# Testing for Potential Resistance of Spotted Wing Drosophila (SWD) to Commonly Used Insecticides in Cherry Orchards

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# Research Statement

SWD management practice has heavily relied on insecticides – spinosyn, pyrethroids, malathion

Structured pesticide applications using limited active ingredients, partly due to the MRL issue for the export market

Risk for pesticide-induced resistance – a heritable modification in a pest population's sensitivity to pesticides

Insect species with high reproductive potential and short generation length are at higher risk due to the greater opportunity for mutations. e.g., *Drosophila* spp.

# SWD populations with reduced susceptibility

In Georgia, a significant decline in the susceptibility of *D. suzukii* adults to spinosad and malathion (Desi and Sial 2021)

In Michigan, reduction in SWD's susceptibility to malathion and spinetoram (Van Timmeren et al. 2019)

# In California, Pesticide Resistant SWD in the Central Coast - Spinosad

## Resistance to Spinosad in Caneberries

- **2017: Spinosad:** Wild SWD from treated fields exhibited spinosad $LC_{50}$ values **4.3–7.7** times higher than those from the untreated location (Gress and Zalom 2018)

- 2017-19: Spinosad: Extensive field studies showed widespread resistance with Resistance Ratio (RR) based on the LC50 values were as high as 10-, 13-, and 17 -folds in 2018, 2019, and 2020, respectively (Ganjisaffar et al. 2022b)

RR (Resistance Ratio) = LC50 of resistant/ LC50 of susceptible

# In California, Pesticide Resistant SWD in the Central Coast - Pyrethroids

Pyrethroid (bifenthrin, Type I; zeta-cypermethrin, Type II)

In 2019, SWD collected from caneberry fields in Monterey County, the RR50s ranged from **7.5- to 8.7 folds** for both pyrethroids (Ganjisaffar et al. 2022a)

In 2020, The RR50 values were from **19.0- to 36.1 folds** for zeta-cypermethrin (Mustang Max) and from -**15.9- to 47.7** folds for bifenthrin (Brigade)

These studies are the first reports of field-derived pyrethroid resistance in SWD from two major California berry production areas (Central Coast, San Luis Obispo areas)

RR (Resistance Ratio) = LC50 of resistant/ LC50 of susceptible

# Research Objective

To assess the insecticide resistance status of field-collected SWD populations to commonly used insecticides — spinosad, lambda-cyhalothrin, in cherries

# 2022 Preliminary Study

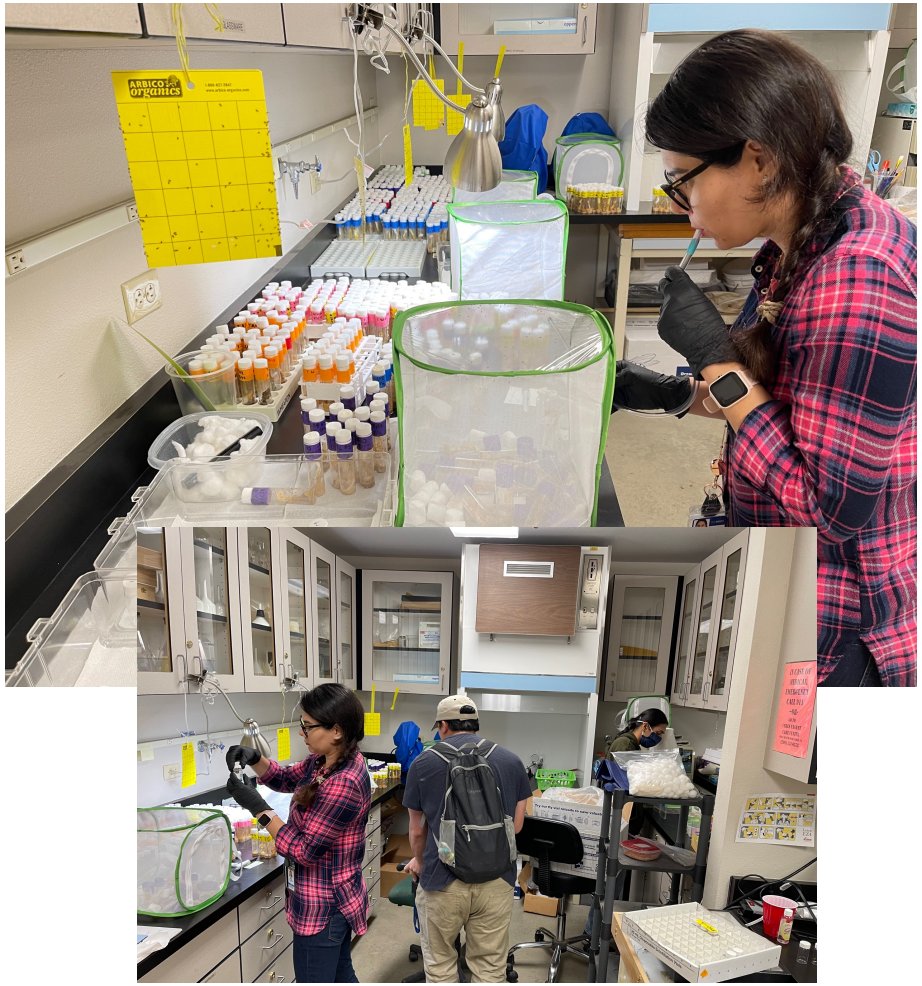
**Wild SWD flies collection**

**SWD rearing in the lab, UCCE Stanislaus**

# 2023 Study-SWD Collection and Rearing

## Wild SWD flies collection

## SWD rearing in the lab, UCCE Stanislaus

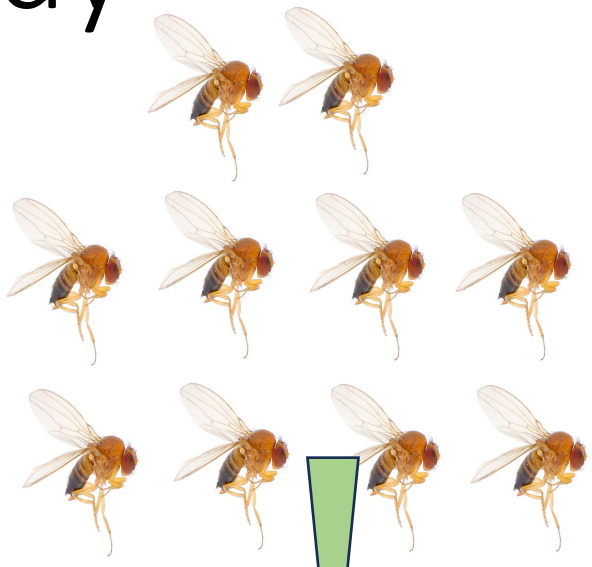


- Use modified McPhail traps
- Used vinegar-water solution as the attractant
- Collected field flies from four orchards: Lodi, Stockton, Morgan Hill1, Morgan Hill 2
- Rearing them separately and tested those flies

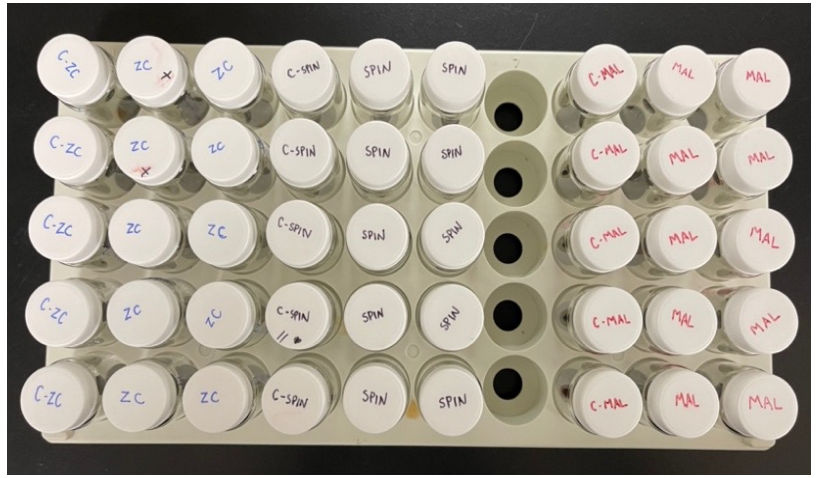
# SWD Resistance Study

**Testing of the resistance using discriminating doses**

- 2 AIs tested:
  -spinosad (928 ppm)
  -zeta-cypermethrin (6.89ppm) – type II pyrethroid
- 15 replications; evaluated after 8h (Spinosad), 6 h (zeta, malathion)
- Collaborated with Dr. Zalom Lab, UC Davis



10 females/vial

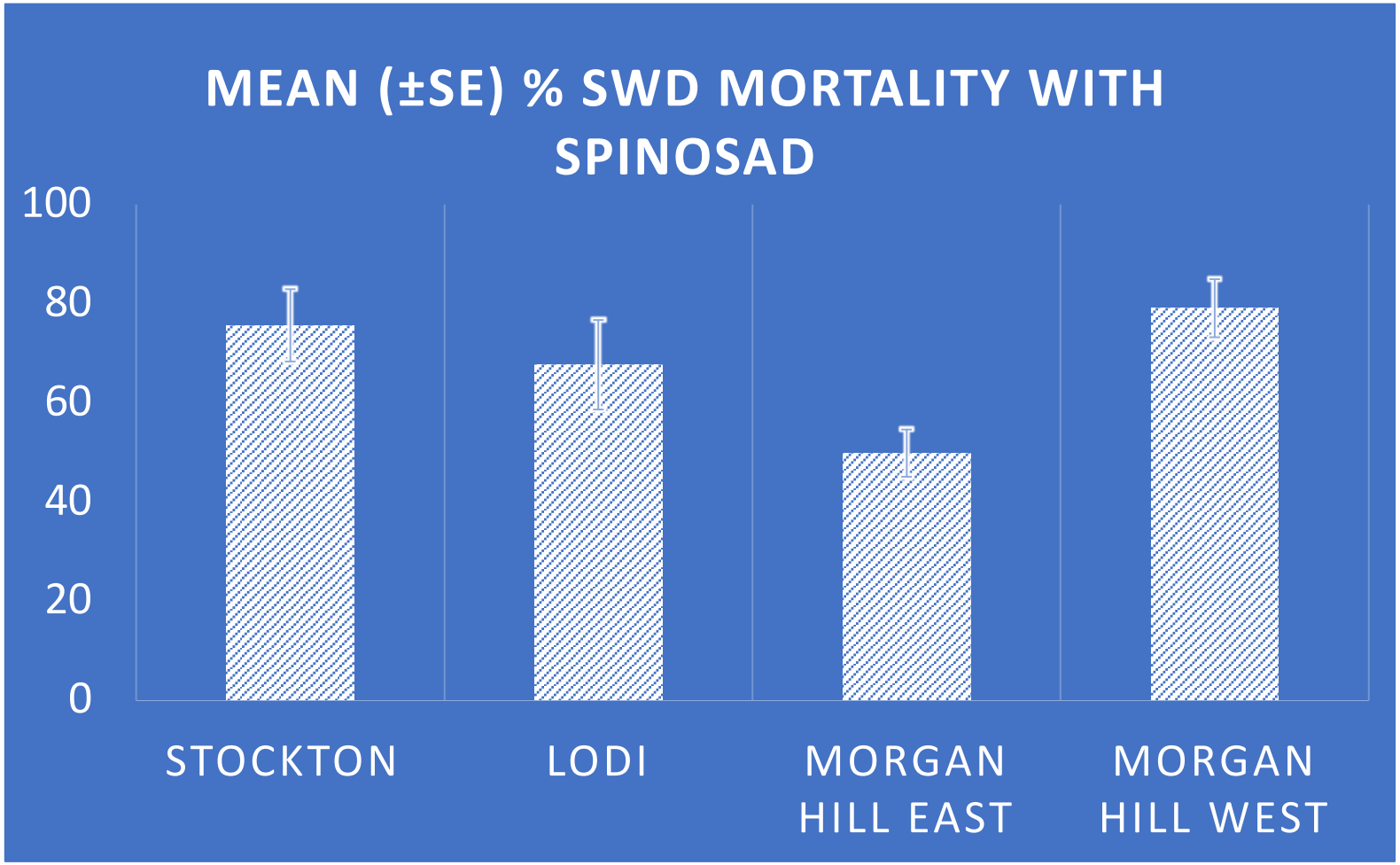



- The discriminating doses (used in GA, MI, CA)
  - **8 x $LC_{90}$ of zeta-cypermethrin**
  - **2 x $LC_{99}$ of spinosad**

100% mortality is expected if the flies are still susceptible to the insecticide

# Spinosad Results:

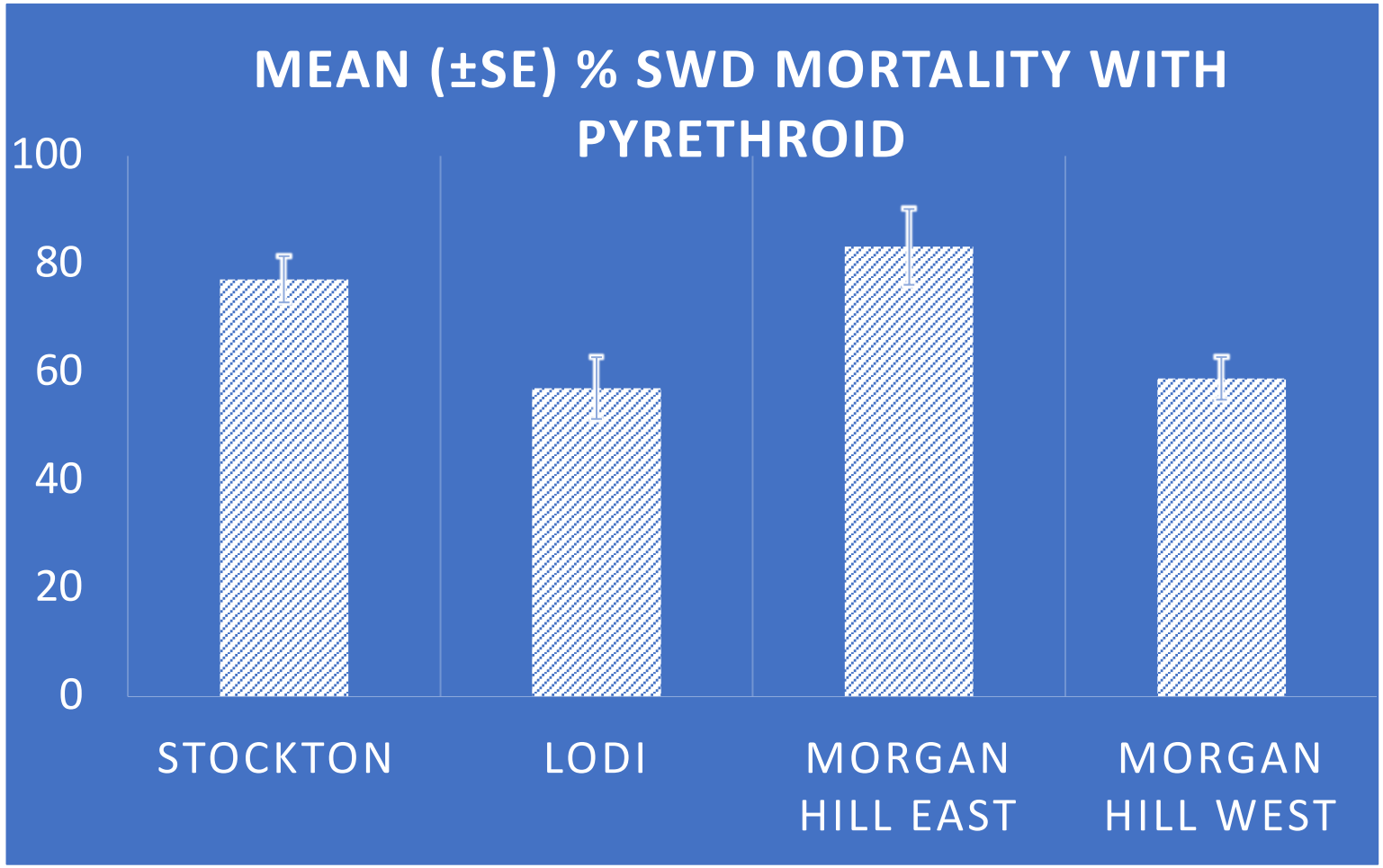
## Average mortality of field-collected SWD when exposed to LC99 x 2 dose of the insecticide




- 50-80% mortality in ***Spinosad*** treated field-collected SWD adults
- 0% mortality in Control SWD adults
- 100% mortality of susceptible “Wolfskill” SWD population

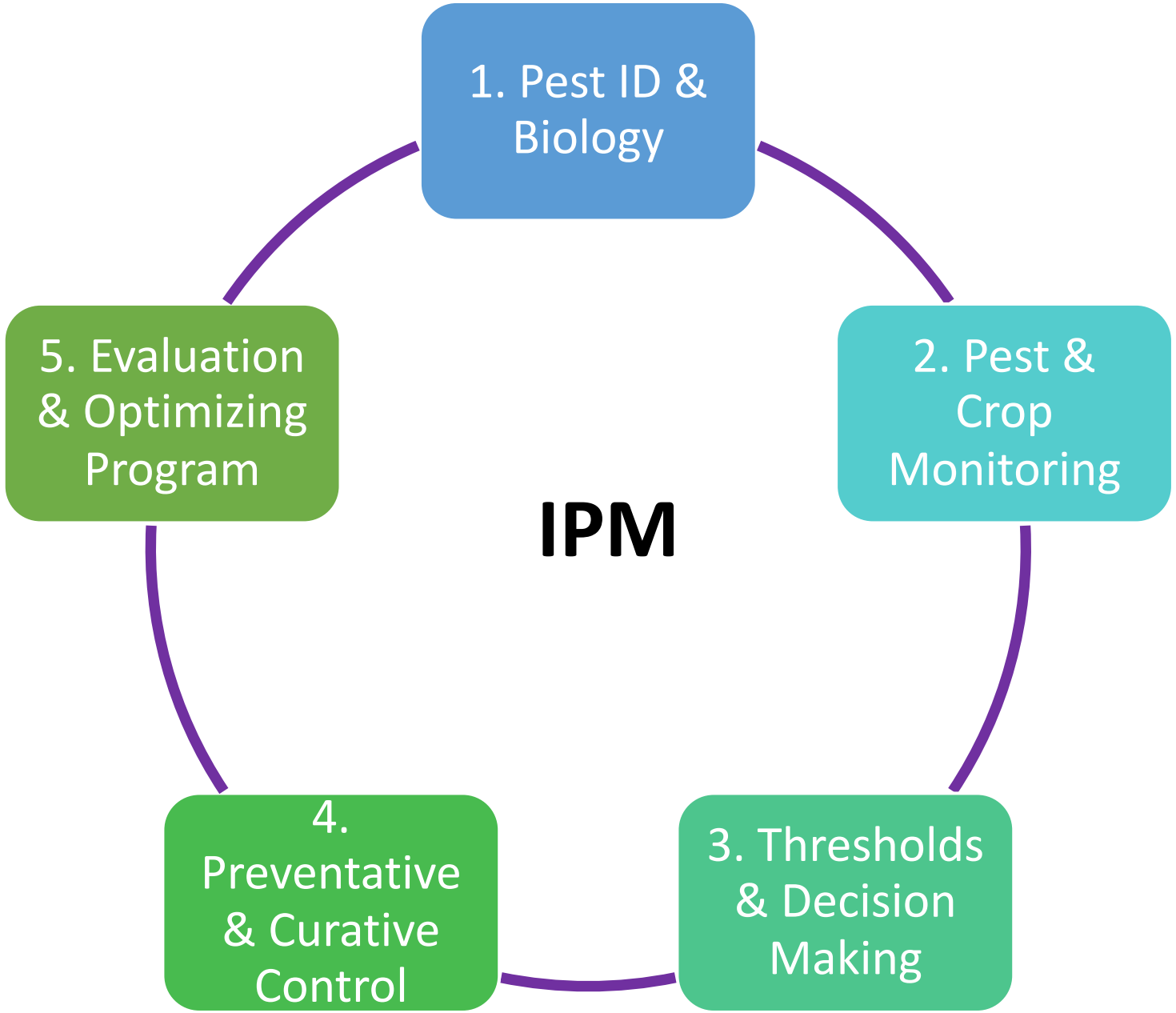
# Zeta-cypermethrin Results:

## Average mortality of field-collected SWD when exposed to LC90 x 8 dose of the insecticide




- Zeta cypermethrin (proxy for lambda-cyhalothrin, Type II pyrethroid
- 57-83% mortality of field-collected SWD adults in ***Zeta-cypermethrin*** treatment
- 0% mortality of field-collected SWD adults in Control
- 100% mortality of susceptible "Wolfskill" SWD population in ***Zeta-cypermethrin*** treatment

# Resistance Management through IPM

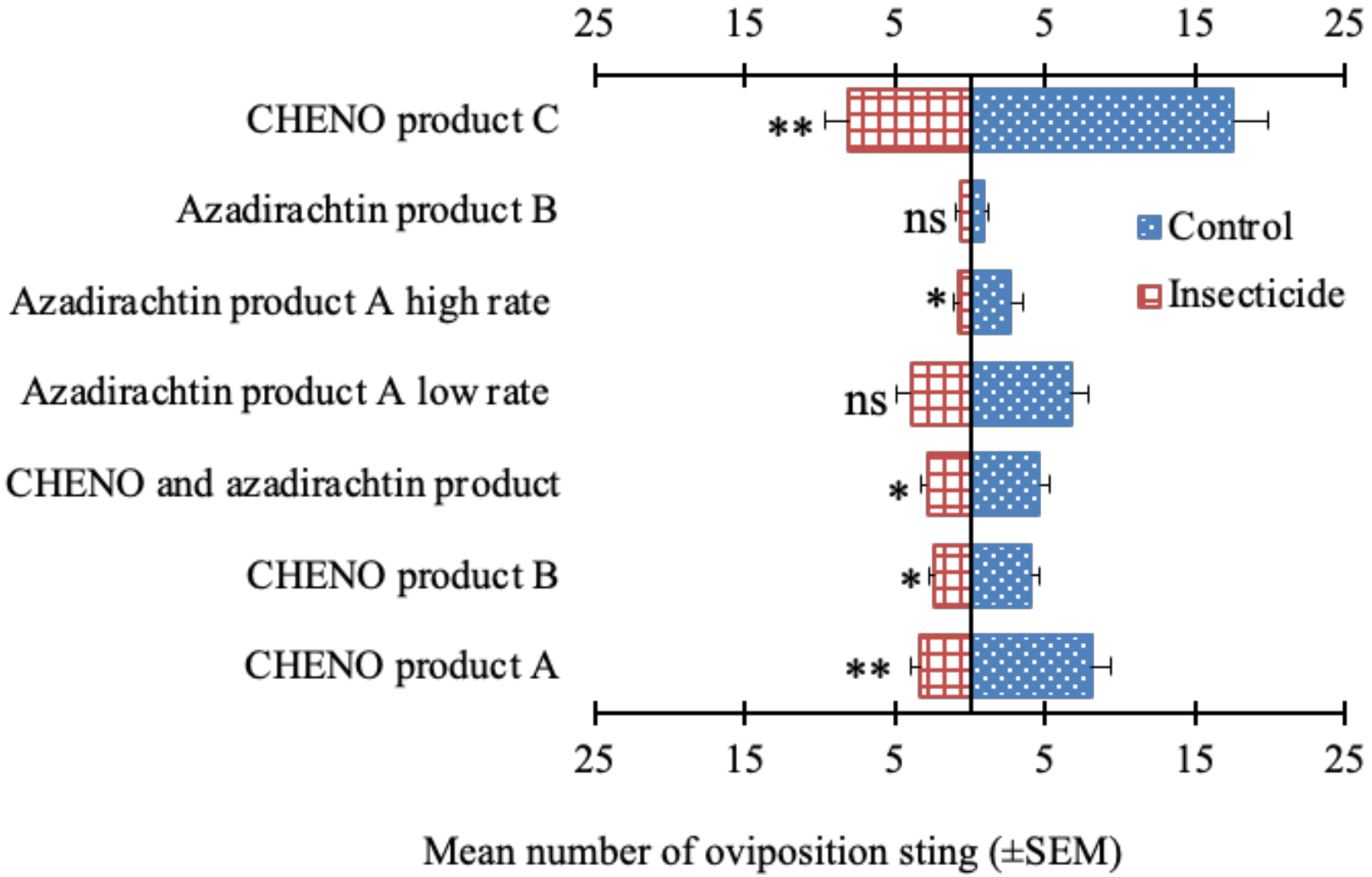


# SWD Adult Mortality with Insecticides (Field-Aged Residue on cherries)

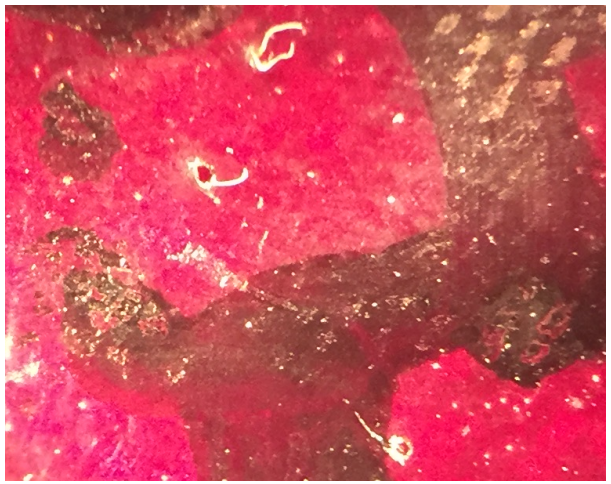
| Insecticides | Adult SWD mortality (%) (Mean±SE) in 1-day field-weathered insecticide residue | | | Adult SWD mortality (%) (Mean±SE) in 1-week field-weathered insecticide residue | |
|---|---|---|---|---|---|
| | 24 h | 48 h | 72 h | 24 h | 48 h |
| Cyantraniliprole | 8 ± 3.3 a | 40 ± 10.1 bc | 88 ± 5.2 b | 14 ± 4.5 | 28 ± 5.9 ab |
| Spiroteteramat | 0 ± 0 a | 2 ± 1.7 a | 4 ± 3.5 a | 2 ± 1.7 | 10 ± 0 a |
| Pyrethrin | 4 ± 2.1 a | 8 ± 3.3 a | 16 ± 6.0 a | 6 ± 2.1 | 12 ± 1.7 a |
| Cyclaniliprole | 8 ± 3.3 a | 22 ± 7.6 ab | 34 ± 9.2 a | 8 ± 5.2 | 20 ± 7.4 ab |
| lambda-cyhalothrin | 24 ± 3.5 b | 54 ± 7.2 c | 76 ± 8.7 b | 16 ± 5.3 | 40 ± 7.4 b |
| Control | 0 ± 0 a | 0 ± 0 a | 4 ± 2.1 a | 4 ± 2.1 | 14 ± 2.1 a |
| Stat. | P<0.05 | P<0.05 | P<0.05 | P<0.05 | P<0.05 |

Results: Cyantraniliprole (88%), Cyclaniliprole (34%) lambda-cyhalothrin (76%) performed well

# Reduction in Oviposition Activity by Neem Products



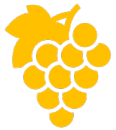




Gyawaly and Rijal, 2022, JEE

Monitor fields with using traps and check them regularly

Use cultural practices (harvest frequently, destroy leftover fruits, etc.) whenever possible

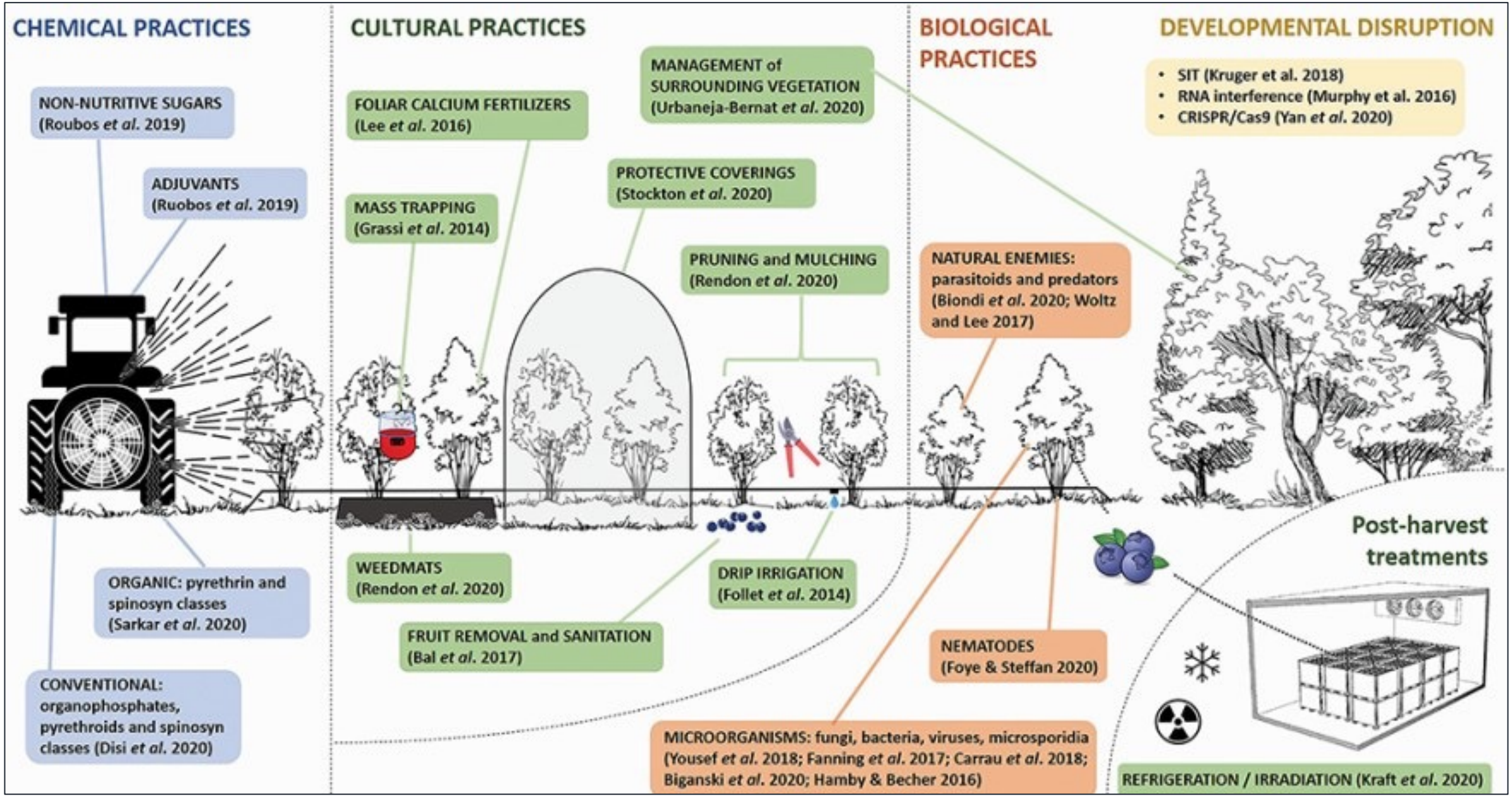


Based on trap capture and the stage of fruit development (ripening or not) apply effective insecticides to protect the fruit

Select based on insecticide efficacy and label requirements, your target markets; MRL has been a big issues for export market

Resistance management should be a goal when planning for SWD control. Include bio-based and other softer products.

Follow good spray practices: Application timing, sprayer type and efficiency, and coverage




Tait et al 2021, *Journal of Economic Entomology*

# Thank you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UCIPM Guidelines for SWD in Cherry:

https://ipm.ucanr.edu/agriculture/cherry/spotted-wing-drosophila/


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