

Vinegar flies in CA strawberries: Species Identification & insecticide resistance monitoring



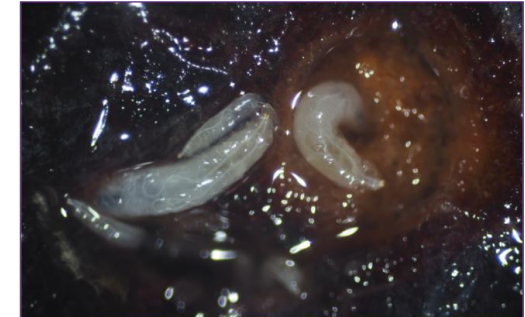
Brian Gress

Previous: Zalom Lab, UC Davis

Current: California Department of Food & Agriculture

BACKGROUND – SPOTTED WING DROSOPHILA

- SWD is an invasive vinegar fly, arrived in CA in 2008 from SE Asia
- First found in strawberry & caneberry fields in Watsonville
- Severe economic pest of raspberries, blackberries, blueberries & cherries
- Females have serrated ovipositor used to lay eggs into firm, still-ripening fruit



BACKGROUND – STRAWBERRY SUSCEPTIBILITY

- Fresh market strawberries may be protected from SWD by cultural practices & chemical controls
 - Short harvest intervals
 - spinosad & malathion
- Strawberries for processing are allowed to ripen in the field & insecticide applications stop
- Can lead to vinegar fly infestation & rejected shipments if detected
 - Impact of SWD unknown

RESEARCH GOALS

- 1) Assess ripe & overripe processing fruit for larval infestation
- 2) Determine the relative abundance of species causing infestation at each developmental stage

Studies to be replicated in 3 main CA growing regions: Oxnard, Santa Maria & Watsonville



METHODS

- Collect at least 40 ripe and 20 overripe strawberries from 3-4 field sites per region

Oxnard
May/ June



Oleg Daugovich

Santa Maria
August



Peter Shearer

Watsonville
TBD



Mark Boldt



METHODS

- Sampled at least 40 ripe and 20 overripe strawberries from 3-4 field sites per region

Ripe



Overripe

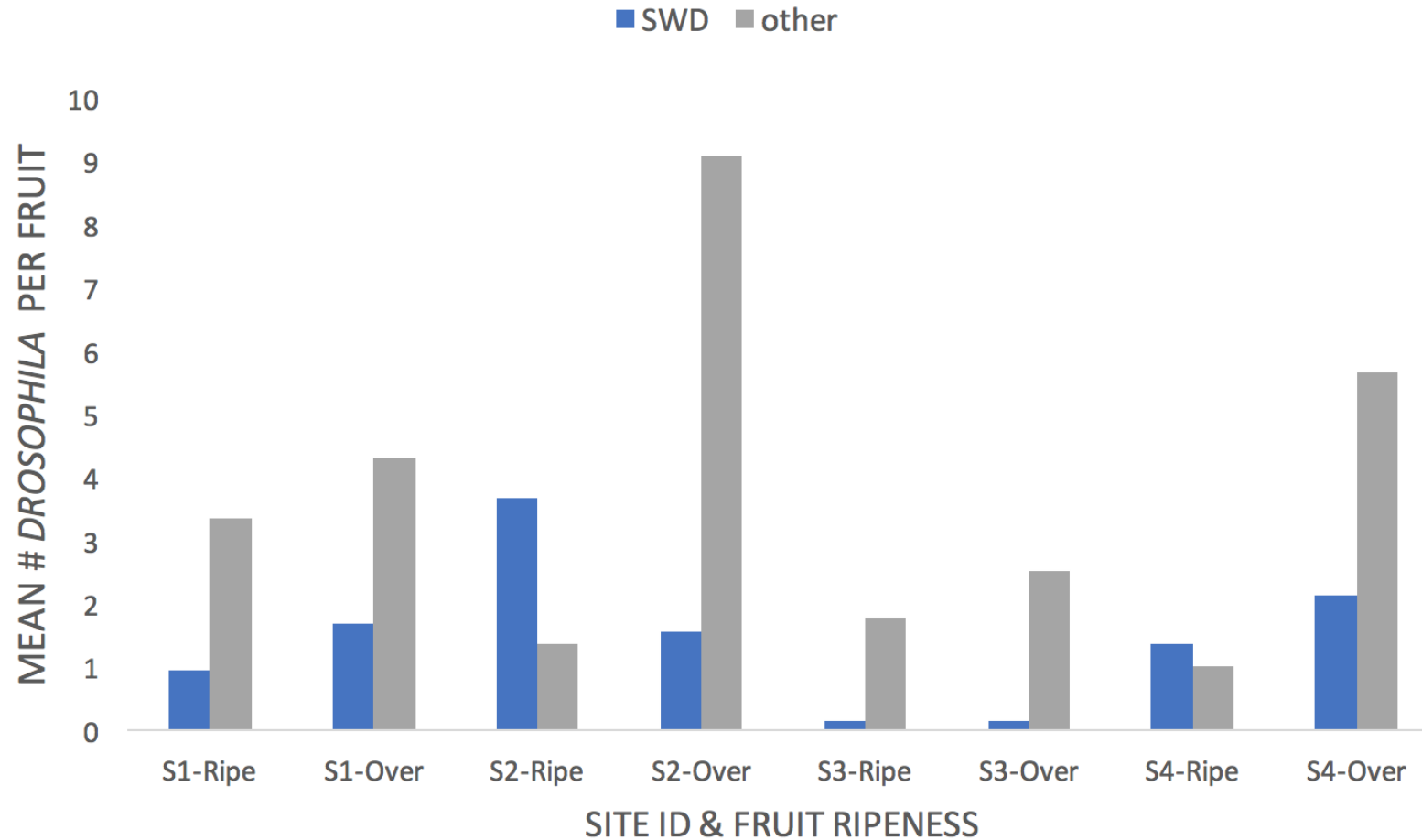


METHODS

- Sampled at least 40 ripe and 20 overripe strawberries from 3-4 field sites per region
- Used morphological characteristics to ID to species



RESULTS – OXNARD



RESULTS – OXNARD



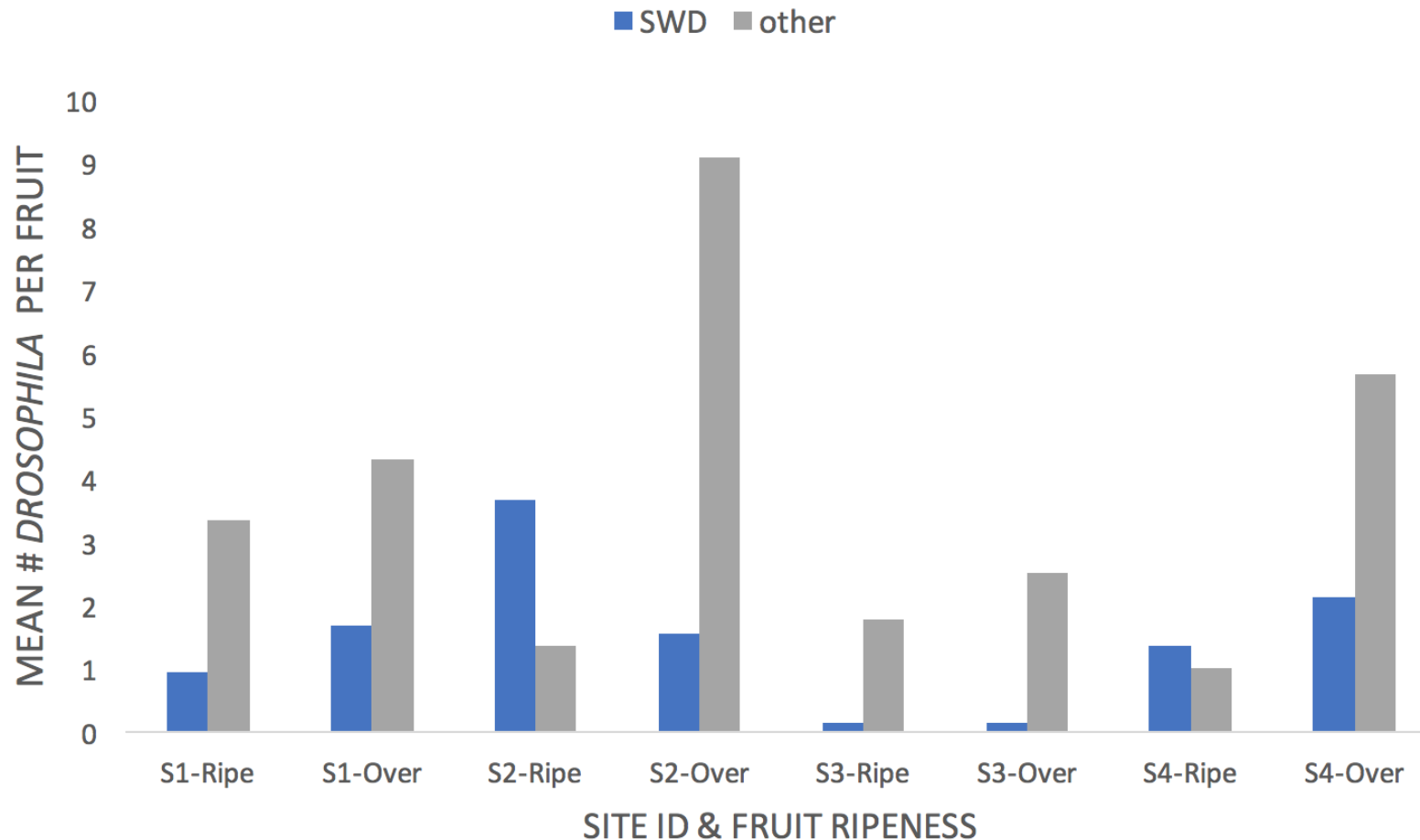
Average number vinegar fly larvae per fruit

Ripe: 3.4 (1.9 – 5)

Overripe: 6.8 (2.7 – 10.7)

$\chi^2 = 128.1, p = 0.0001^{*}$**

RESULTS – OXNARD



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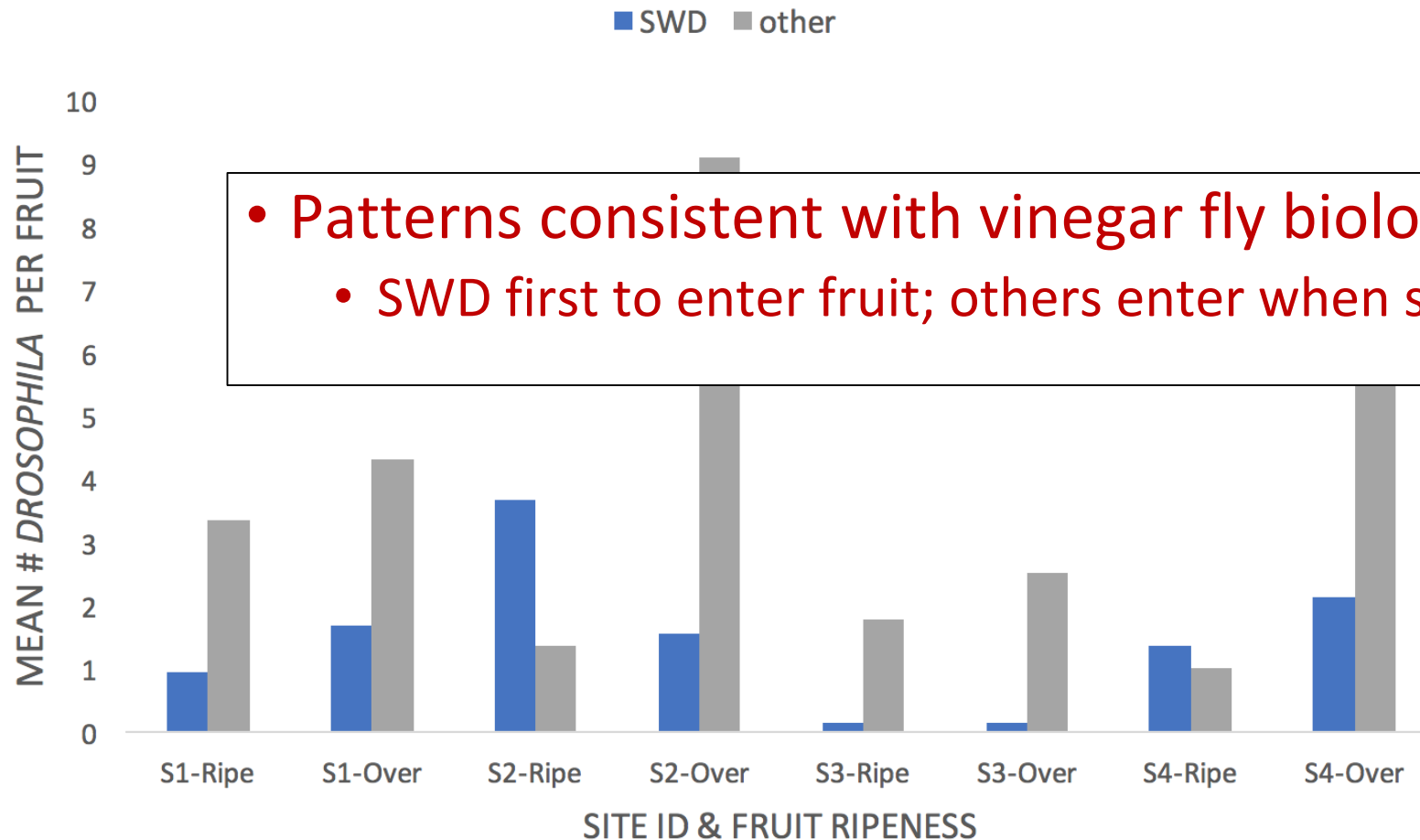
Percent of total sample represented by SWD

Ripe: 40% (7.1% – 73.1%)

Overripe: 19% (4.9% - 28%)

$z = 4.813, p = 0.0002^{}$**

RESULTS – OXNARD



Average number vinegar fly larvae per fruit

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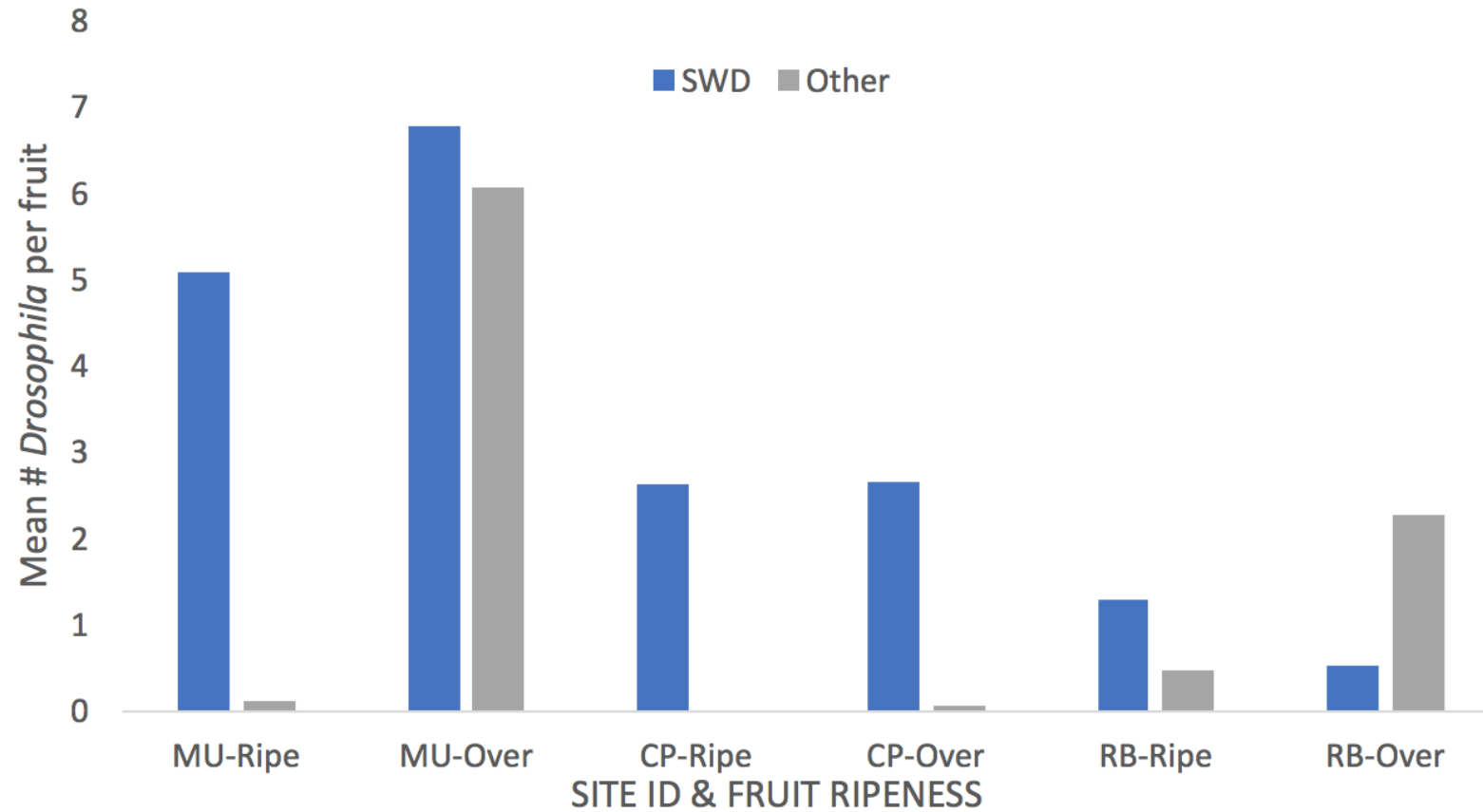
Percent of total sample represented by SWD

Ripe: 40% (7.1% – 73.1%)

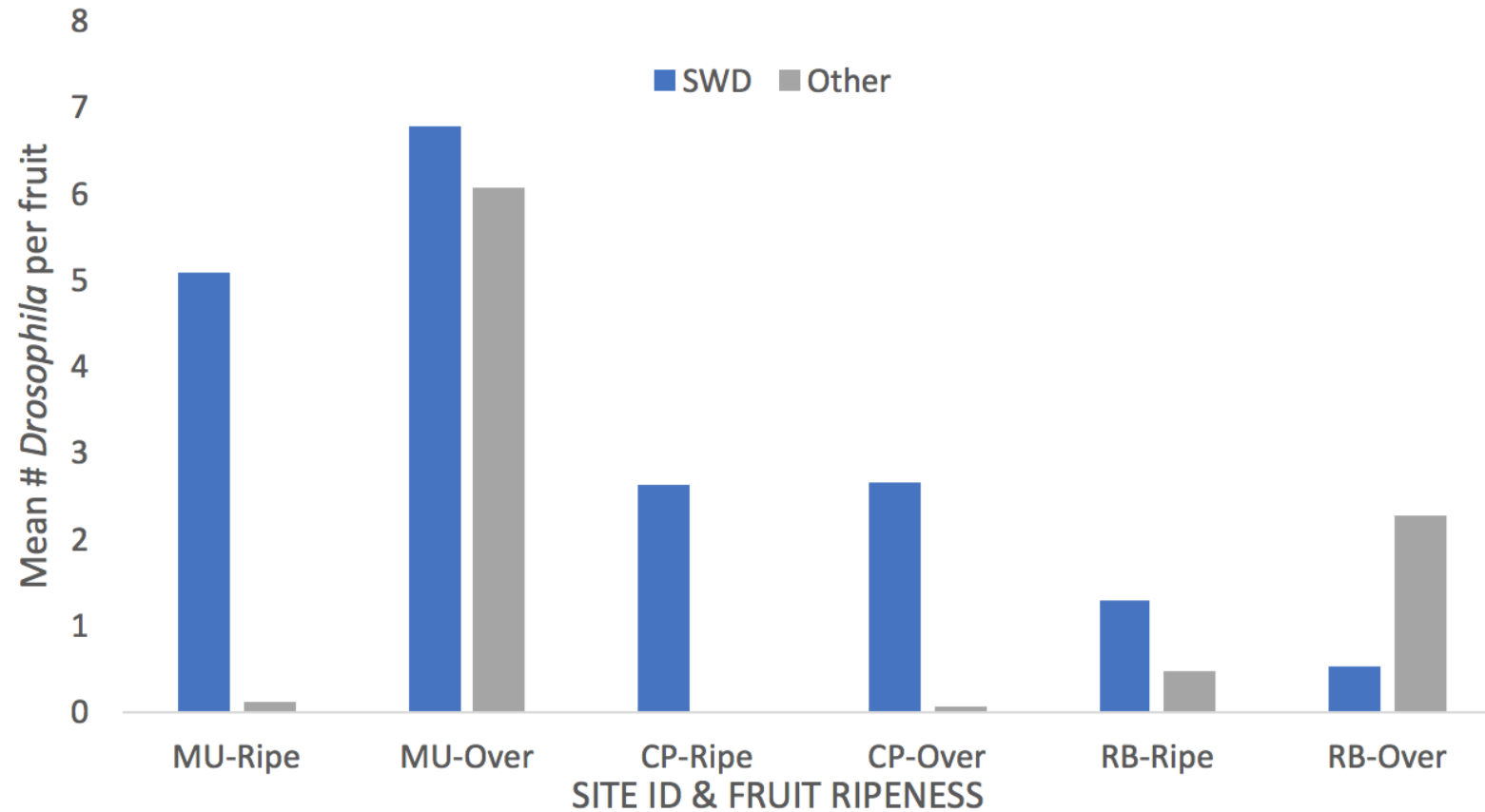
Overripe: 19% (4.9% - 28%)

$z = 4.813$, $p = 0.0002^{}$**

RESULTS – SANTA MARIA



RESULTS – SANTA MARIA



Average number vinegar fly larvae per fruit

Ripe: 3.2 (1.7 – 5.2)

Overripe: 6.1 (2.7 – 12.8)

$\chi^2 = 43.633$, $p < 0.0001$

RESULTS – SANTA MARIA



Average number vinegar fly larvae per fruit

Ripe: 3.2 (1.7 – 5.2)

Overripe: 6.1 (2.7 – 12.8)

$\chi^2 = 43.633, p < 0.0001$

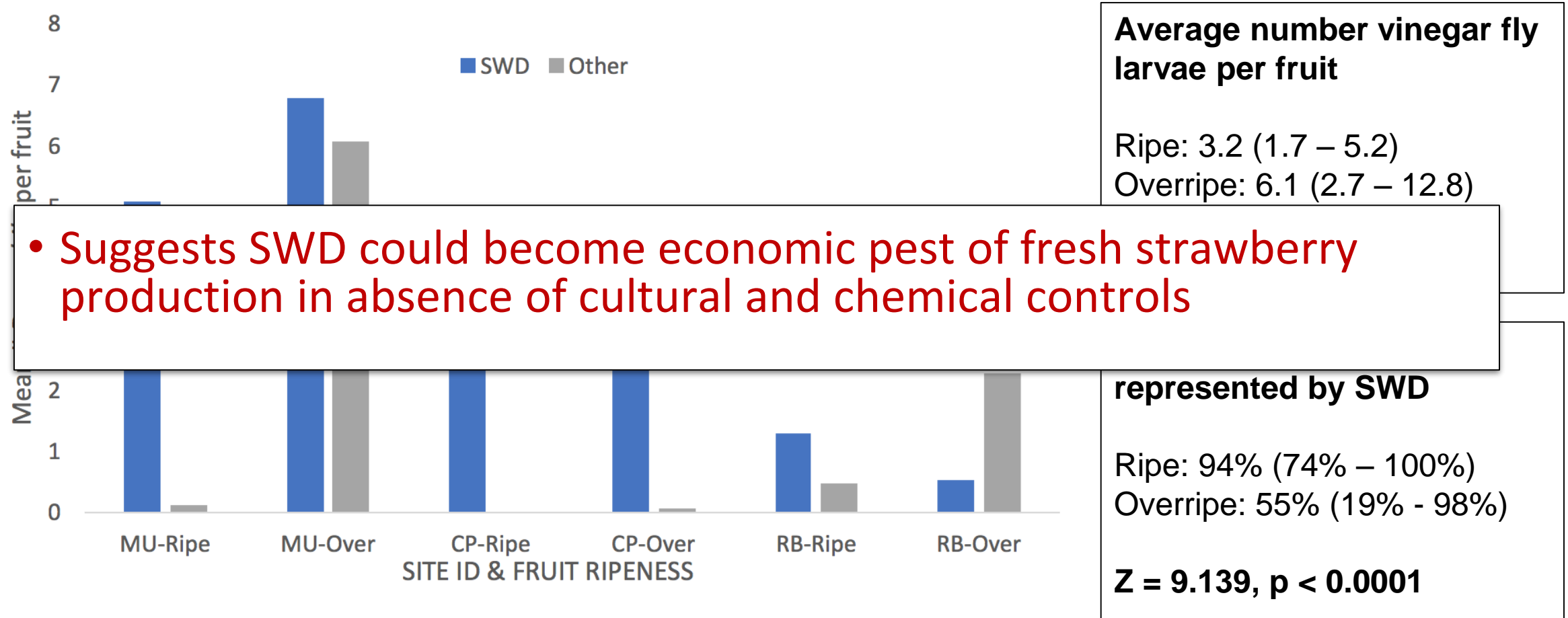
Percent of total sample represented by SWD

Ripe: 94% (74% – 100%)

Overripe: 55% (19% - 98%)

$Z = 9.139, p < 0.0001$

RESULTS – SANTA MARIA



SPINOSAD RESISTANCE IN CA SWD

- Low to moderate levels of spinosad resistance emerging in Watsonville region
- Able to tolerate 5-12 x higher concentrations than susceptible SWD
- Significant increase in resistance observed after 5 generations of laboratory selection (~8-17 x)

Strain	LC50	SE	RR _w	RR _s
Susceptible (MI)	13.1	5.3	0.44	1
Wolfskill (untreated)	29.4	7.2	1	2.2
Watsonville	152.6	40.6	5.2	11.6
Watsonville-select	227.6	46.0	7.8	17.4

SPINOSAD RESISTANCE IN CA SWD

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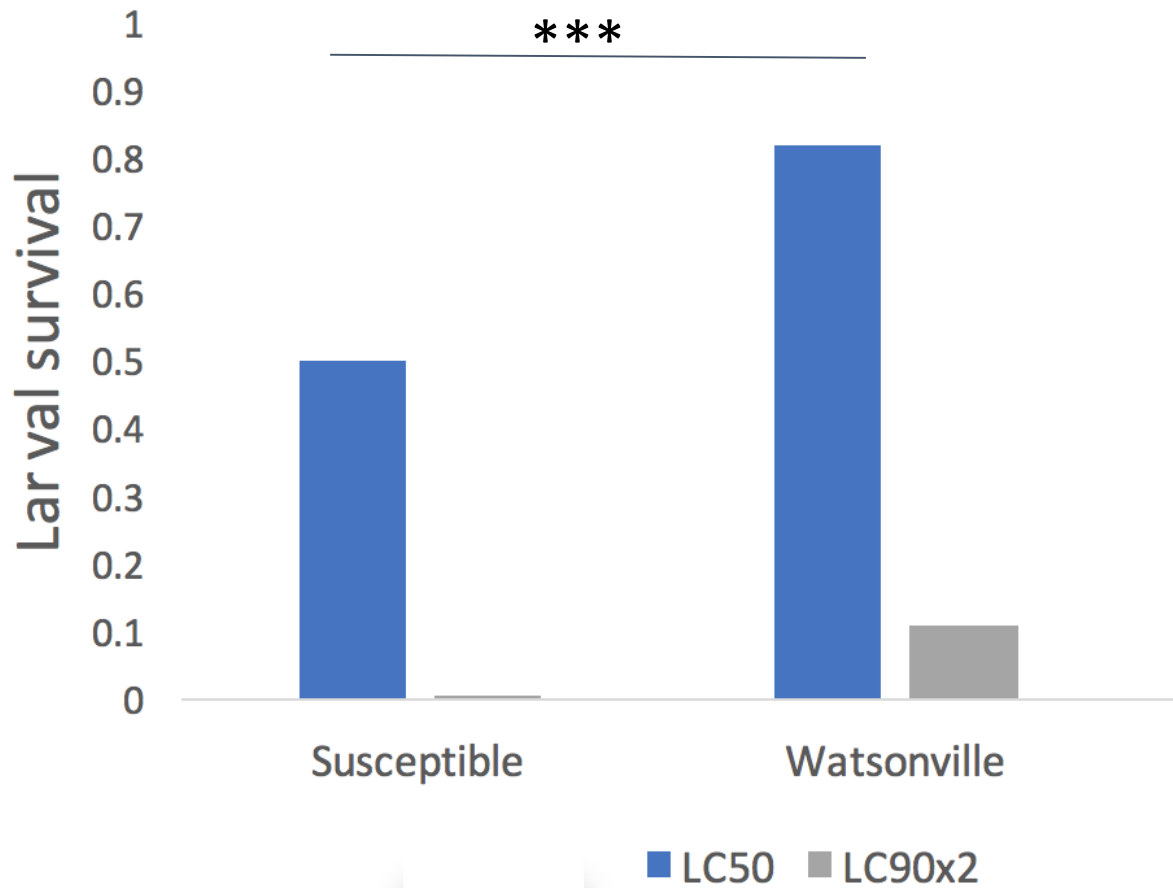
		Strain	LC50	SE	RR _w	RR _s
Is resistance to malathion beginning to emerge in CA SWD populations?						
SWD		Watsonville	152.6	40.6	5.2	11.6
		Watsonville-select	227.6	46.0	7.8	17.4

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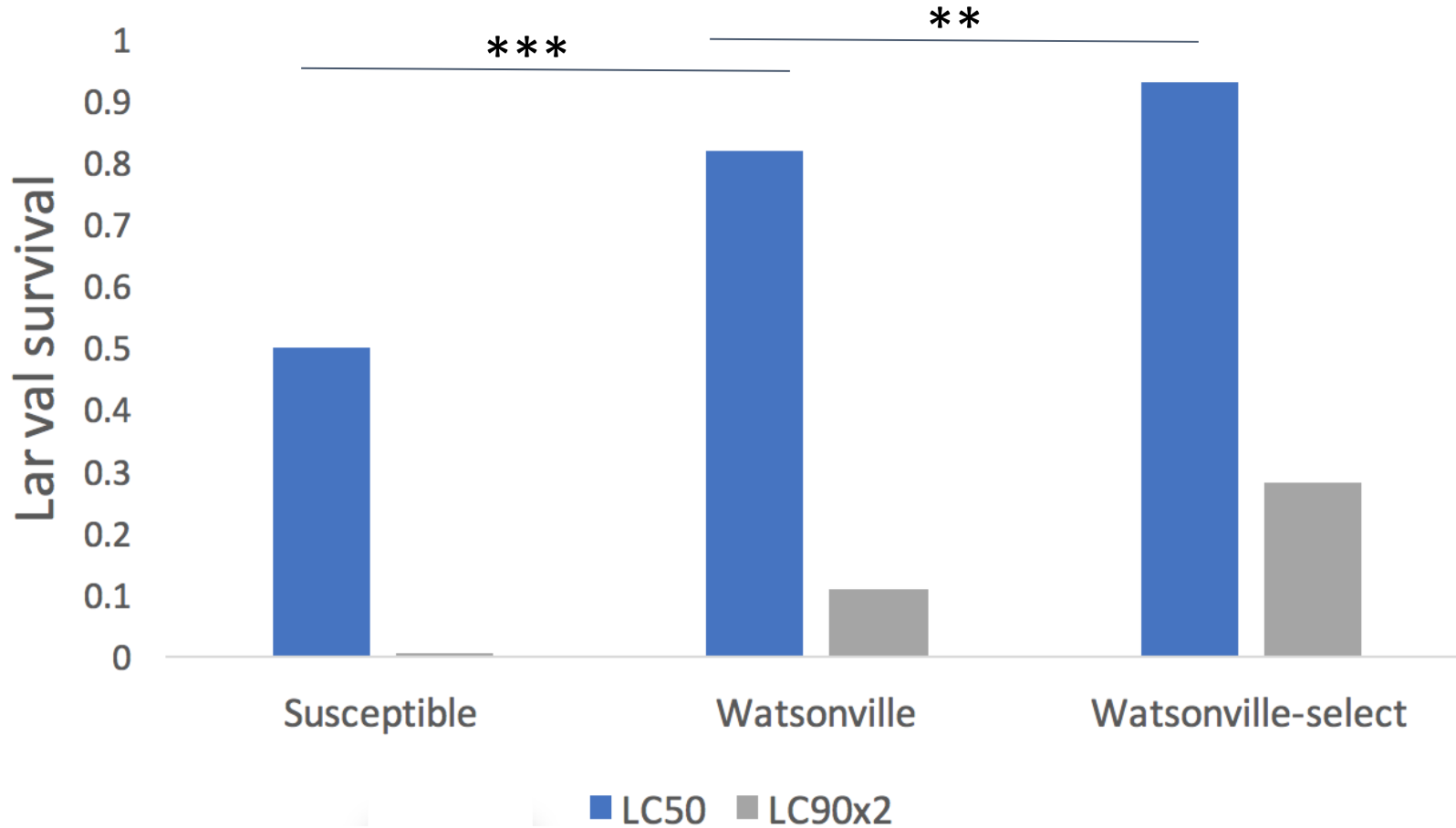
MALATHION SUSCEPTIBILITY IN WATSONVILLE SWD (ADULTS)

- Initial monitoring effort indicated reduced malathion susceptibility in Watsonville
- Subsequent dose-response bioassays using adults showed that tolerance was low (~2-fold increase)

MALATHION SUSCEPTIBILITY IN WATSONVILLE SWD (LARVAE)



MALATHION SUSCEPTIBILITY IN WATSONVILLE SWD (LARVAE)



CONCLUSIONS

- Vinegar fly larvae were present in fruit from all stages and locations
 - SWD comprise between 5% and 100% of total larval load
 - Likely enter fruit first & create opportunities for other species (*D. simulans*)
- Spinosad & malathion resistance could create problems in fresh market crop
- Tolerance to both insecticides already present in commercial CA fields
- Susceptibility will likely further decline with continued field exposure
- Non-spray alternatives to control SWD need to be developed and implemented

ACKNOWLEDGEMENTS



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Department of
Agriculture

Undergraduate researcher
Chase Matterson



CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

