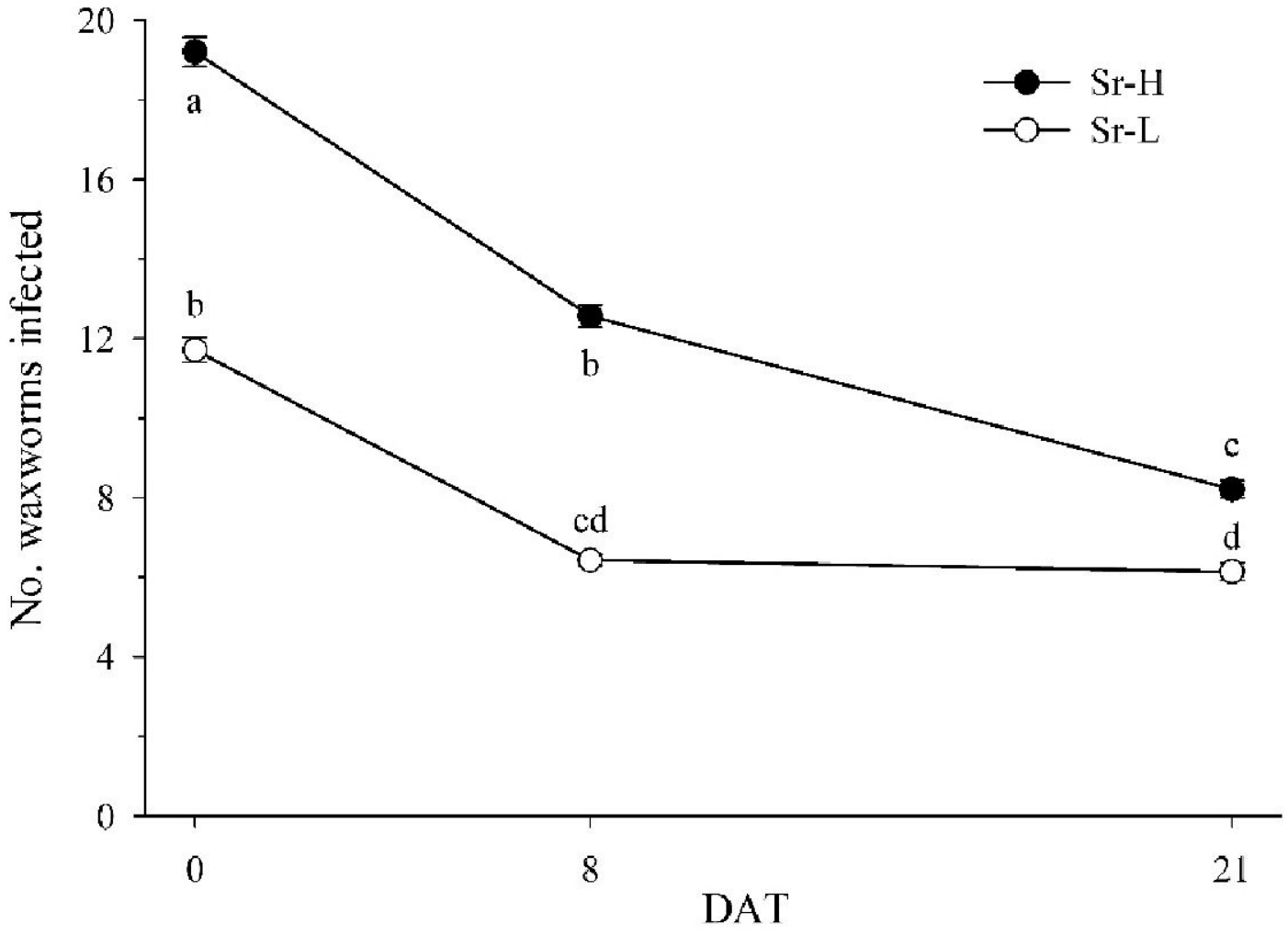
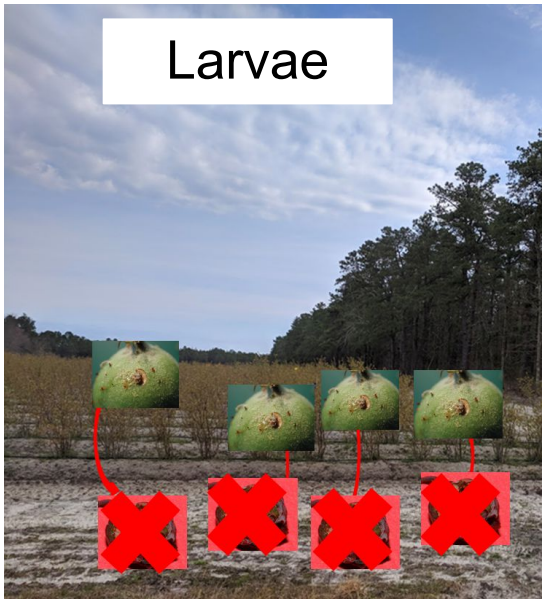


Sousa, Rodriguez-Saona et al. 2021

PLUM CURCULIO

CONCLUSIONS

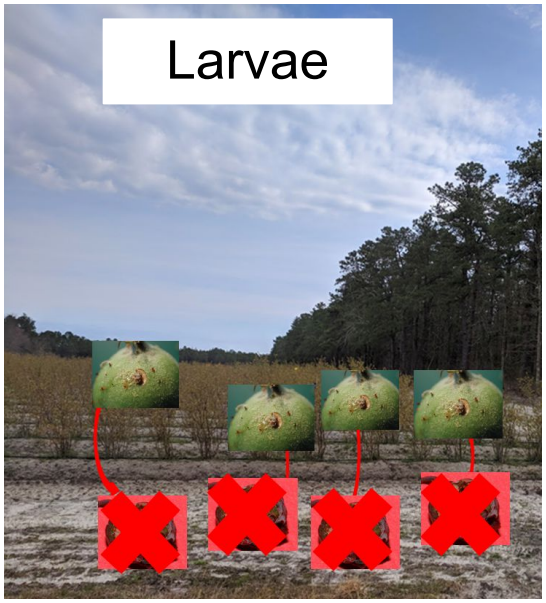
- A multi-stage approach to manage PC seems effective.
- Insecticides can be applied after bloom to target adults.
- EPN can be applied after bloom to target the larvae.
- EPNs commercially available.



PLUM CURCULIO

FUTURE DIRECTIONS

- Test EPNs in commercial farms: timing and rates.
- Combine with trap-bush approach to prevent PC movement.
- Border spays?



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Thrips						
Gall midge						
Leafminers						
Plum curculio						
Aphids						
Leafhoppers						
Blueberry maggot						
Oriental beetle						
Spotted-wing drosophila						
Japanese beetle						
Bud mite						

BLUEBERRY APHIDS

- Many species of aphid found in blueberry – state specific.
- Aphids transmit viruses – shoestring, scorch.
- Overwinter as eggs on bushes.
- In spring, eggs hatch before bloom and young aphids seek new foliage.

BLUEBERRY APHIDS

- Populations build during June and July, by parthenogenetic reproduction.
- Some winged forms may be produced once colonies are crowded and move within or between fields.
- Fall conditions stimulate true males and egg-laying females.

<u>Chemical Control</u>

Assail, Actara, (Imidacloprid).

BLUEBERRY APHIDS

- Low tolerance because of vector status.
- Use of broad-spectrum (pyrethroid) insecticides leading to natural enemy destruction.
- Poor coverage.

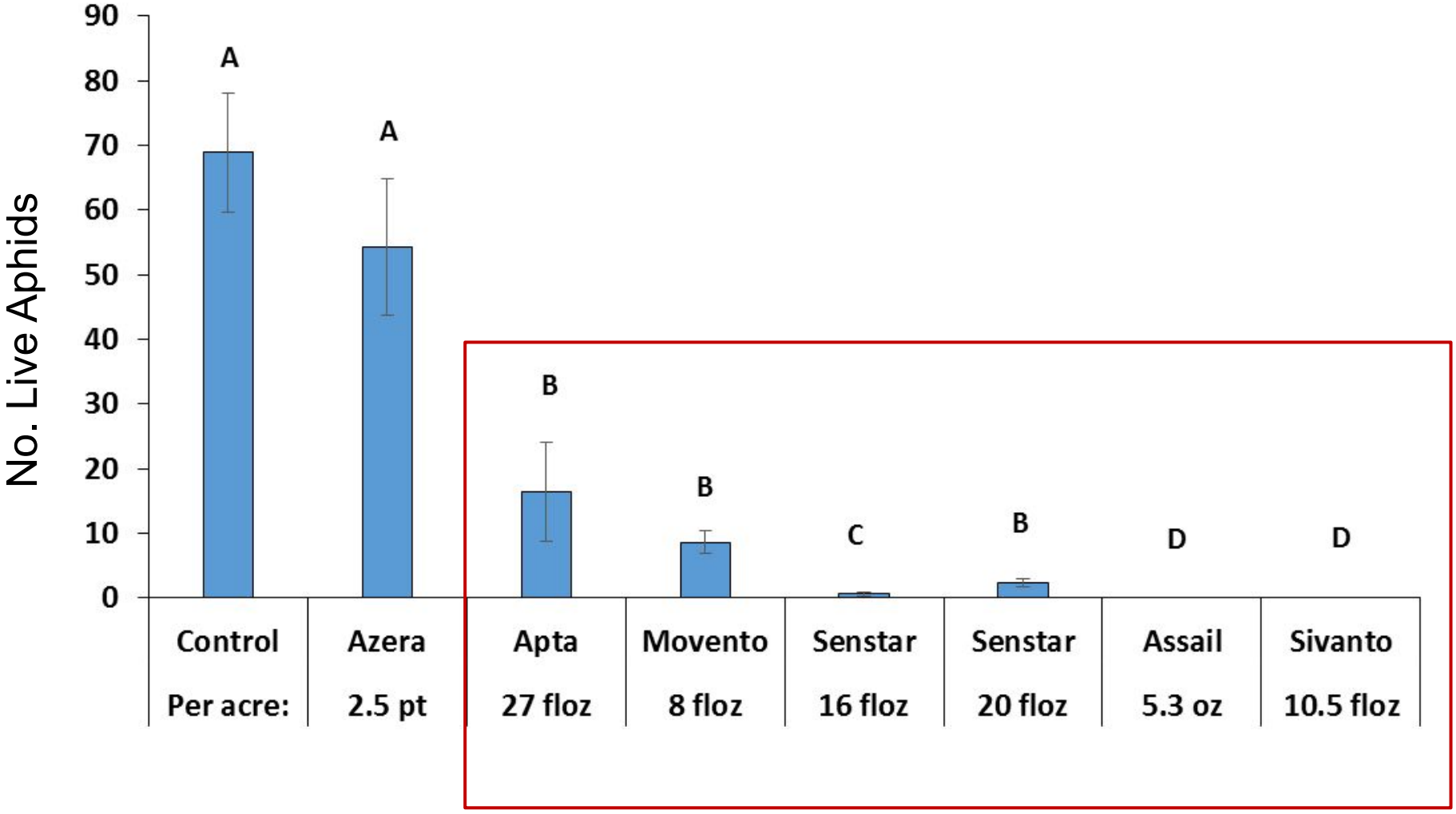
BLUEBERRY APHIDS

Treatments:

1. Azera (azadirachtin + pyrethrins)
2. Apta (tolfenpyrad)
3. Senstar (spirotetramat + pyriproxyfen)
4. Movento 240SC (spirotetramat)
5. Assail 30SG (acetamiprid)
6. Sivanto 200SL (flupyradifurone)
7. Untreated control.

- Blueberry field at P.E. Marucci Center.
- 8-12 bushes per treatment.
- Cage - 1 terminal/bush enclosed with mesh.
- 5 aphid adults + 12 nymphs per cage
- Mortality recorded after 5 days.

BLUEBERRY APHIDS



Rodriguez-Saona and Holdcraft 2022

CONCLUSIONS

- New insecticides registered against blueberry aphids.
- Apta, Senstar, **Movento**, and **Sivanto** reduced aphid numbers compared to control.
- Rotate insecticides with different modes of action.

FUTURE DIRECTIONS

- New insecticide under IR-4.

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SPOTTED-WING DROSOPHILA

Drosophila suzukii

- Invasive pest from Asia.
- First detected in 2008 in California and in 2011 in the Northeast.
- Many hosts: strawberries, raspberries, cherries, blueberries.
- Females with prominent serrated ovipositor.

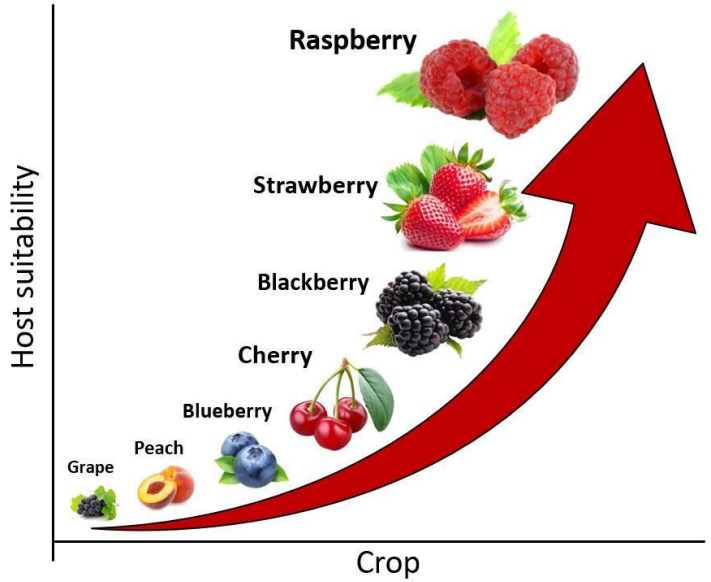
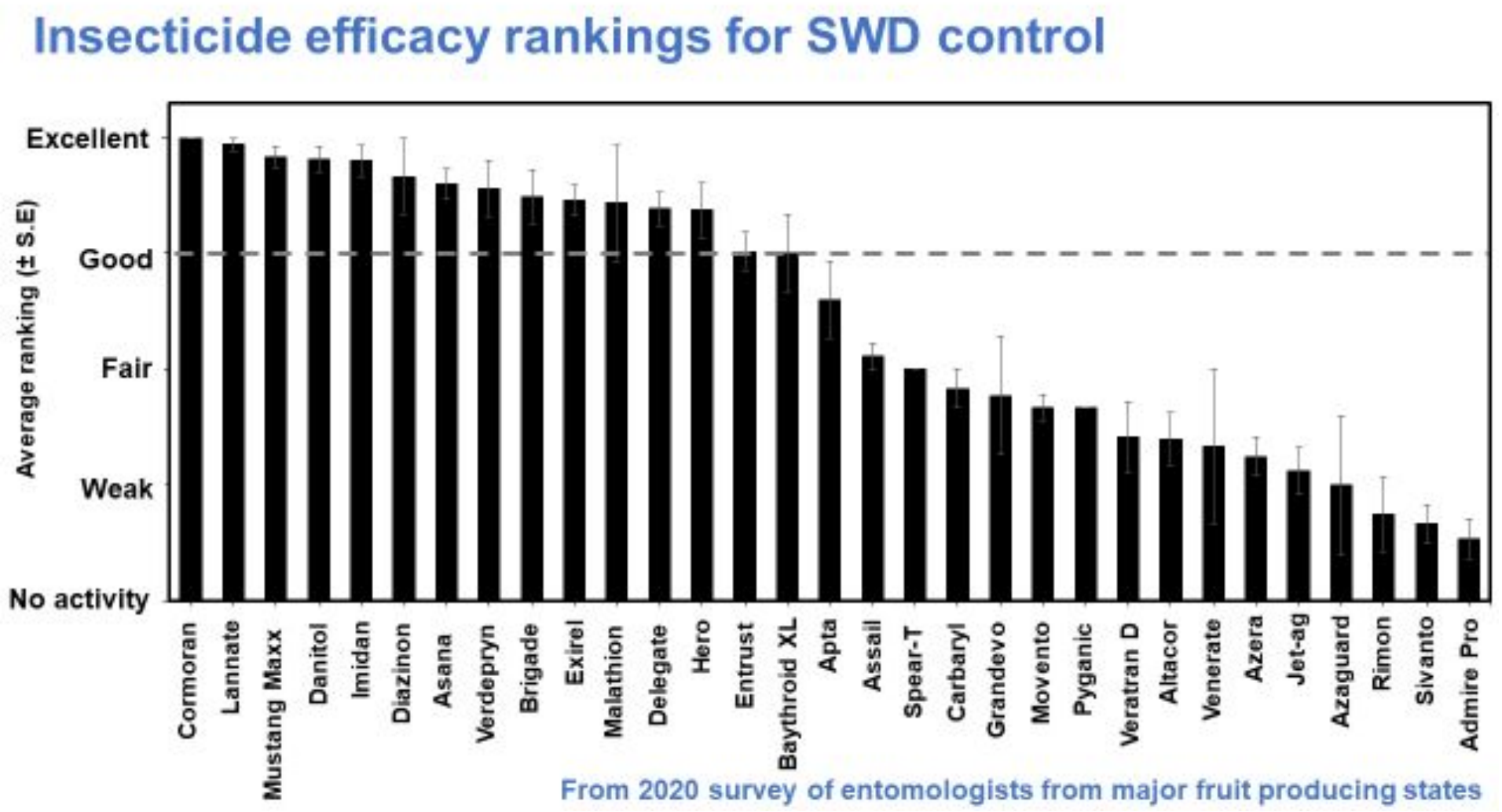


Illustration: Marco Rossi-Stacconi, © Oregon State University

SPOTTED-WING DROSOPHILA



2020 summary rankings of insecticide efficacy against SWD.

10 states: CA, OR, WA, MI, ME, NY, NJ, NC, GA, FL

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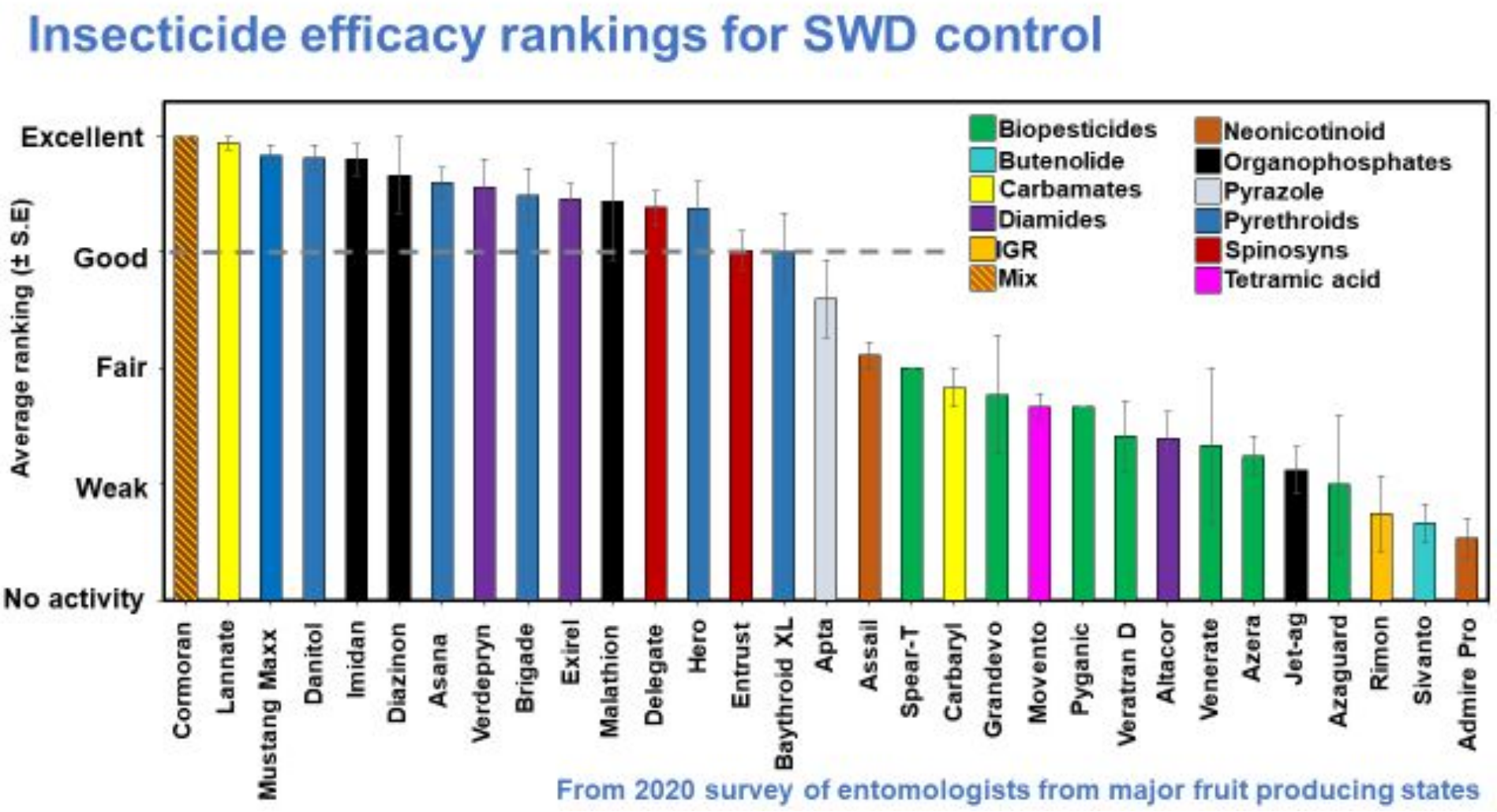

2020 summary rankings of insecticide efficacy against SWD.

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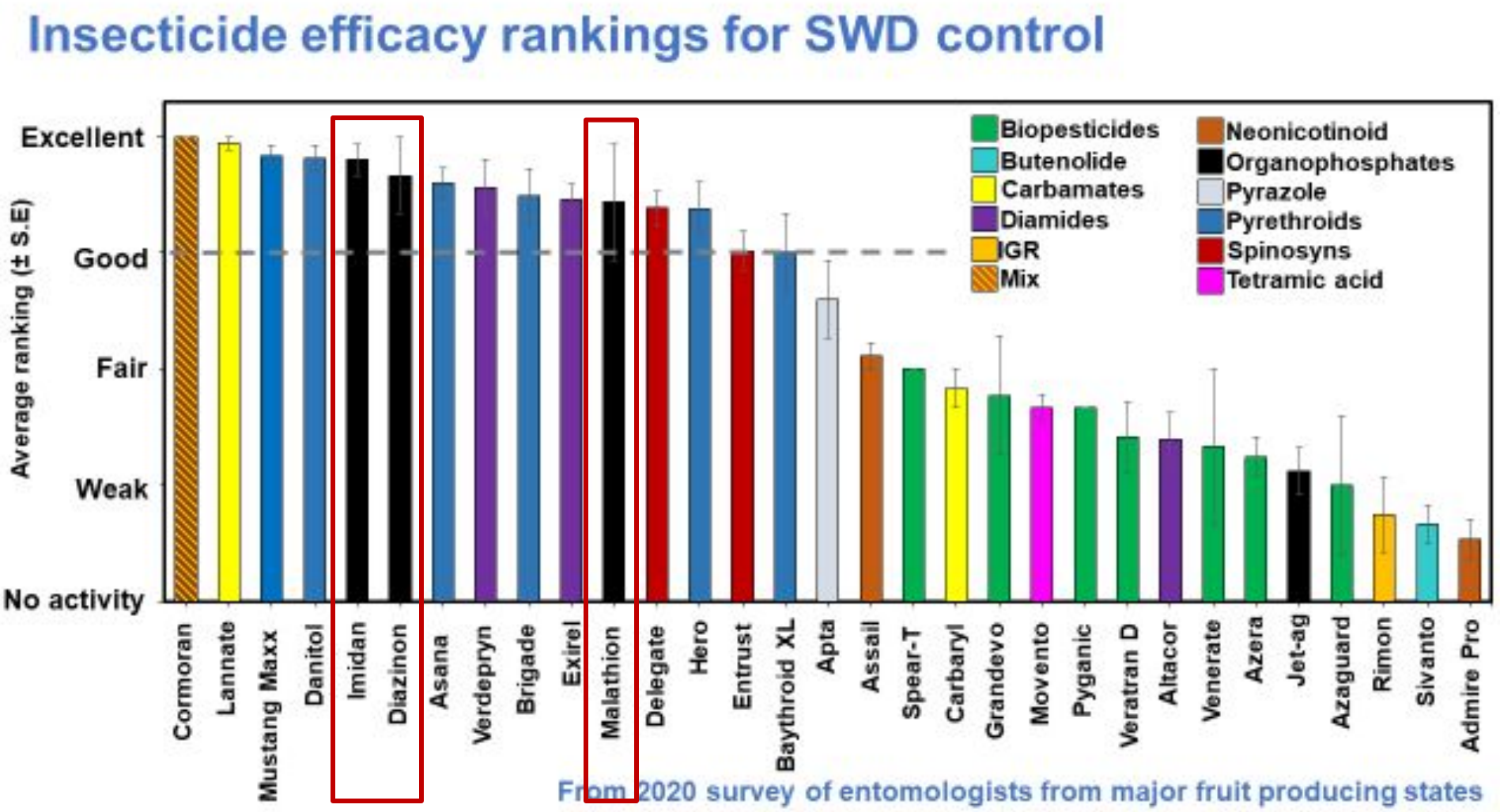

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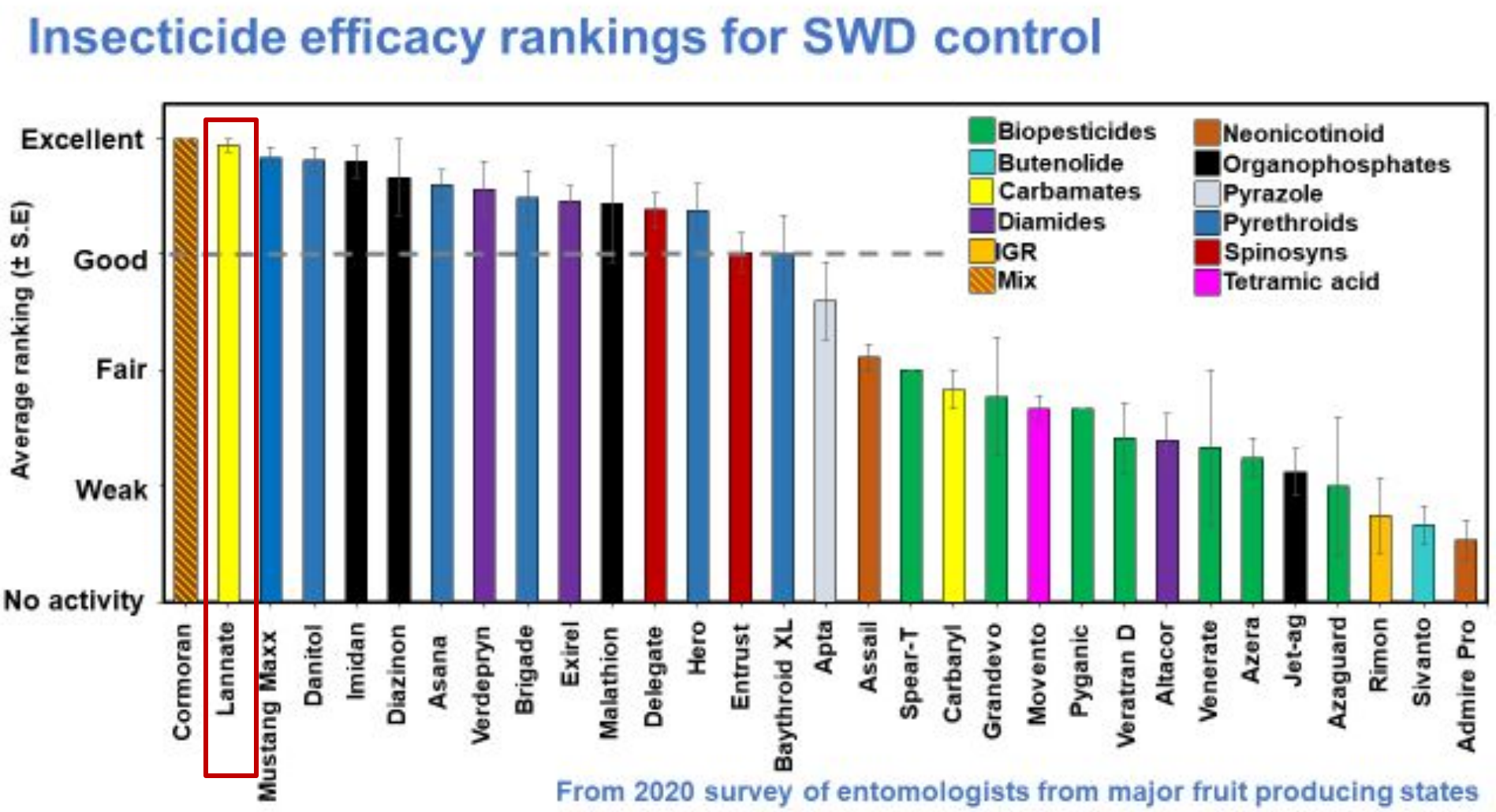

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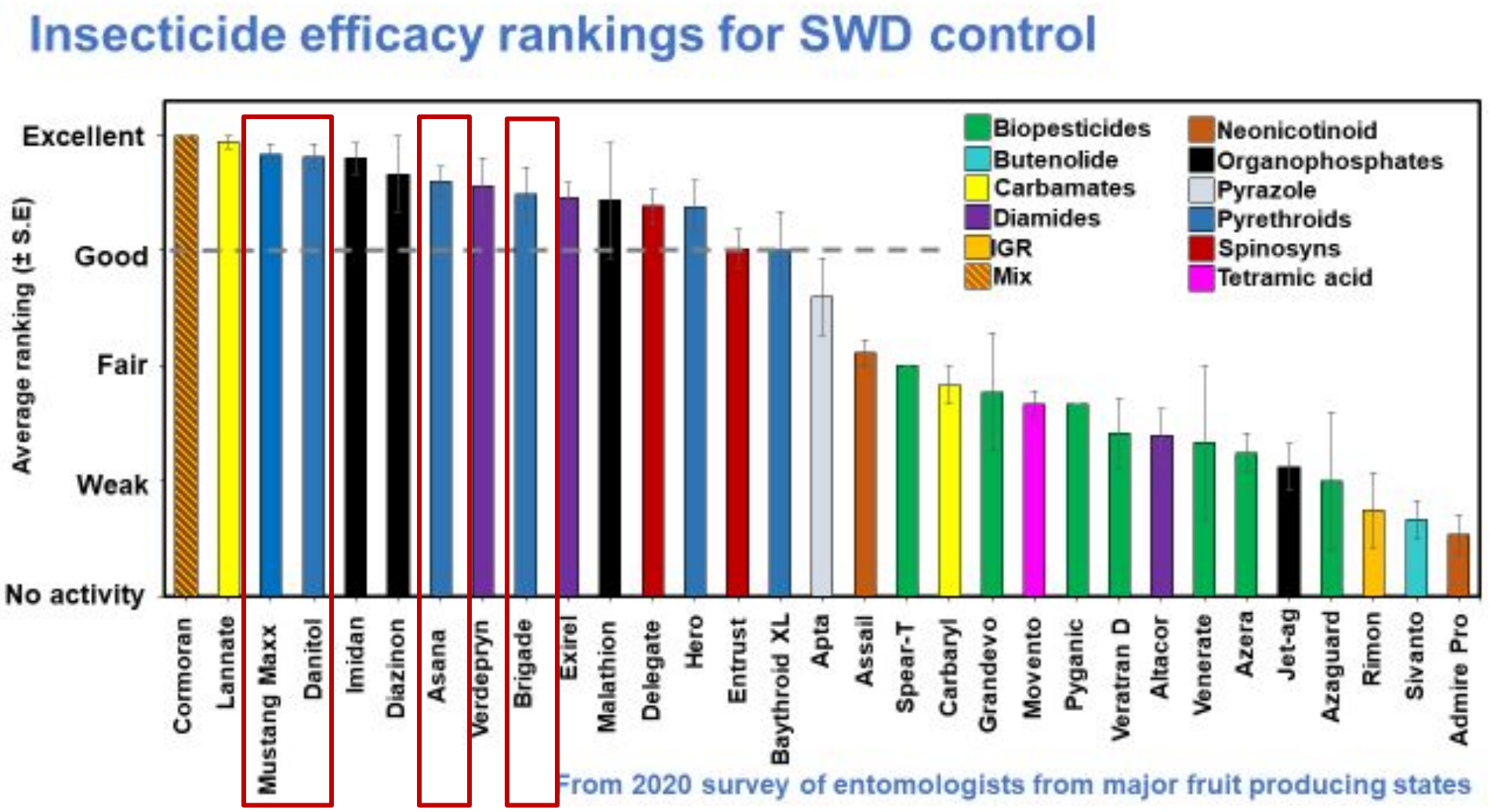

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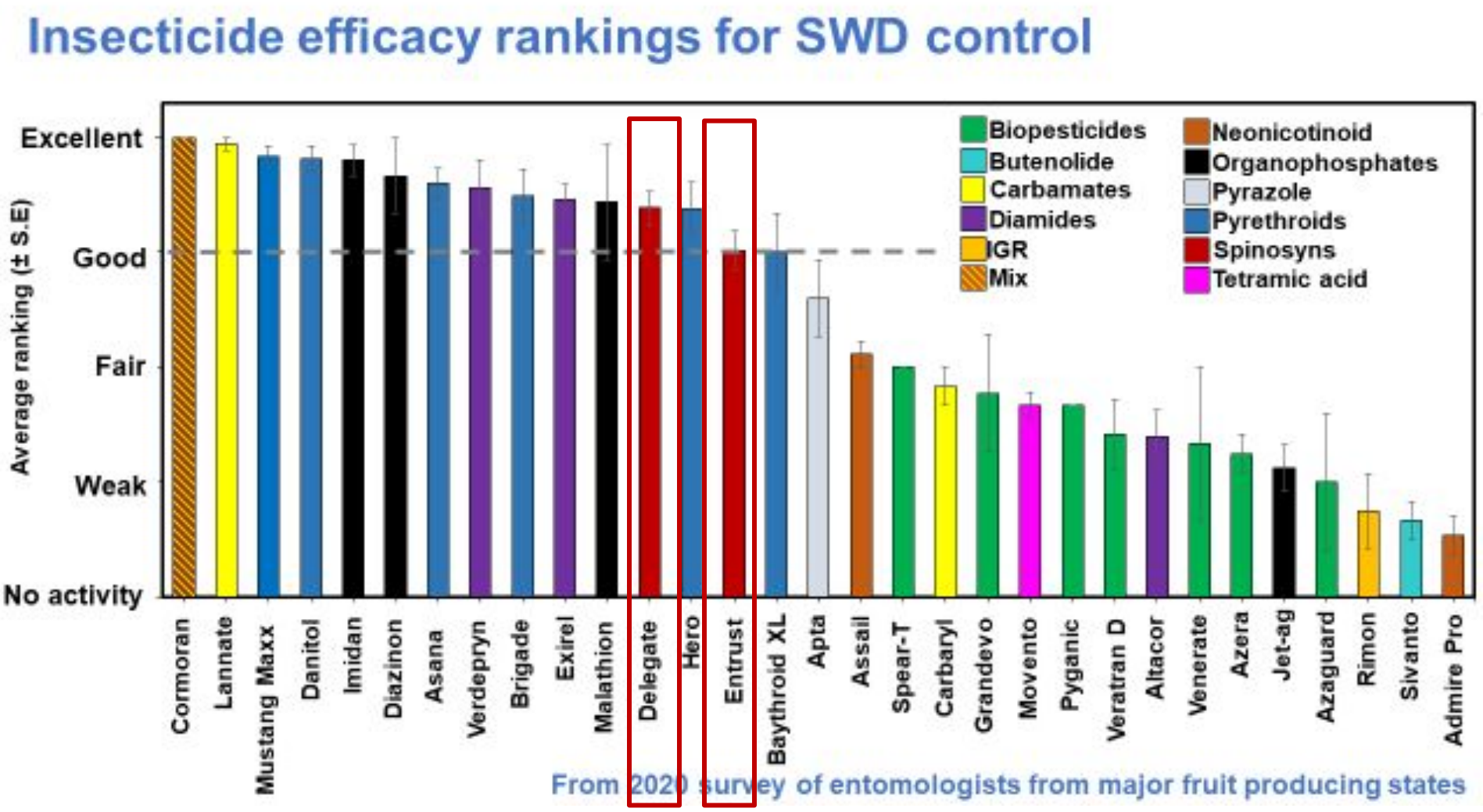

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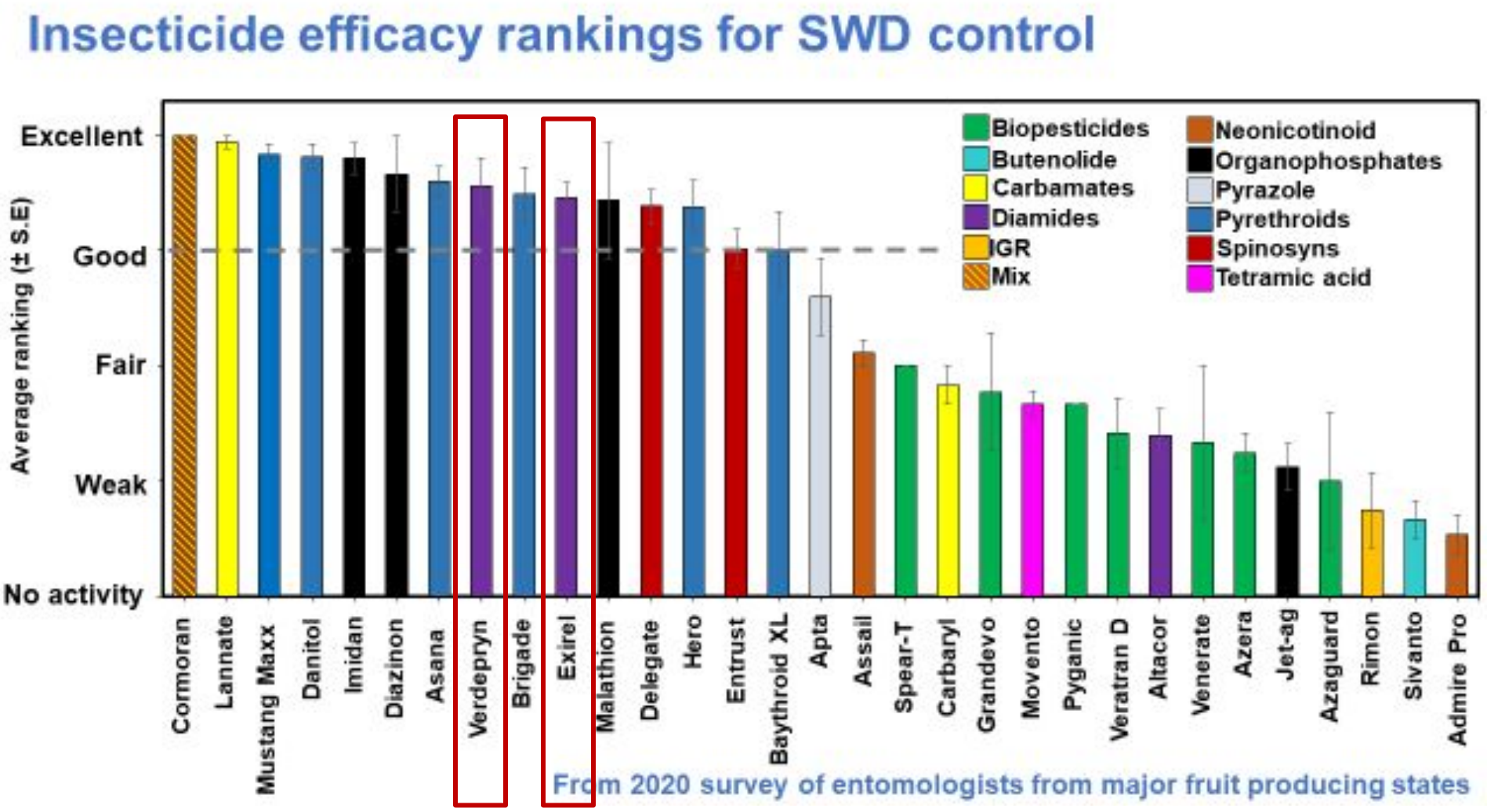

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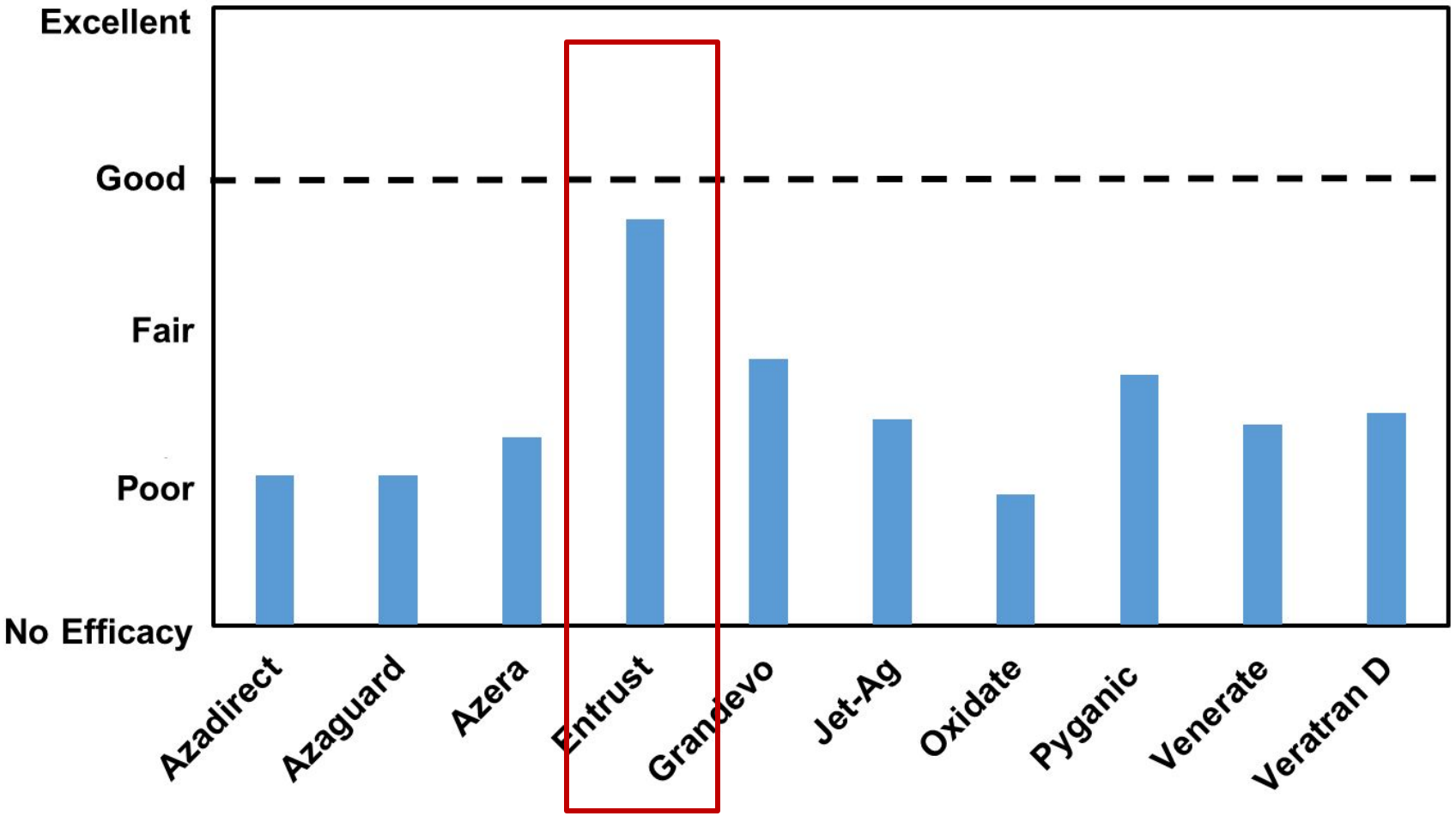
OMRI Listed Materials



Research Article

SCI

Received: 16 July 2018 Revised: 9 October 2018 Accepted article published: 16 October 2018 Published online in Wiley Online Library: 4 December 2018

(wileyonlinelibrary.com) DOI 10.1002/ps.5240

Identification and risk assessment of spinosad resistance in a California population of *Drosophila suzukii*

Brian E Gress* and **Frank G Zalom**

Journal of Economic Entomology, 115(4), 2022, 972–980
https://doi.org/10.1093/jee/toac011
Special Collection: Research Advances in Spotted-Wing Drosophila suzukii Management

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Special Collection: Research Advances in Spotted-Wing Drosophila suzukii Management

Spatio-temporal Variation of Spinosad Susceptibility in *Drosophila suzukii* (Diptera: Drosophilidae), a Three-year Study in California's Monterey Bay Region

Fatemeh Ganjisaffar,[1] Brian E. Gress, Mark R. Demkovich, Nicole L. Nicola, Joanna C. Chiu, and Frank G. Zalom

SPOTTED-WING DROSOPHILA

Pachycrepoideus vindemiae

- Widespread geographic range
- Large host range
- Can be mass-reared
- 'Augmentation' trials
- Results poor
- 0-10% parasitism

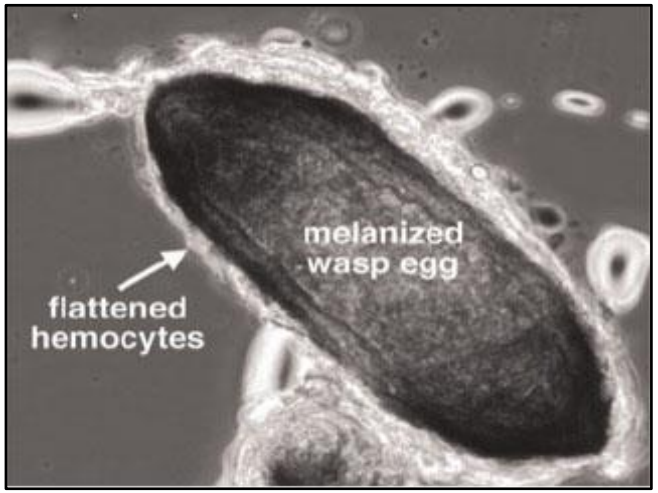
Trichopria drosophilae

- Not recovered everywhere in North America
- Narrower T° tolerance than *Pachycrepoideus*
- Large host range
- Can be massed-reared
- 0-10% parasitism
- Insectary in Europe & Mexico releasing, not available in the USA

No or rare larval parasitoids on SWD:

- *Leptopilina* (Figitidae)
- *Asobara* (Braconidae)
- All attacking other drosophilids

SPOTTED-WING DROSOPHILA

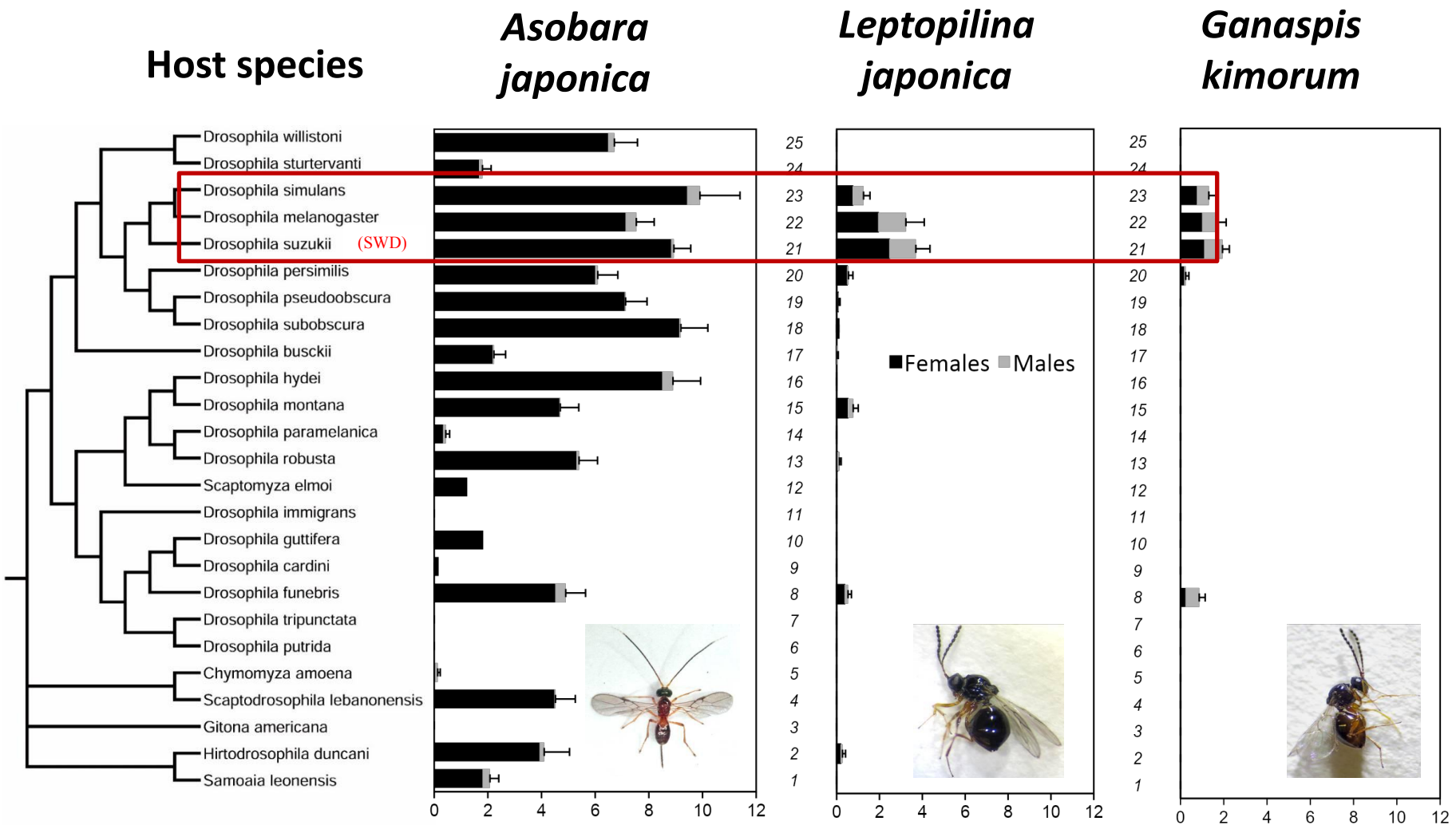


Larval parasitoids already in the US can attack SWD – but rarely do their offspring survive

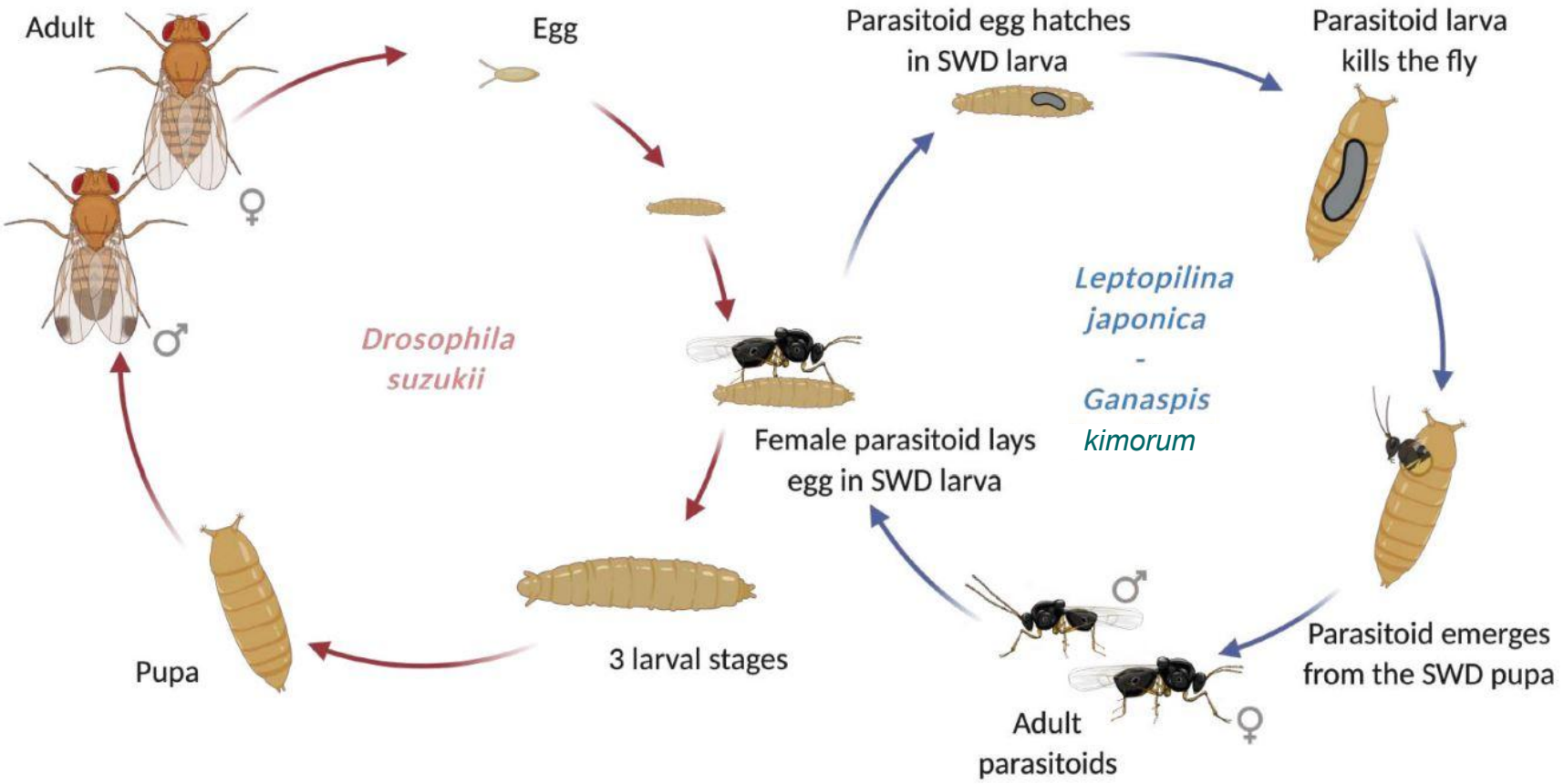
SPOTTED-WING DROSOPHILA

- Three parasitoids selected as candidates for classic bio-control.
- From China and South Korea.
- The figitids were more common in early fruit.
- The braconid was more common later in the season in rotted fruit.

SPOTTED-WING DROSOPHILA

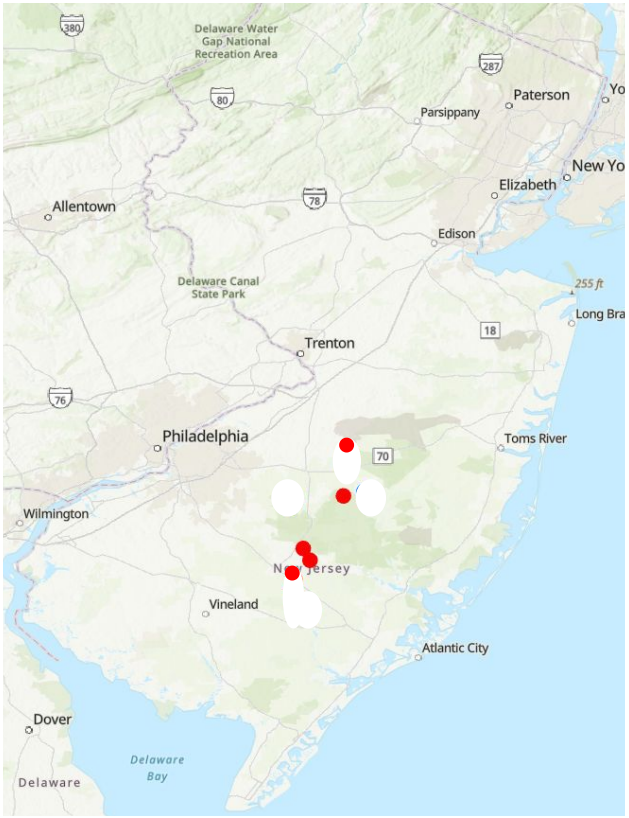


SPOTTED-WING DROSOPHILA



Ganaspis kimorum releases in New Jersey

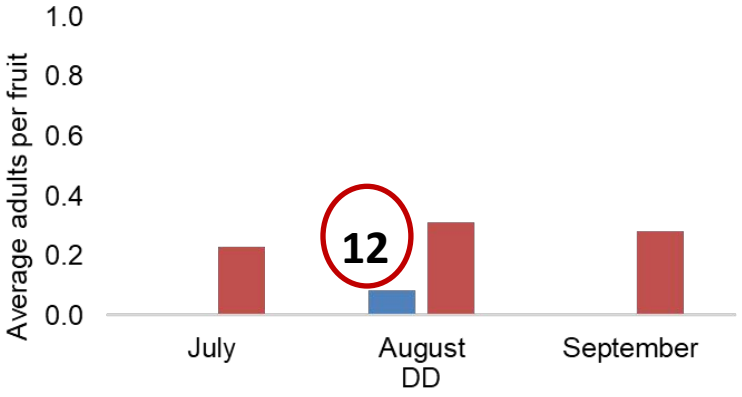
- **2022:** 5,000 adults released in 5 different sites; each site received two releases of a total of 1,000 wasps (1:1 sex ratio)



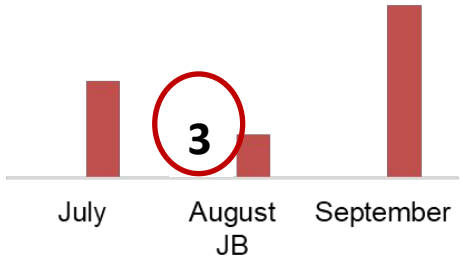
PHILLIP ALAMPI
BENEFICIAL INSECT
REARING LABORATORY

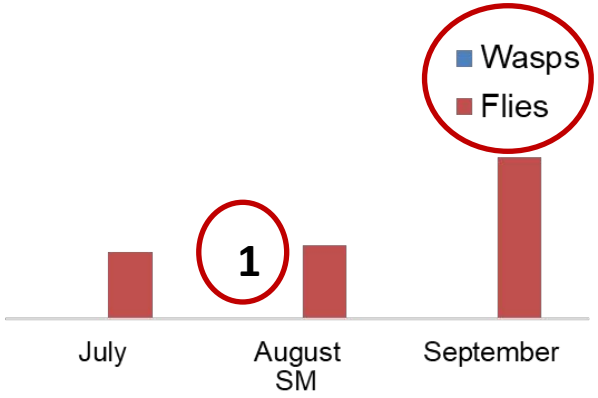
SPOTTED-WING DROSOPHILA

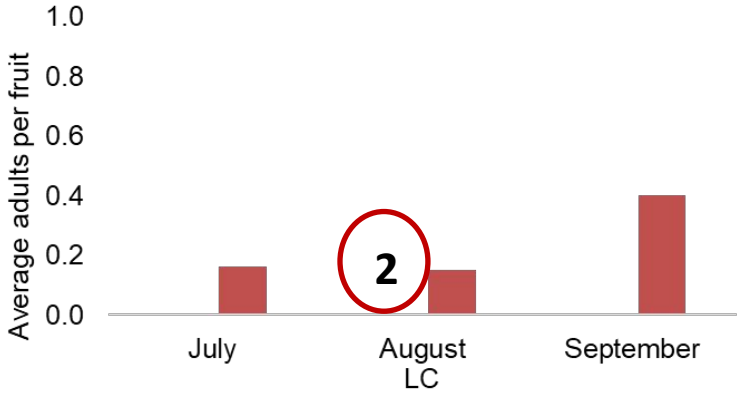
Post Release Sampling

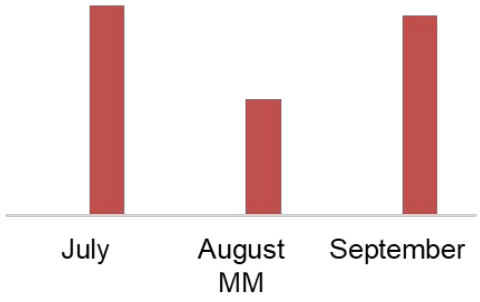


2022







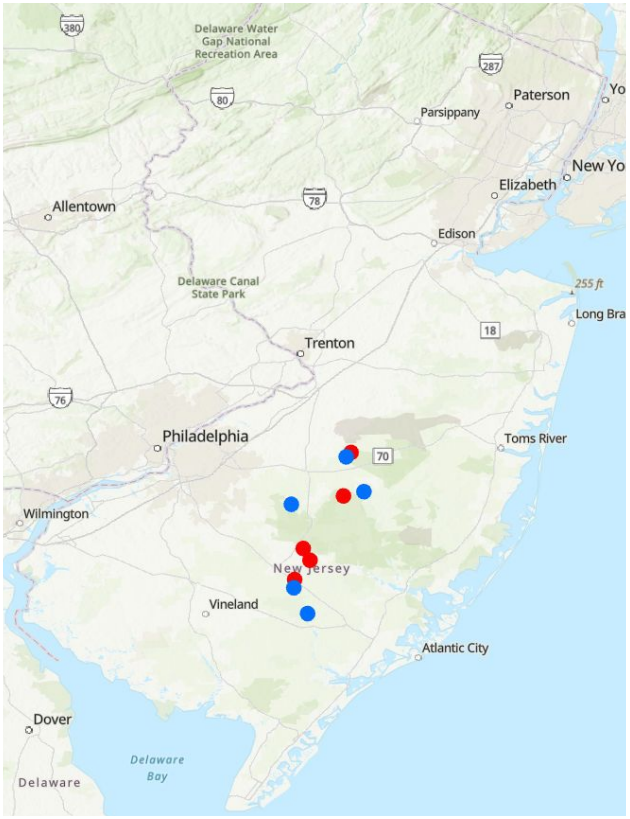


Leptopilina japonica **>**  ***Ganaspis brasiliensis***

Ganaspis kimorum releases in New Jersey

- **2022:** 5,000 adults released in 5 different sites; each site received two releases of a total of 1,000 wasps (1:1 sex ratio)

- **2023:** 10,000 adults released in 10 different sites (5 new and 5 from 2022); each site received two releases of a total of 1,000 wasps (1:1 sex ratio)

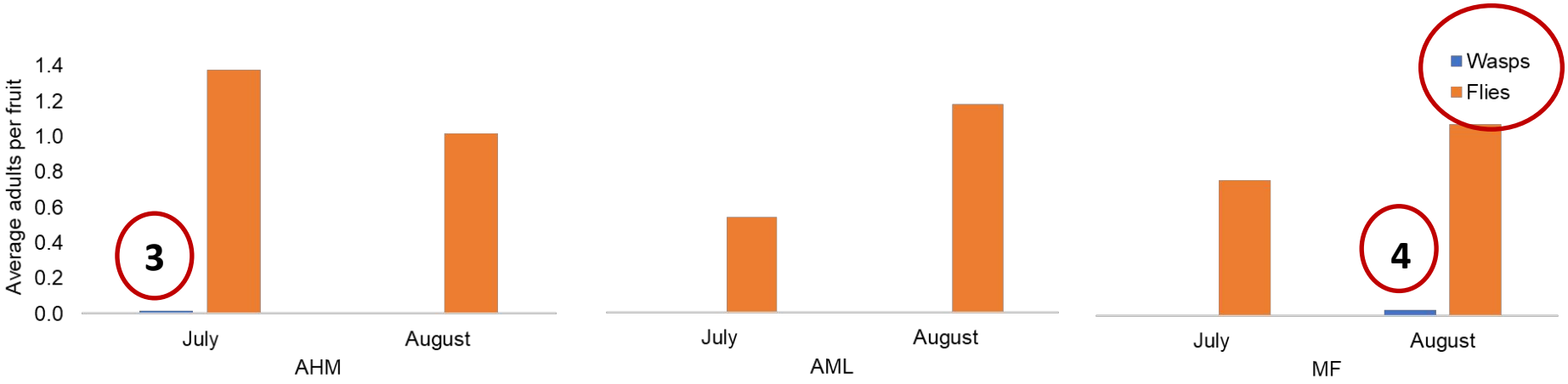


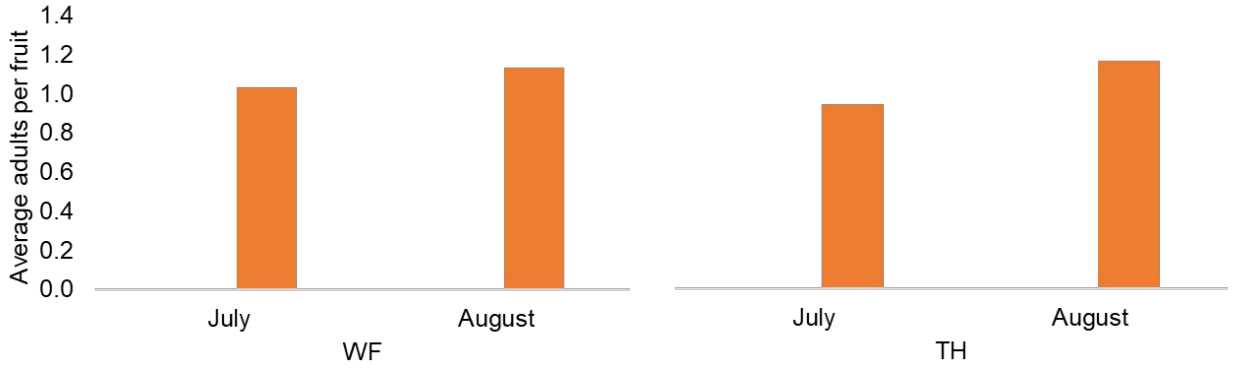
PHILLIP ALAMPI
BENEFICIAL INSECT
REARING LABORATORY

SPOTTED-WING DROSOPHILA

2023

Post Release Sampling





Leptopilina japonica

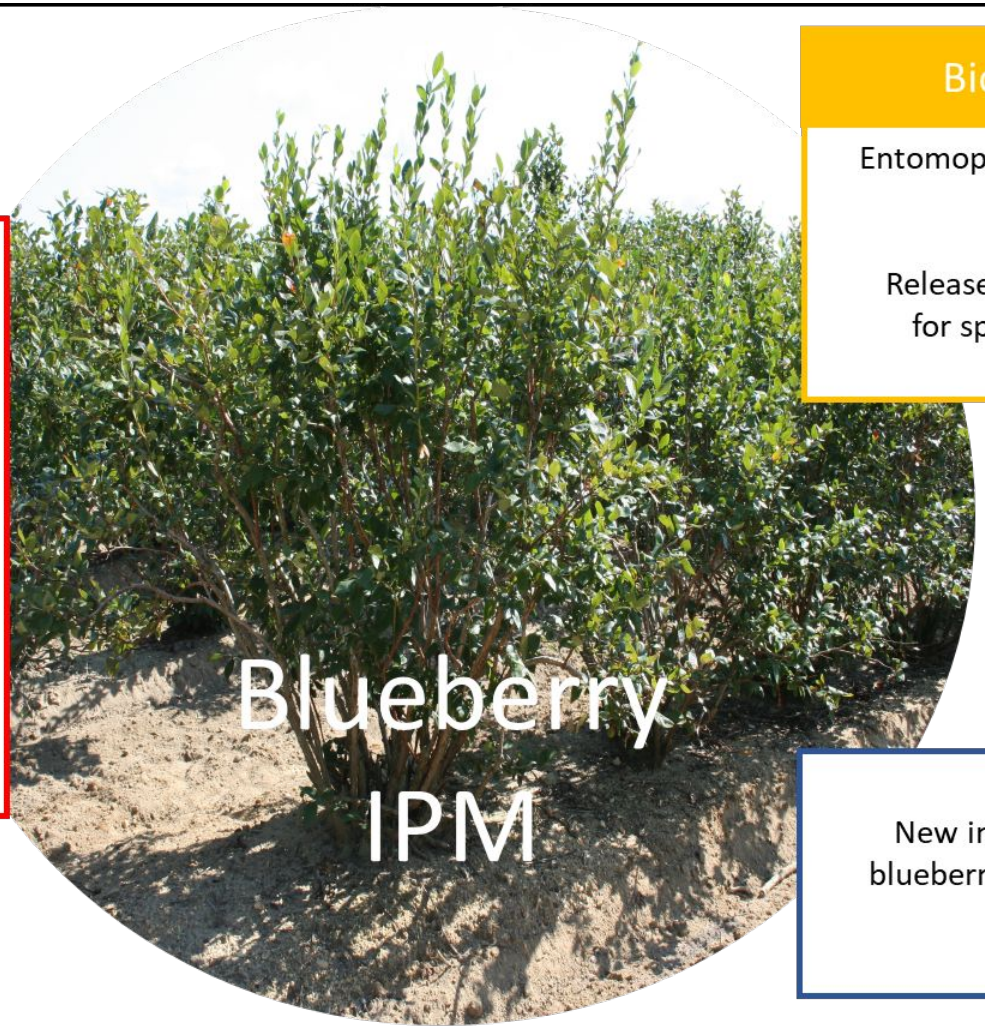
CONCLUSIONS

- Low establishment of *G. kimorum* thus far.
- During our surveys, we discovered the presence of *L. japonica*, which has been detected consistently across all years of sampling.
- These results suggest that adventive populations of *L. japonica* are already widely established in New Jersey.

FUTURE DIRECTIONS

- Continue releasing *G. kimorum* and monitoring its establishment in New Jersey.
- Refine release strategies and optimize conditions for parasitoid establishment.
- Expand monitoring efforts to include more farms and habitats to better assess *G. kimorum*'s impact on SWD populations and its interaction with adventive parasitoids like *L. japonica*.

TAKE-HOME MESSAGES



Behavioral Control

Use of the "trap bush" approach for plum curculio

Use of attract-and-kill for spotted-wing drosophila

Biological Control

Entomopathogenic nematodes for plum curculio

Releases of *Ganaspis kimorum* for spotted-wing dosophila

Chemical Control

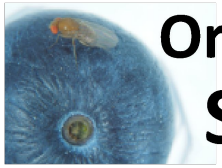
New insecticides for blueberry aphid control

Thank you

NEW JERSEY BLUEBERRY CRANBERRY RESEARCH COUNCIL

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture



Organic SWD Management

Sustainable SWD Management
Project # 2020-51181-32140