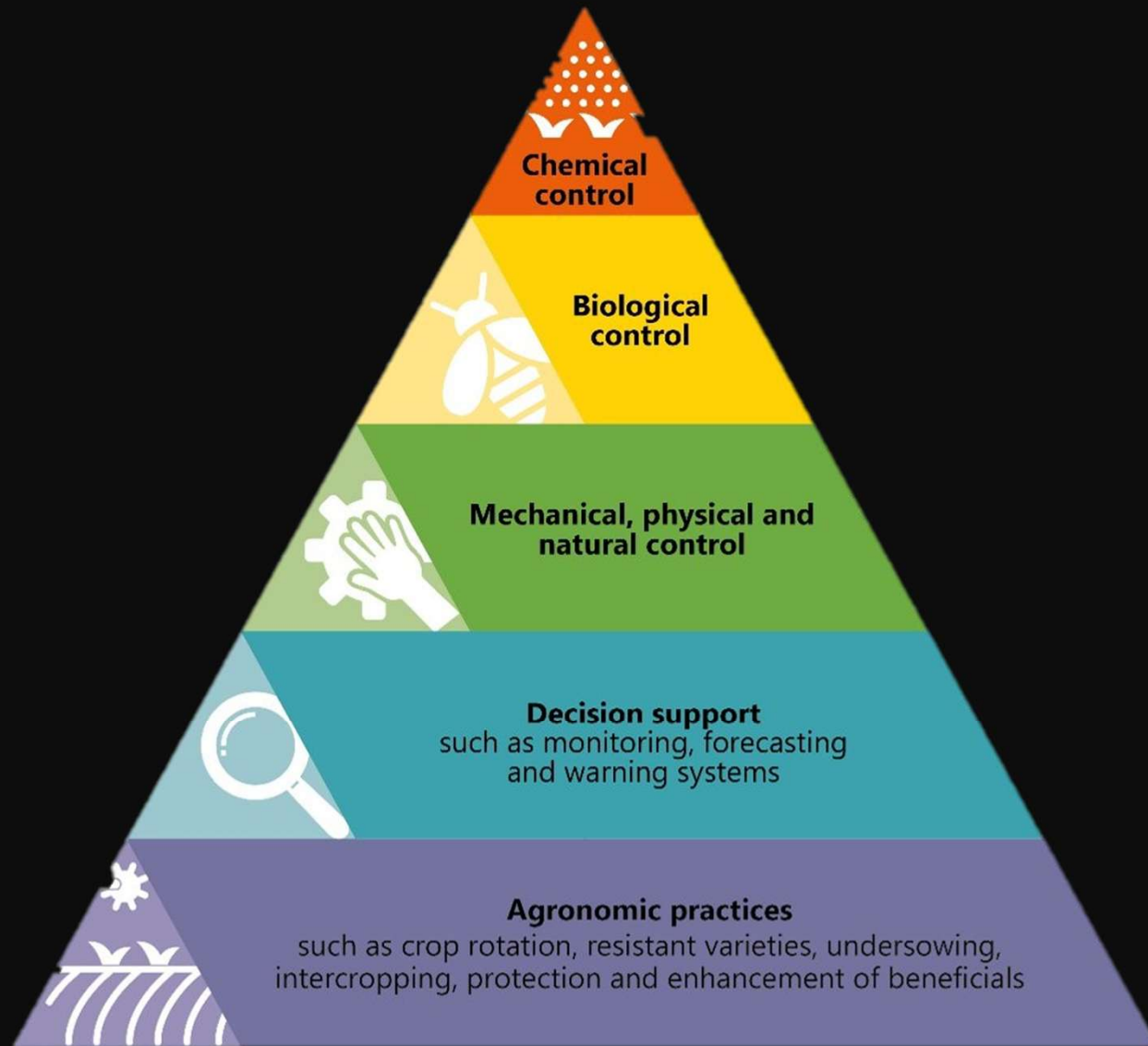


*Insecticide resistance in DBM populations
in coastal cole crops*

Ian Grettenberger, Cooperative Extension Specialist
UC Davis Dept. of Entomology & Nematology









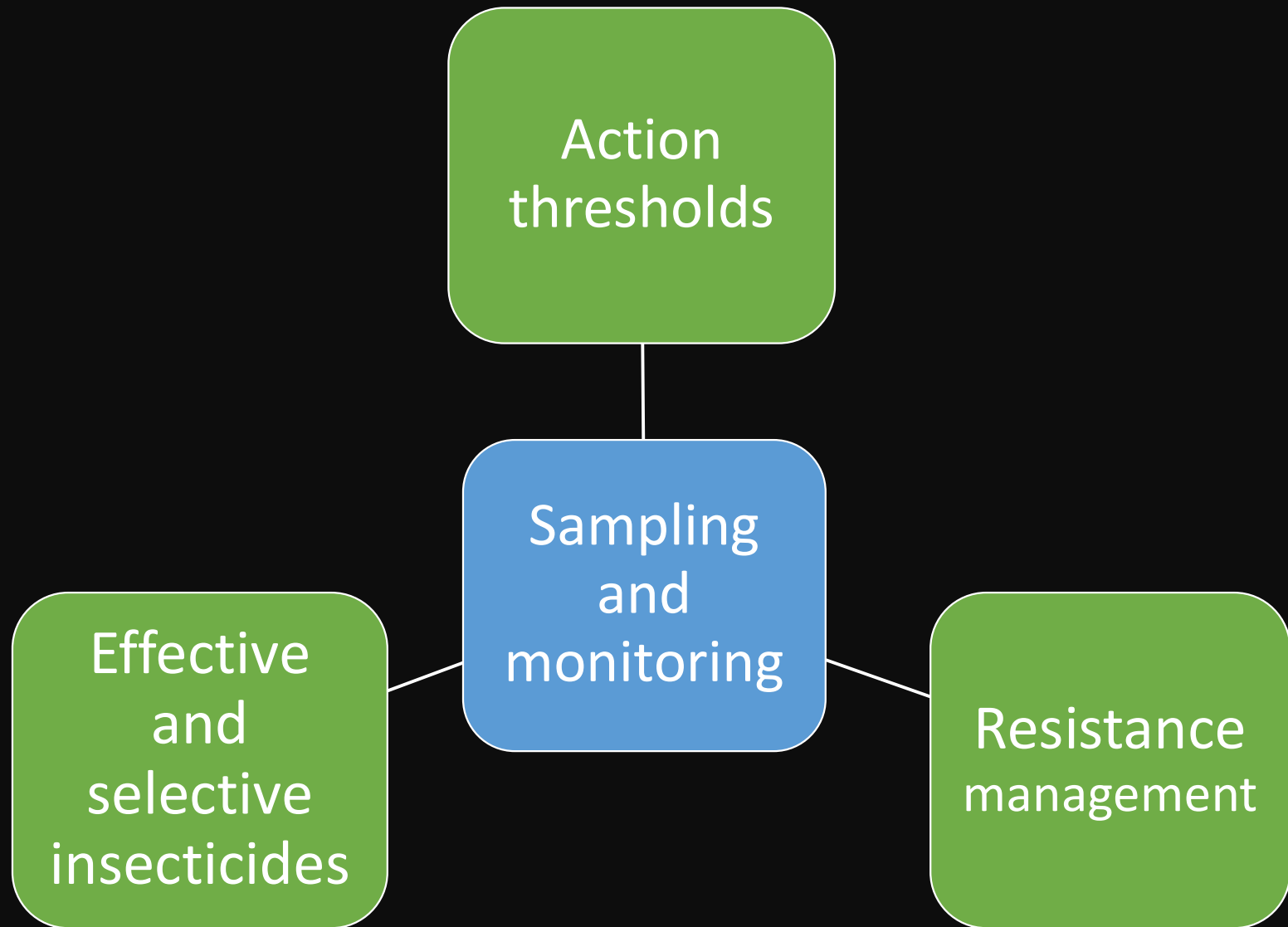
EVERYTHING WILL CHANGE

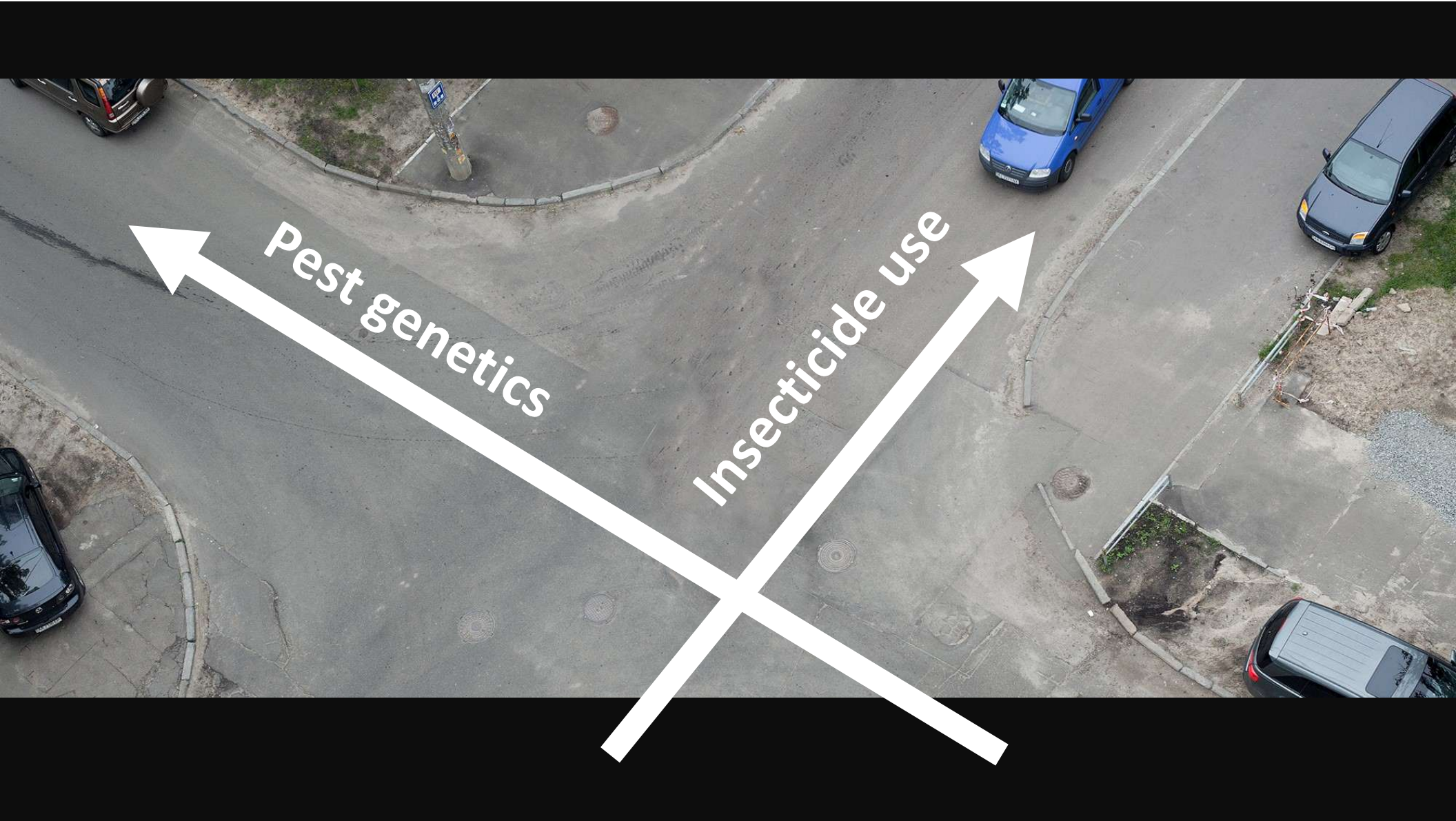
EVERYTHING HAS CHANGED

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Insecticide resistance





Pest genetics

Insecticide use

An aerial photograph of a street intersection. In the center, a silver sedan and a dark sedan are parked with their driver-side doors open. A blue hatchback is parked on the right side of the road, and a dark van is parked further down. A utility pole stands on the left side of the road. The text 'Insecticide resistance' is centered in a black box. The words 'Insecticide use' and 'Pest genetics' are written diagonally across the cars.

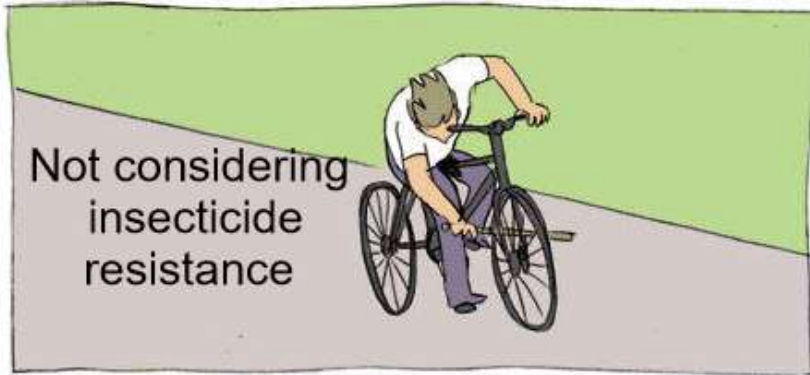
Insecticide resistance

Insecticide use

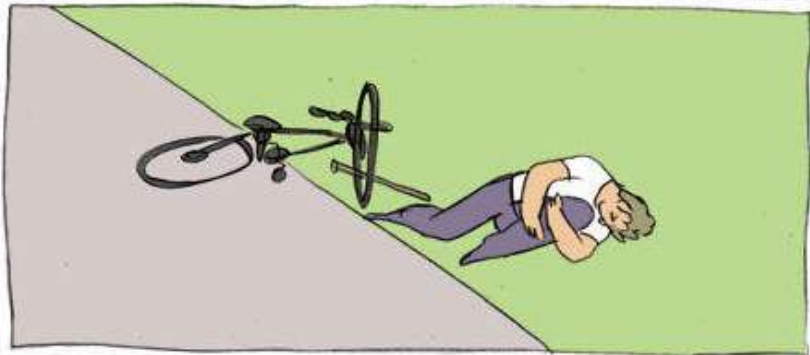
Pest genetics



Managing
insect pests



Not considering
insecticide
resistance





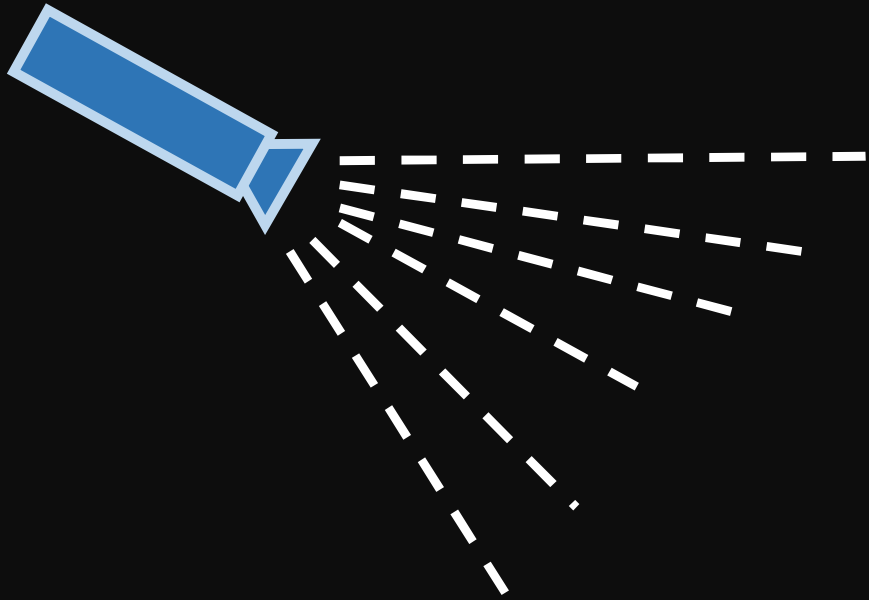
**Many years +
Uncertainty**

Index Open





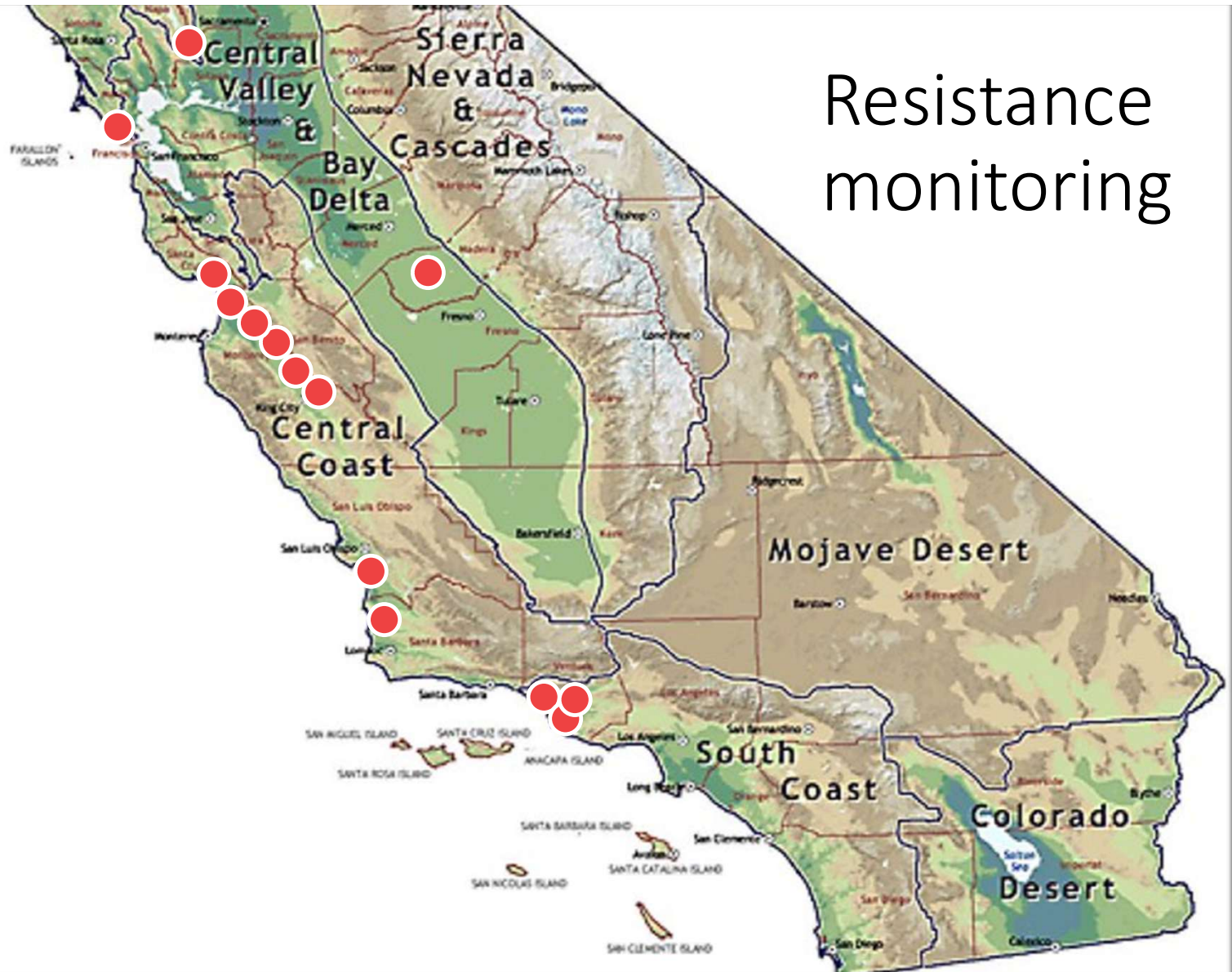




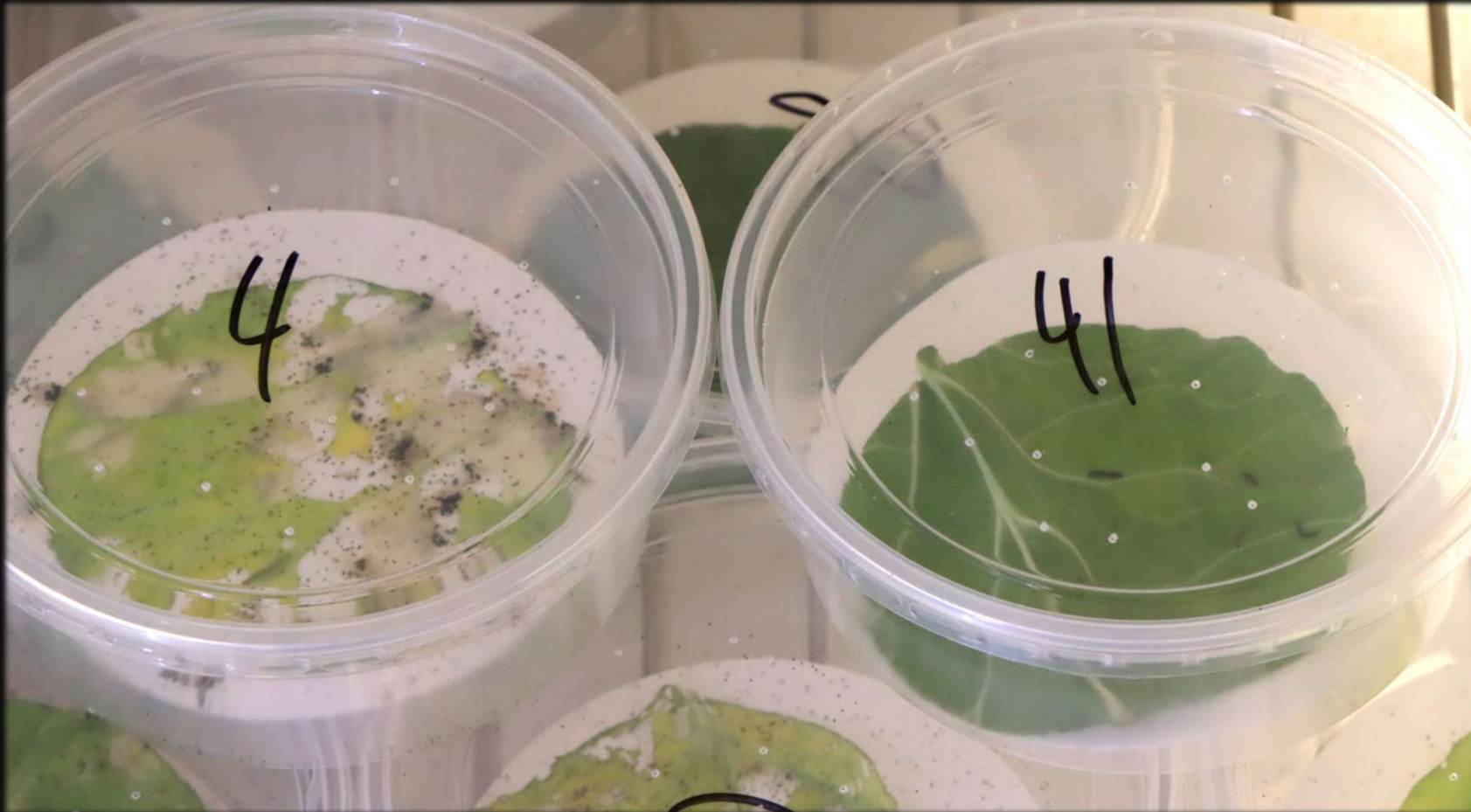
Problem: Insecticide-resistant diamondback moths

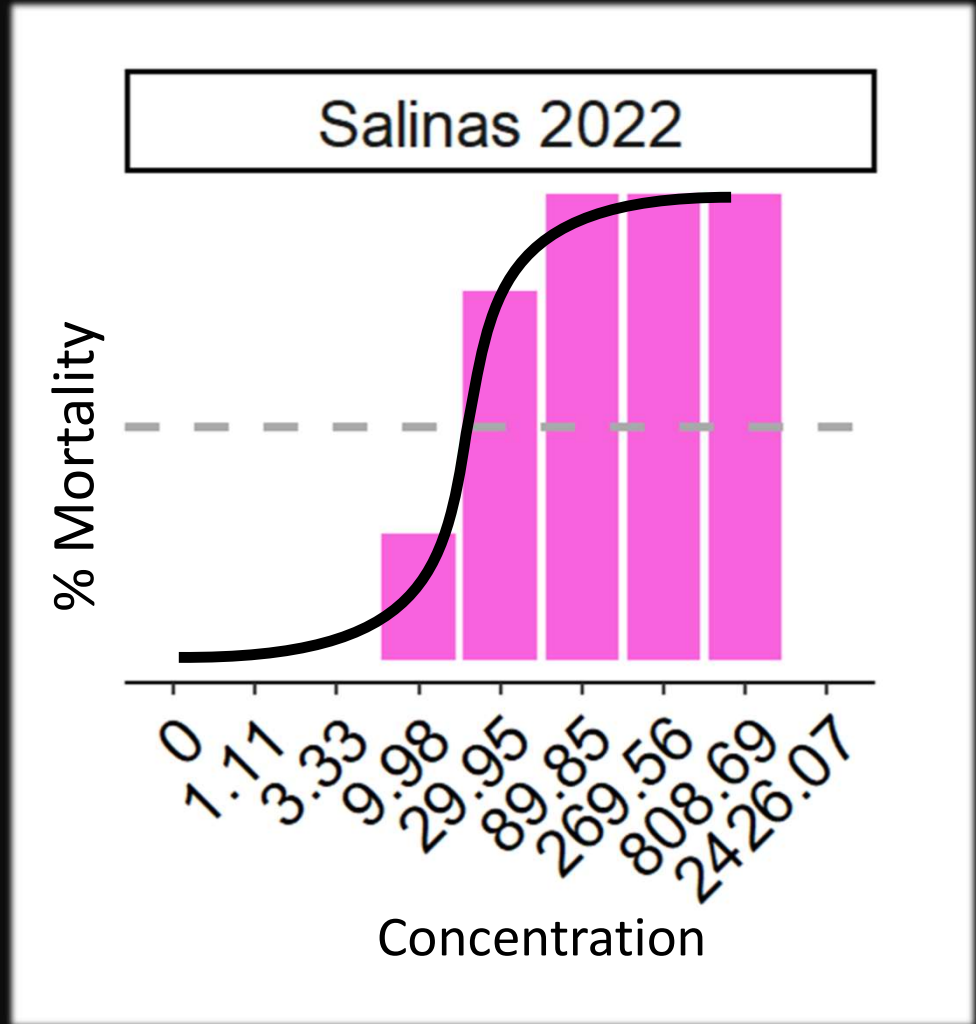


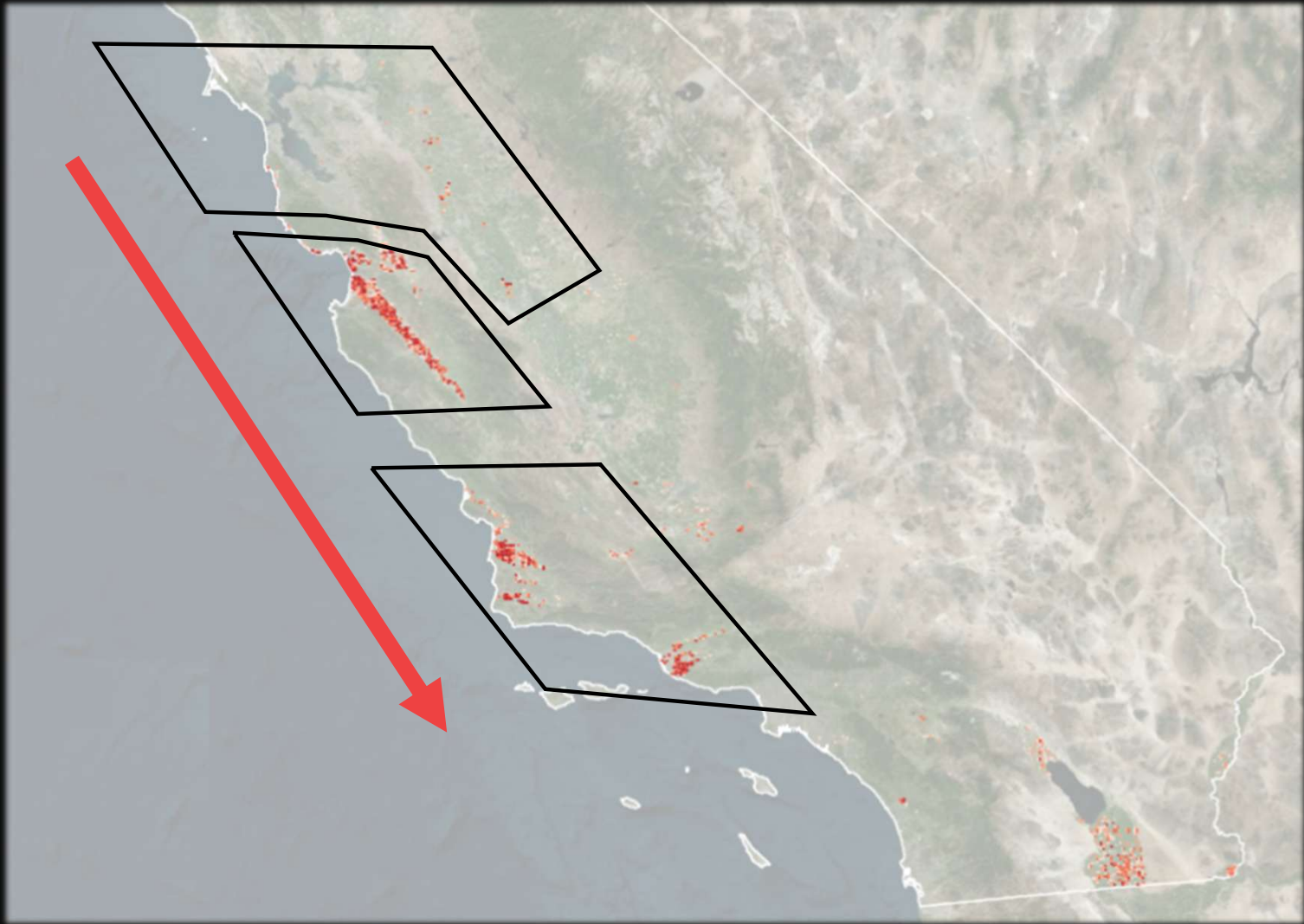
Resistance monitoring



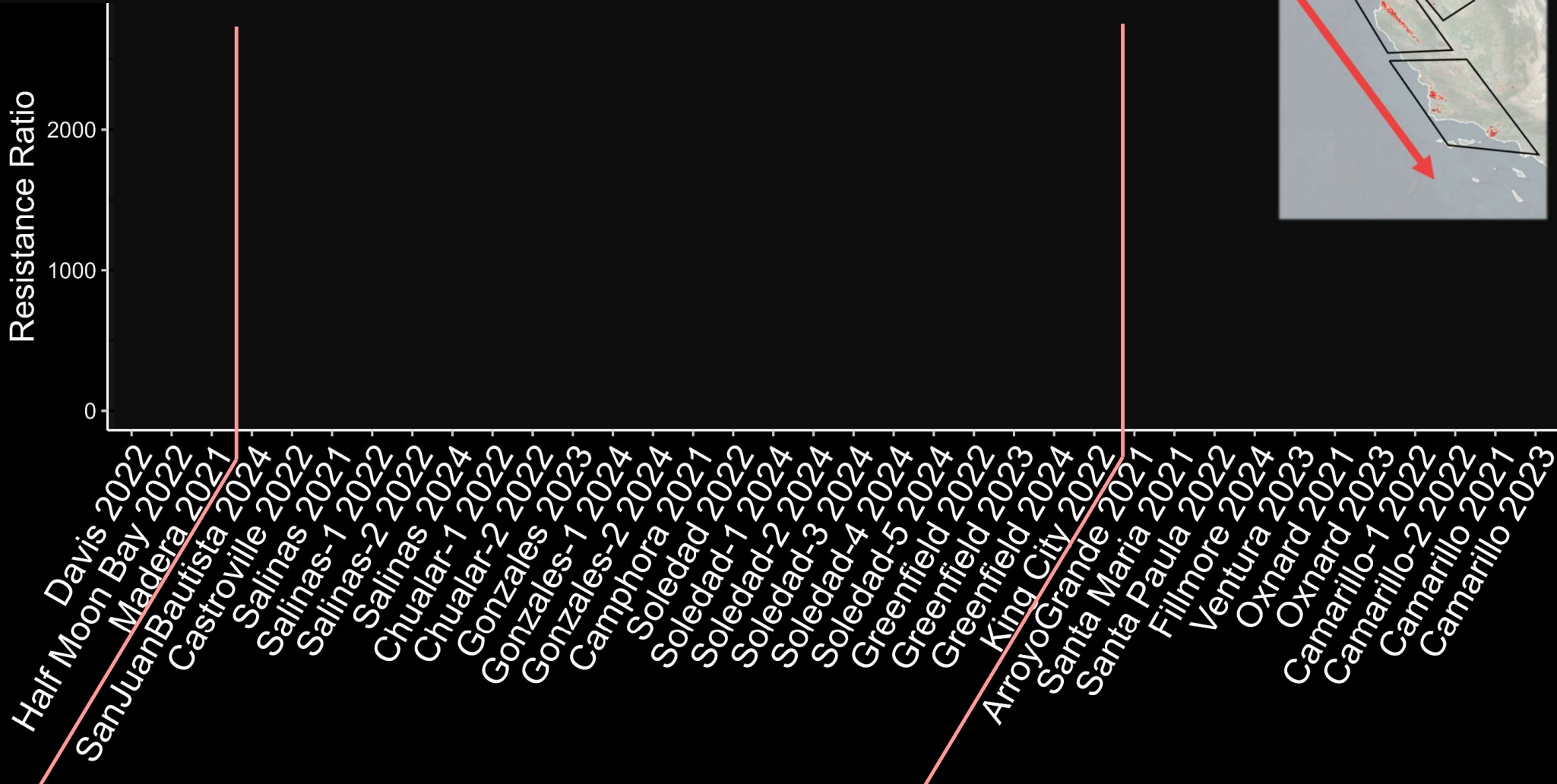
Resistance monitoring – leaf dip assay



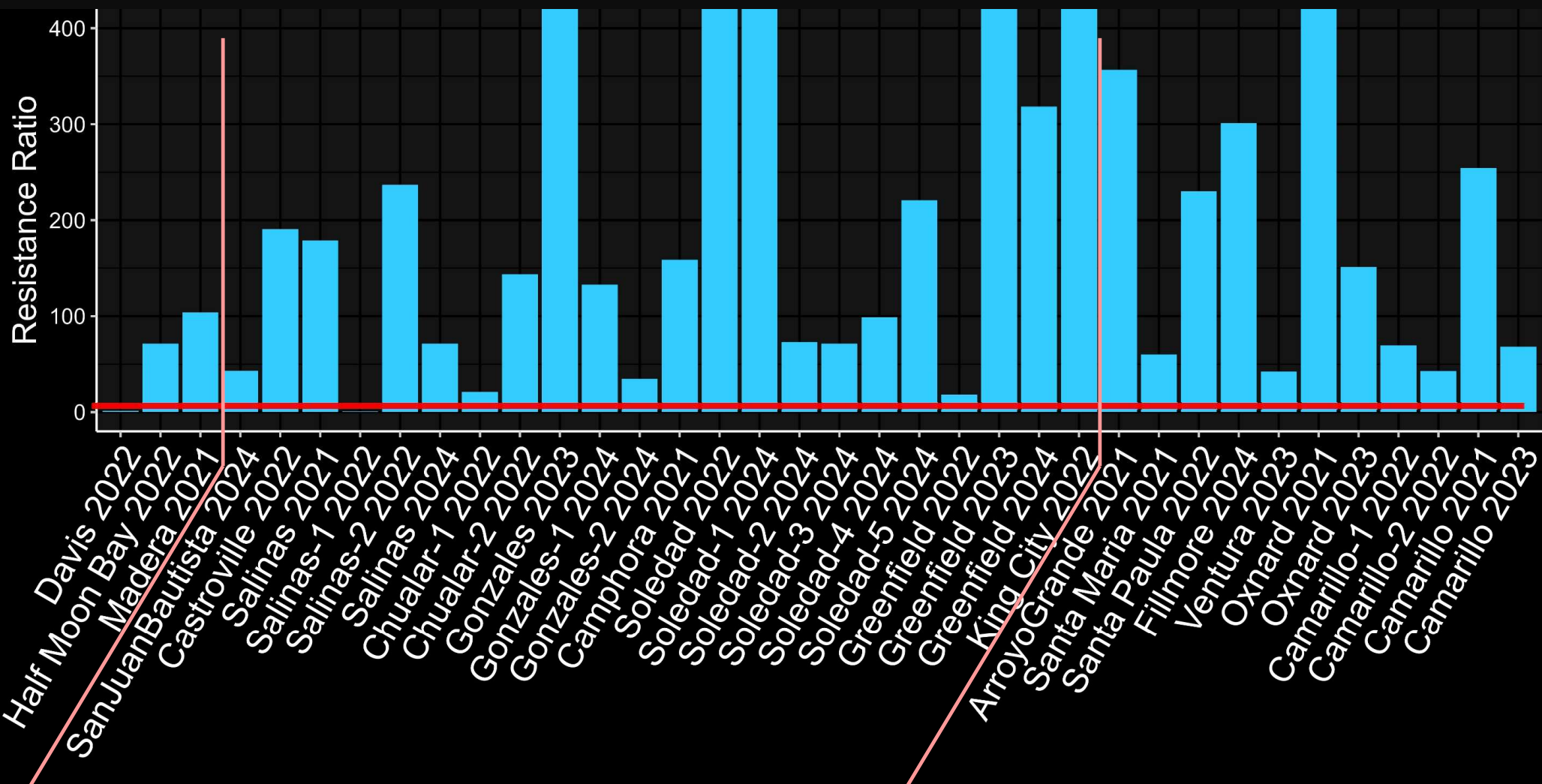




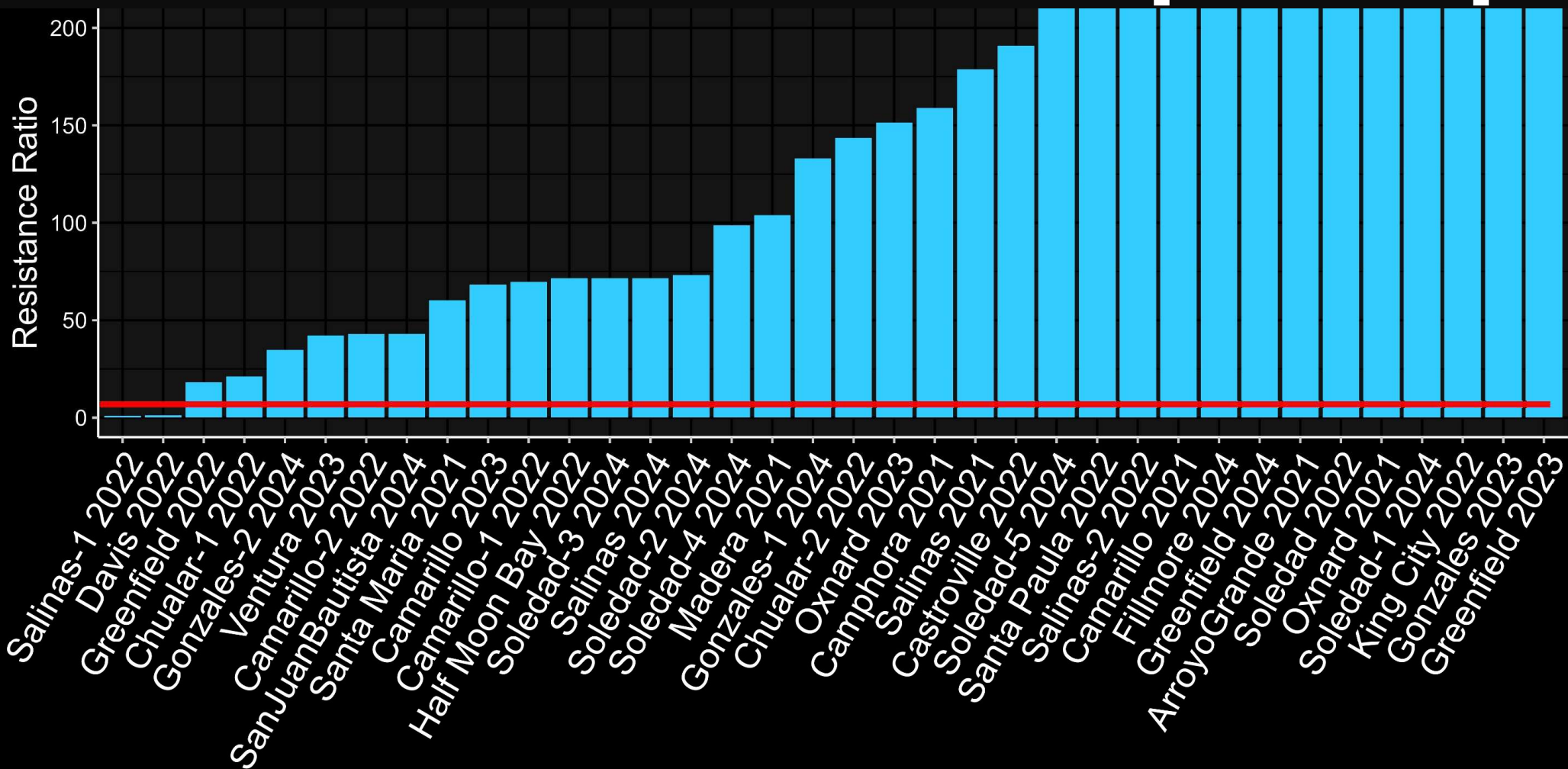
Chlorantraniliprole – Coragen (diamide)



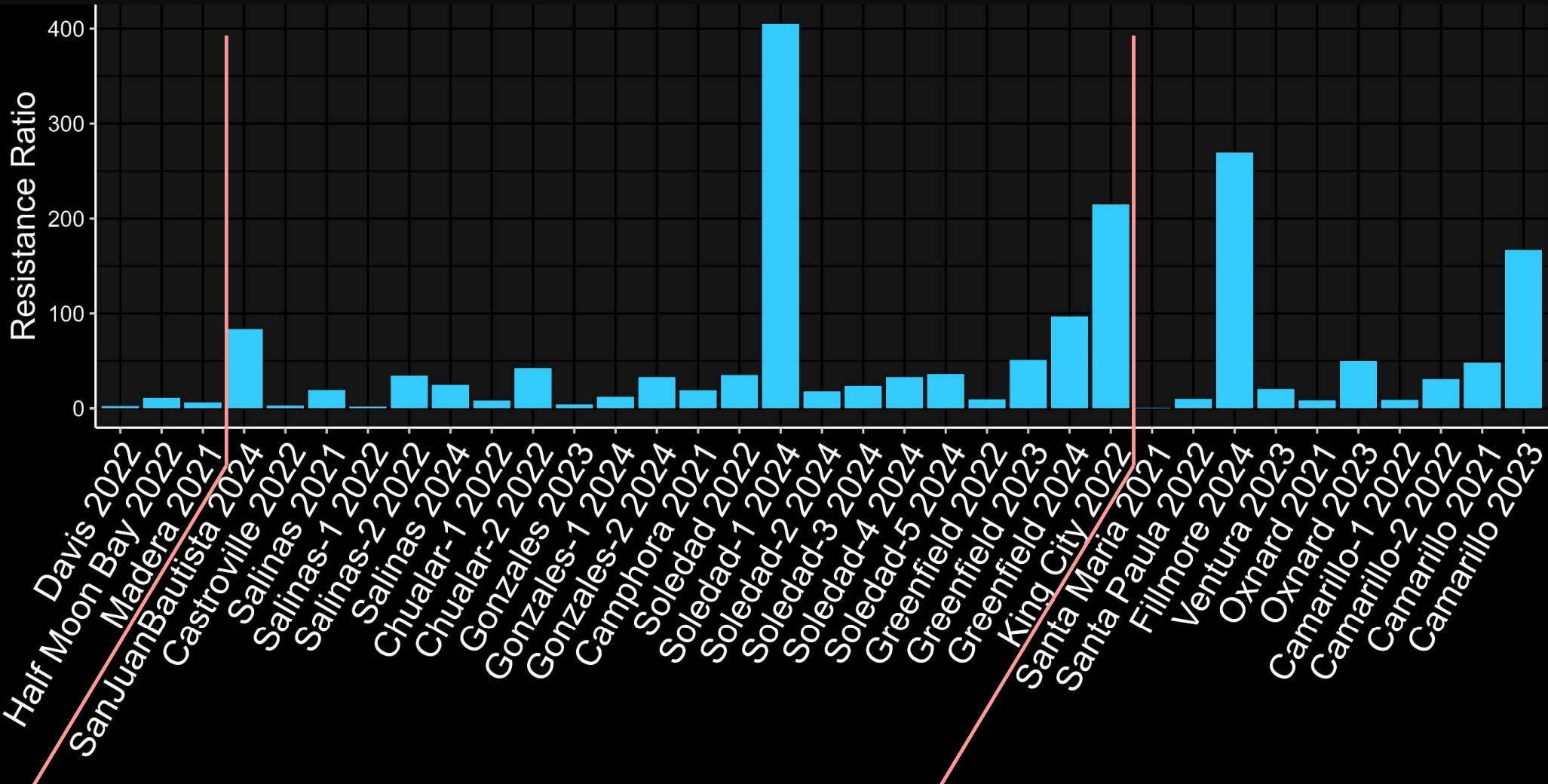
Chlorantraniliprole – Coragen (diamide)



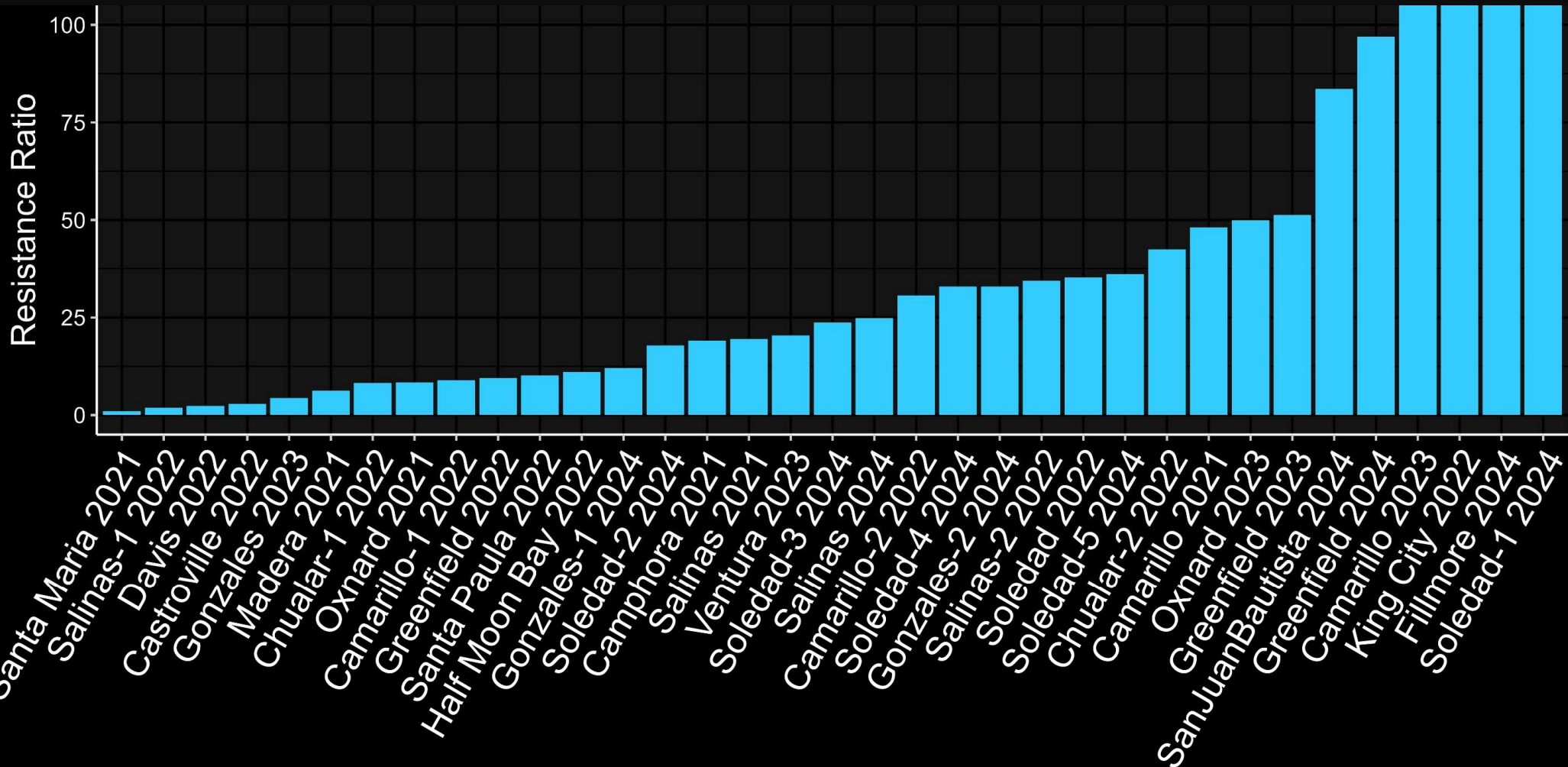
Chlorantraniliprole – Coragen (diamide)



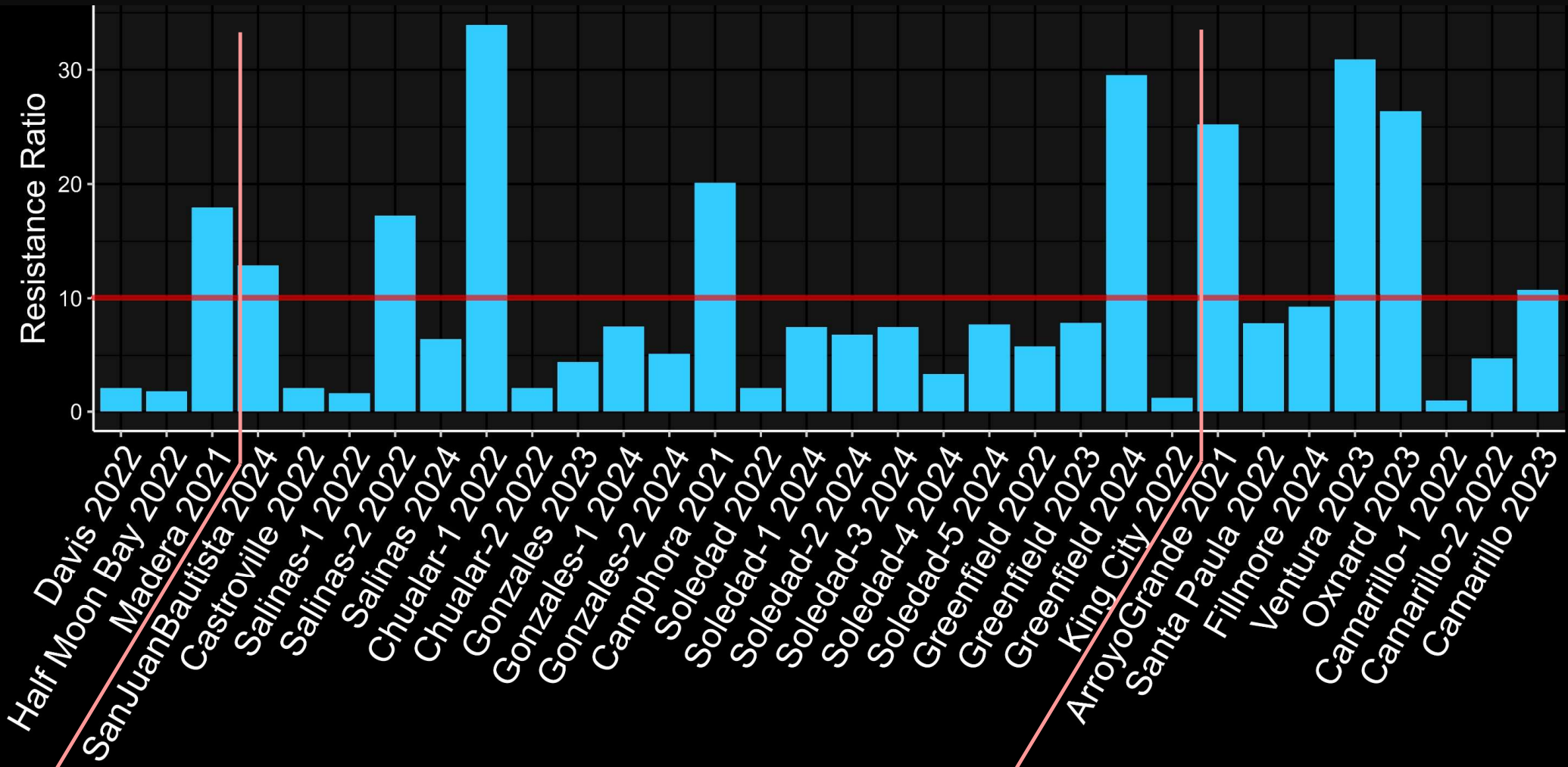
Cyantraniliprole – Exirel/Verimark) (diamide)



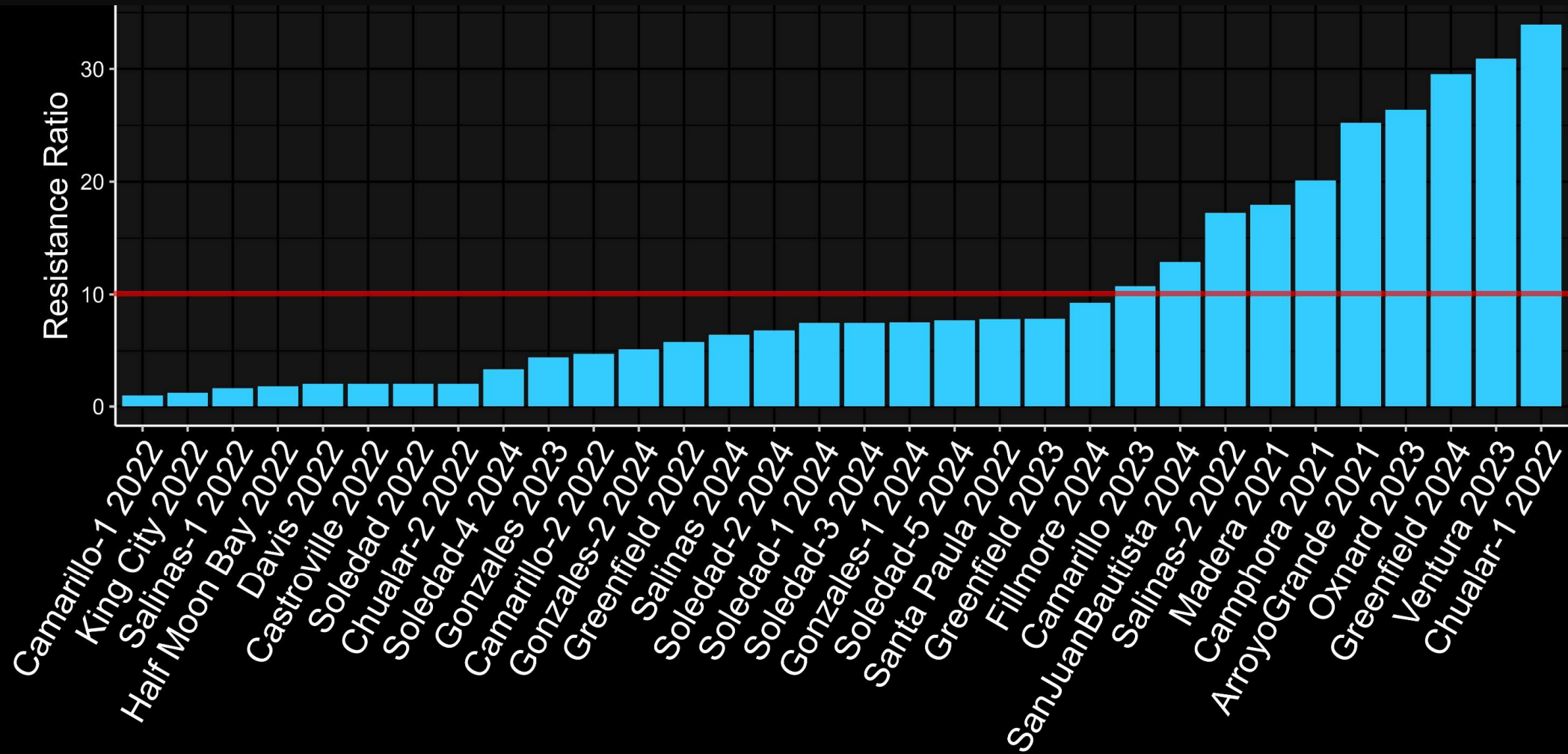
Cyantraniliprole – Exirel/Verimark) (diamide)



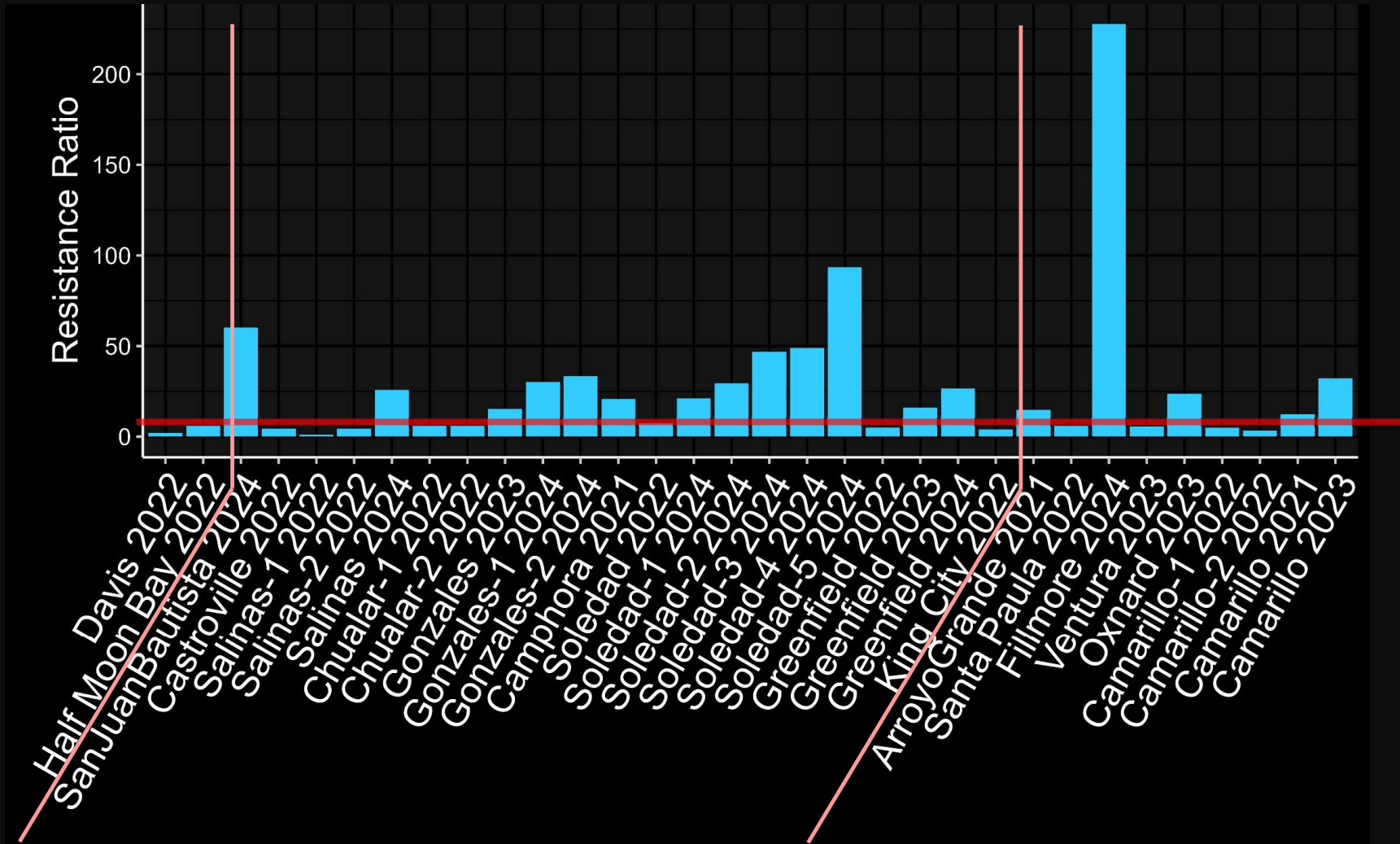
Emamectin benzoate Proclaim



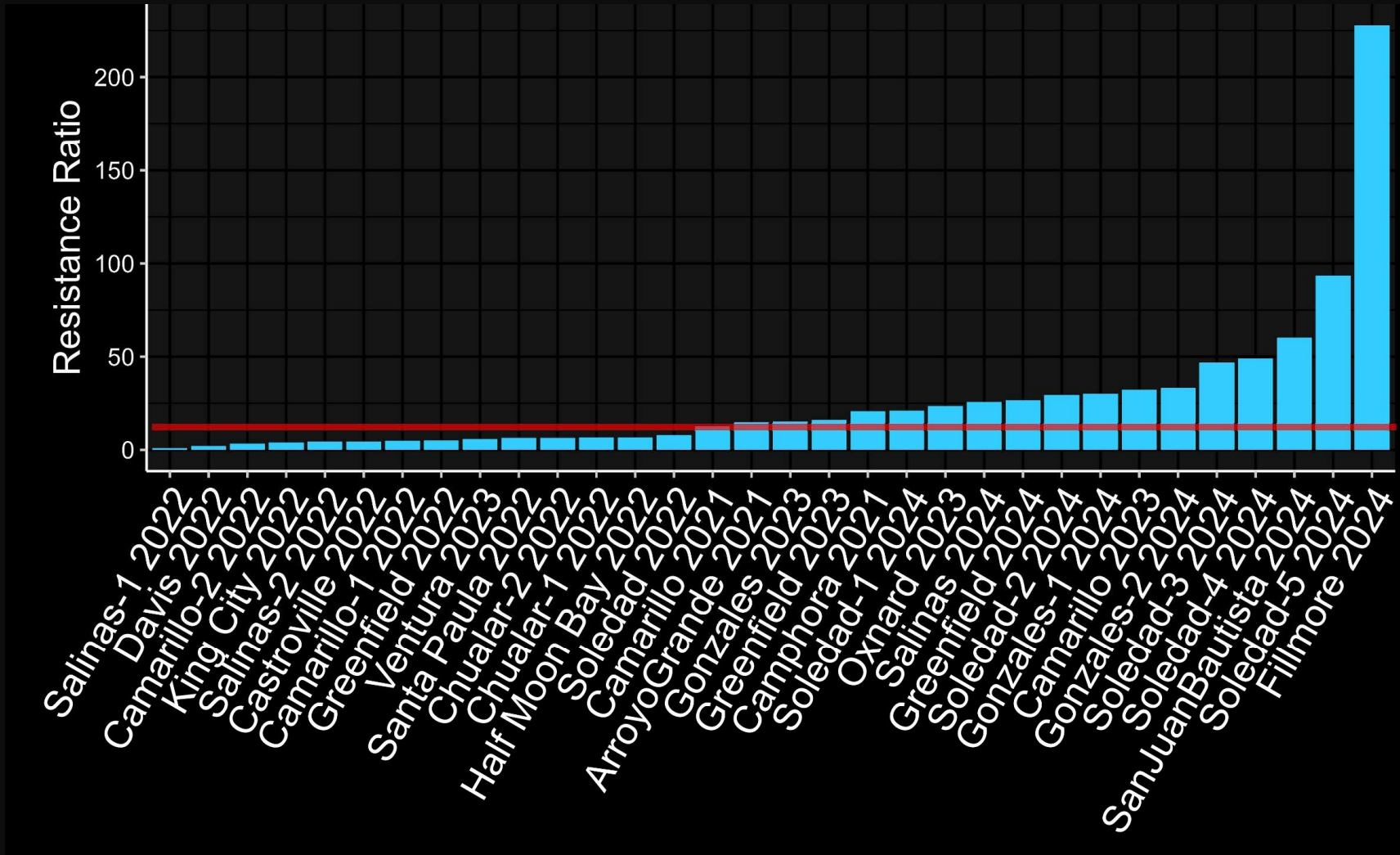
Emamectin benzoate Proclaim



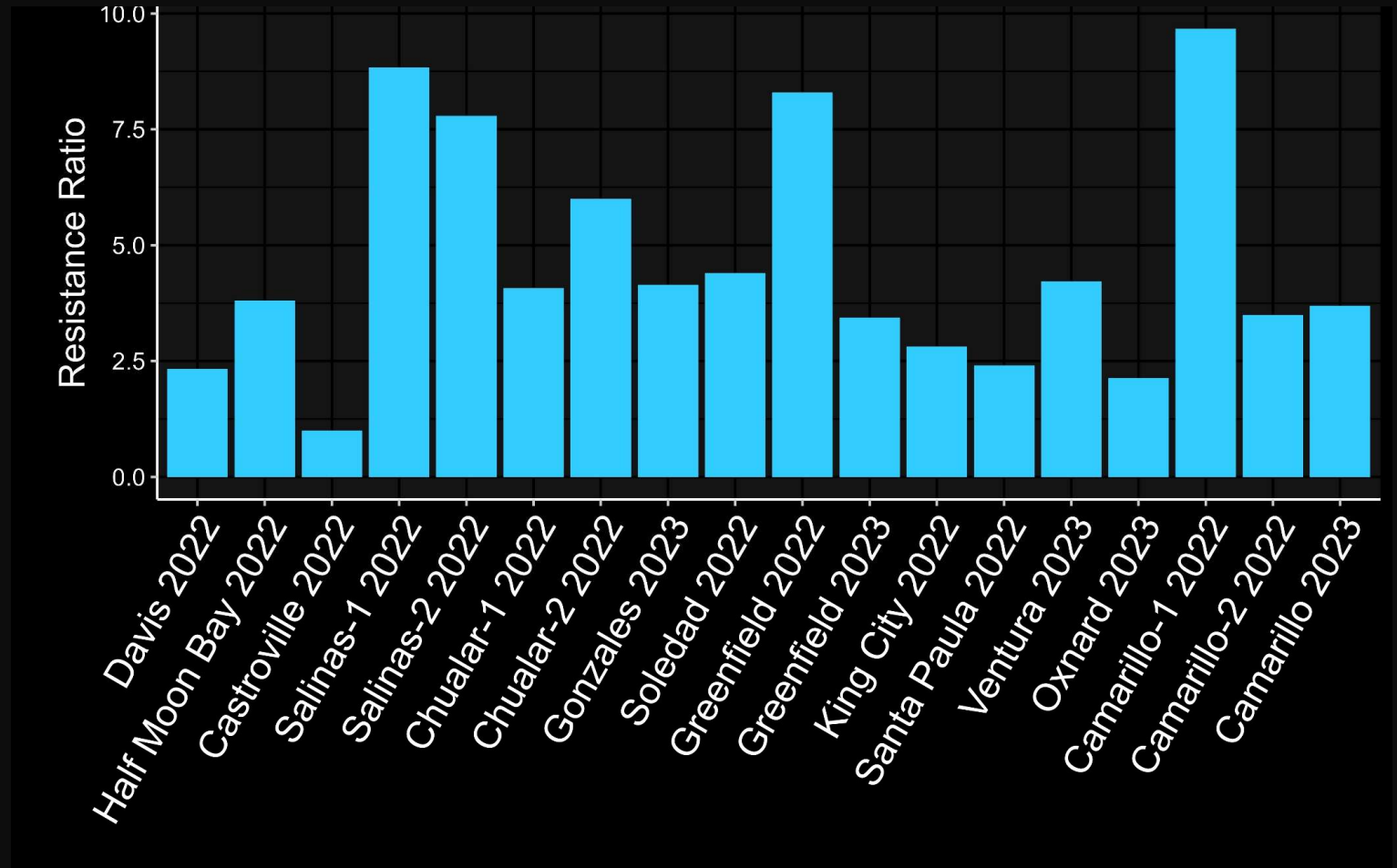
Spinetoram – Radiant (spinosyn)



Spinetoram – Radiant (spinosyn)

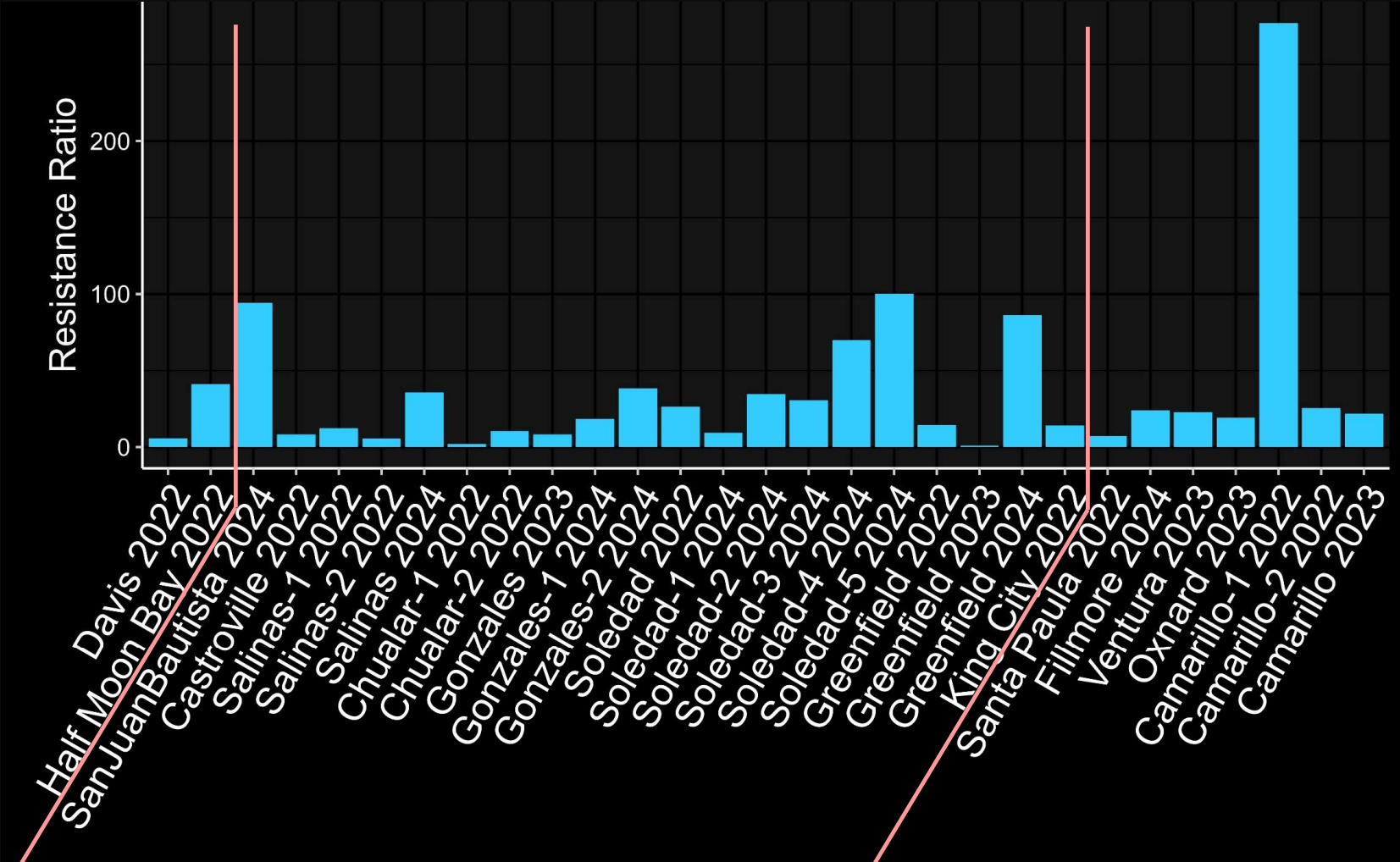


Indoxacarb Avaunt

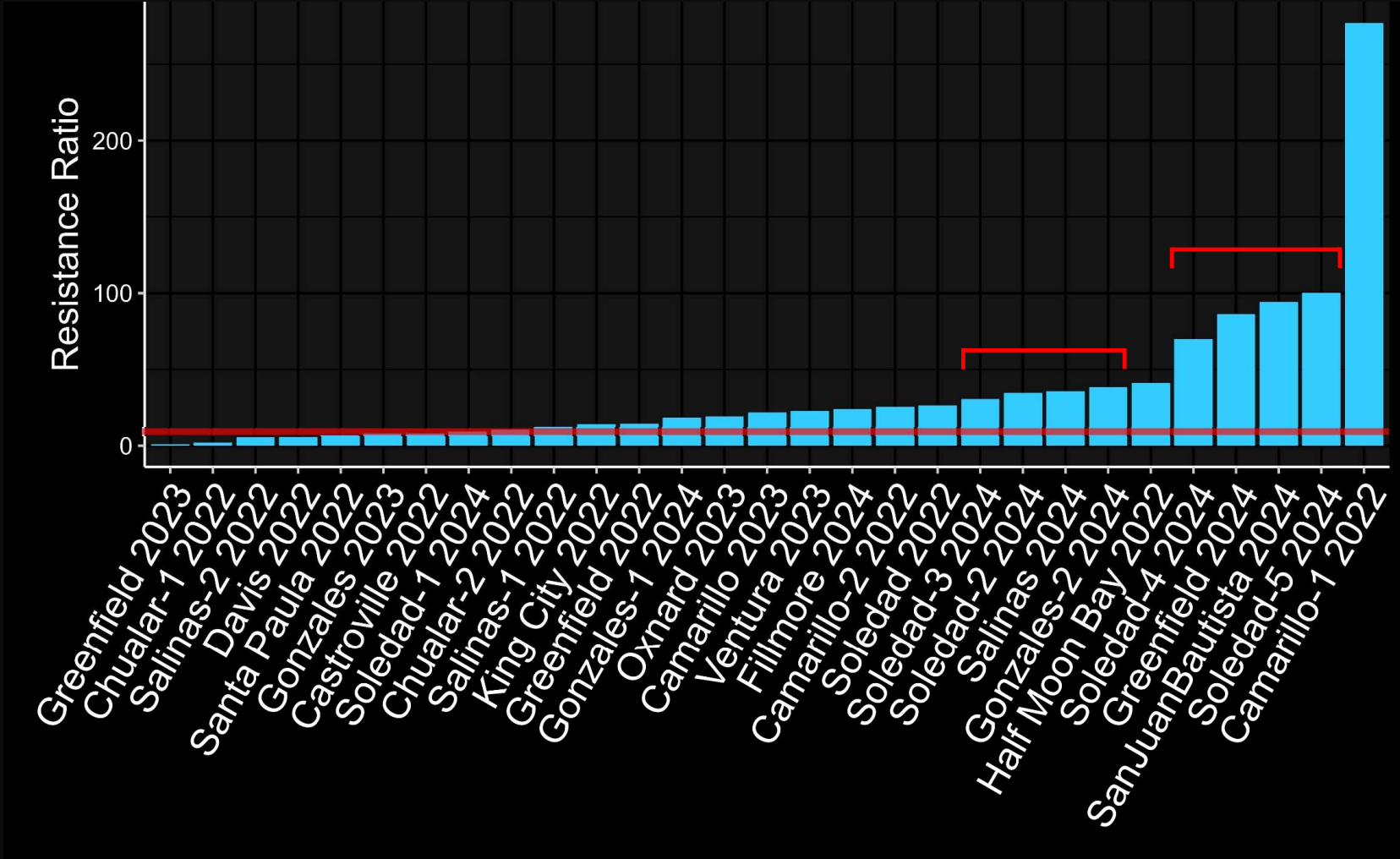


But.... LC_{50} 's
closer to
label rate

Bacillus thuringiensis/Bt aizawai - XenTari



Bacillus thuringiensis/Bt aizawai - XenTari





What has been the insecticide selection pressure in CA cole crops?

- Chemicals
- Crops
- Counties



Insecticide use



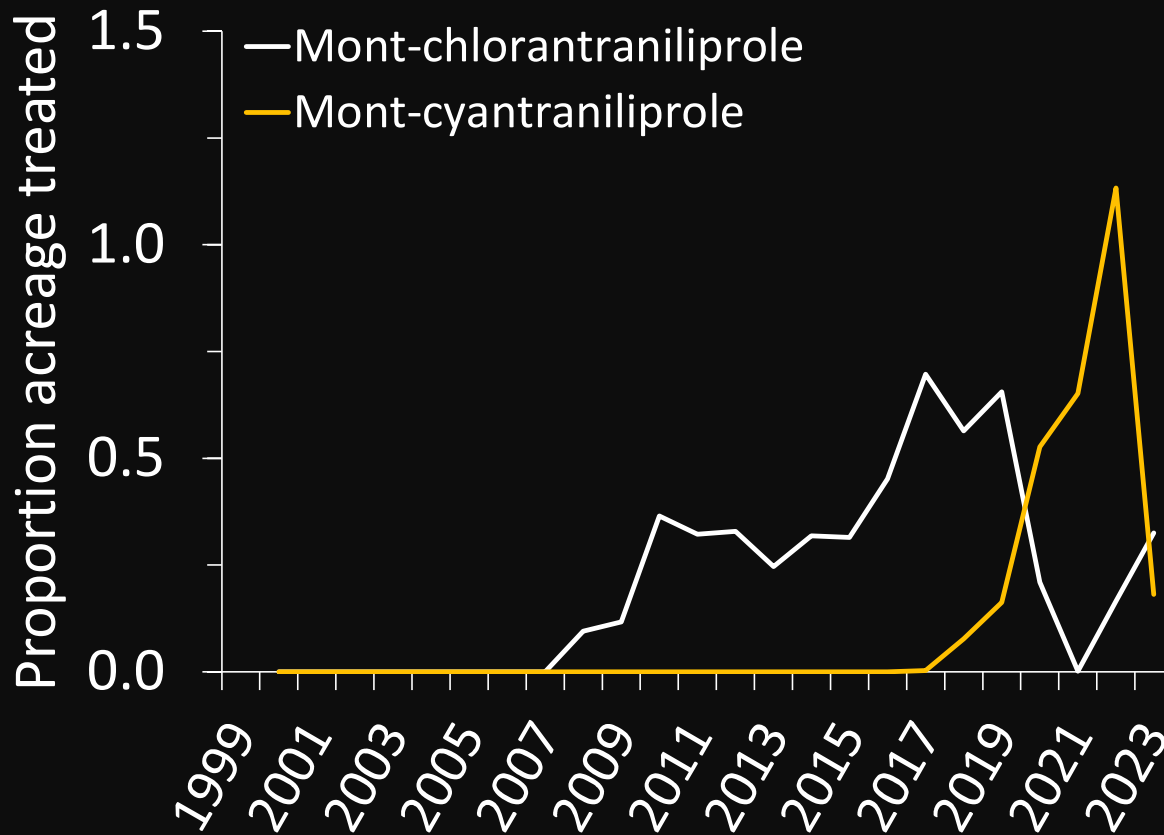
Monterey Co.



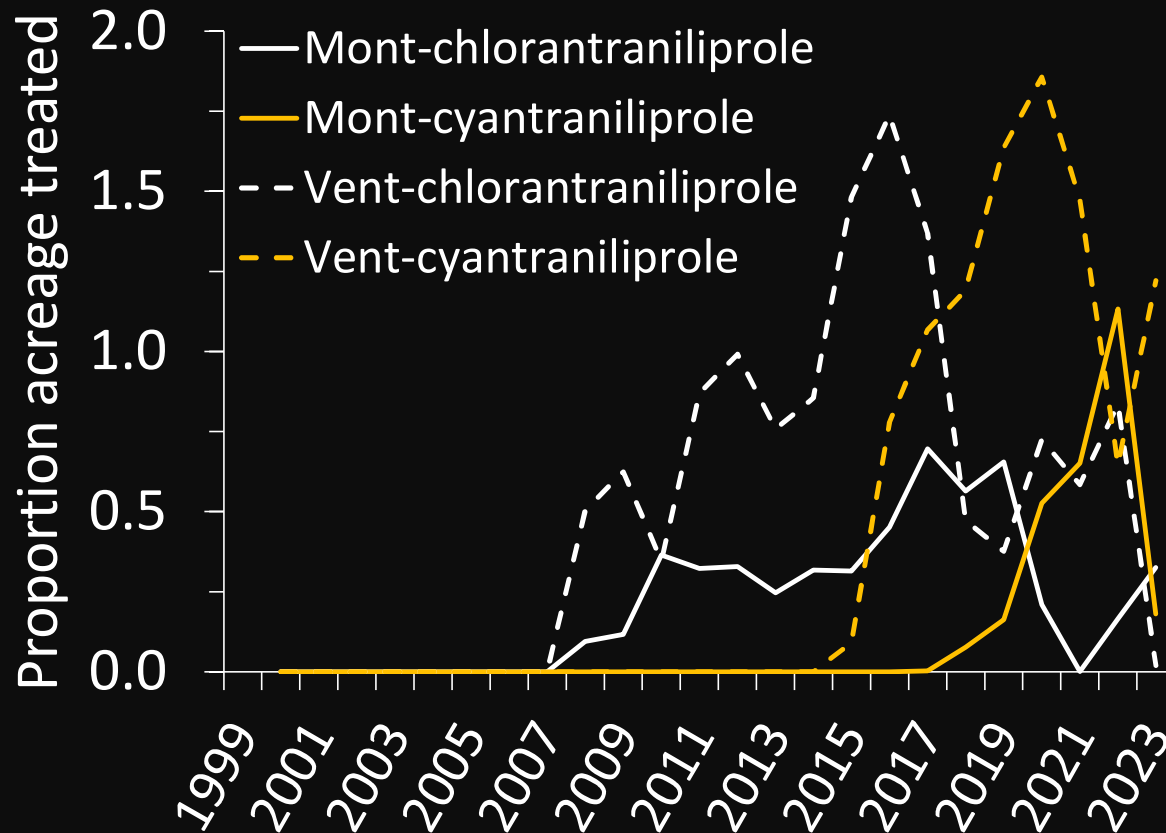
Ventura Co.



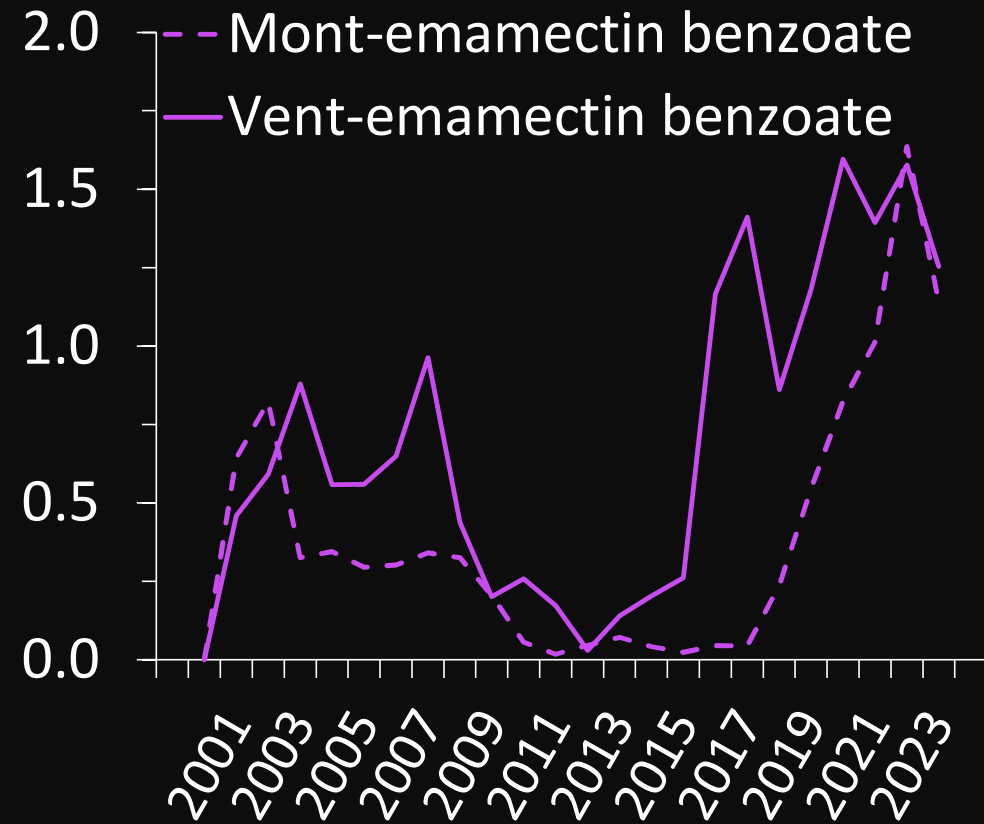
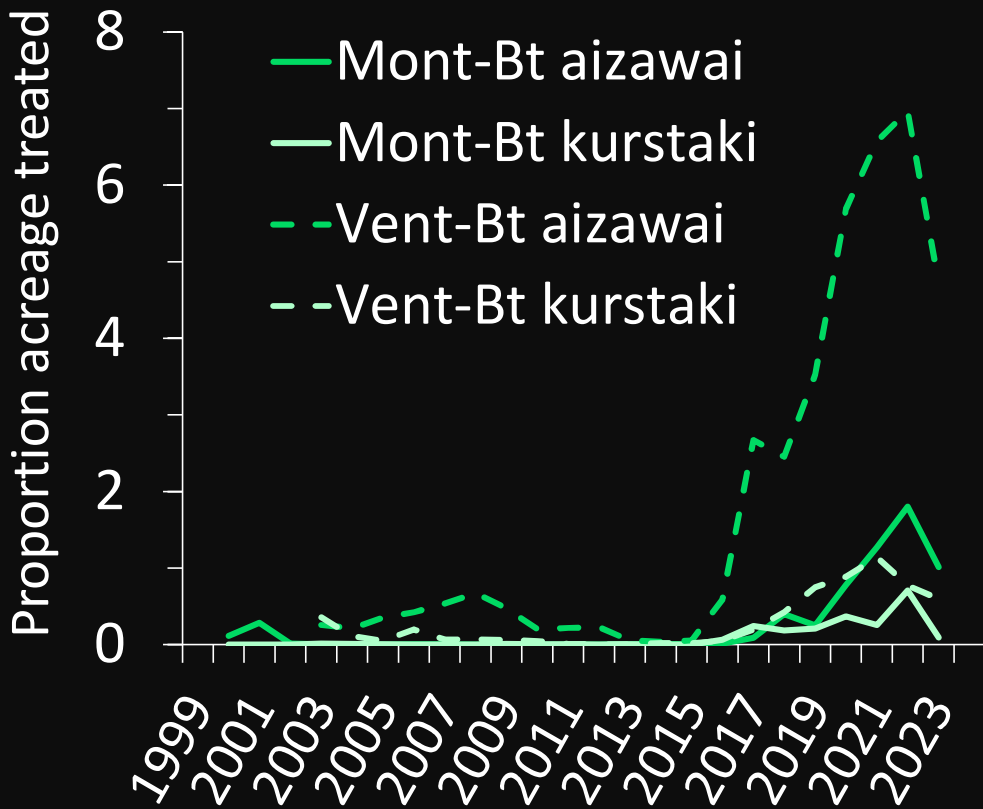
Monterey and Ventura Co. - cabbage



Monterey and Ventura Co. - cabbage



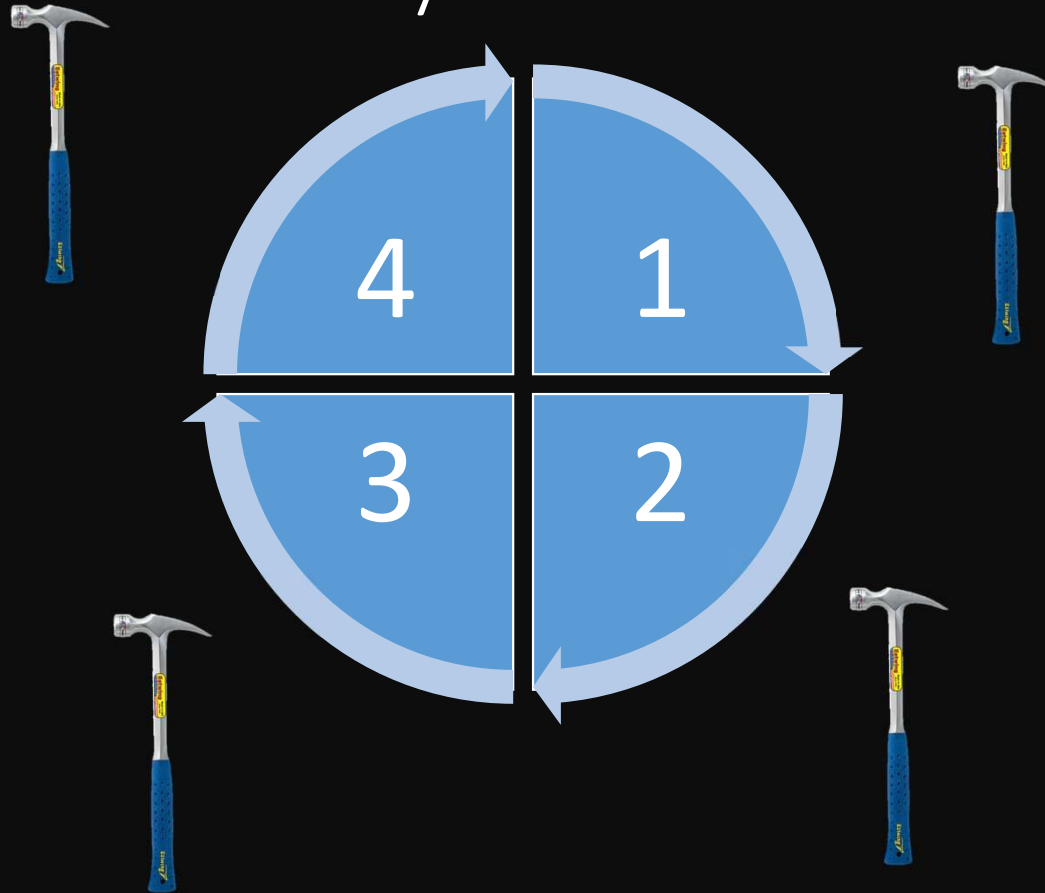
Monterey and Ventura Co. - cabbage



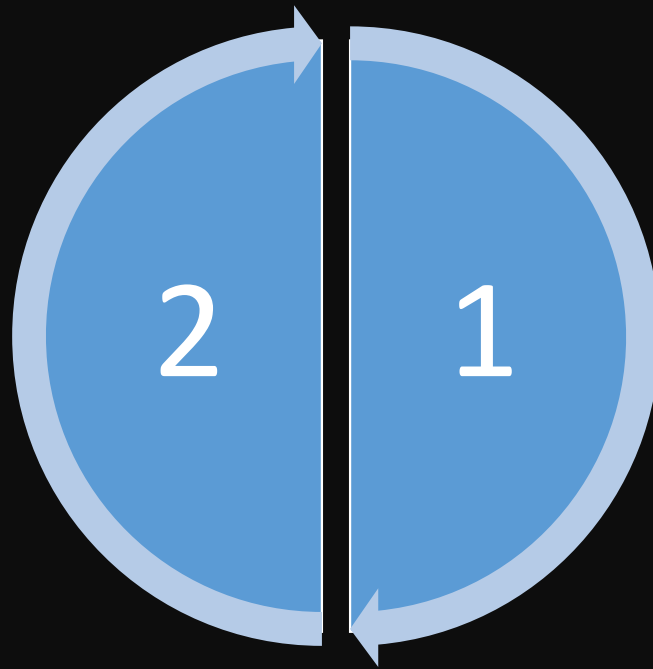
What can we do?



Rotation is necessary

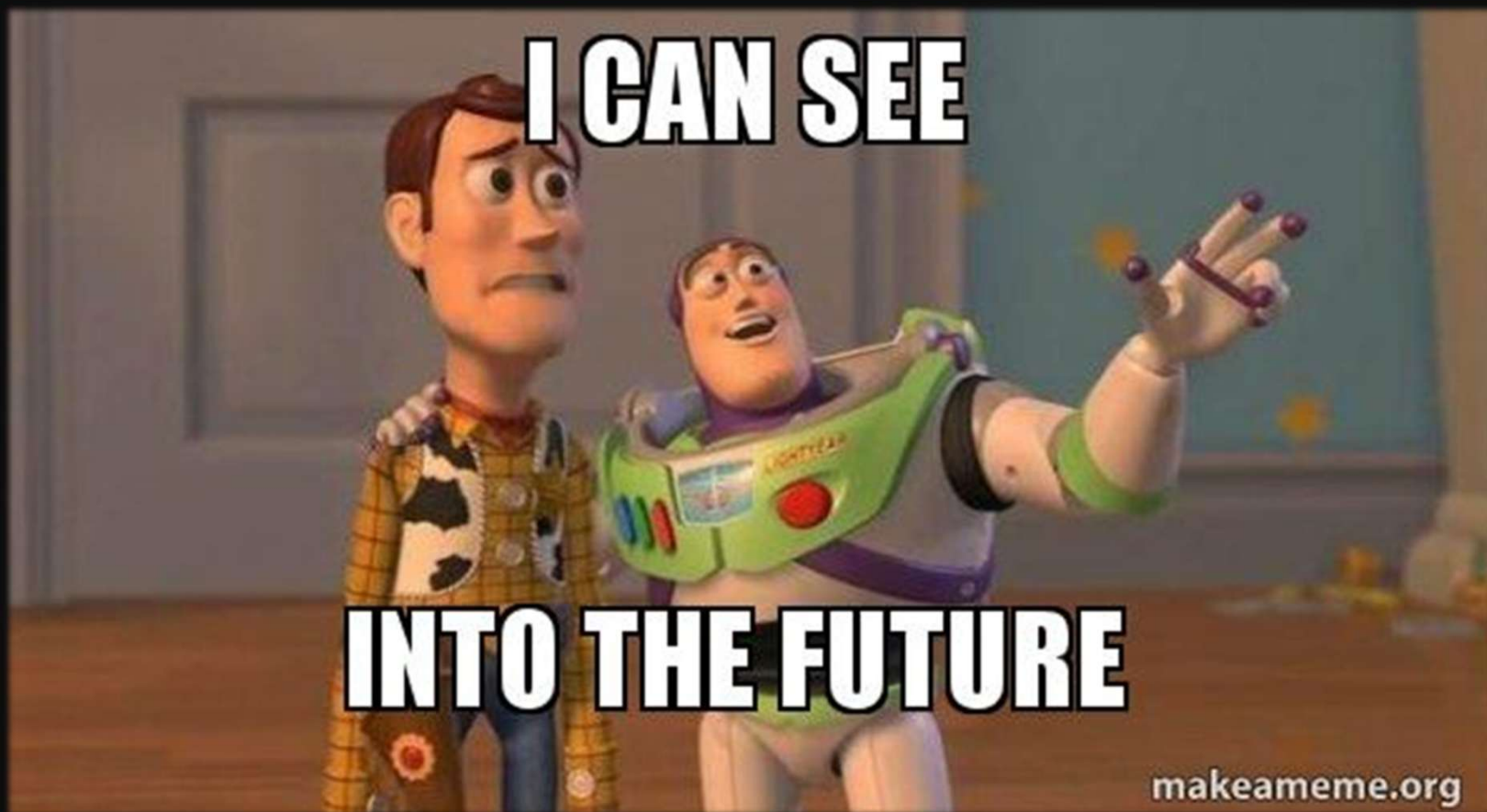


Rotation is necessary



Rotation is necessary





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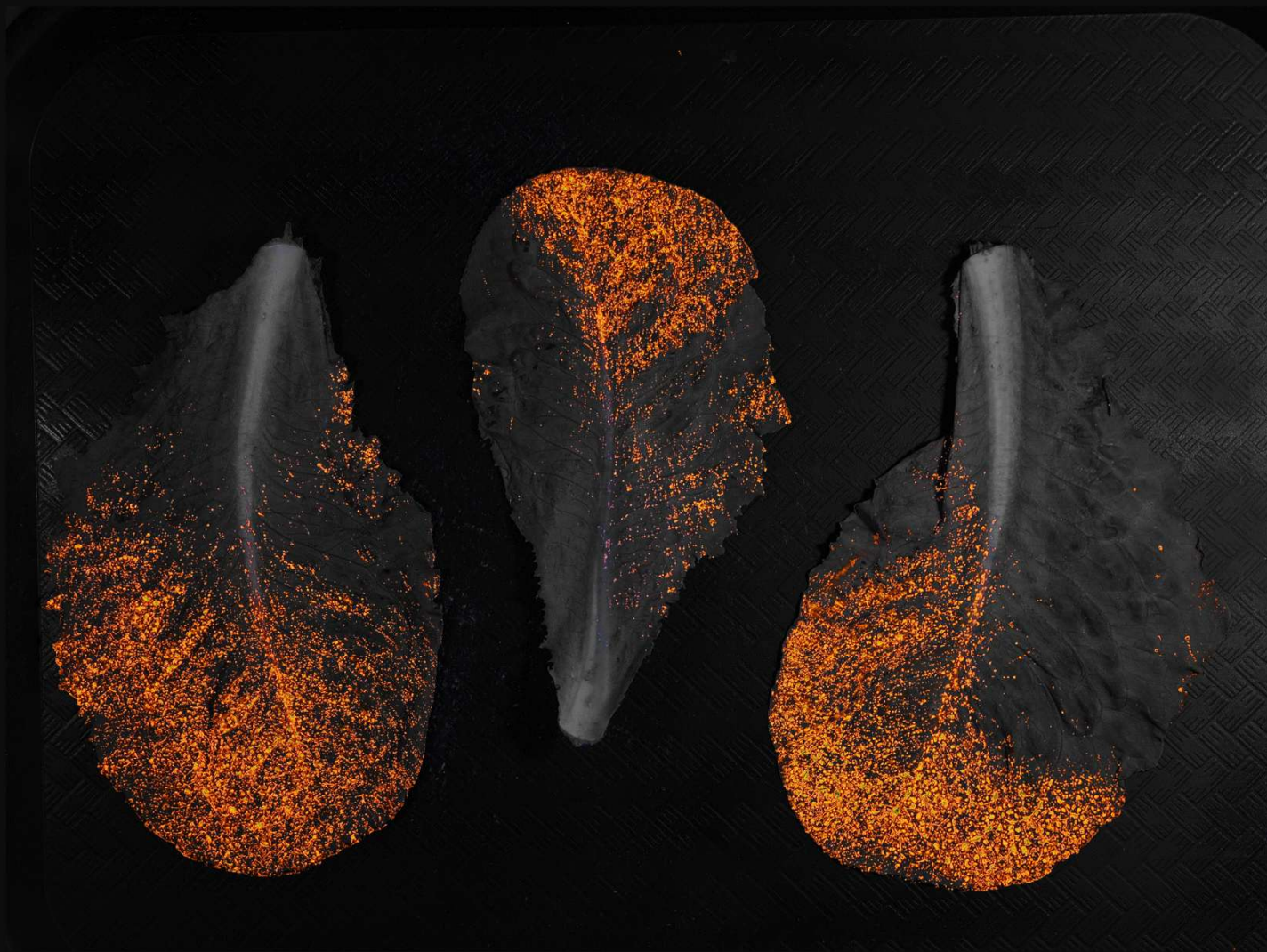








Outer
Upper



Outer
Underside













Susceptible



Susceptible



Resistant



Resistant

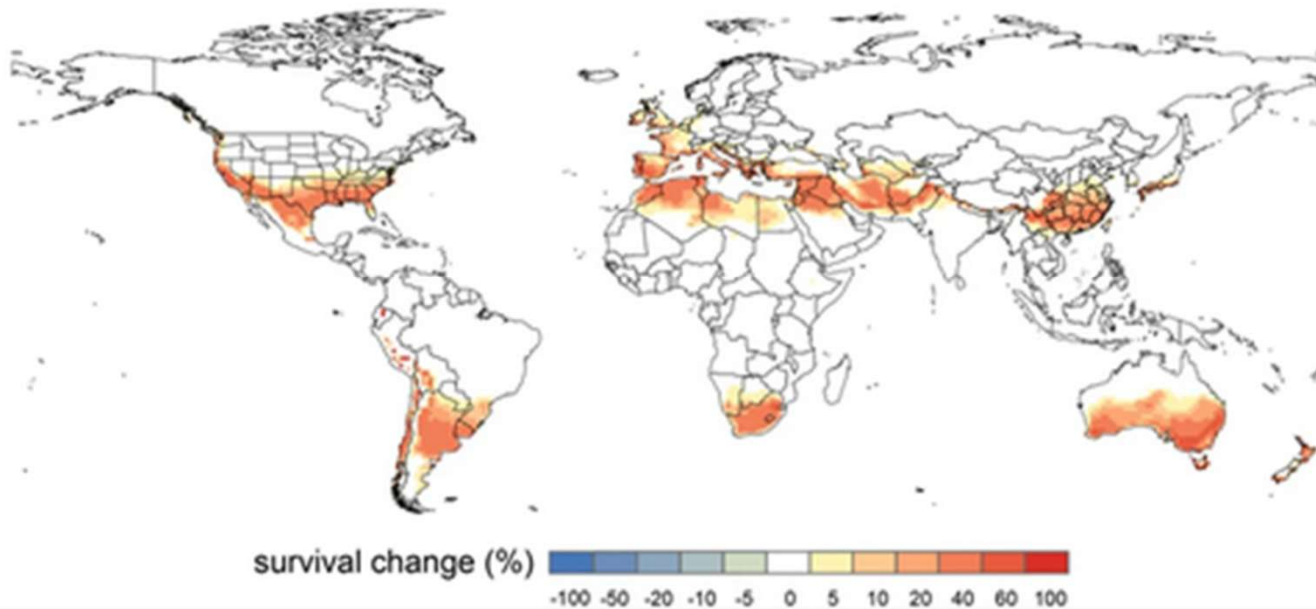


Can we avoid the icebergs?

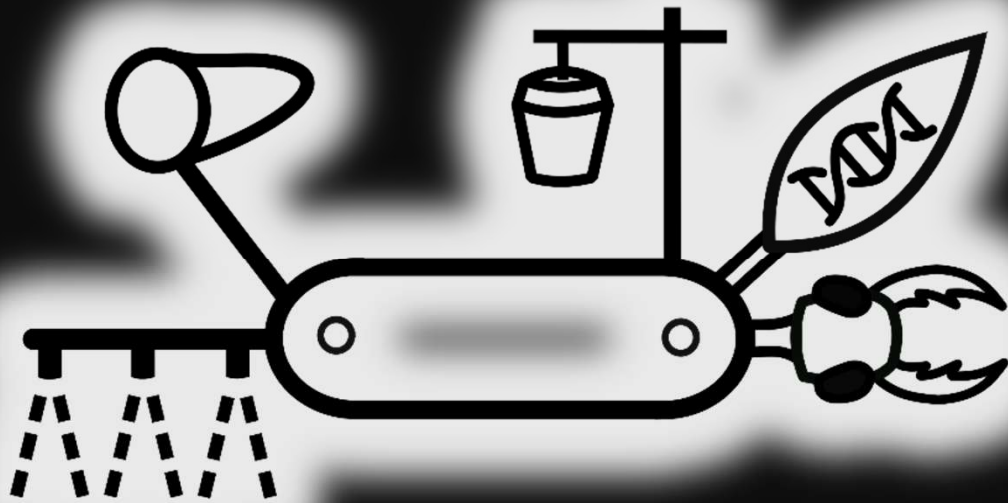


Climate warming promotes pesticide resistance through expanding overwintering range of a global pest

Future expansion (2012-2016 +2°C vs. 1967-1971)



What will it take to continue to manage diamondback moth?







New CDFA-funded project on DBM resistance, non-crop habitat, dispersion and mating disruption



Ian Grettenberger
UCD



Daniel Hasegawa
USDA-ARS



Ricky Lara
CDFA



Matt Greishop
Cal Poly SLO



Oleg Daugovish
UCCE Ventura

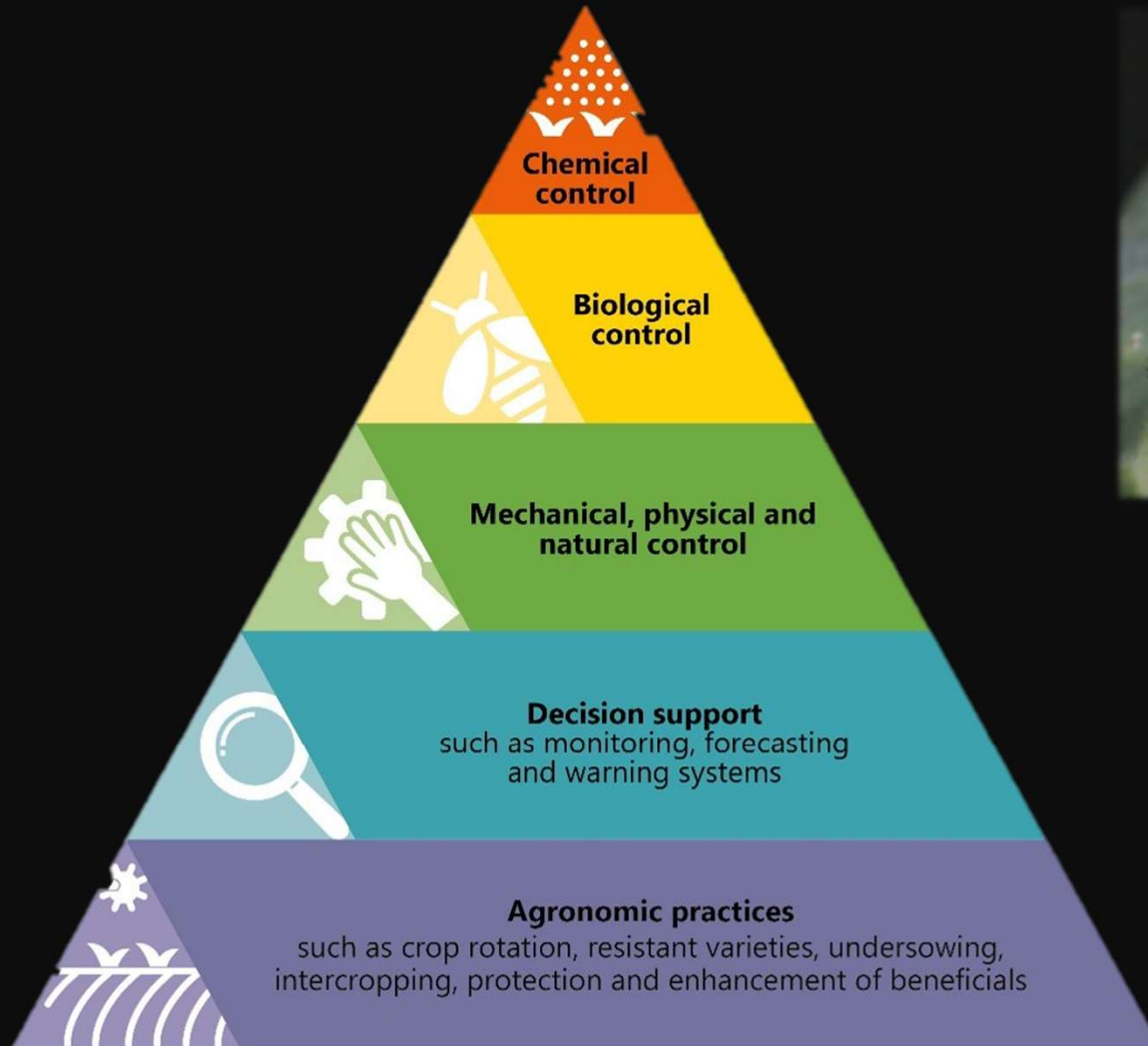


Hamutahl Cohen
UCCE Ventura



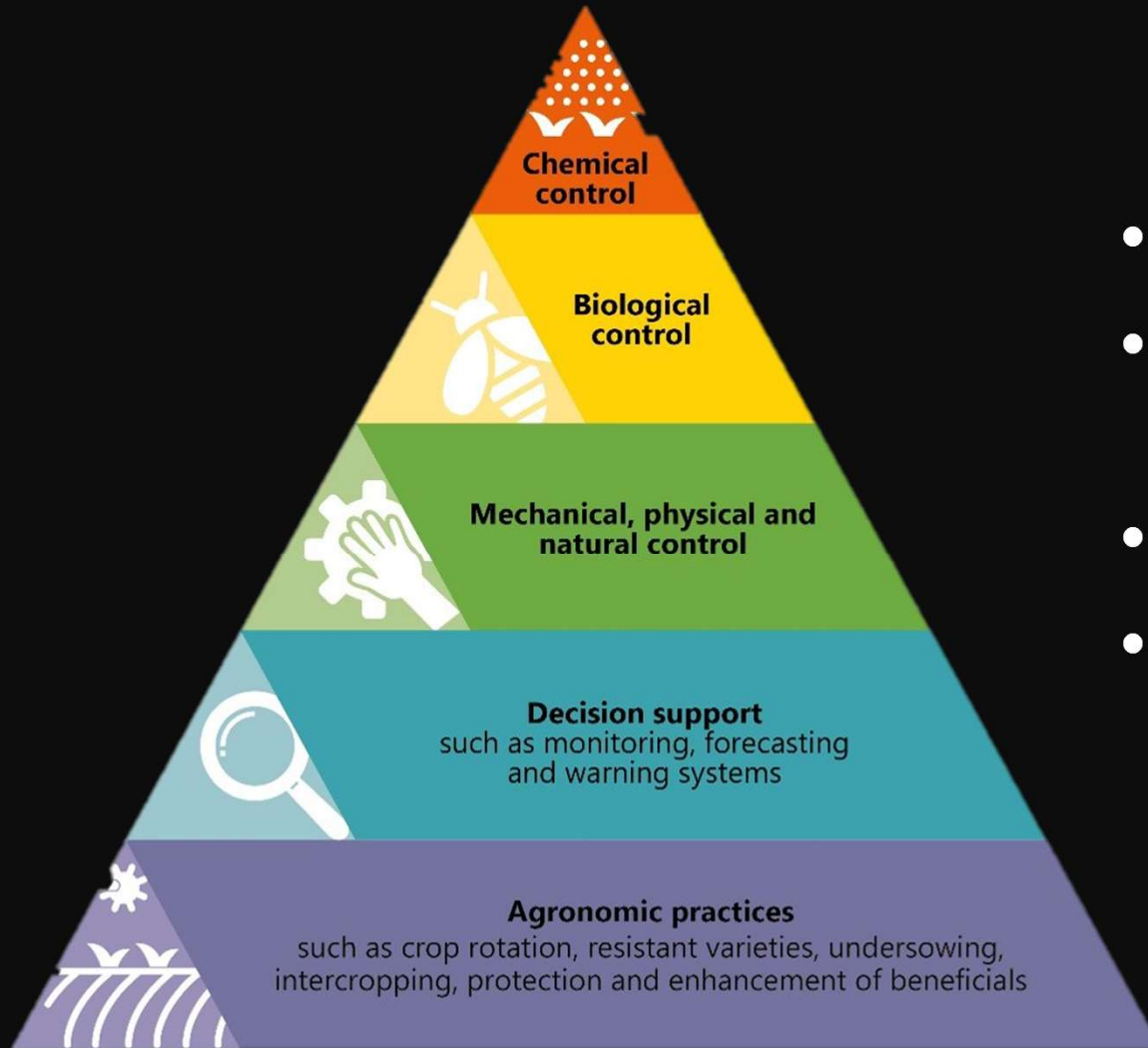
Dylan Beal
UCCE Monterey/Santa
Cruz/San Benito







Index Open



- Mating disruption
- Non-crop hosts and dispersal
- Resident parasitoids
- Insecticide resistance

Mating disruption



PC: Oxitec

Mating disruption



PC: Oxitec

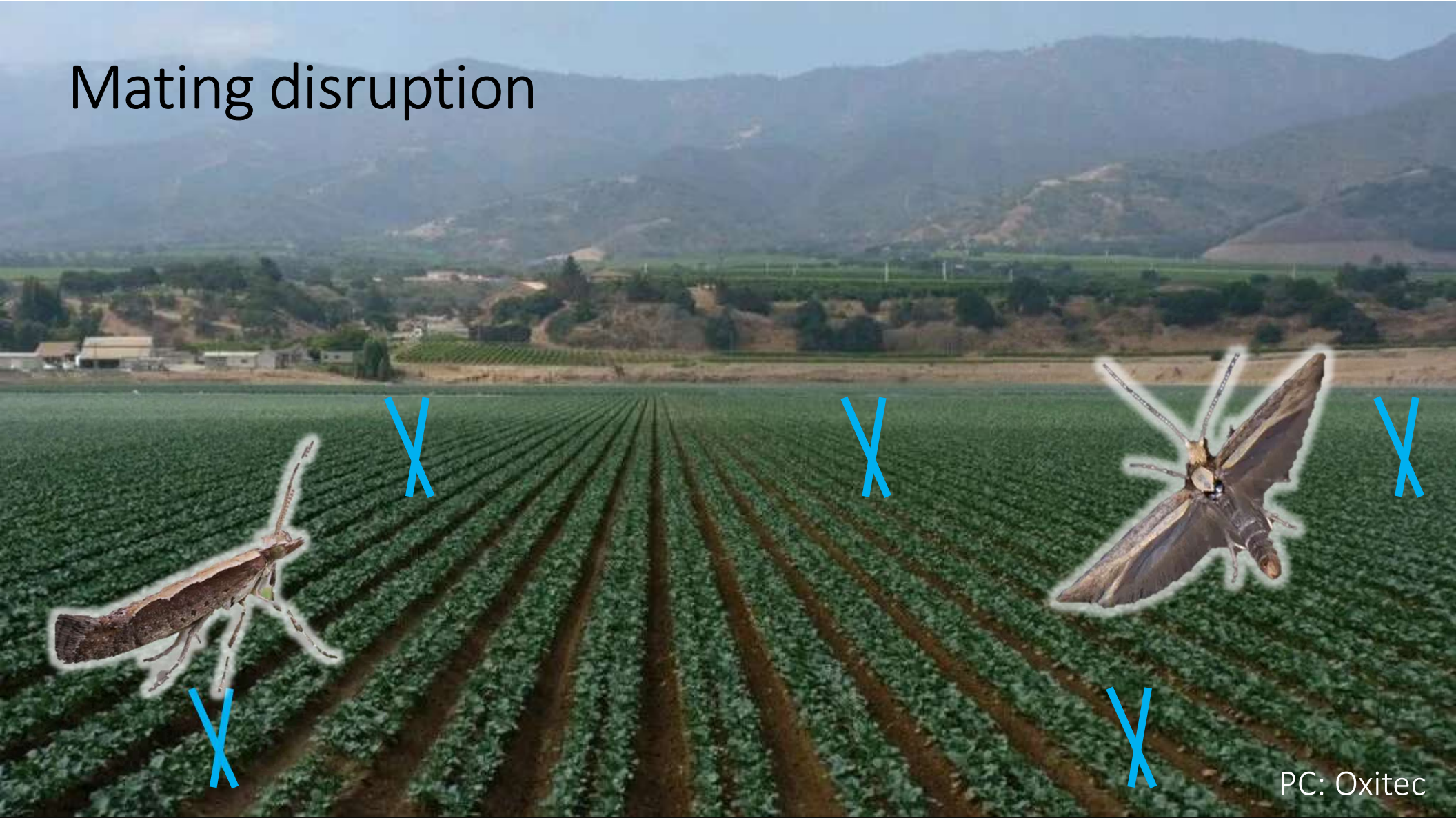


Mating disruption

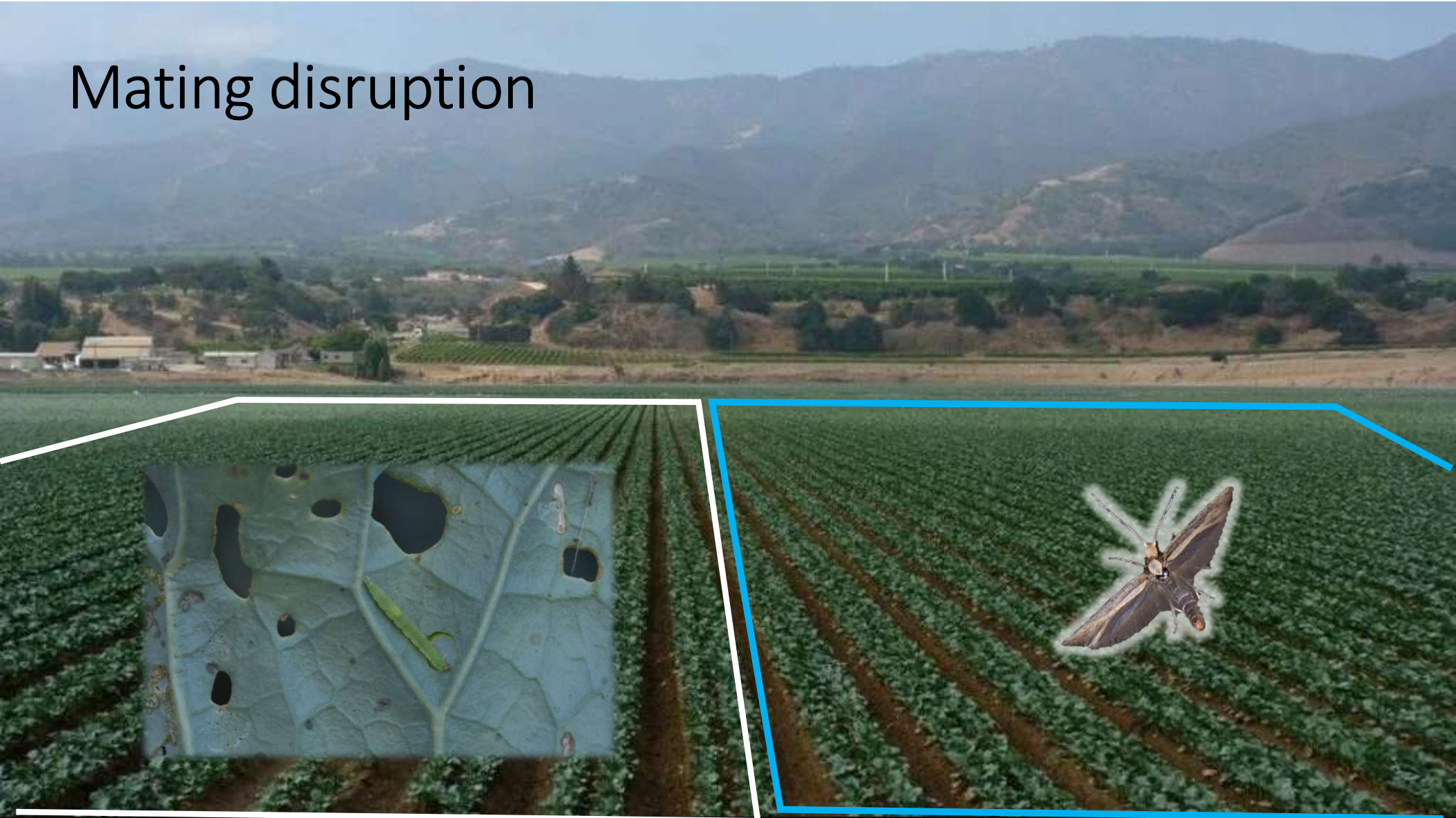


PC: Oxitec

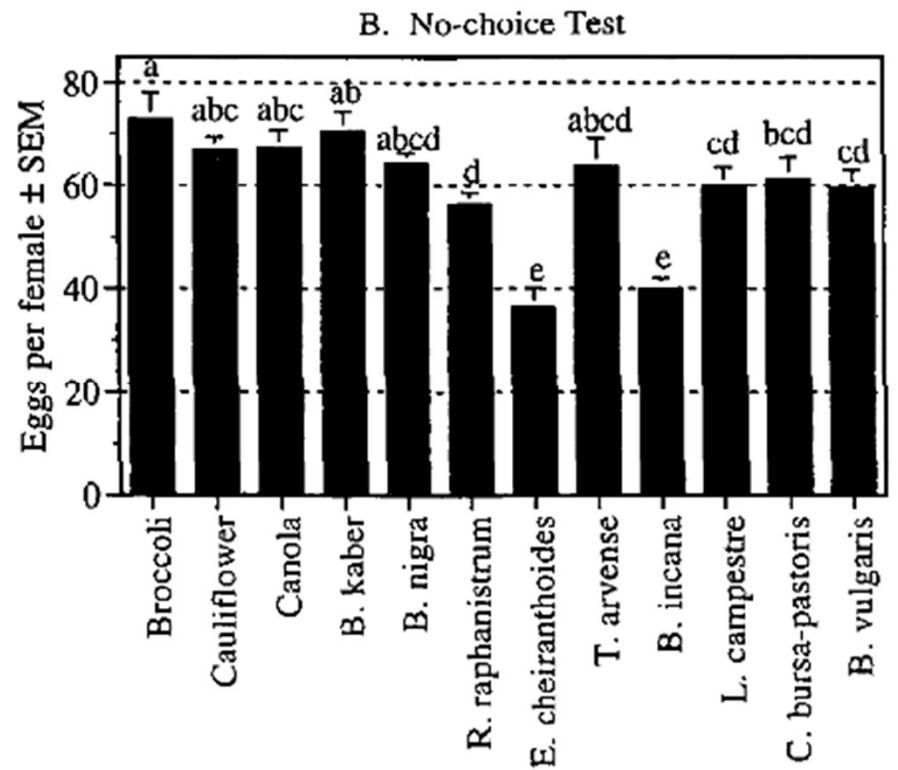
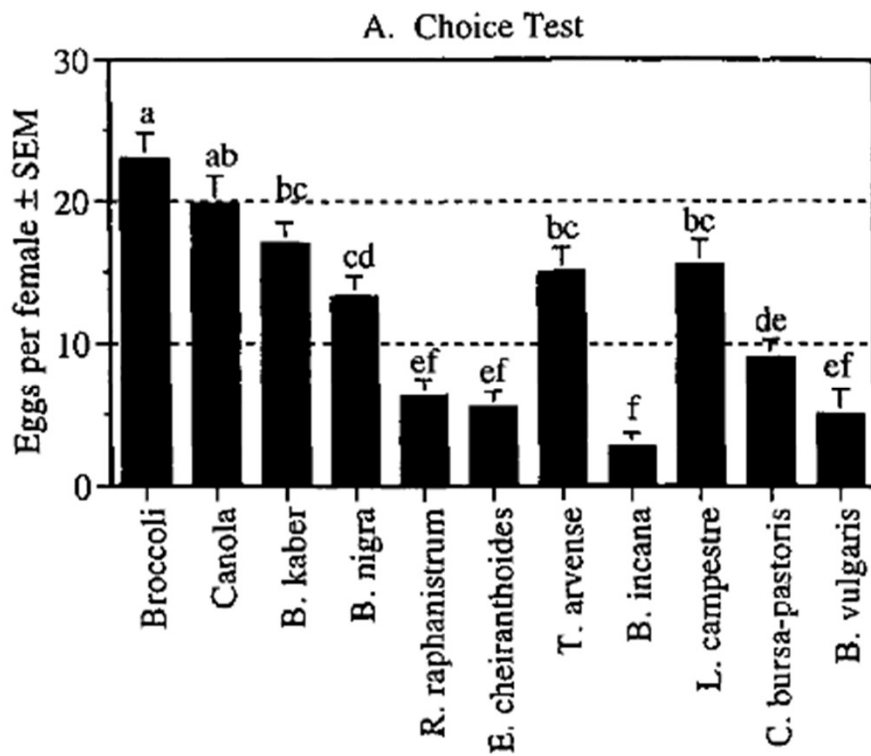
Mating disruption



Mating disruption



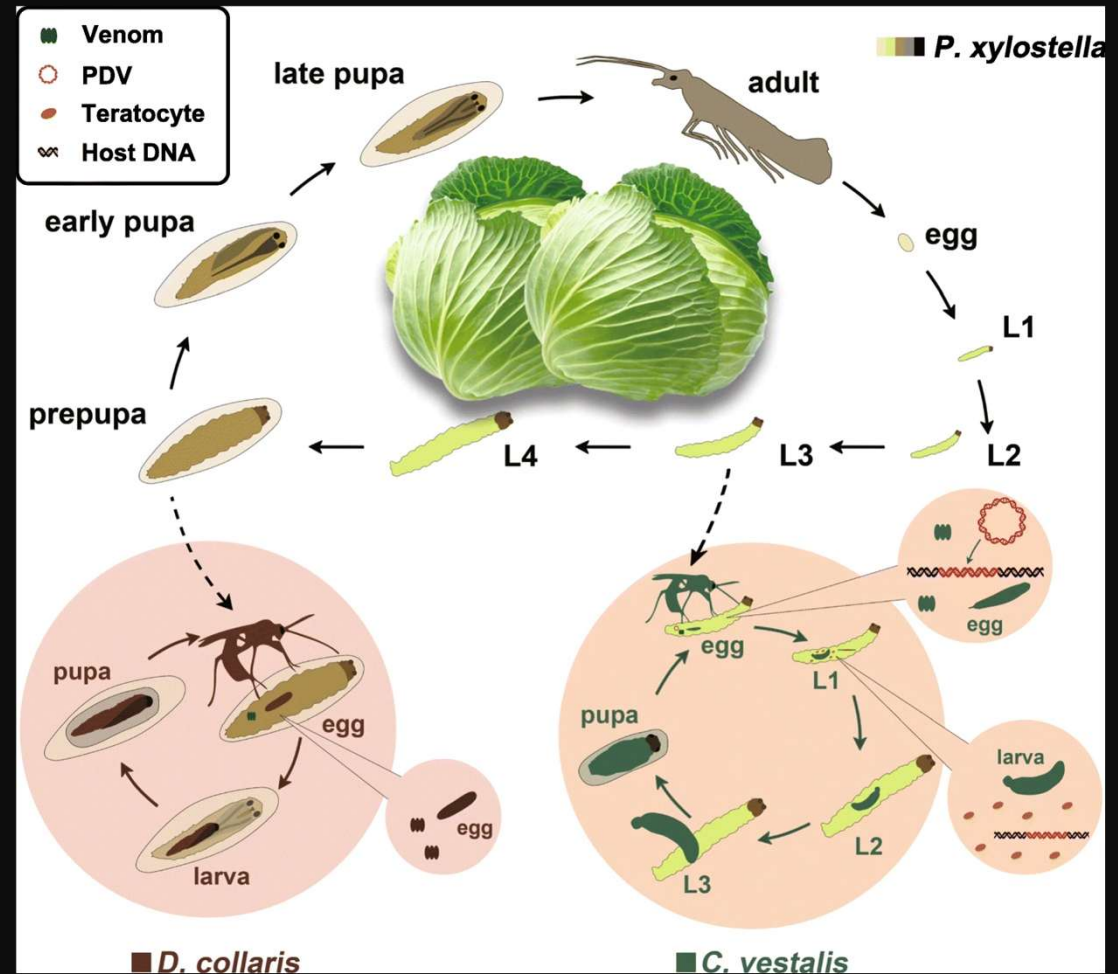




Idris and Grafius 1996

DBM parasitoids

- 150+ of hymenopteran parasitoids recorded in the world.
- Egg: Trichogramma parasitoids. Not entirely host specific to just DBM. Inundative biological control.
- Larval parasitoid: *Diadegma insulare*
- Larval parasitoid: *Diadegma semiclausum*
- Pupal parasitoid: *Diadromus collaris*



Shi et al. 2019

From Ricky Lara, CDFA

Biological control – resident parasitoids

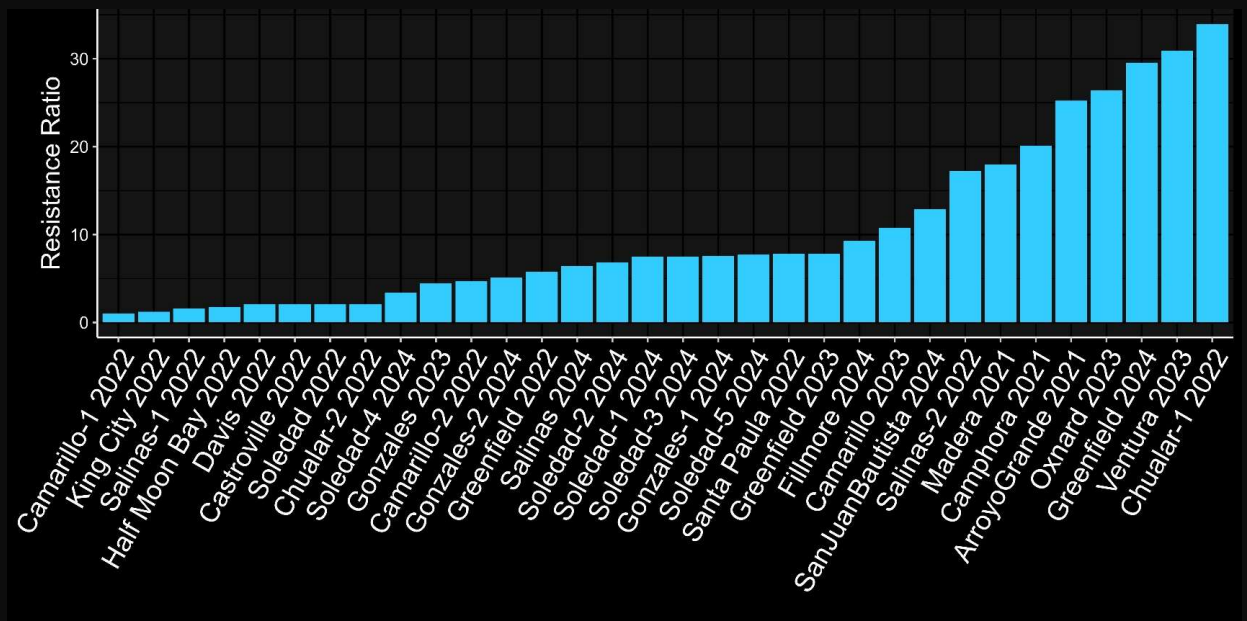


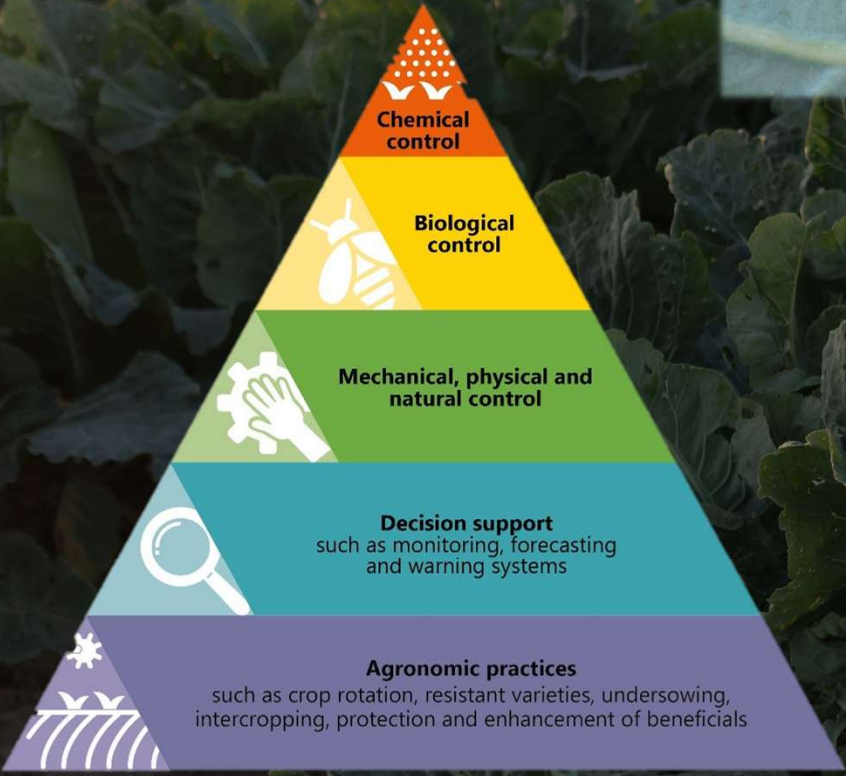
Cotesia sp. parasitizing DBM larvae



From Ricky Lara, CDFA
J. Holopainen

Insecticide resistance - monitoring





Acknowledgements




- Kevin Goding
- Field-Vegetable IPM lab undergraduates
- Industry cooperators/FMC
- PCA/grower cooperators

Questions?

imgrettenberger@ucdavis.edu



- 
- Kevin Goding
 - Field-Vegetable IPM lab undergraduates
 - Industry cooperators/FMC