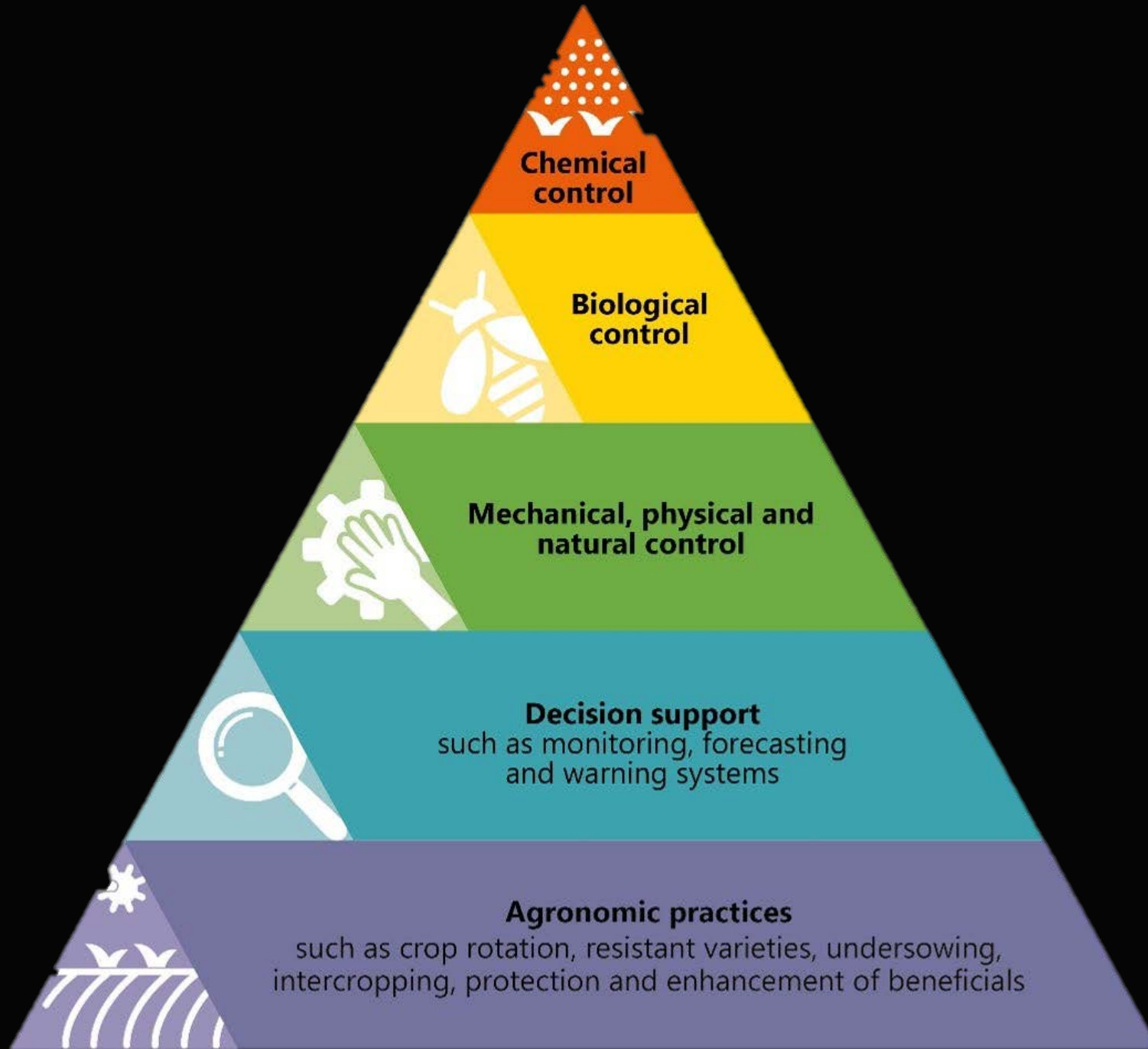
A close-up photograph of alfalfa leaves. One leaf in the foreground shows a distinct hole eaten into it. At the bottom left of this leaf, a small, green, segmented caterpillar is visible. Another leaf to the right also shows signs of damage. The background is a soft-focus green.

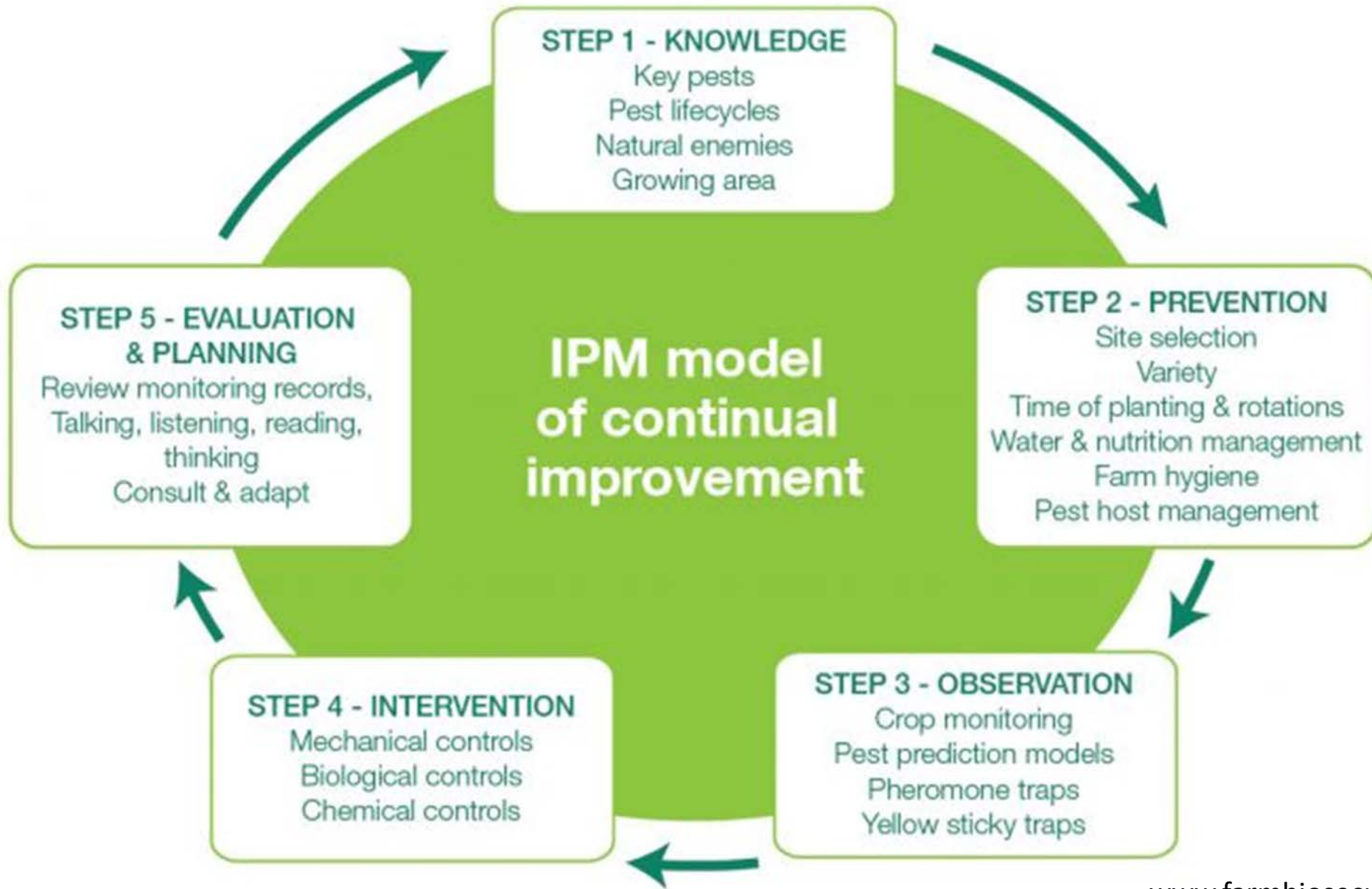
Insect IPM in alfalfa:
Case studies of issues with alfalfa
weevil and aphids

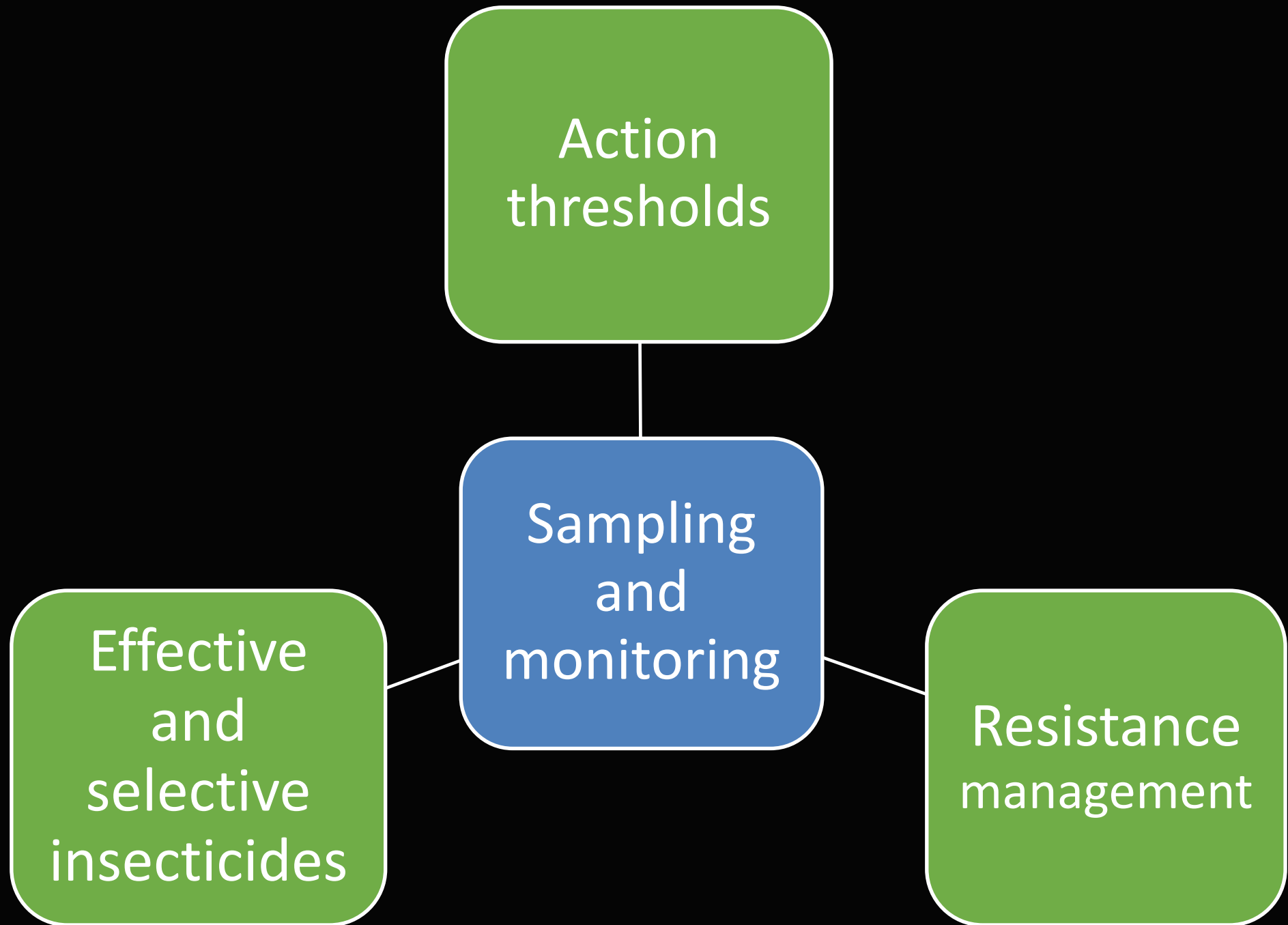
Ian Grettenberger – UC Davis
Field and Veg. Crop Entomology CE Specialist











EVERYTHING WILL CHANGE

EVERYTHING HAS CHANGED

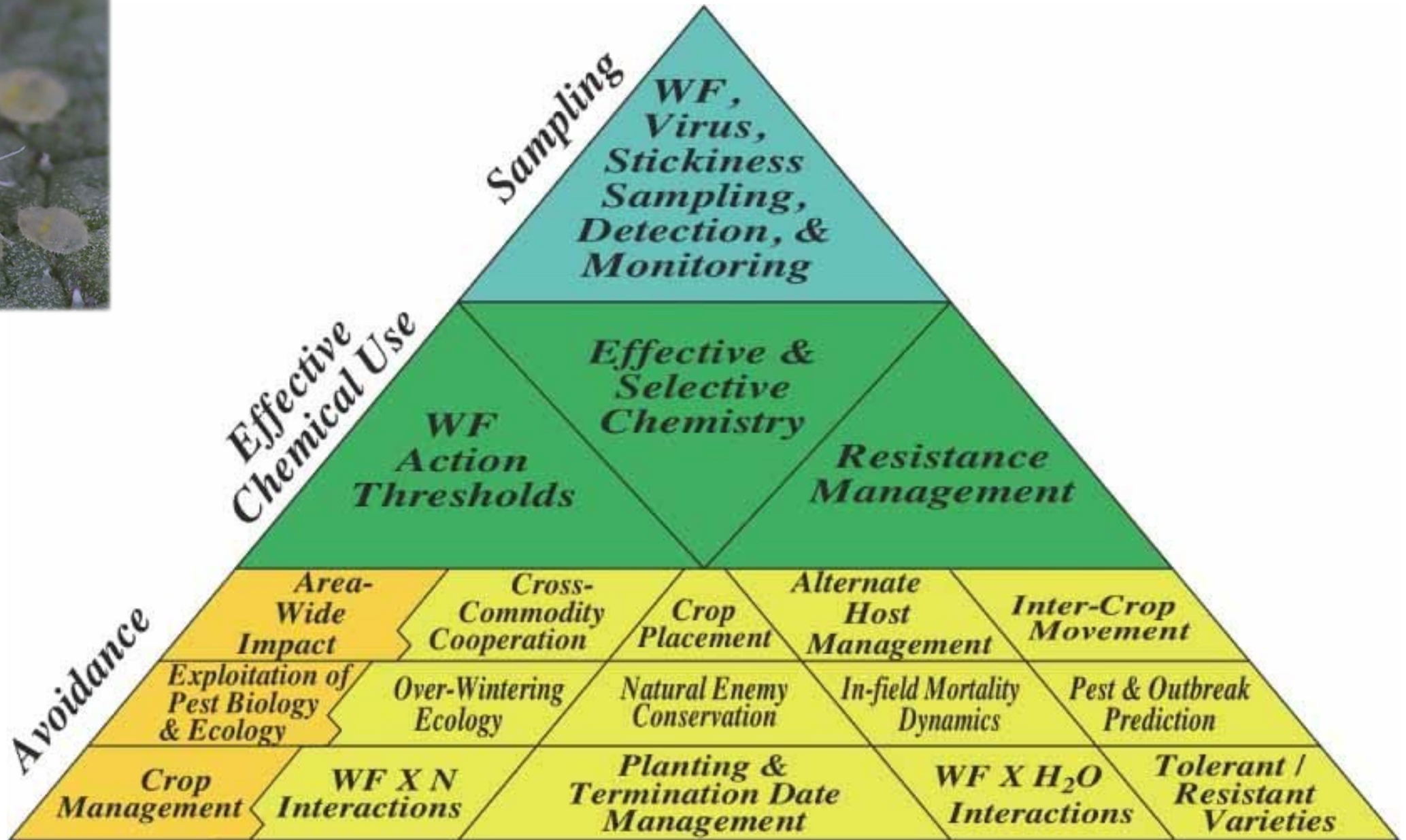


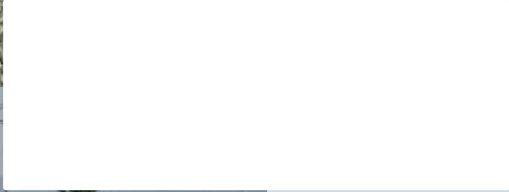
CHANGE

It's never too late to turn over a new leaf, unless you're really really old and close to the end. Then ya, it's probably too late.

- IPM can't be "close to the end"...

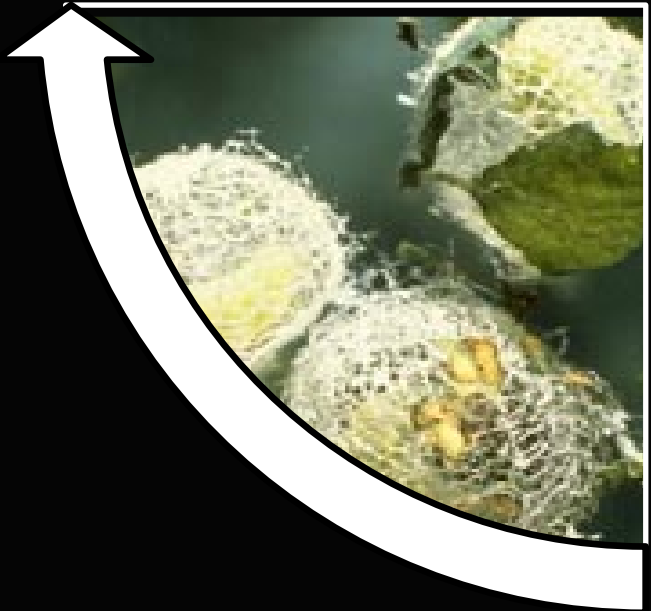
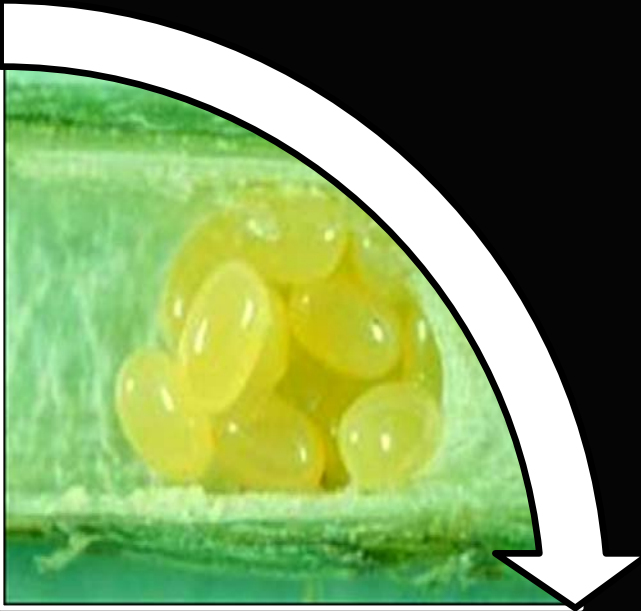
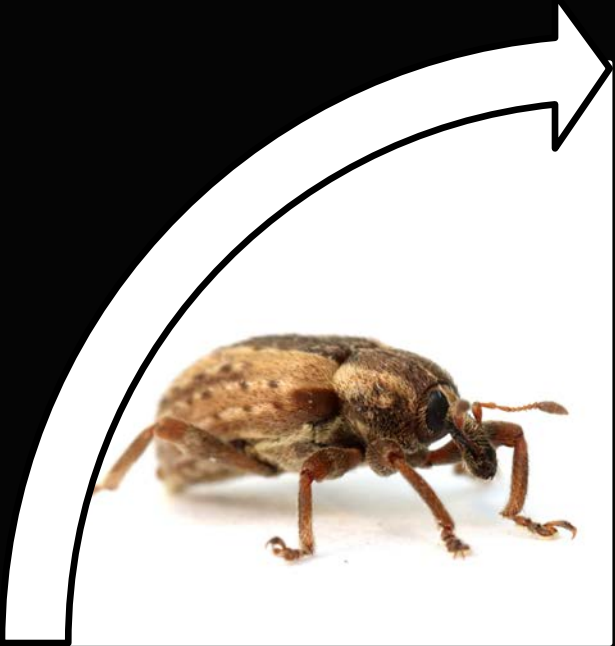
need to adapt





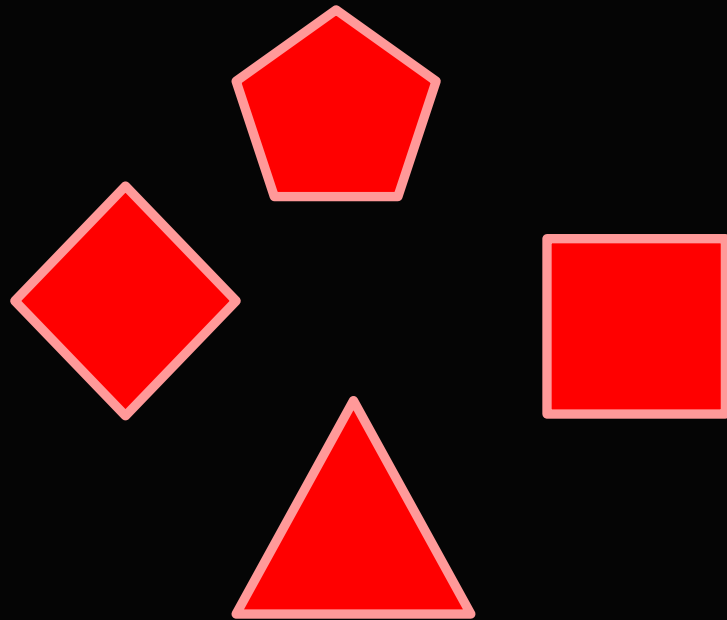




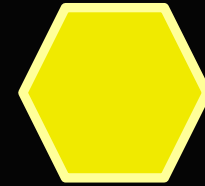


Problem: Limited modes of actions

Pyrethroids (3A)



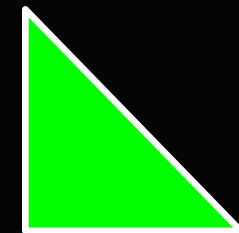
Spinosyns-Spinosad (5)



Oxadiazines – Indoxacarb (22A)



Organophosphates – malathion (1B)



CropLife Crop Inputs ▾ IRON ▾ Management ▾ Precision CropLife 100 Webinars

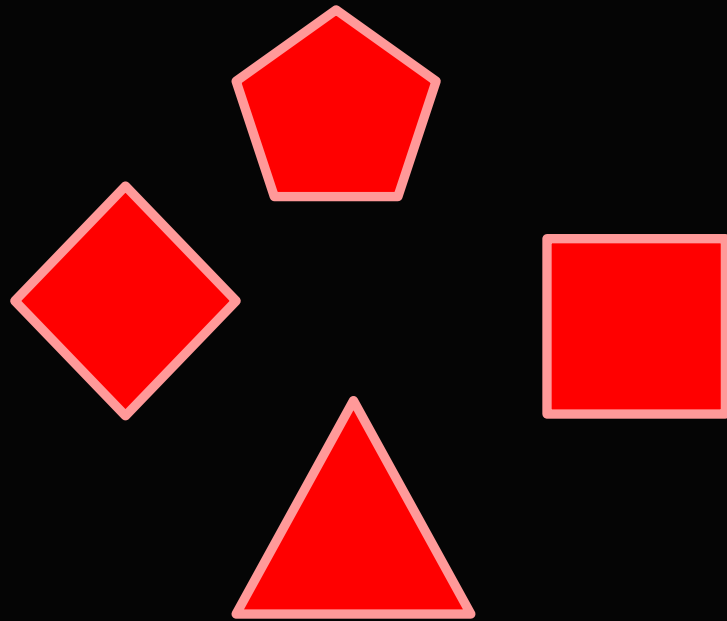
California Loses Chlorpyrifos: What's Next?

Problem: Limited modes of actions

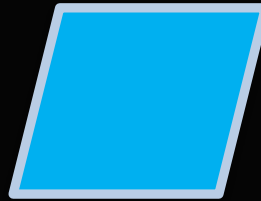
Spinosyns-Spinosad (5)



Pyrethroids (3A)



Oxadiazines – Indoxacarb (22A)





Problem: Pyrethroid-resistant alfalfa weevils

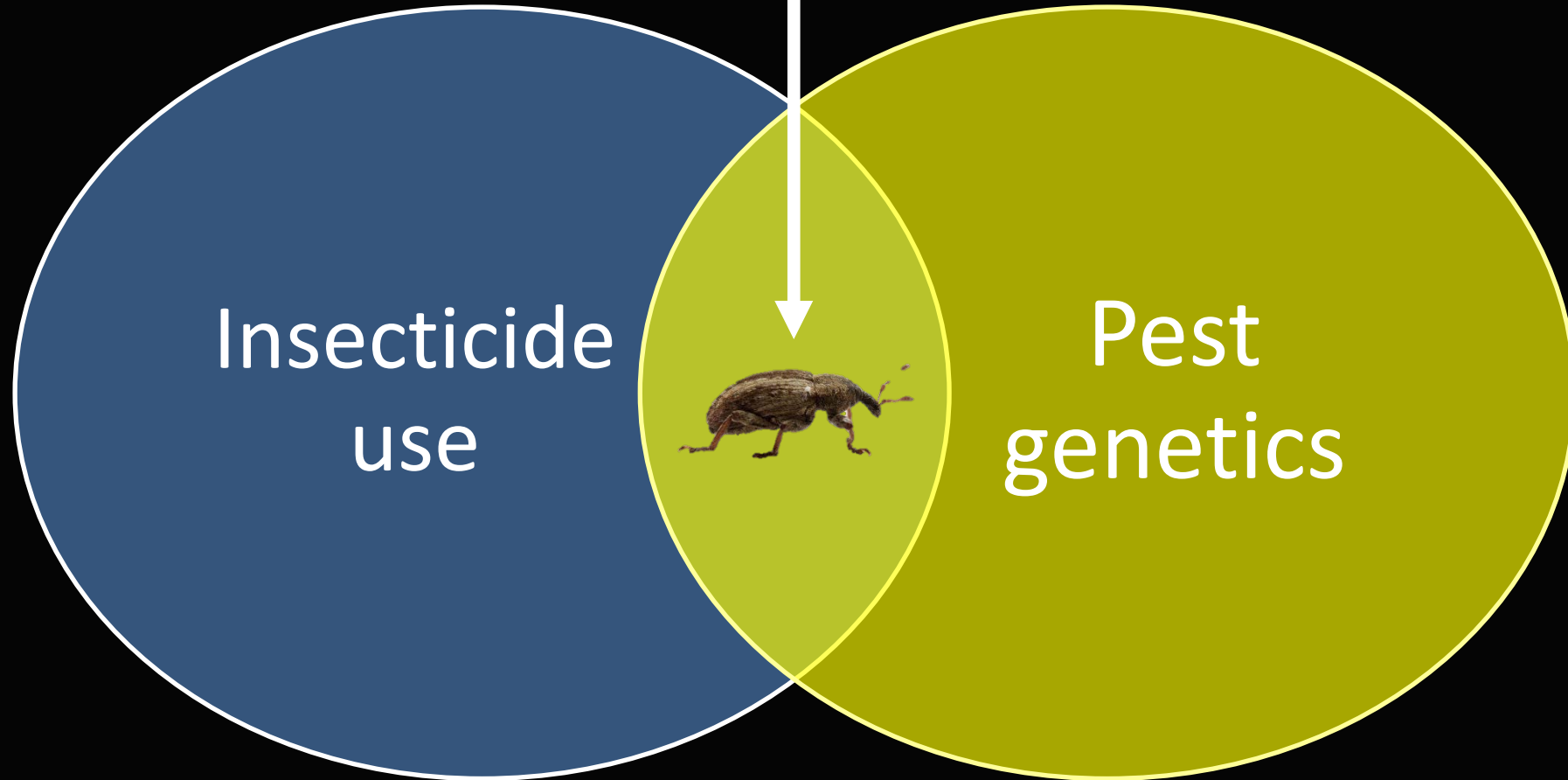
Growers
Pest control advisors





**PEST MANAGER WAITING
FOR RESISTANCE TO SOLVE ITSELF**

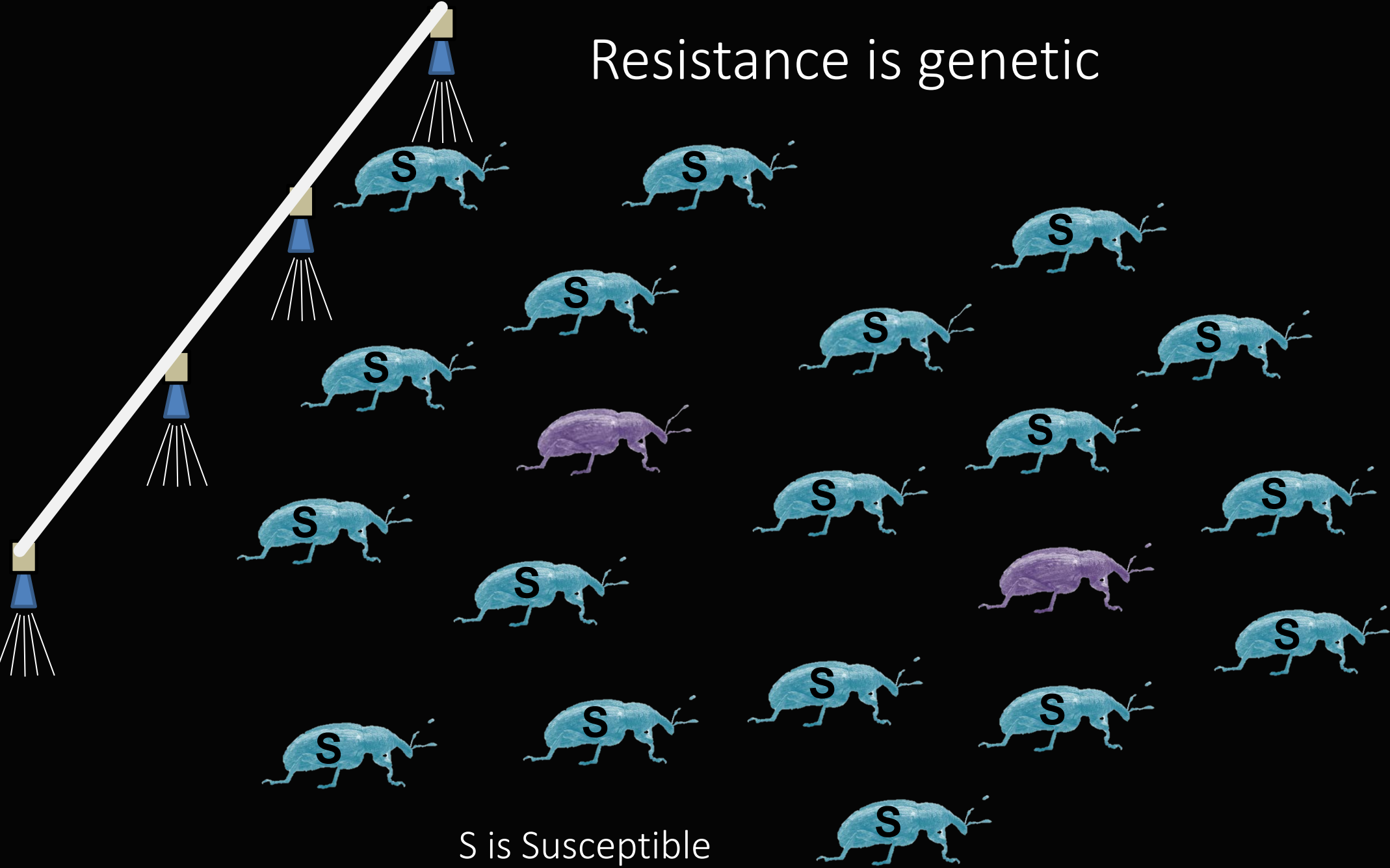
Insecticide resistance



Insecticide
use

Pest
genetics

Resistance is genetic

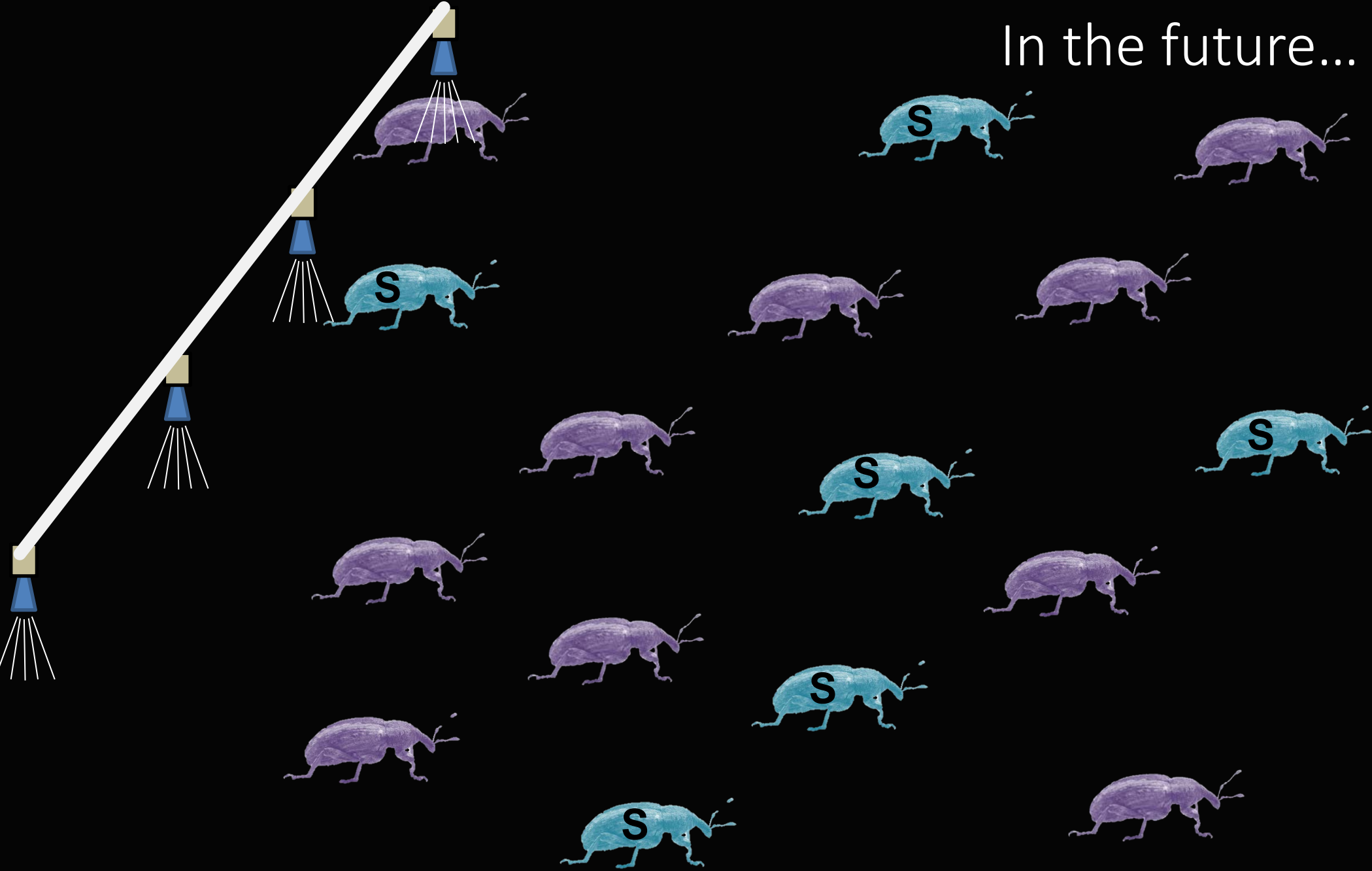




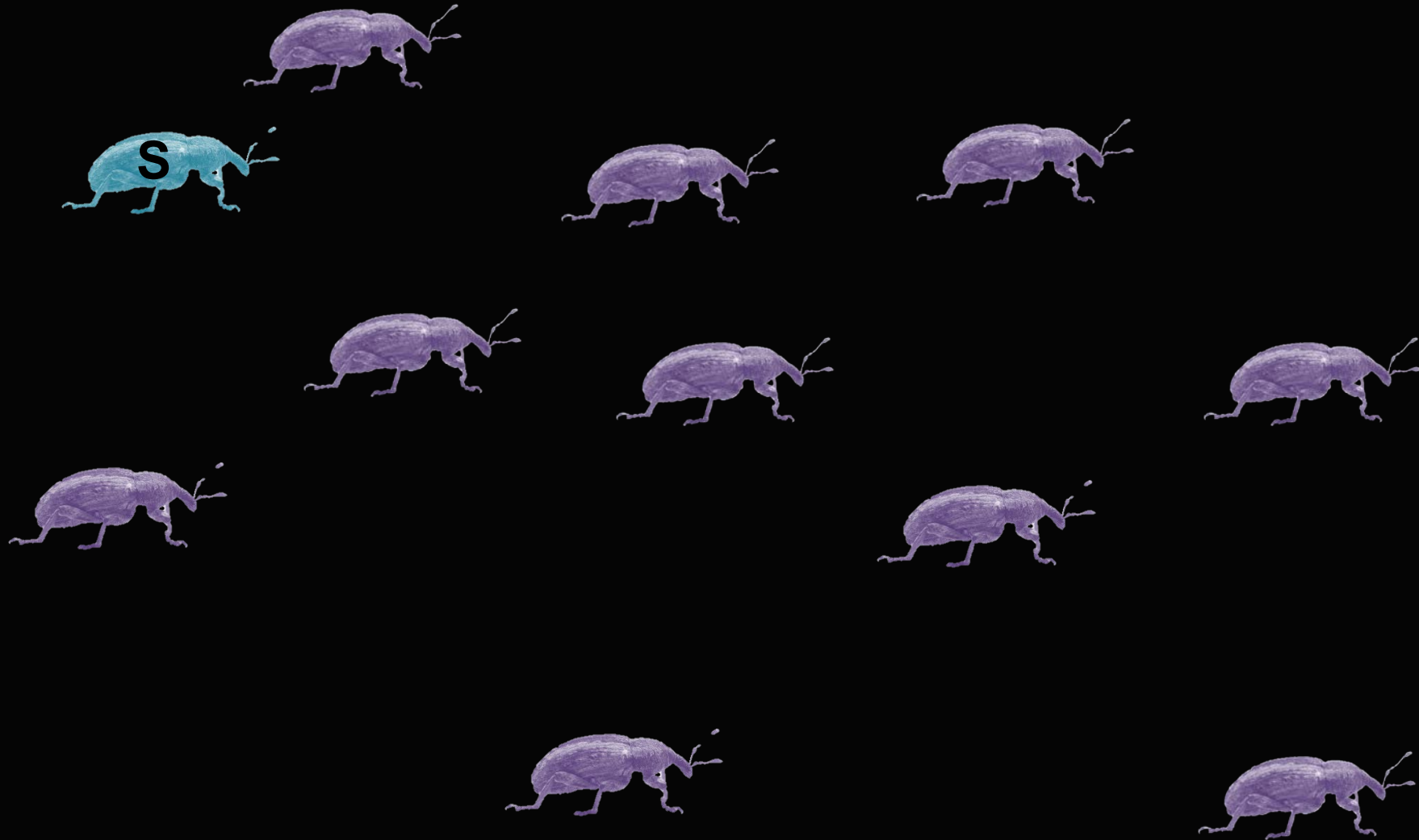
Mating



In the future...



Resistance is now common



Insecticide resistance is not a new issue

Resistance of the Alfalfa Weevil to Heptachlor¹

V. E. ADLER and C. C. BLICKENSTAFF
Entomology Research Division, Agr. Res. Serv.,
USDA., Beltsville, Md.

Reports (USDA 1962, 1963; Bissell and Harding 1963; Howell 1963) and personal correspondence indicate that in many

WARNING: Hazardous If Swallowed, Inhaled or Absorbed Through Skin! In case of contact, immediately remove contaminated clothing and flush skin or eyes with plenty of water; for eyes, get medical attention. Wash thoroughly with soap and water after handling and before eating or smoking, wear clean clothing. Do not apply or allow to drift to areas occupied by unprotected humans or beneficial animals. Keep out of reach of children. **DANGER**—Keep away from heat or open flame. Avoid contamination of feed and foodstuffs. To protect fish and wildlife, do not contaminate streams, lakes or ponds with this material. When container is empty, immediately wash thoroughly and destroy. Never re-use.

NOTICE: California Spray-Chemical Corporation makes no warranty, express or implied, concerning this material, except that it conforms to the chemical description on the label. Neither California Spray-Chemical Corporation nor the seller shall be held responsible in any manner for any personal injury or property damage or other type of loss resulting from the handling, storage or use of this material. The buyer assumes all risk and liability therefrom and accepts and uses this material on these conditions.

Manufactured by
CALIFORNIA SPRAY-CHEMICAL CORP.
Richmond, Calif. • Orlando, Fla. • So. Plainfield, N. J.
St. Louis, Mo.
Form W-4617-A
Product No. 2290



TREATS 2000 SQUARE FEET
NET CONTENTS
ONE PINT

ORTHO[®] 95
DIELDRIIN
SPRAY

KILLS
ANTS, LAWN EGGS (Sod Webworms), WHITE GRUBS,
GRASSHOPPERS, CRICKETS, CUTWORMS and Ornamental Soil Insects



ANT



LAWN MOTH



EARWIG

Active Ingredients
Hexachloro-epoxy-octahydro-dimethano
isophthalene (from Dieldrin) 35.8%
Related Compounds (from Dieldrin) 2.8%
Aromatic Petroleum Derivative Solvent 73.4%
Inert Ingredients 8.0%

A SOIL INSECTICIDE

READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH LABEL CAUTIONS, WARNINGS AND DIRECTIONS.

DIRECTIONS

Apply with an ORTHO Lawn & Garden Sprayer for easy, uniform distribution.

HOME LAWNS: Ants, Lawn Moth (Sod Webworm), Cutworms, Sowbugs, Pillbugs, Wireworms, White Grubs, Snails, Slugs, June Beetle Grubs, Armyworms, Mole Crickets, Crickets, Grasshoppers—8 Tablespoonfuls in 15 gals. water per 500 sq. ft. of lawn area (1½ teaspoonful per gal. water for 33 sq. ft.). Also spray under ornamental plantings. Sprinkle lightly after treatment. Do not permit children and pets to go on treated lawn until the insecticide has been washed off the grass and into soil, and grass has completely dried.

NURSERY, GREENHOUSE AND GARDEN SOILS (where ornamentals are grown): Brachyrhinus Weevils and pests listed under Home Lawns—8 table-spoonfuls in 15 gallons water per 500 square feet (1½ teaspoonfuls per gal. water for 33 sq. ft.). In open soil, mix into top 3 or 4 inches of soil. Do not treat when soil is wet. Apply before rain or sprinkling.

EARWIGS: Apply at above dosage to daytime hiding places, such as lawns, around base of trees, shrubs, along walks, fences and building foundations.



...cash by the bushel for Orland Manternach!

HEPTACHLOR
soil insecticide
increases corn yield
35 bushels
per acre!

HEPTACHLOR YIELD CHECK NO. 761

Orland Manternach feeds 700 to 800 hogs a year on his 400 acre farm near Cascade, Iowa. Last season, he planted 110 acres of corn, and gained 35.4 bonus bushels per acre by using Heptachlor soil insecticide.

Orland Manternach Farm, Cascade, Ia. Two pounds of 20% granular Heptachlor per acre applied broadcast with a fertilizer granular. Took on third year corn land not treated previously.

	STAND COUNT PER ACRE	YIELD BUSHELS/ACRE CORRECTED TO 15.5% MOISTURE
HEPTACHLOR	14,300	138.0
CHECK	12,800	107.6
INCREASE WITH HEPTACHLOR	1,500	35.4



HEPTACHLOR PAYS—If cash returns were measured as corn yields are, you'd find that Heptachlor soil insecticide would give you bushel after bushel of "money in the bank." Heptachlor protection often makes 4 acres produce as much as 5 untreated acres. And most of the yield increase is profit, because the cost of treatment is often as low as \$1.00 per acre.

SOIL INSECT CONTROL—Soil insect damage causes root injury, reduced stands, poor ear development, and lodging. Heptachlor prevents this damage. Treated corn grows well and stands straight. You can pick it at maximum safe speeds. Heptachlor kills all major soil insect pests of corn. You can apply it broadcast or in the row, in granular or liquid form, or in liquid or dry fertilizer mixtures. To save time and work, application can be combined with other operations.

BUSHEL BETTER—Heptachlor gives corn more protection per pound. It's easier to handle, too, and has no unpleasant odor. For further information, request folder 503-30.

VELSICOL CHEMICAL CORPORATION
330 East Grand Avenue • Chicago 11, Illinois
EXCLUSIVE BASIC MANUFACTURERS OF TECHNICAL HEPTACHLOR

ask for
HEPTACHLOR
SOIL INSECTICIDE

SEED TREATERS ... for extra protection during germination.
Just mix HEPTACHLOR with seed in planter box!





RESISTANT ALFALFA WEEVIL



Kevin Wanner



Erika Rodbell

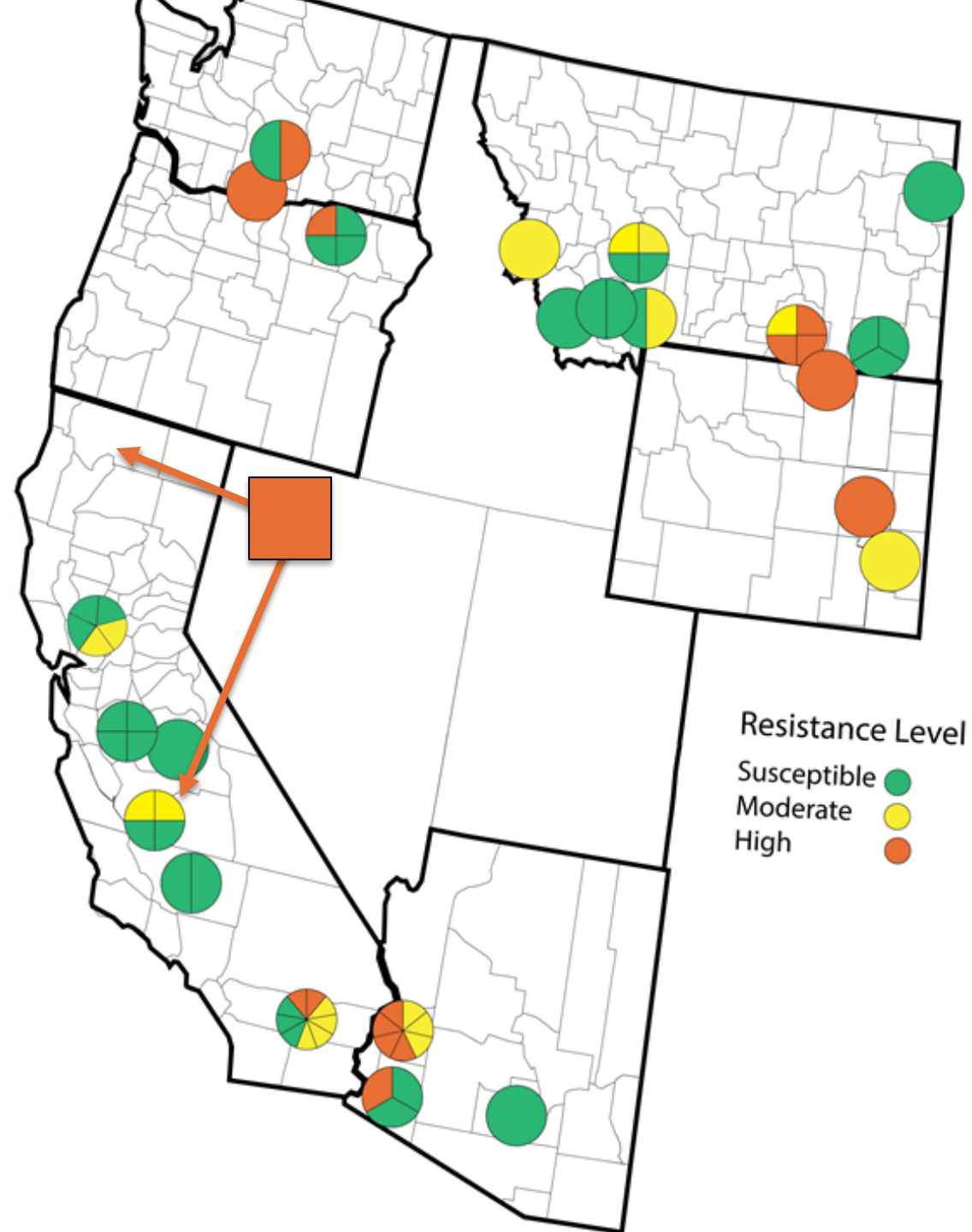


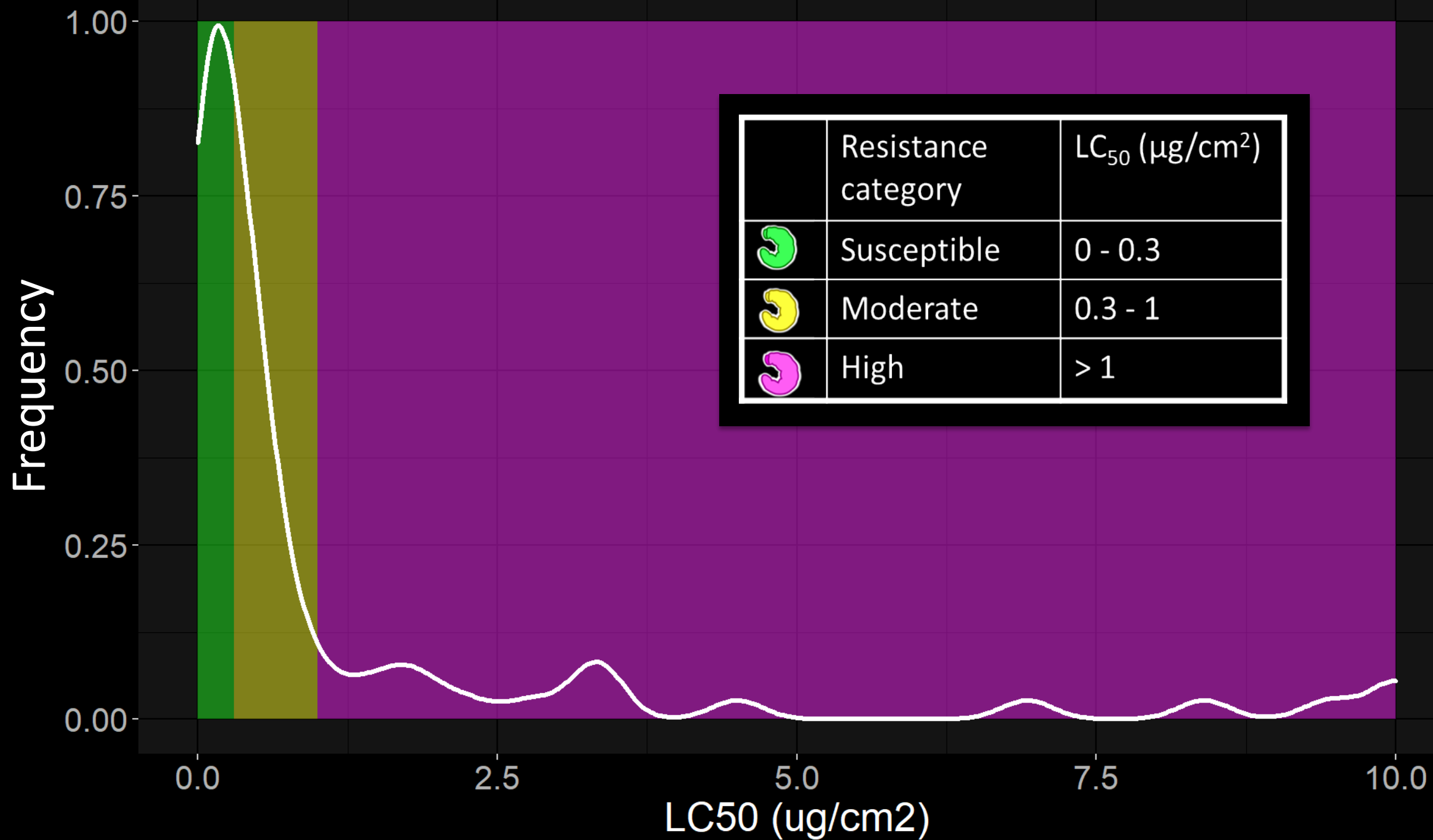
Madi Hendrick



Lambda-cyhalothrin bioassays





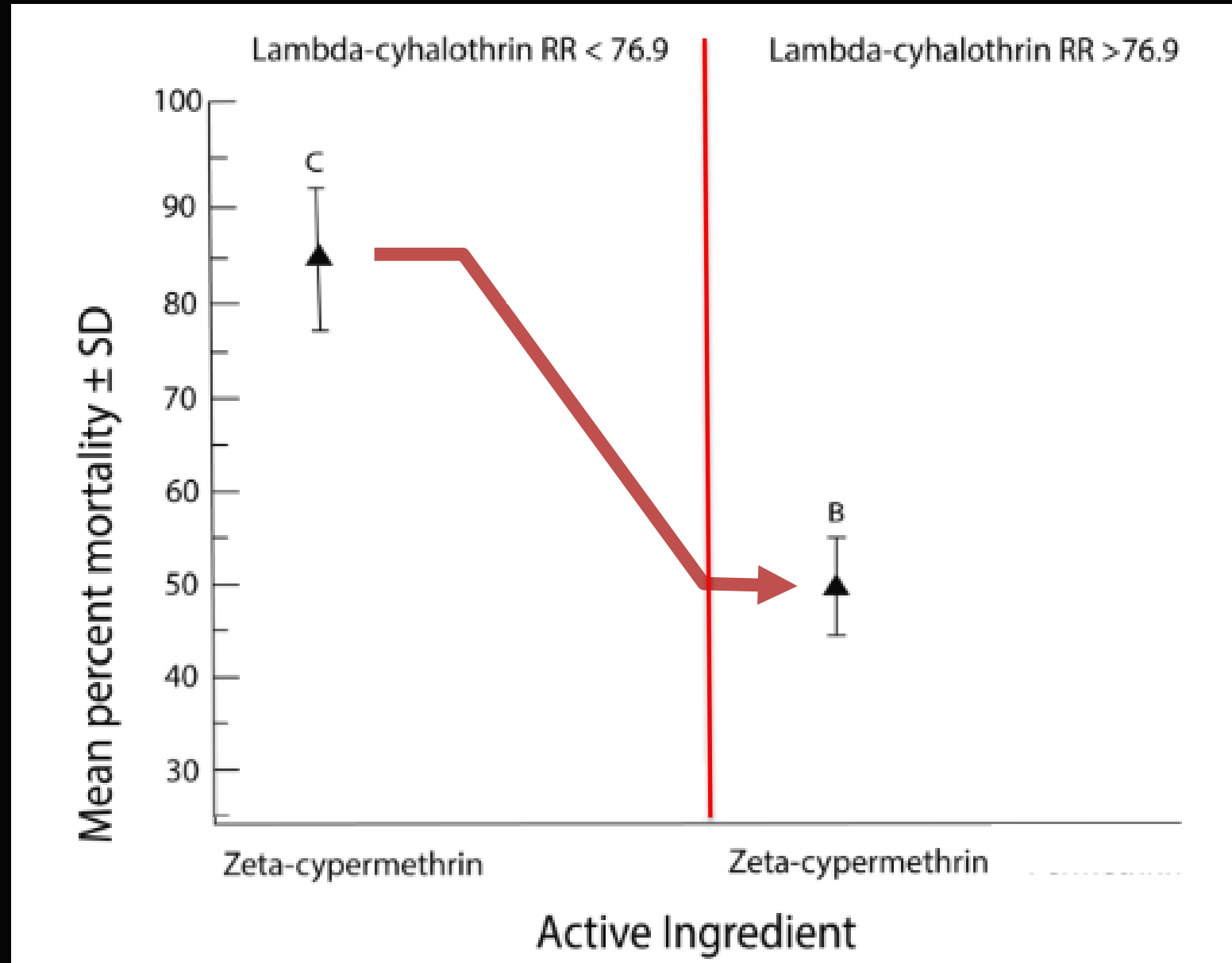


What about cross resistance?

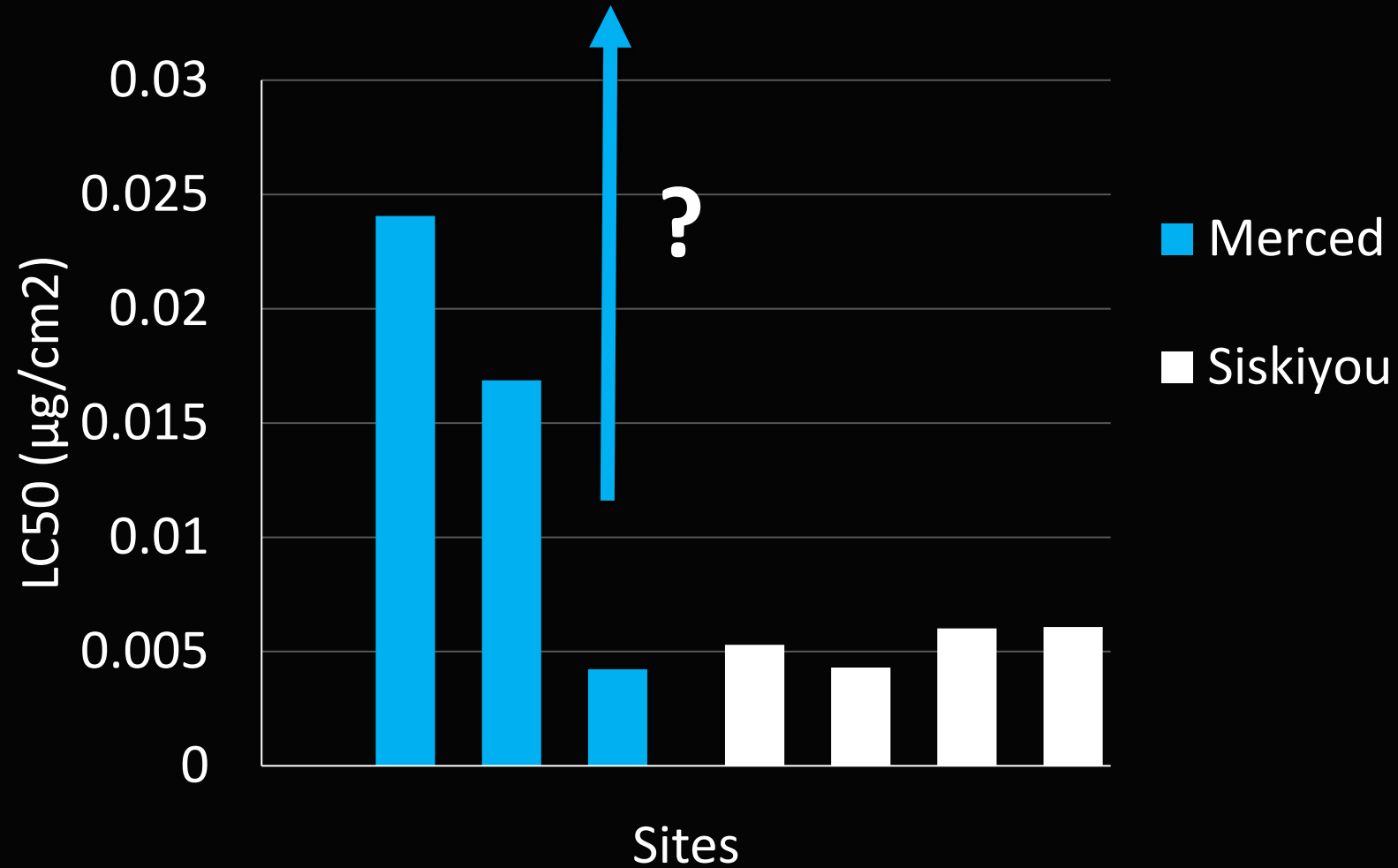


- Cross resistance between lambda-cyhalothrin and zeta-cypermethrin
- Limited cross resistance between lambda-cyhalothrin and permethrin

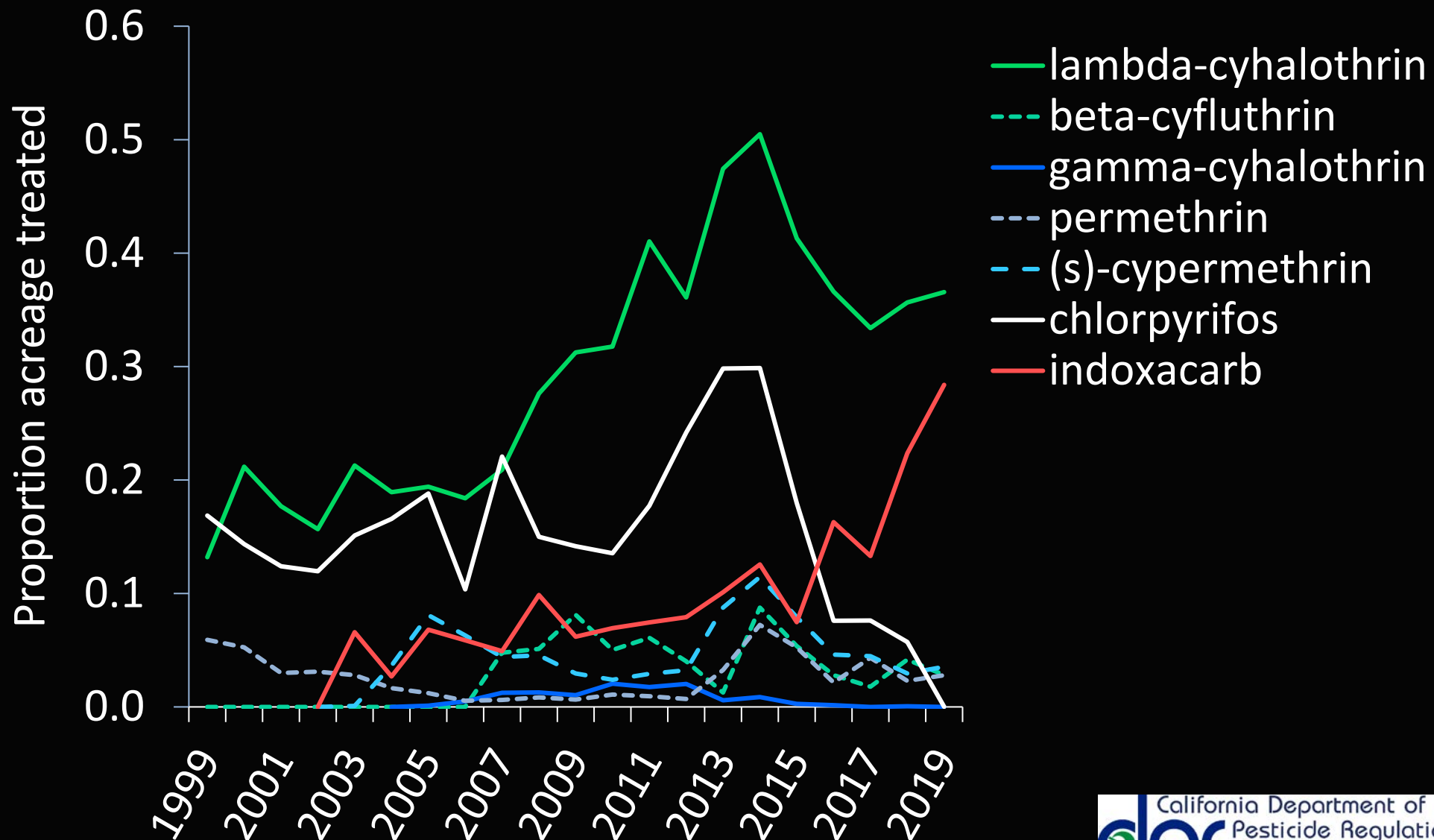
“Not resistant” → Resistant



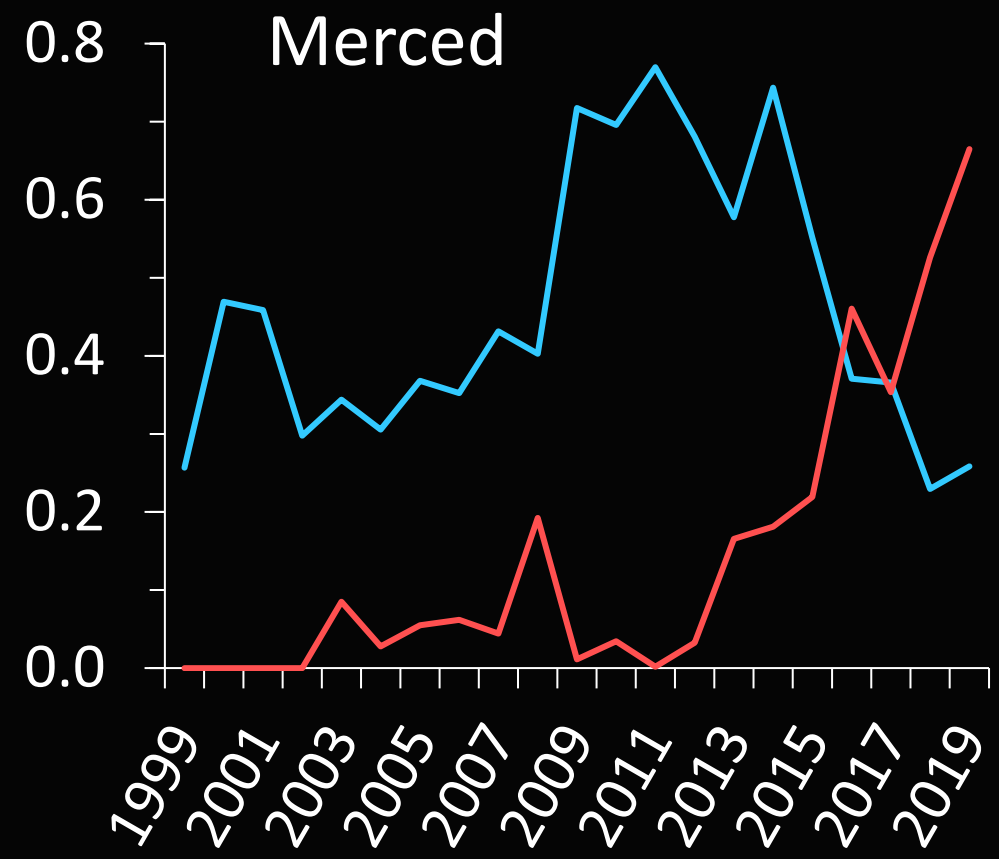
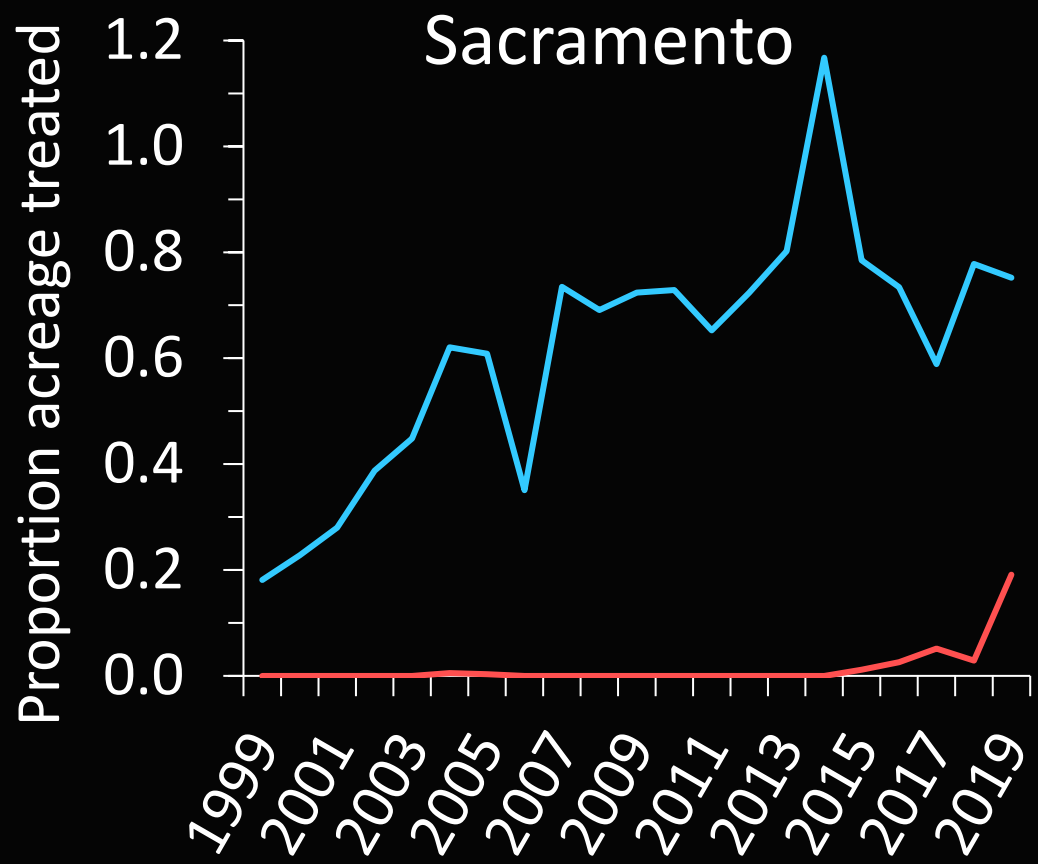
Steward/indoxacarb: opportunity to be proactive



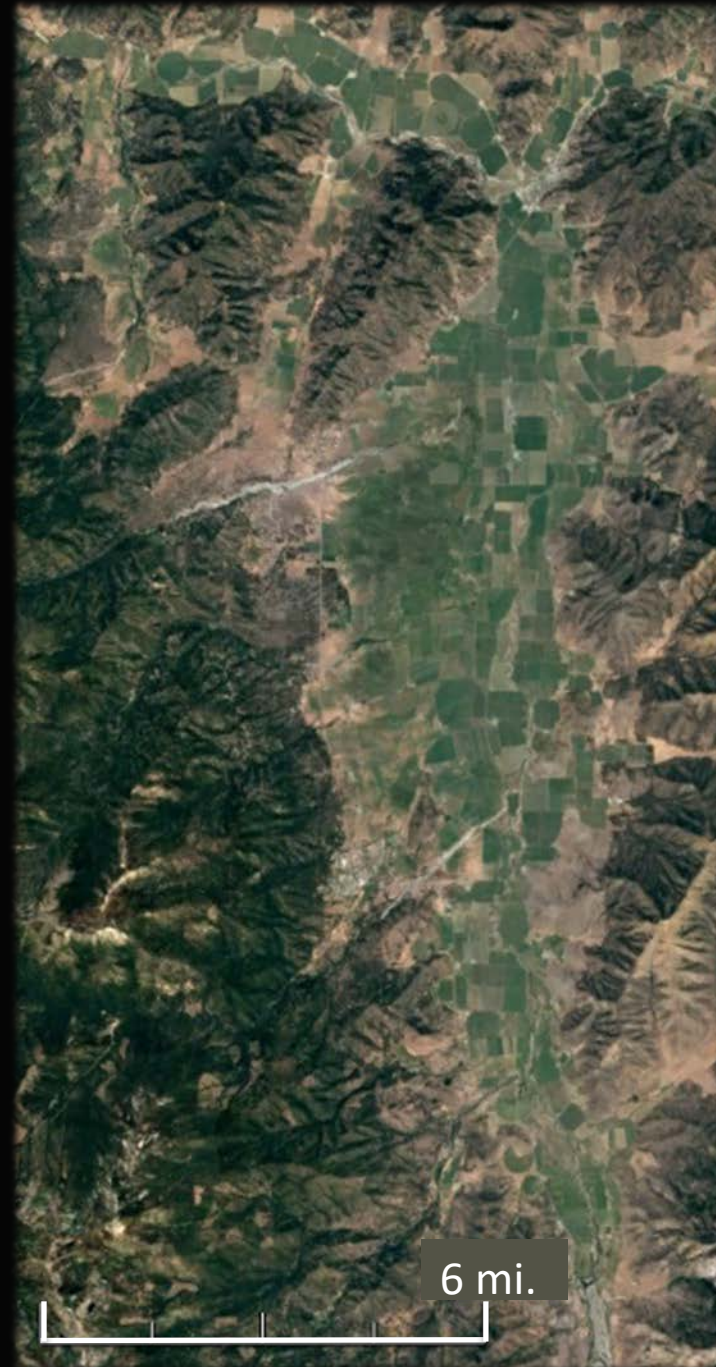
What have we seen in CA?



- Pyrethroids
- Indoxacarb



How does resistance spread...
how far, how quickly?





Bowles Farming

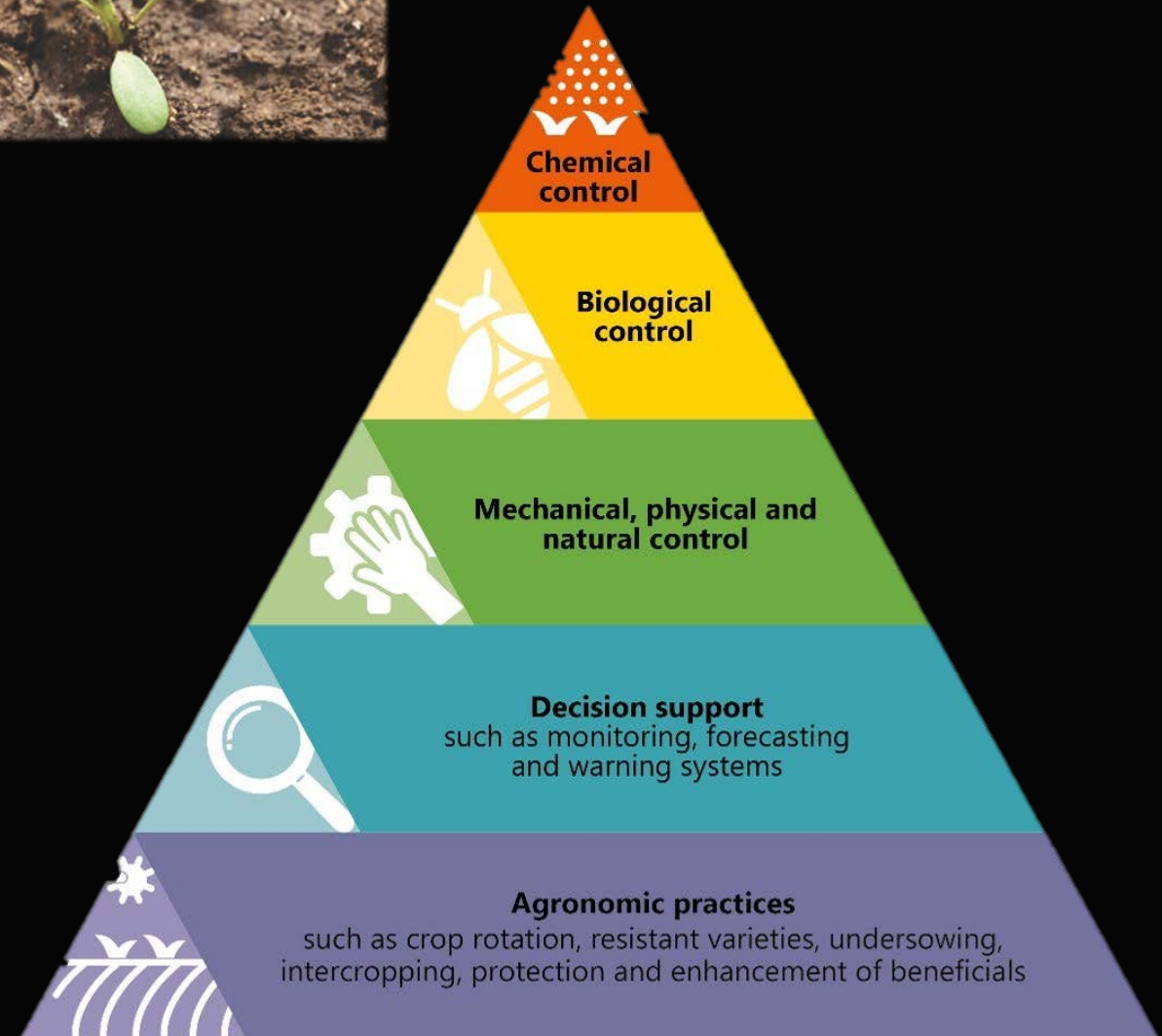
What do we have to look forward to?

- Resistance across the landscape
- Likely not a lot of future chemicals (see # registered since resistance arose)
- Still DO have susceptibility in the landscape
- Need to make BEST use of current tools in all regions

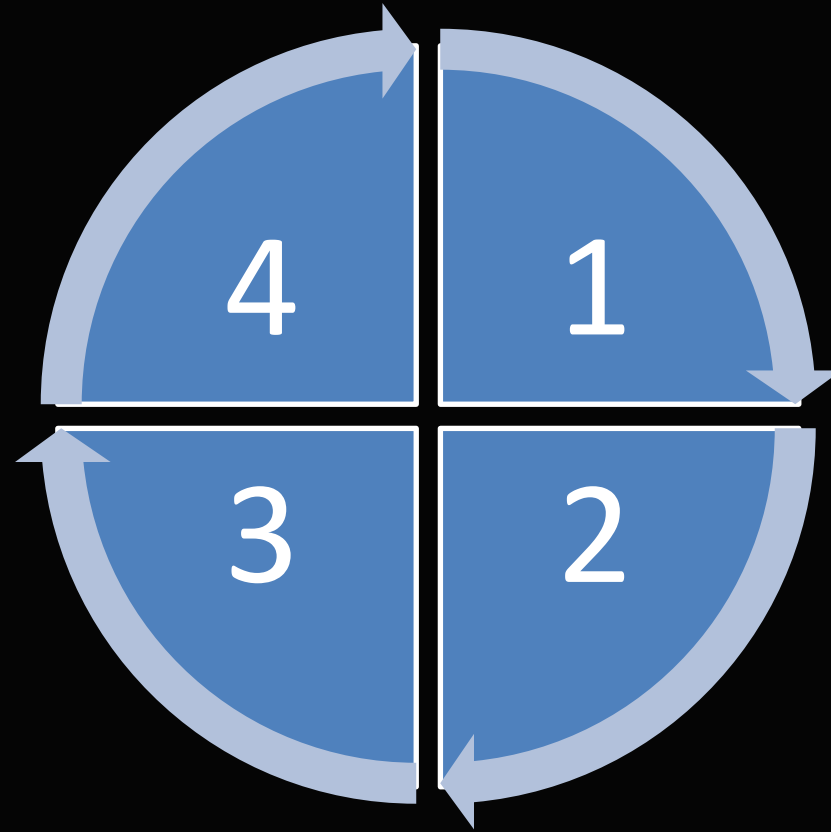


What can we do?

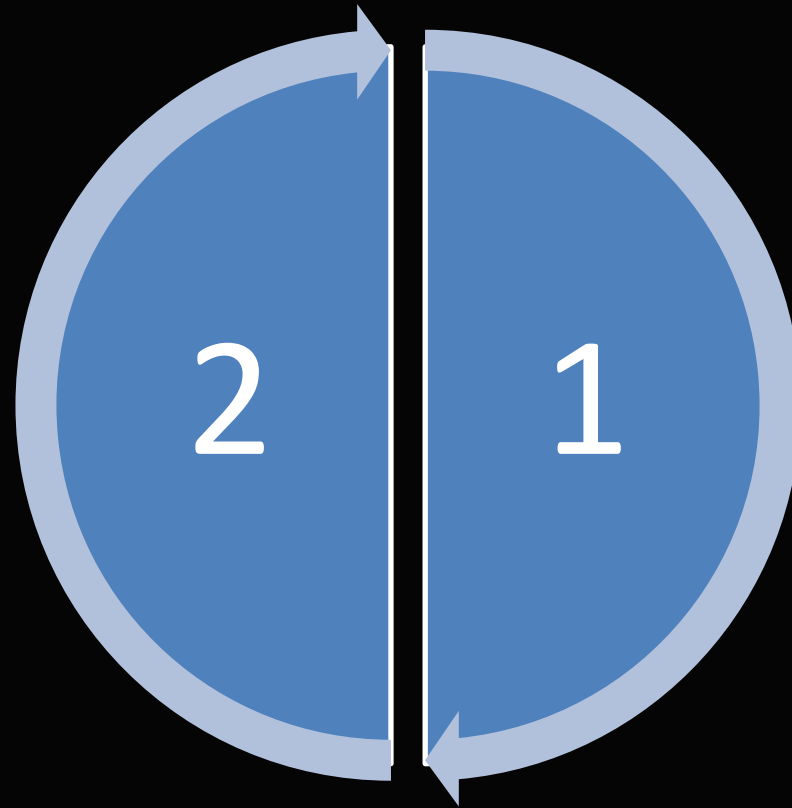
- Vigorous crop
- Cultural controls
- Monitoring/thresholds
 - No spray, no selection
- Best practices for applications
- Rotate modes of actions



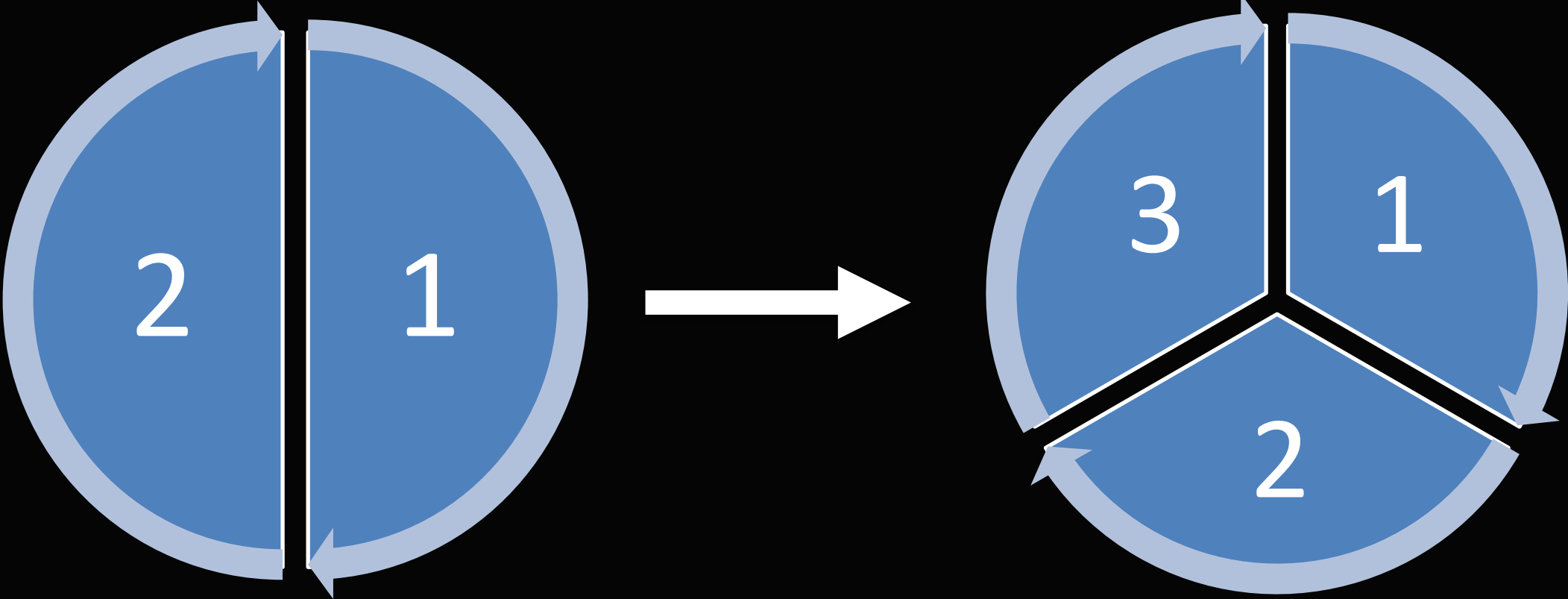
Rotation is necessary



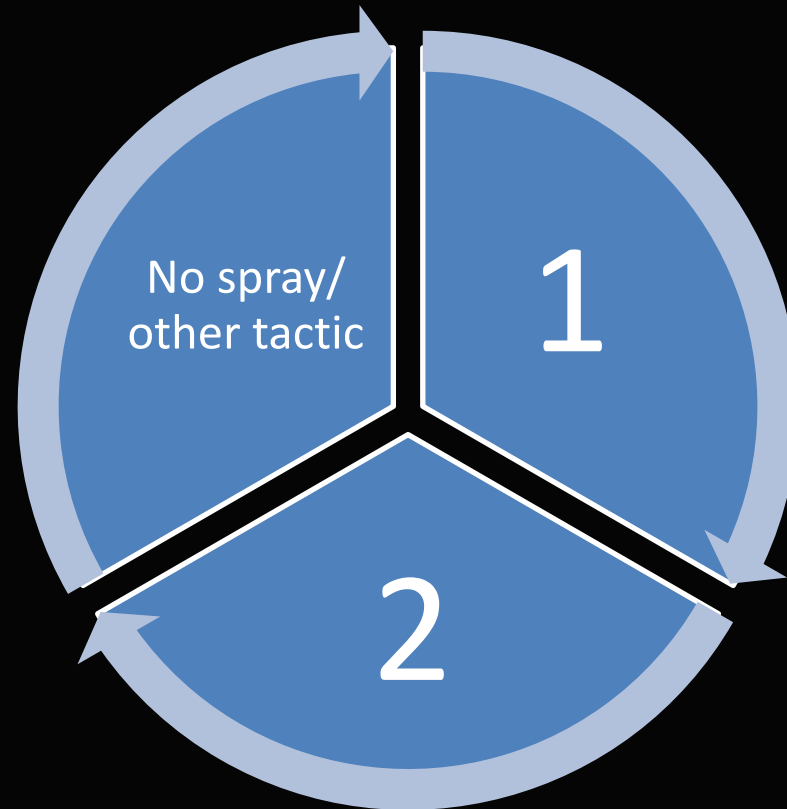
Rotation is necessary



Rotation is necessary

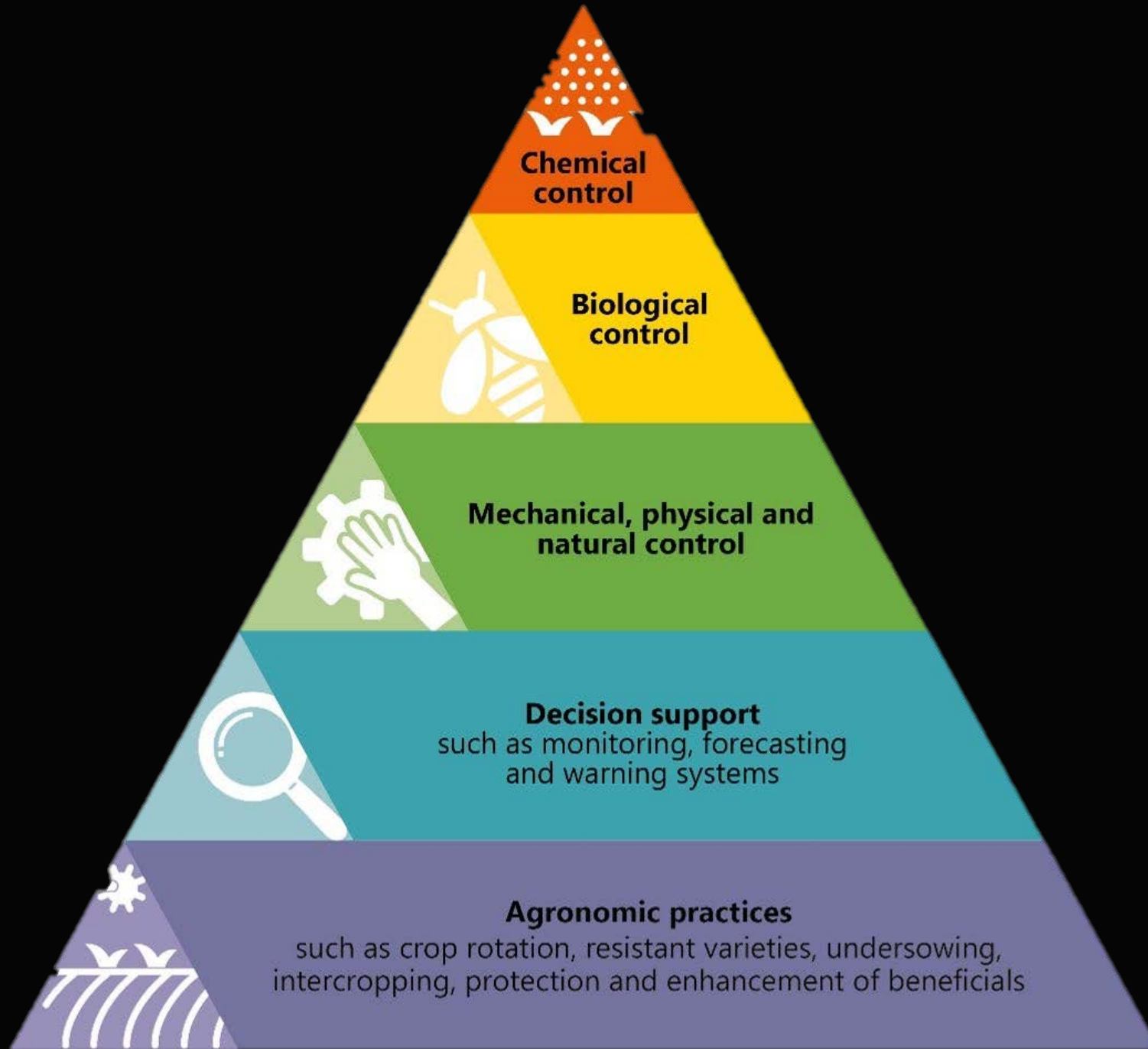


Rotation is necessary

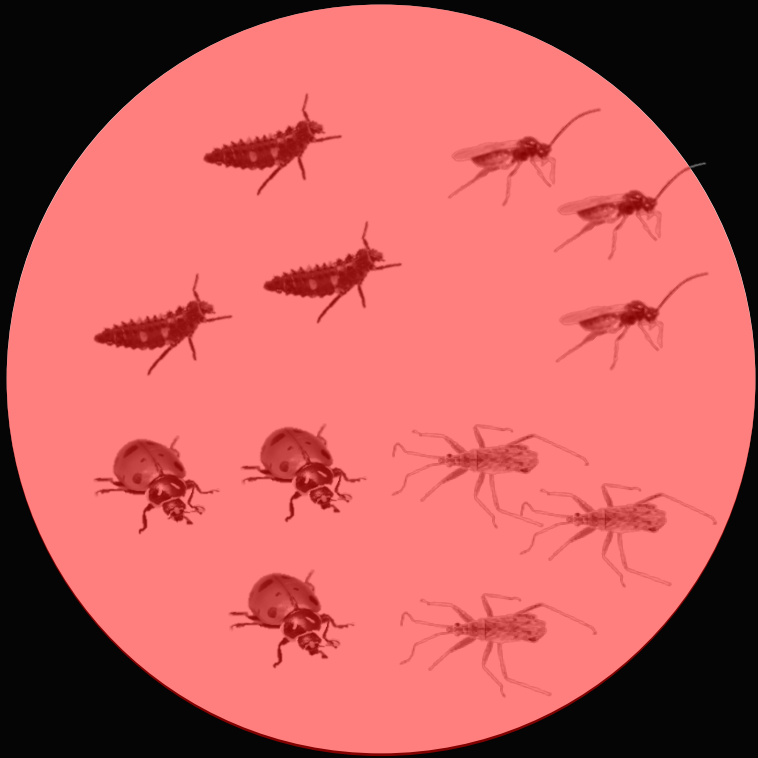




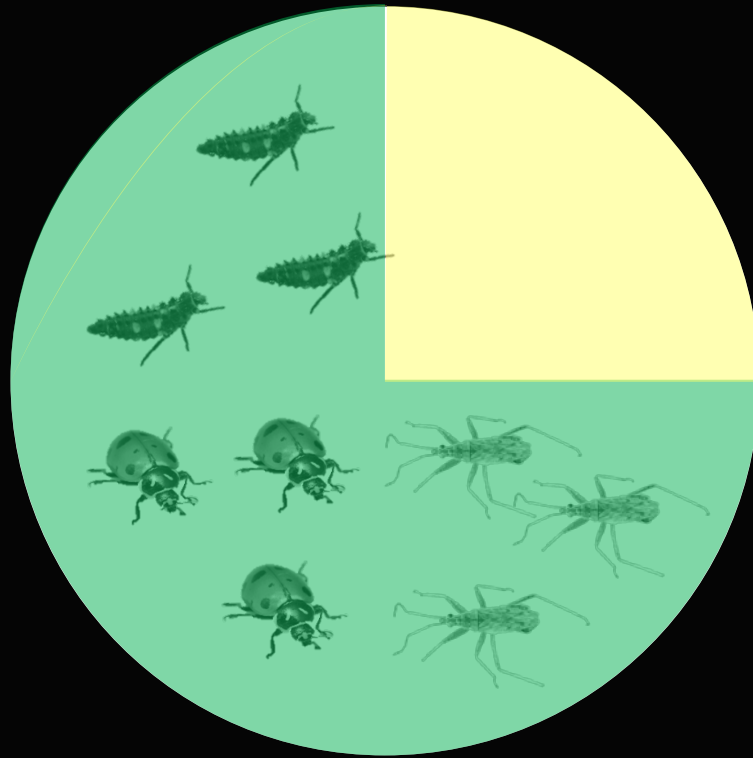




Insecticide selectivity →



Broad-spectrum



Partially safe for NEs



Safe for NEs





Study overview

- Broad-spectrum insecticides/mixtures
- More selective materials

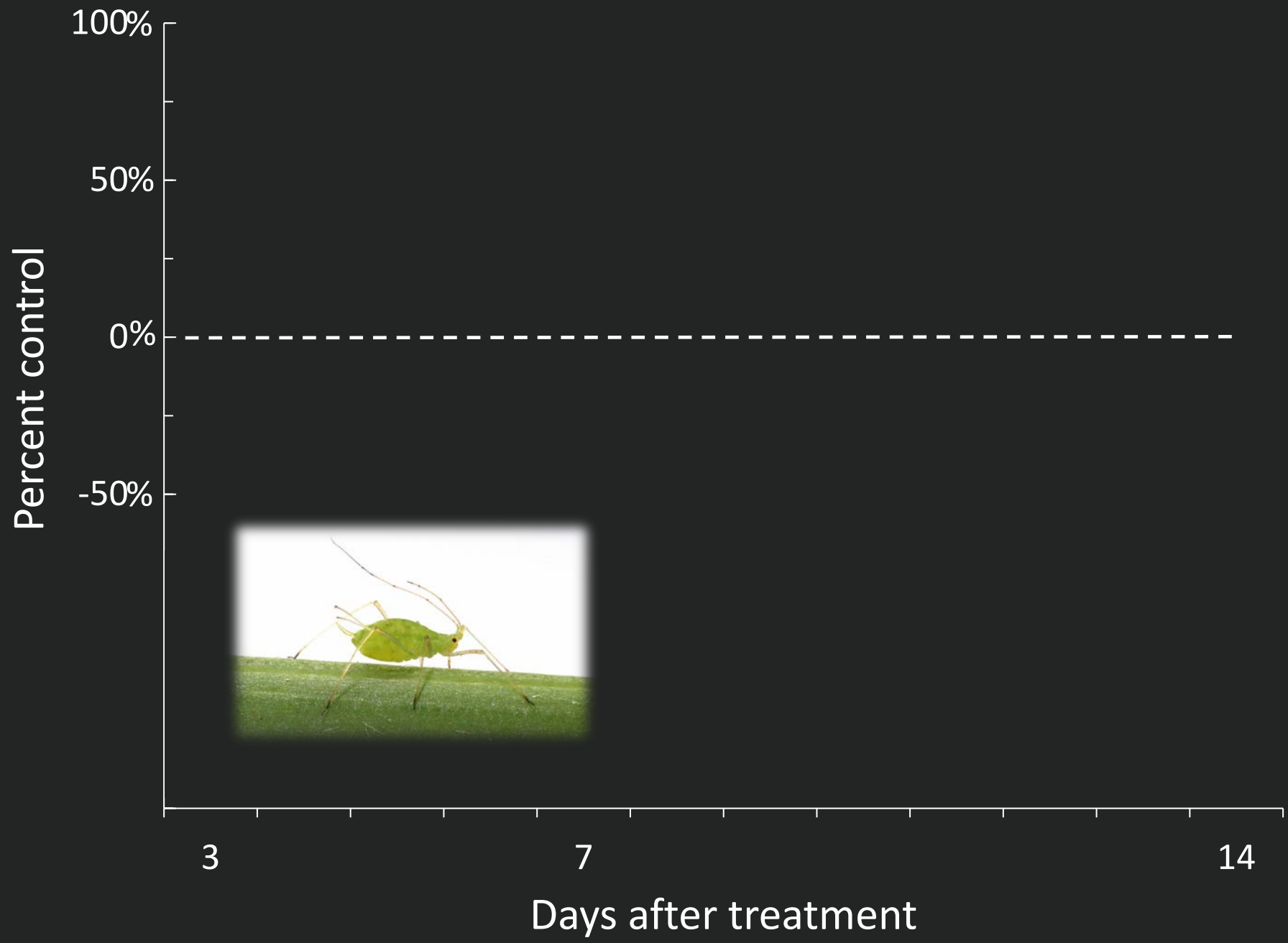
**Some materials are no longer registered or have not yet been registered in CA

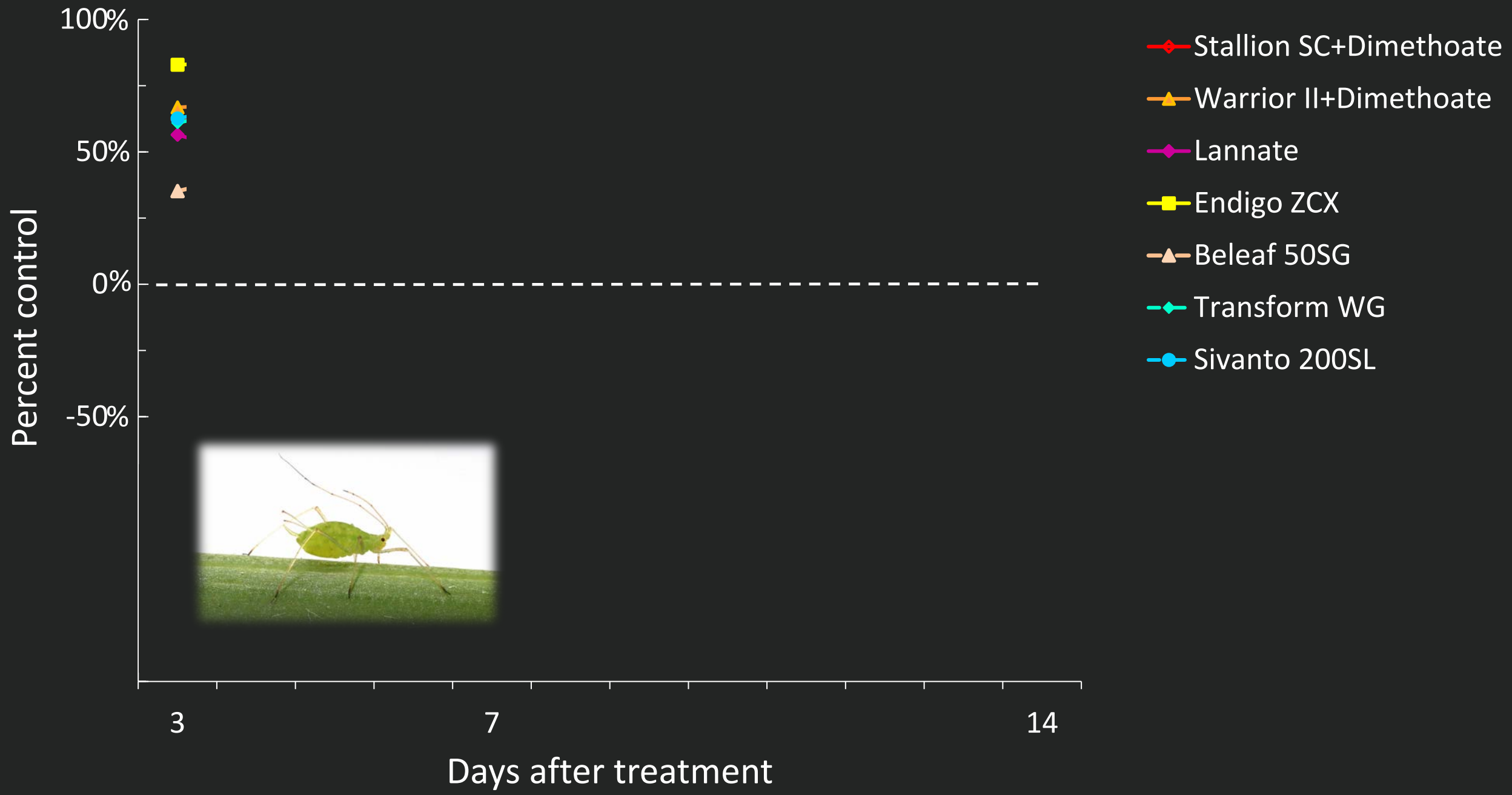
Treatment	Active ingredient	Rate	Mode of action	Group
Stallion SC** + Dimethoate	Zeta-cypermethrin + chlorpyrifos + dimethoate	11.75 + 16 fl oz/A	Pyrethroid / organophosphates	3A / 1B
Warrior II + Dimethoate	Lambda-cyhalothrin + dimethoate	1.92 + 16 fl oz/A	Pyrethroid / organophosphate	3A / 1B
Lannate	Methomyl	32 fl oz/A	Carbamate	1A
Endigo ZCX**	Lambda-cyhalothrin + thiamethoxam	4.5 fl oz/A	Pyrethroid / neonicotinoid	3A / 4A
Beleaf 50SG	Flonicamid	2.8 oz/A		29
Transform WG**	Sulfoxaflor	0.75 / 1 oz/A	Sulfoximine	4C
Sivanto 200SL	Flupyradifurone	5 / 7 / 10 fl oz/A	Butenolide	4D
Untreated				

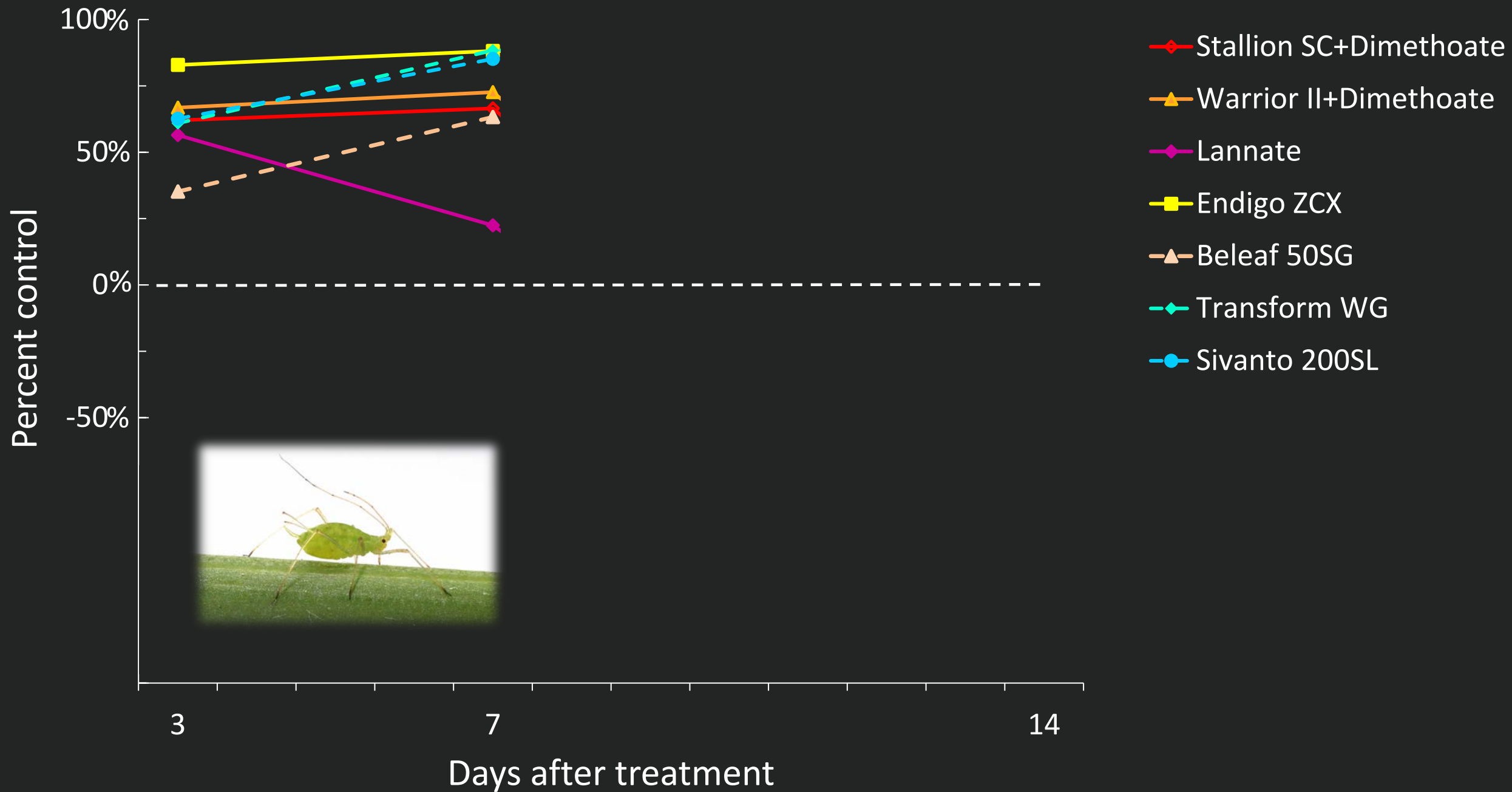
Study overview

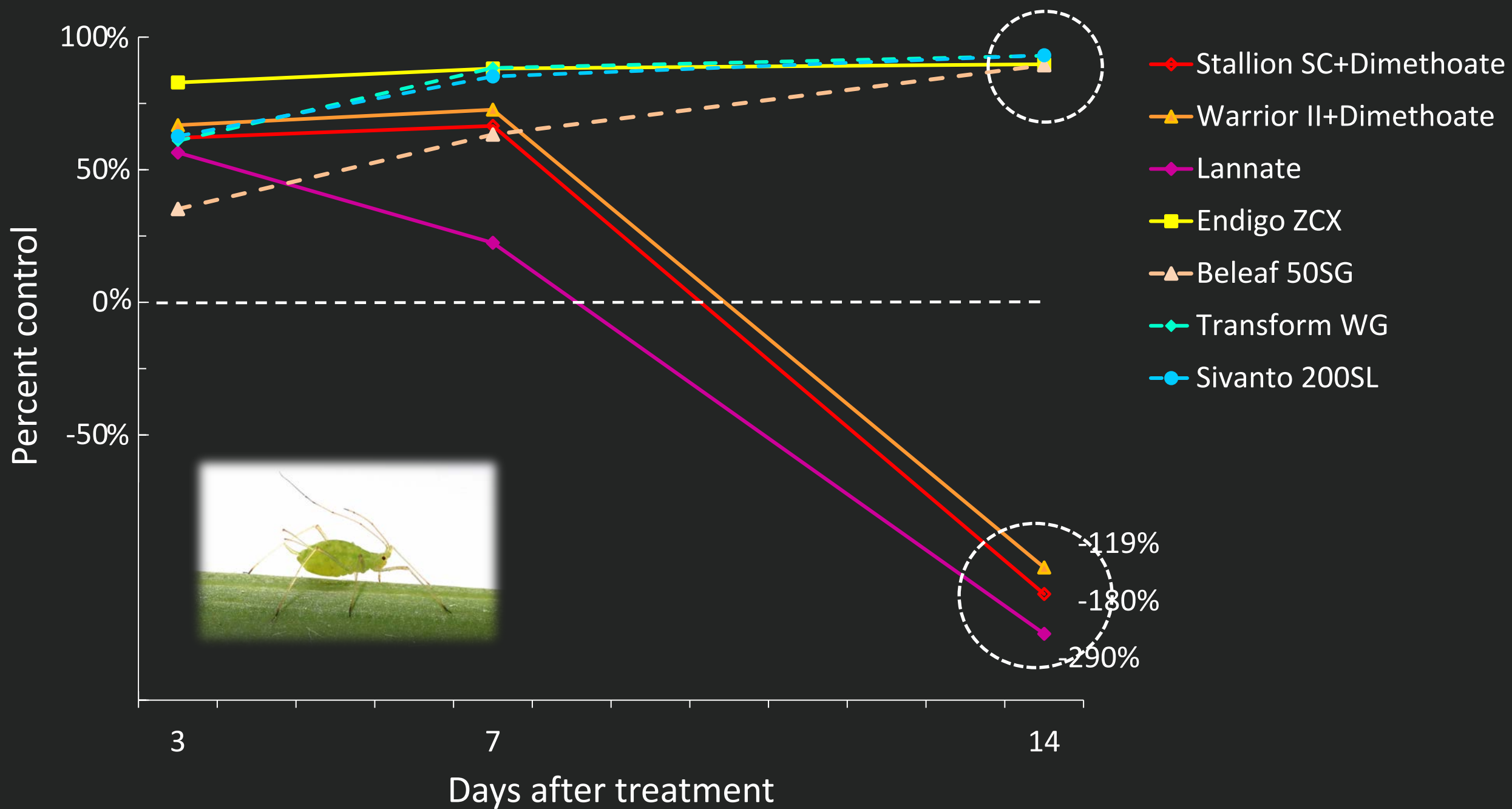
- Data collected 3, 7, and 14 days after treatment





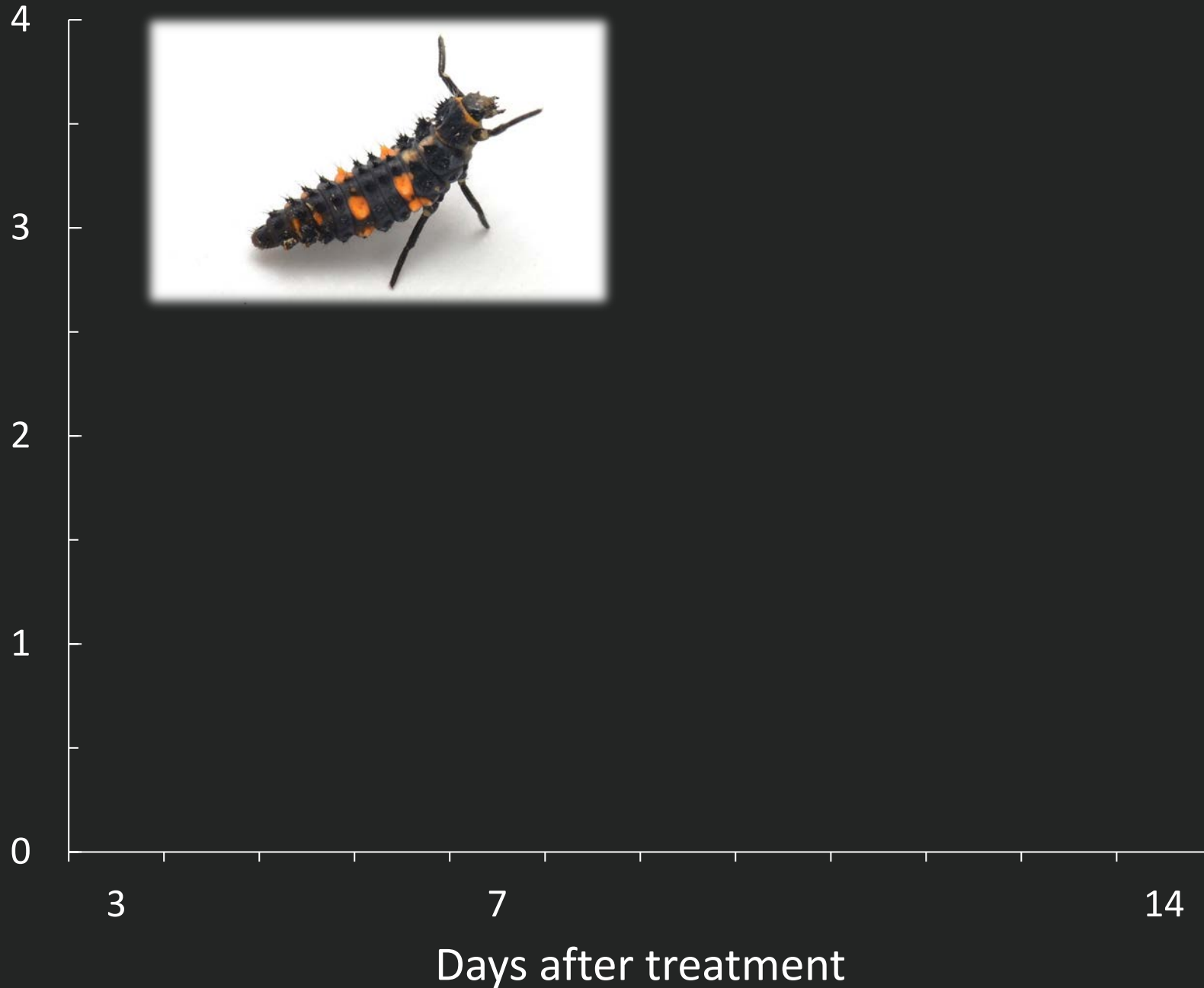






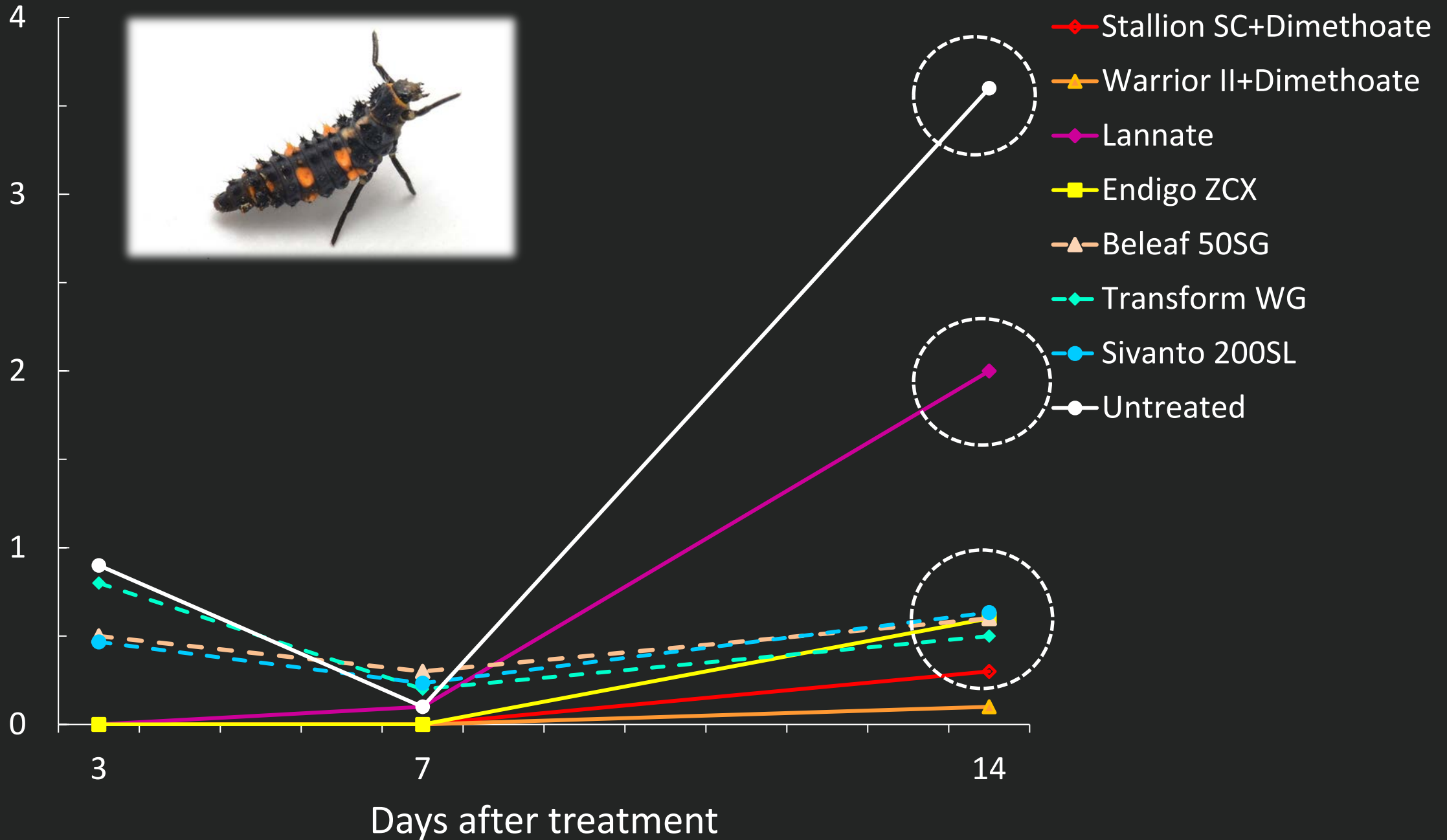
What explains these patterns...?

Lady beetle larvae
per sweep

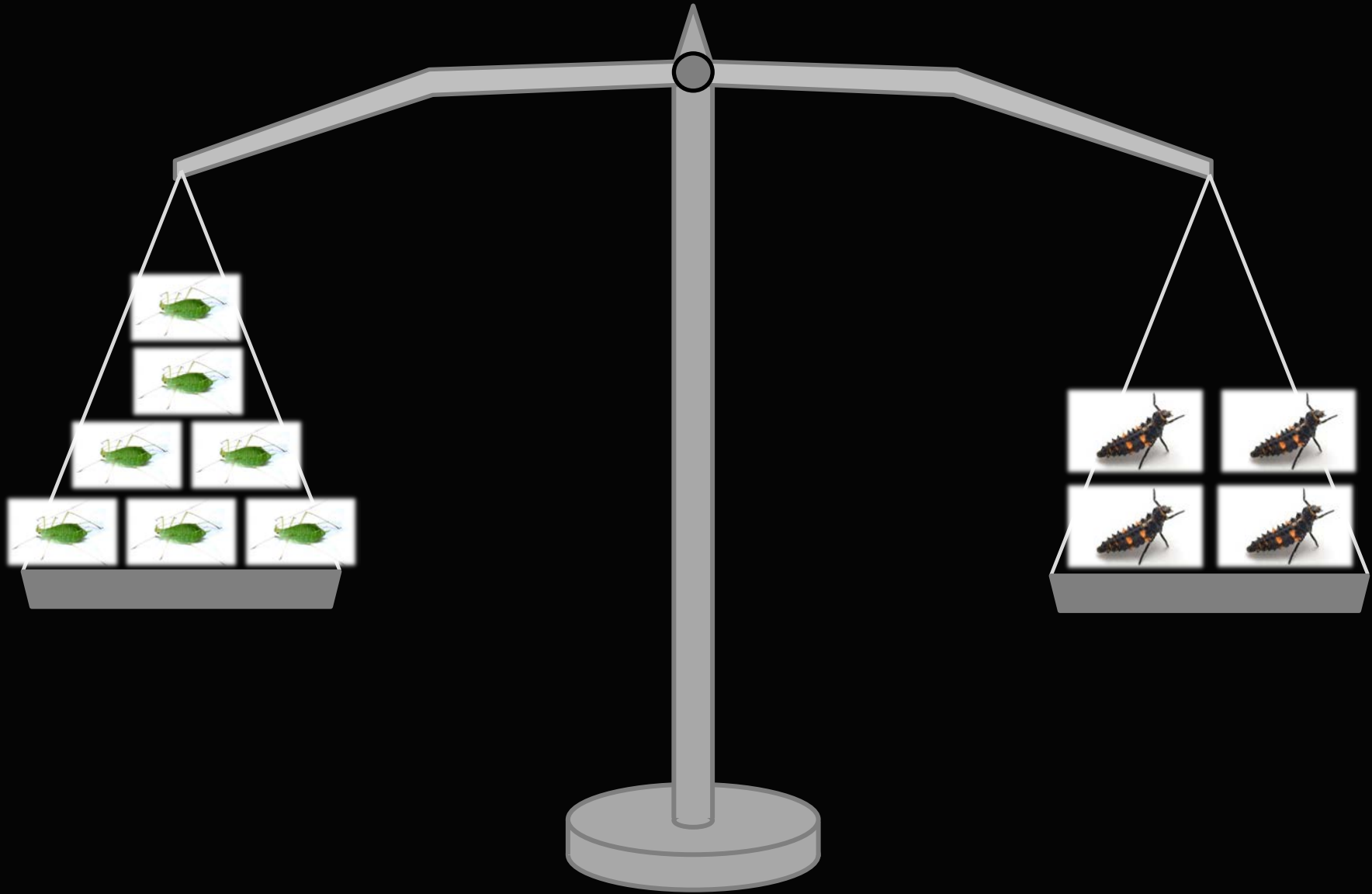


- Stallion SC+Dimethoate
- Warrior II+Dimethoate
- Lannate
- Endigo ZCX
- Beleaf 50SG
- Transform WG
- Sivanto 200SL
- Untreated

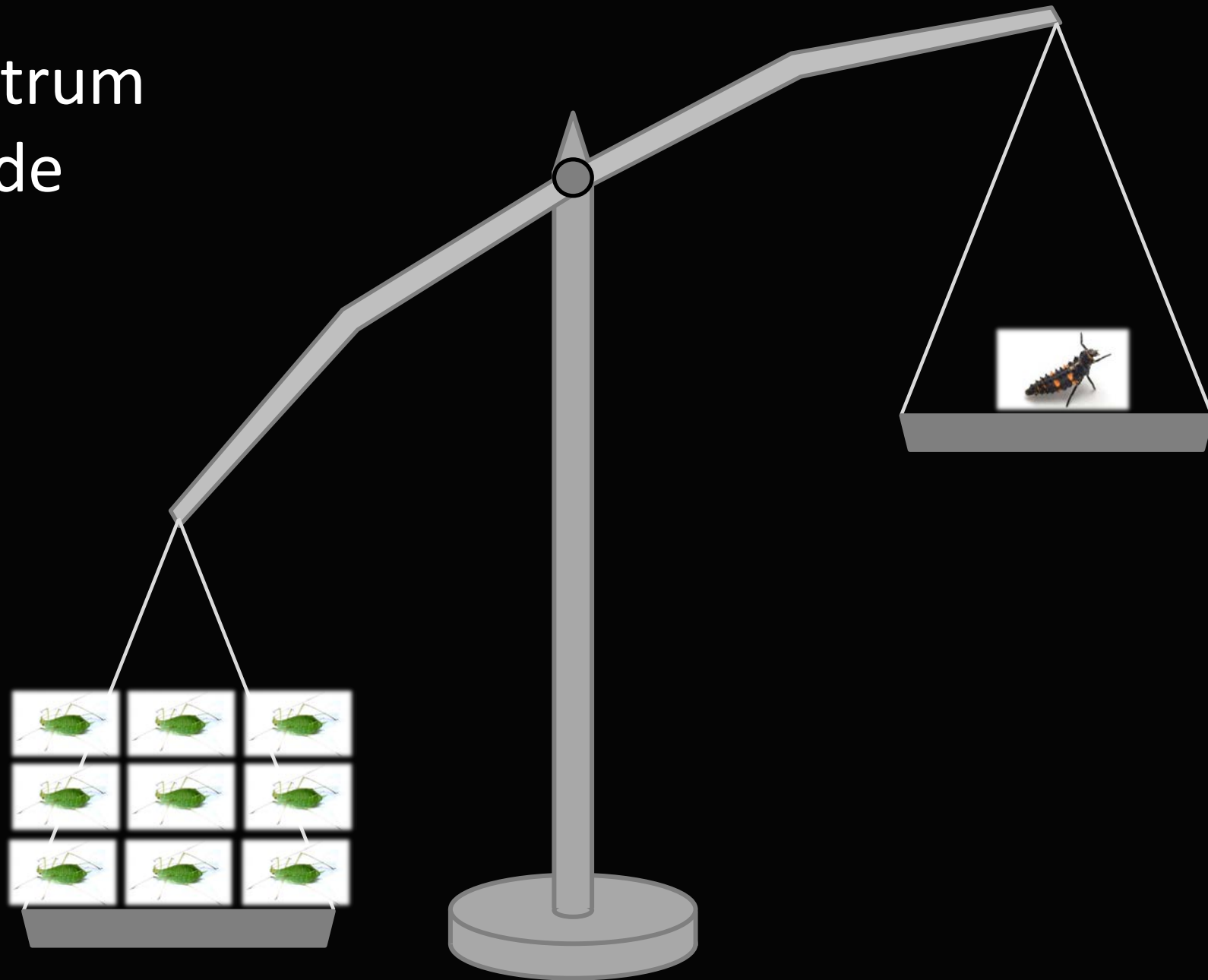
Lady beetle larvae
per sweep

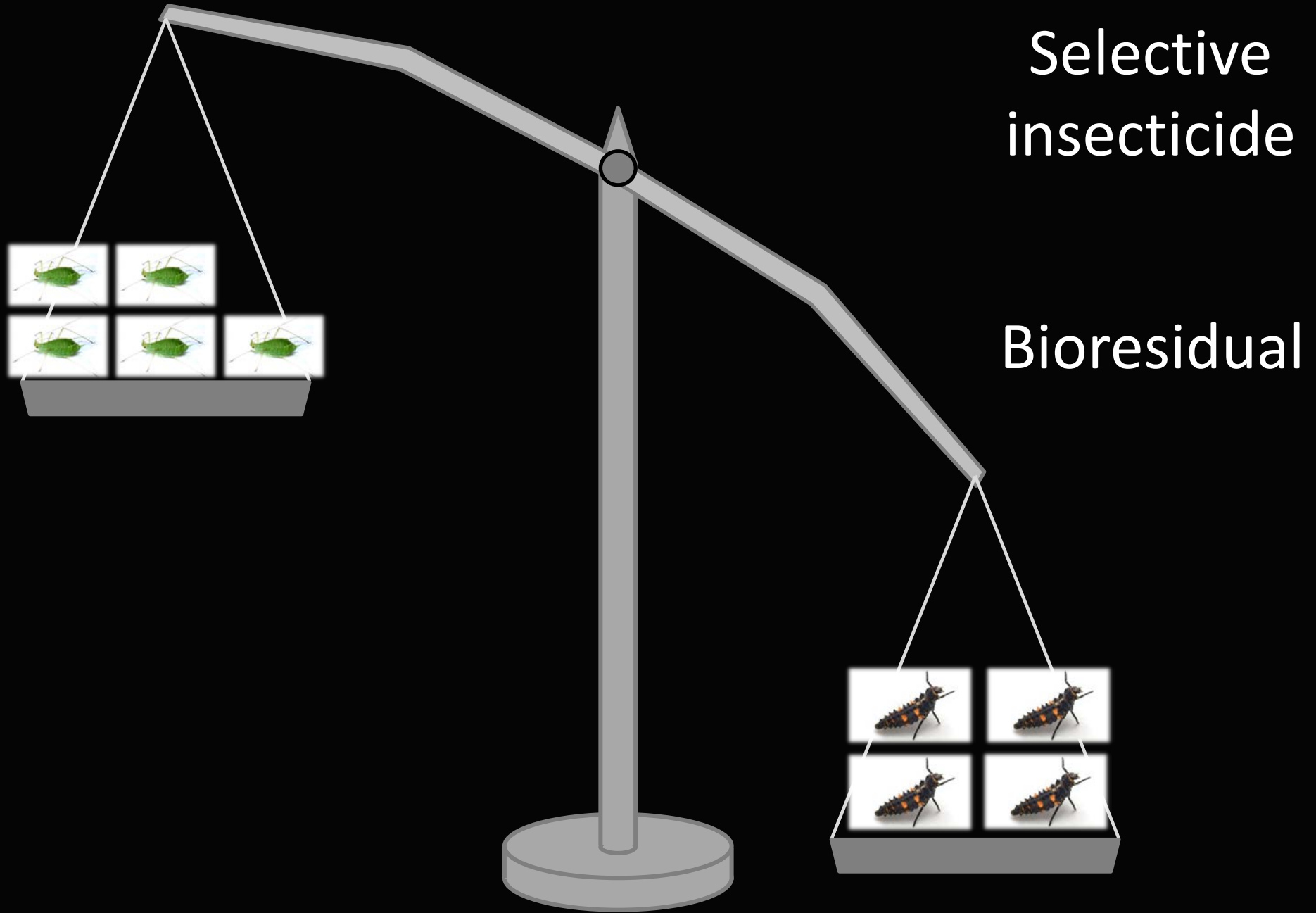


Natural enemy: pest ratios



Broad-spectrum
insecticide





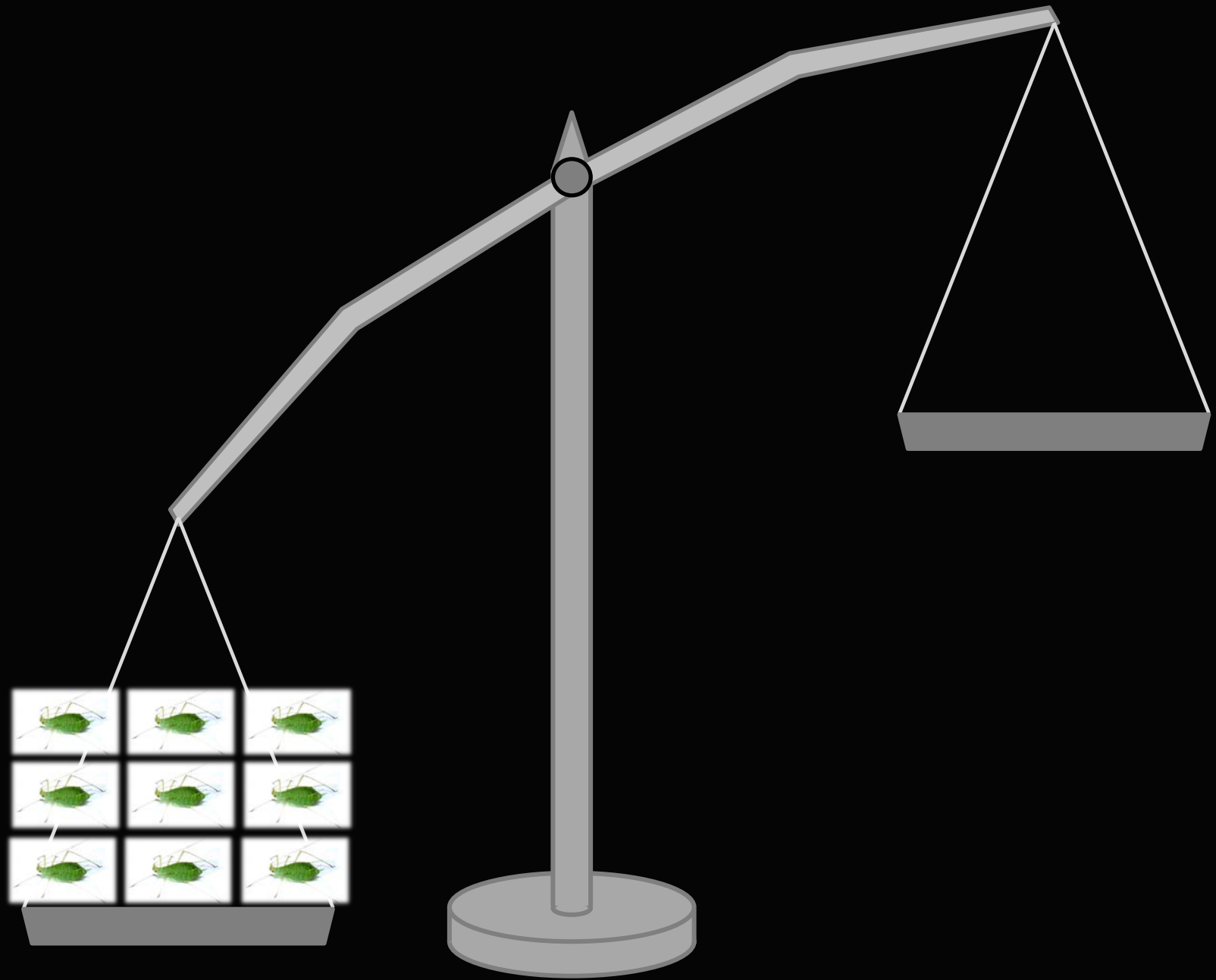


Bioresidual

“Other pest effects”

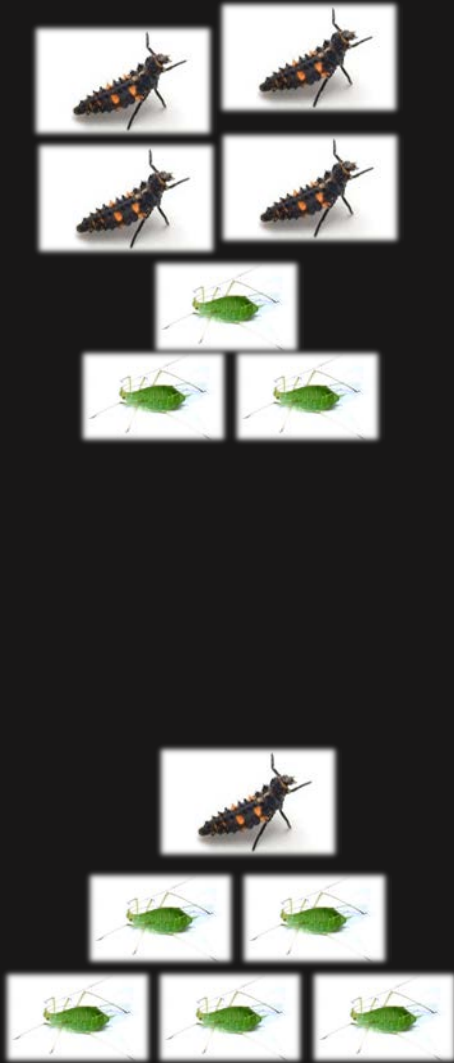


Direct efficacy



14 days after treatment

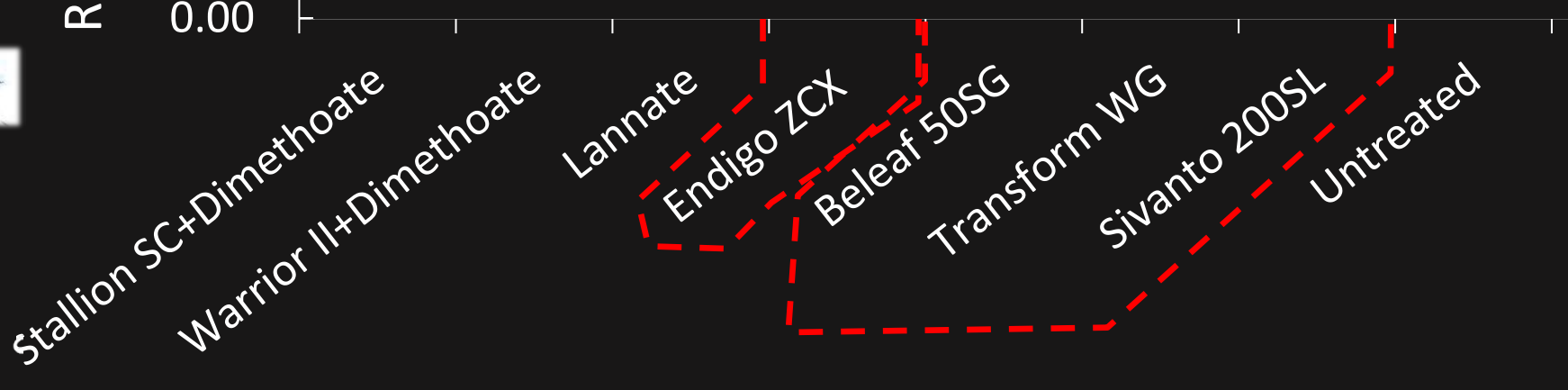
Natural enemies provide bioresidual effect



Ratio lady beetle larvae: aphid

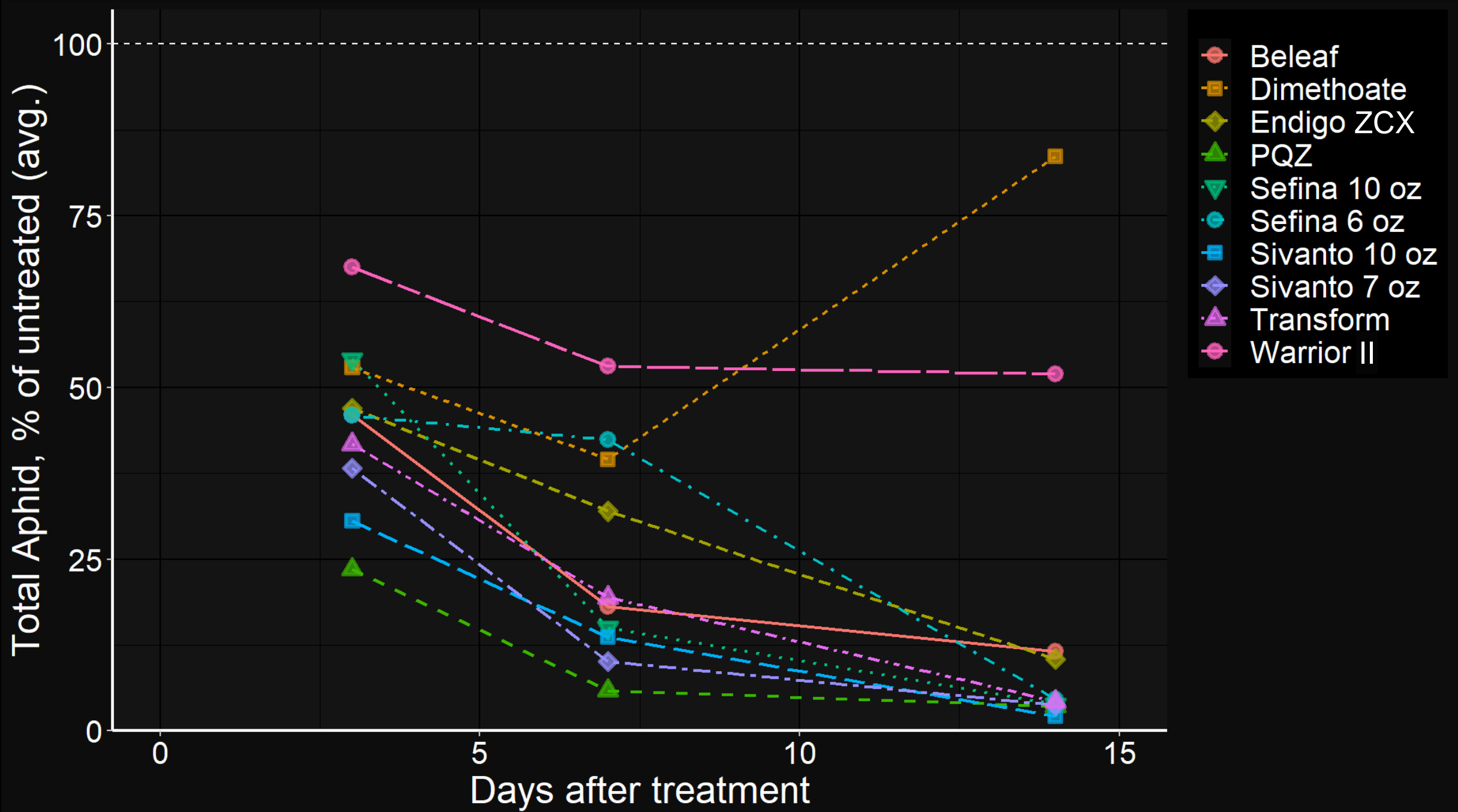
0.04
0.04
0.03
0.03
0.02
0.02
0.01
0.01
0.00

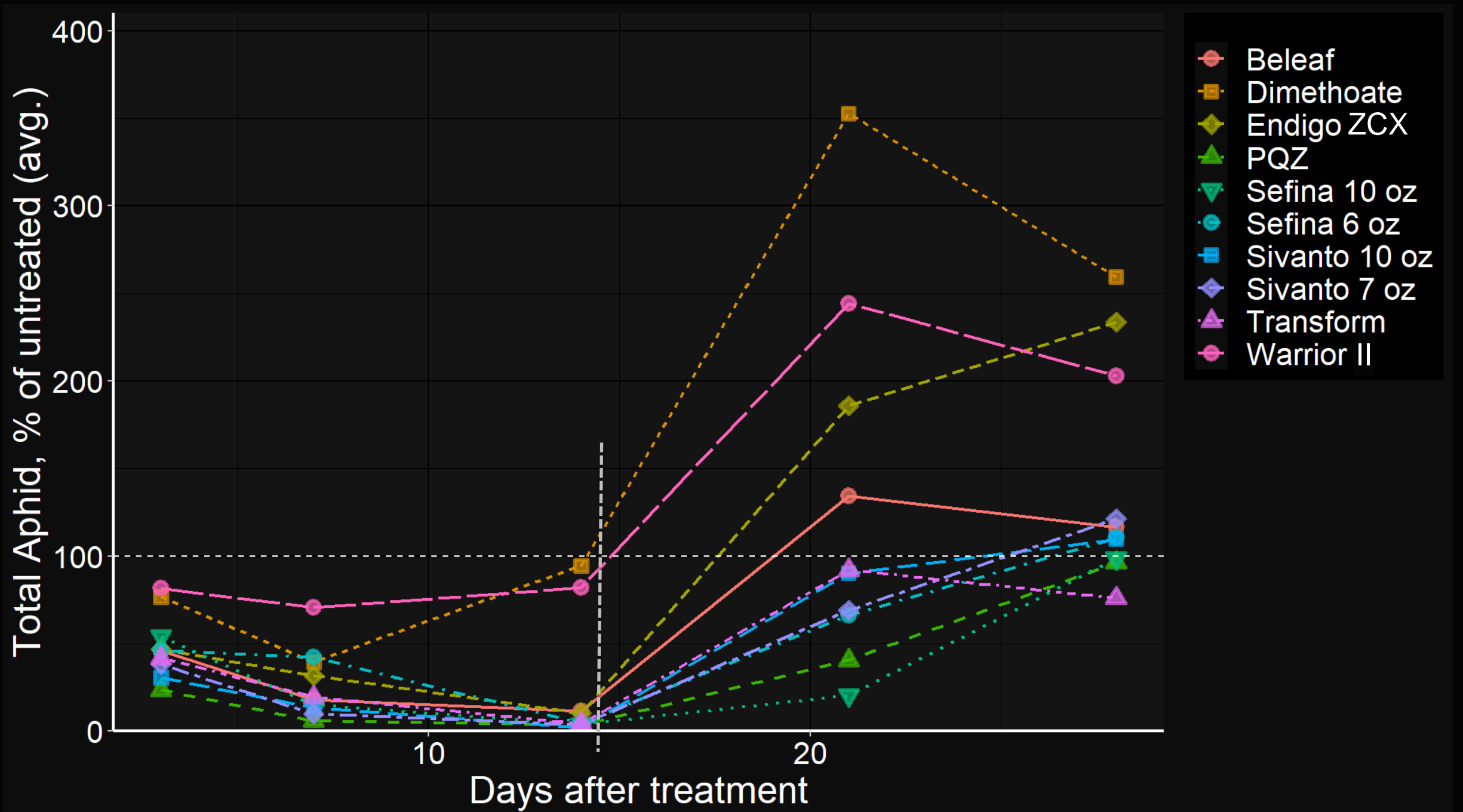
Stallion SC+Dimethoate
Warrior II+Dimethoate
Lannate
Endigo ZCX
Beleaf 50SG
Transform WG
Sivanto 200SL
Untreated









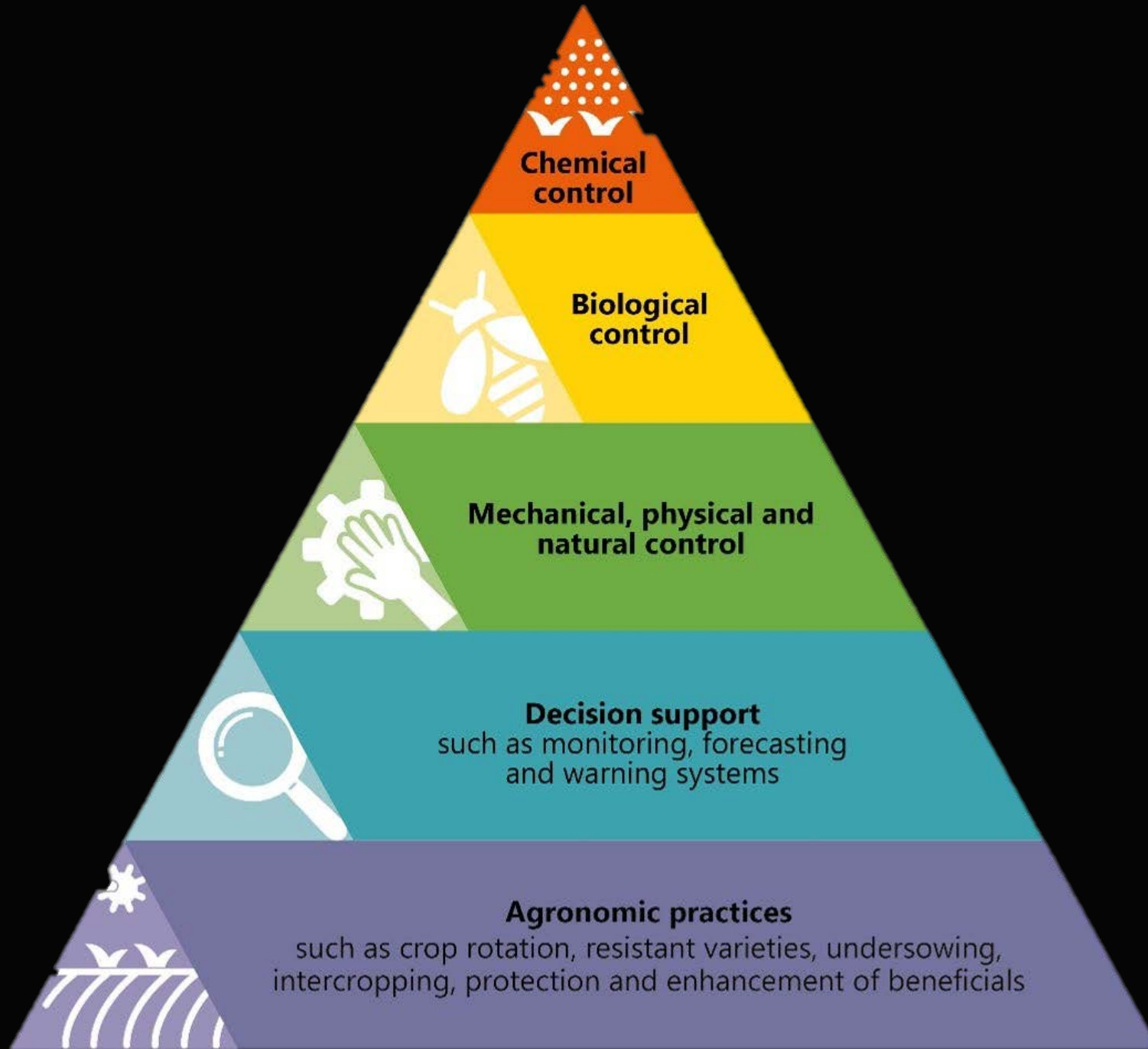


Tank mixtures

Selectivity

Efficacy





~~Reactive~~
Proactive



Acknowledgements



- Rachael Long (Yolo, Solano, Sacramento)
- Nick Clark (Kings, Tulare, Fresno)
- Rob Wilson (Intermountain REC, Siskiyou)
- Giuliano Galdi (Siskiyou)
- Tom Getts (Lassen, Modoc, Plumas-Sierra)
- Michelle Leinfelder-Miles (Delta)
- Michael Rethwisch (Imperial)

- Kevin Goding (UCD)
- Treanna Pierce (UCD)
- Omir Livneh (UCD)
- Ben Lee (UCD)

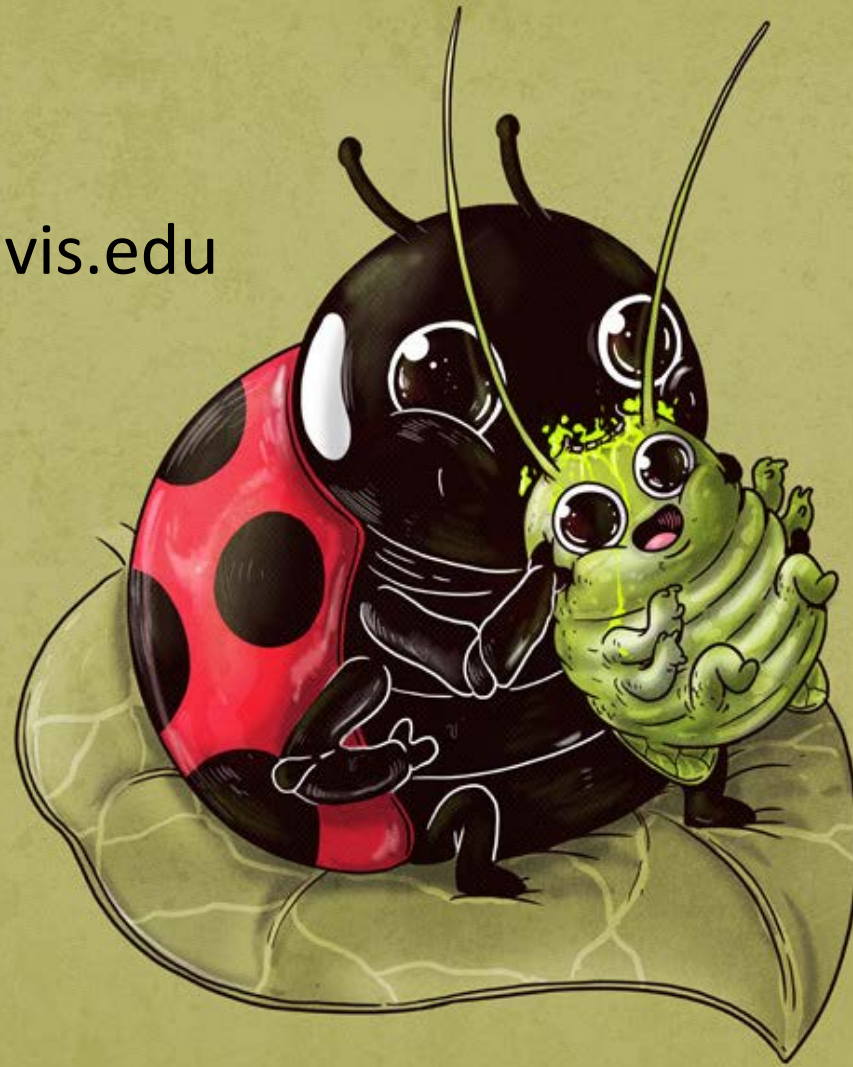
- Growers/PCAs



Questions?

Ian Grettenberger

imgrettenberger@ucdavis.edu



Alex Solis

