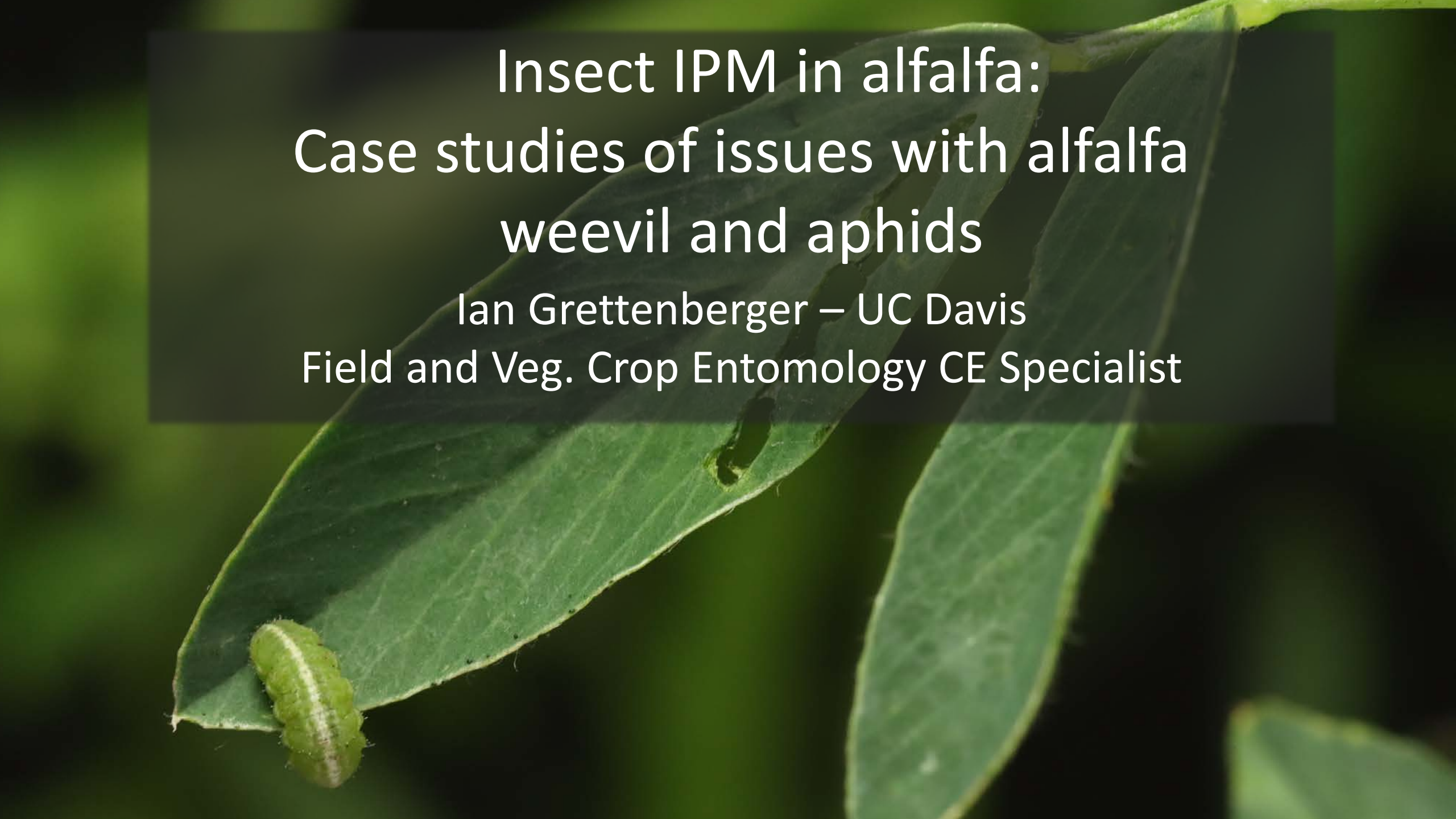
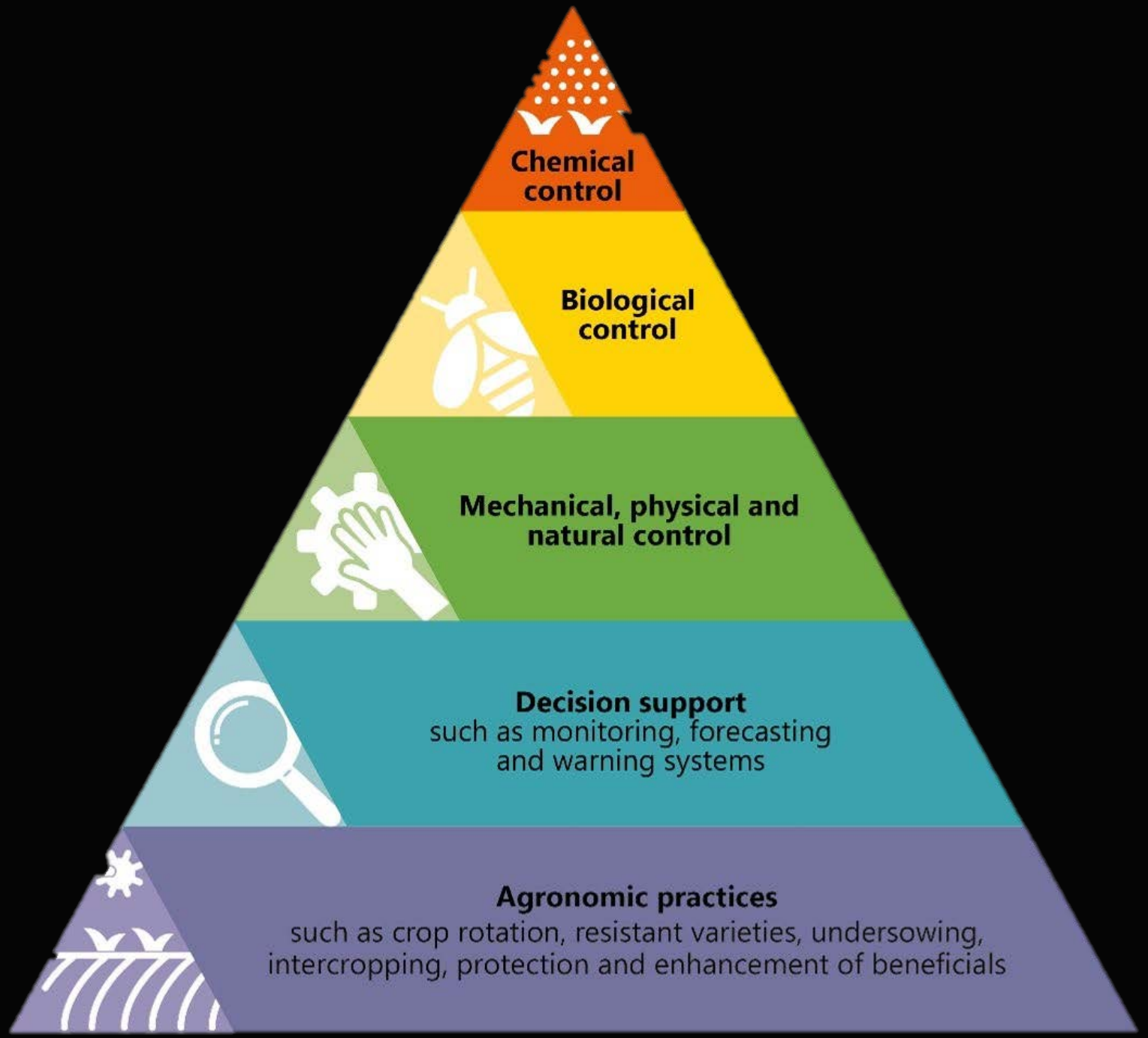


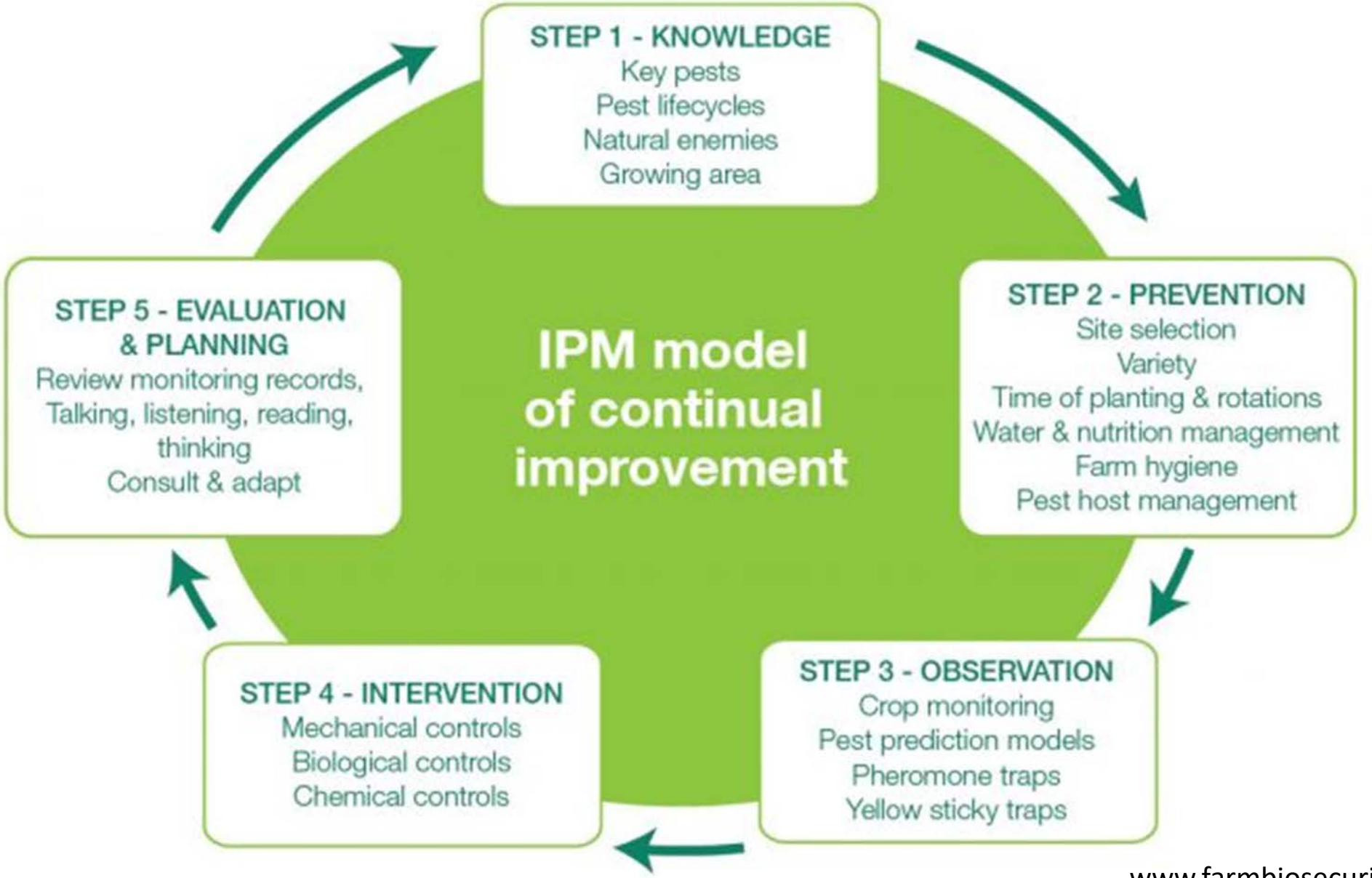
Insect IPM in alfalfa: Case studies of issues with alfalfa weevil and aphids

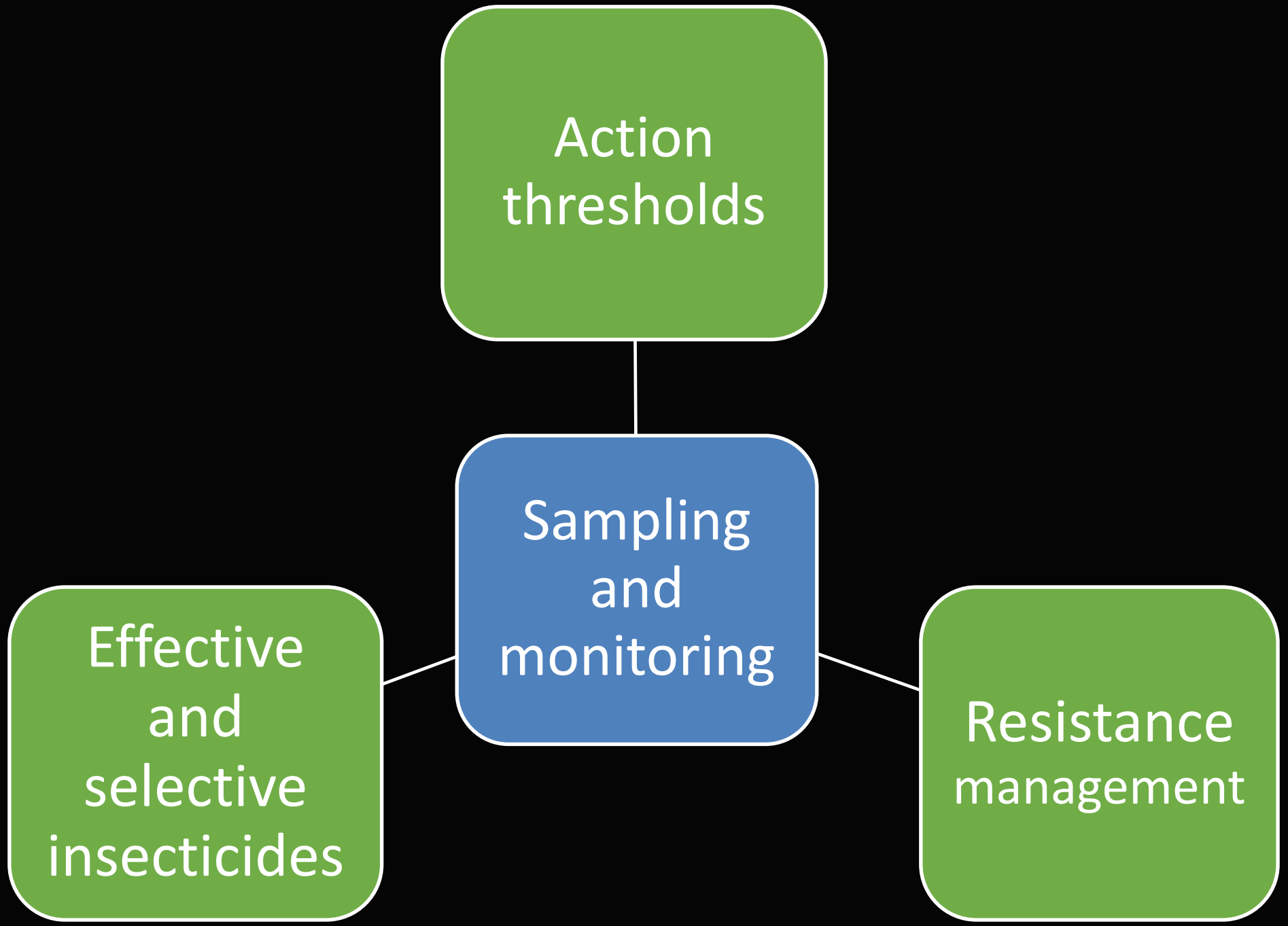
Ian Grettenberger – UC Davis
Field and Veg. Crop Entomology CE Specialist


Chemical control
Biological control
Mechanical, physical and natural control
Decision support
such as monitoring, forecasting and warning systems
Agronomic practices
such as crop rotation, resistant varieties, undersowing, intercropping, protection and enhancement of beneficials


FISKARS


Estwing
Estwing



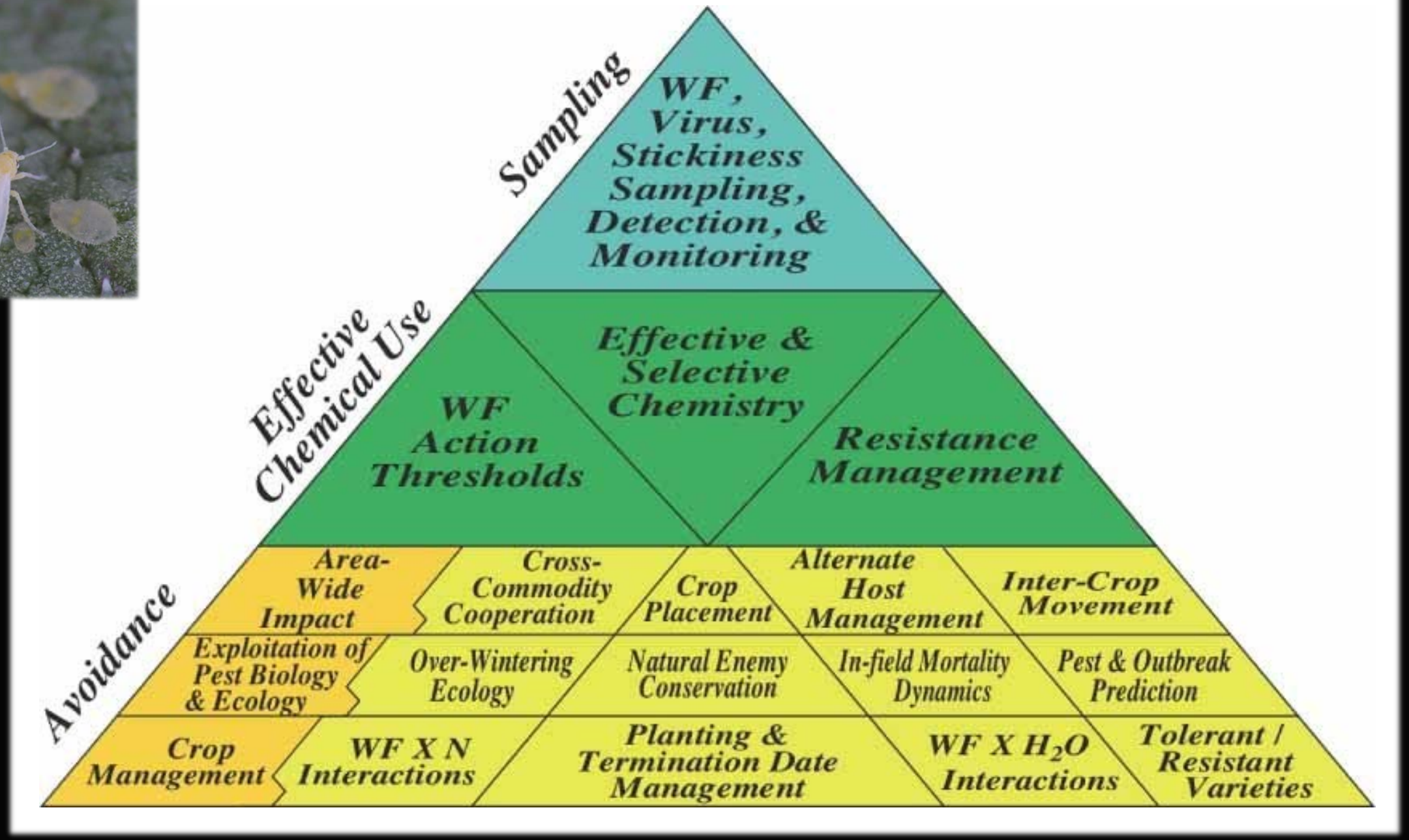

Action thresholds
Sampling and monitoring
Effective and selective insecticides
Resistance management


EVERYTHING WILL CHANGE
EVERYTHING HAS CHANGED
makeameme

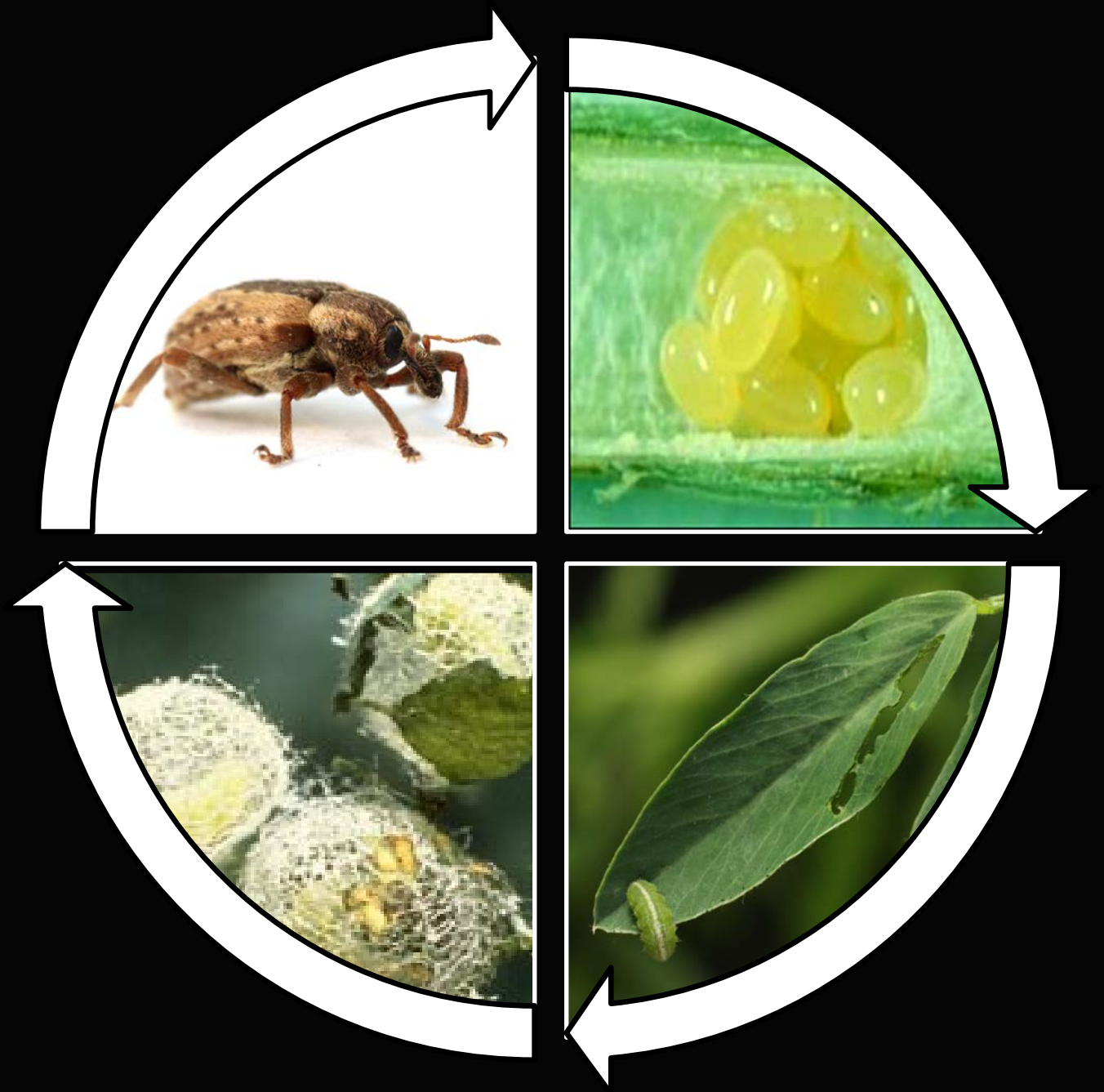
- IPM can't be "close to the end"…

  need to adapt

Mr. Mark, Flickr

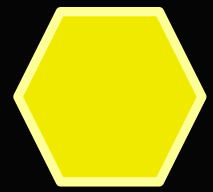


Naranjo and Ellsworth 2009

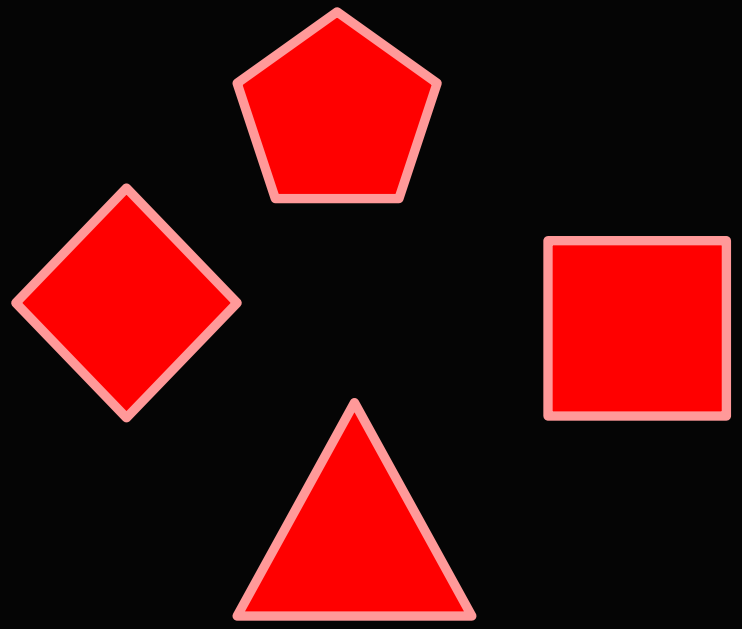


Problem: Limited modes of actions

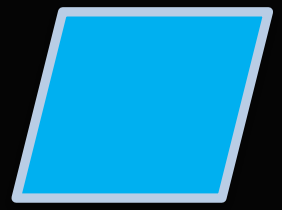
Spinosyns-Spinosad (5)



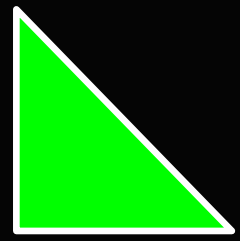
Pyrethroids (3A)



Oxadiazines – Indoxacarb (22A)



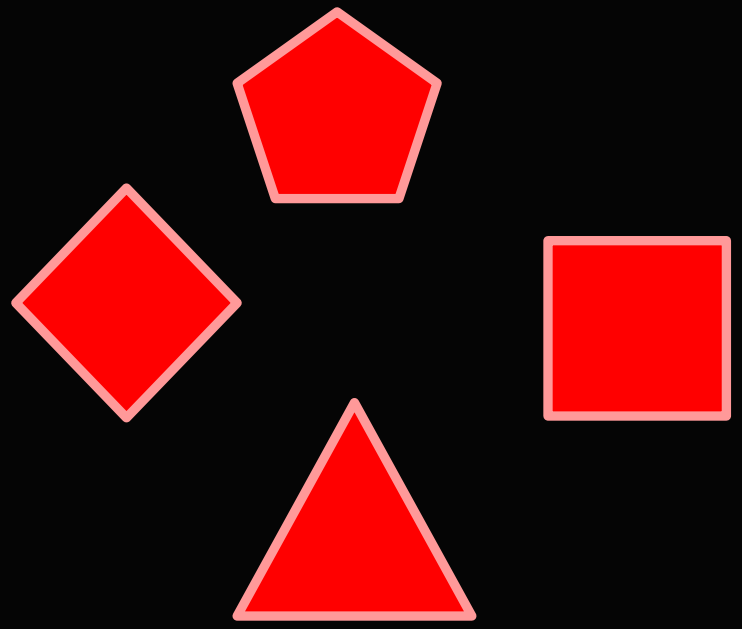
Organophosphates – malathion (1B)



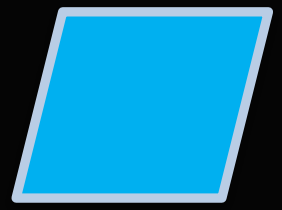
Problem: Limited modes of actions

Spinosyns-Spinosad (5)

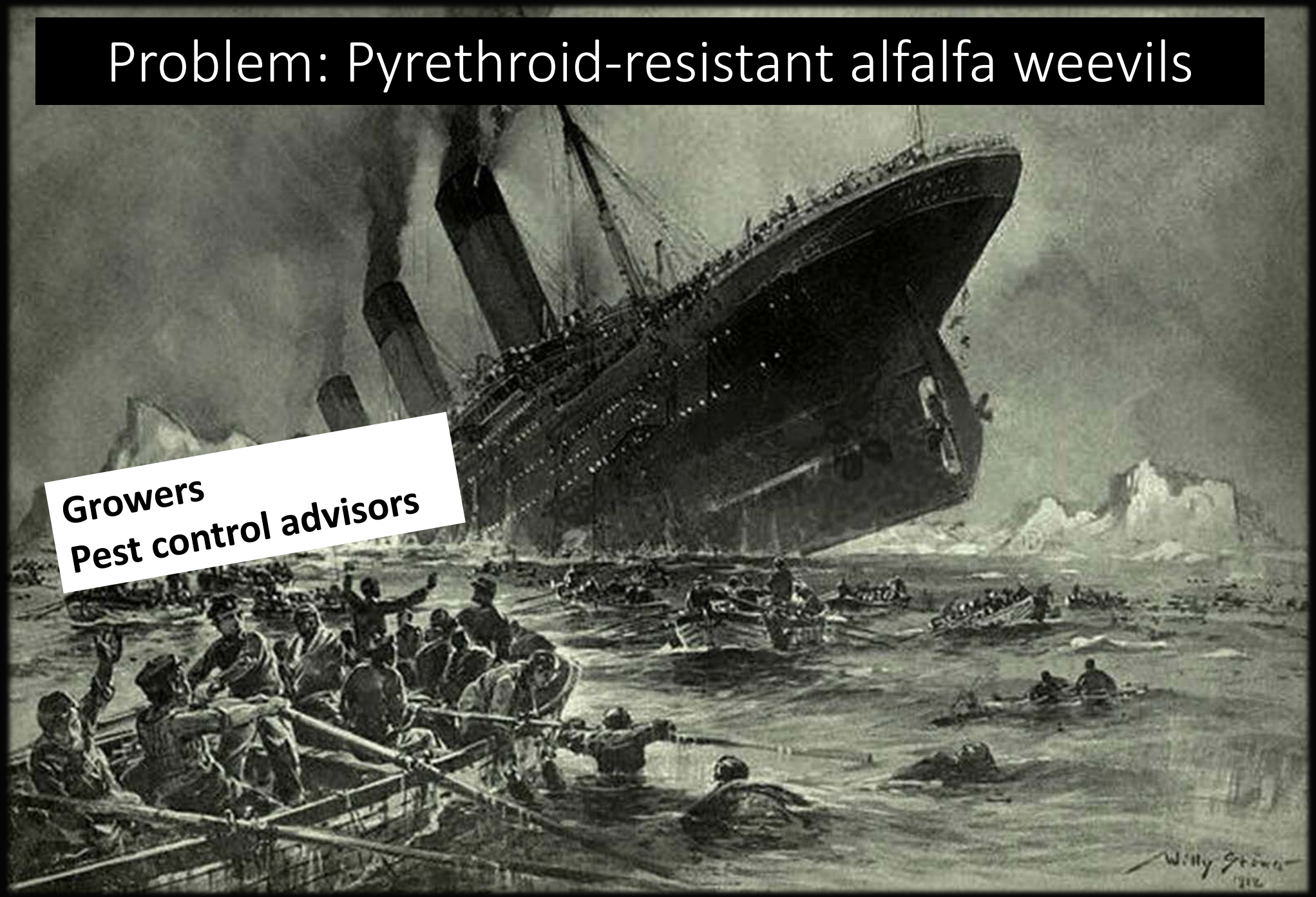
Pyrethroids (3A)



Oxadiazines – Indoxacarb (22A)

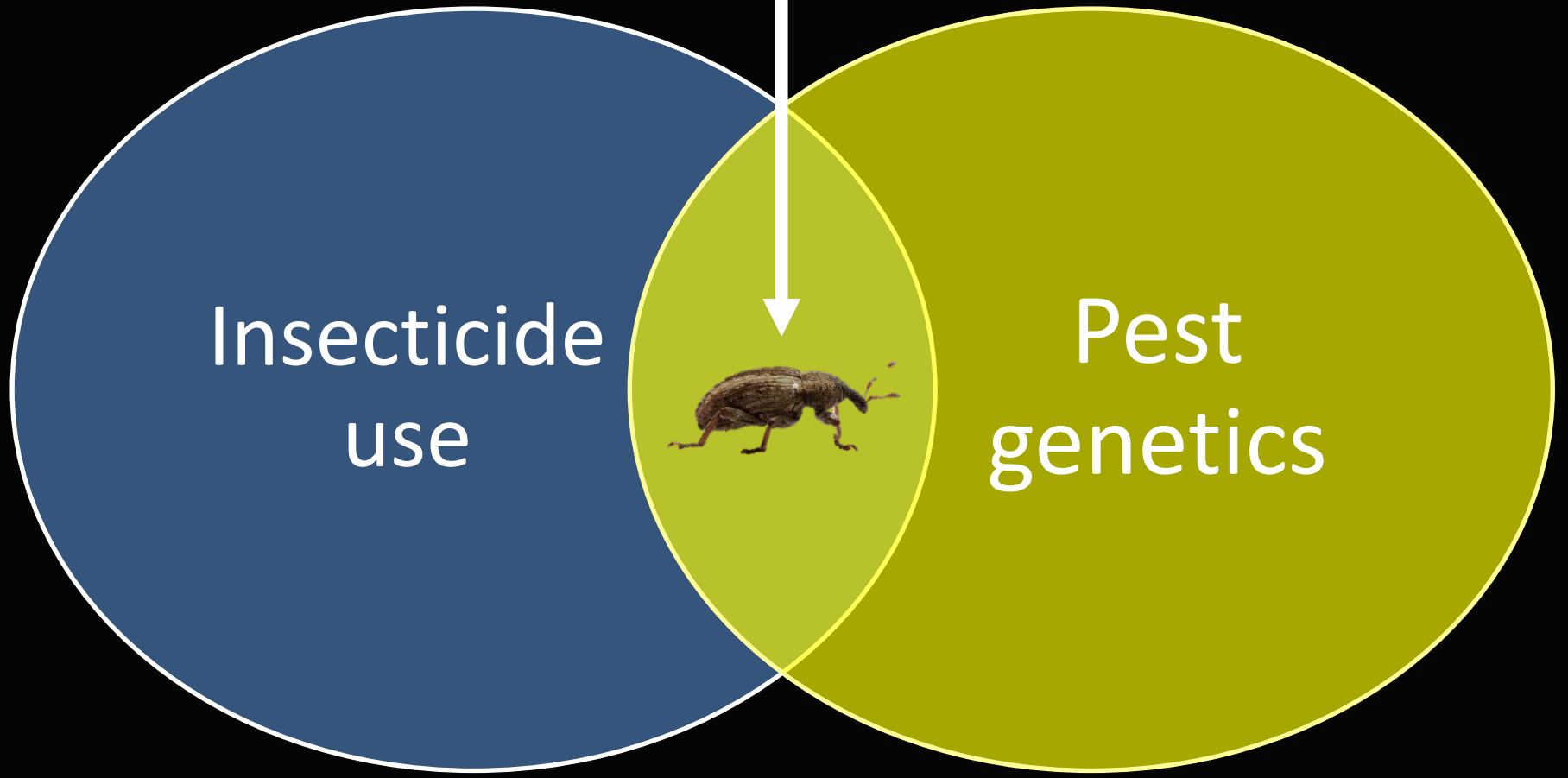


Problem: Pyrethroid-resistant alfalfa weevils

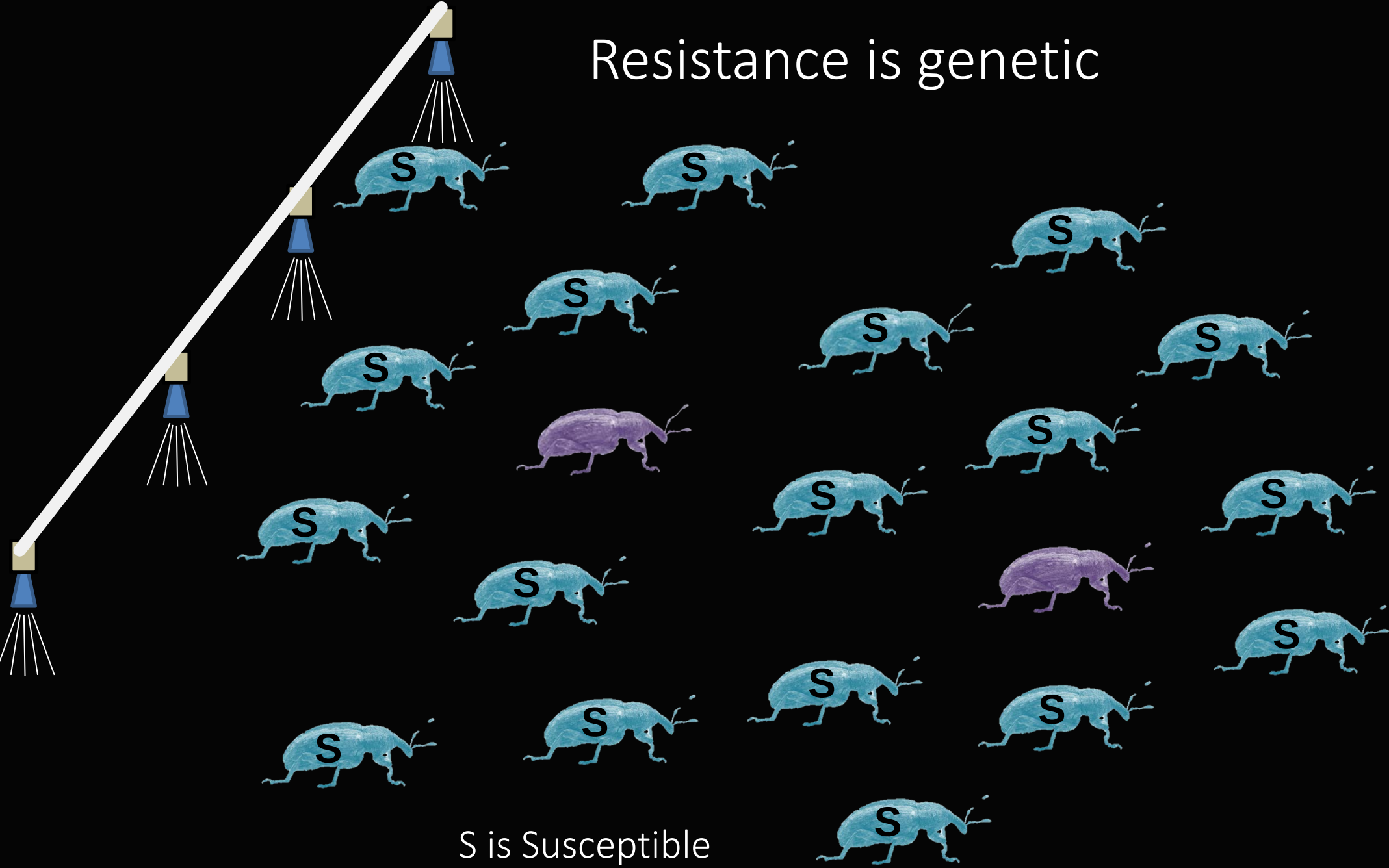



PEST MANAGER WAITING
FOR RESISTANCE TO SOLVE ITSELF
imgflip.com

Insecticide resistance



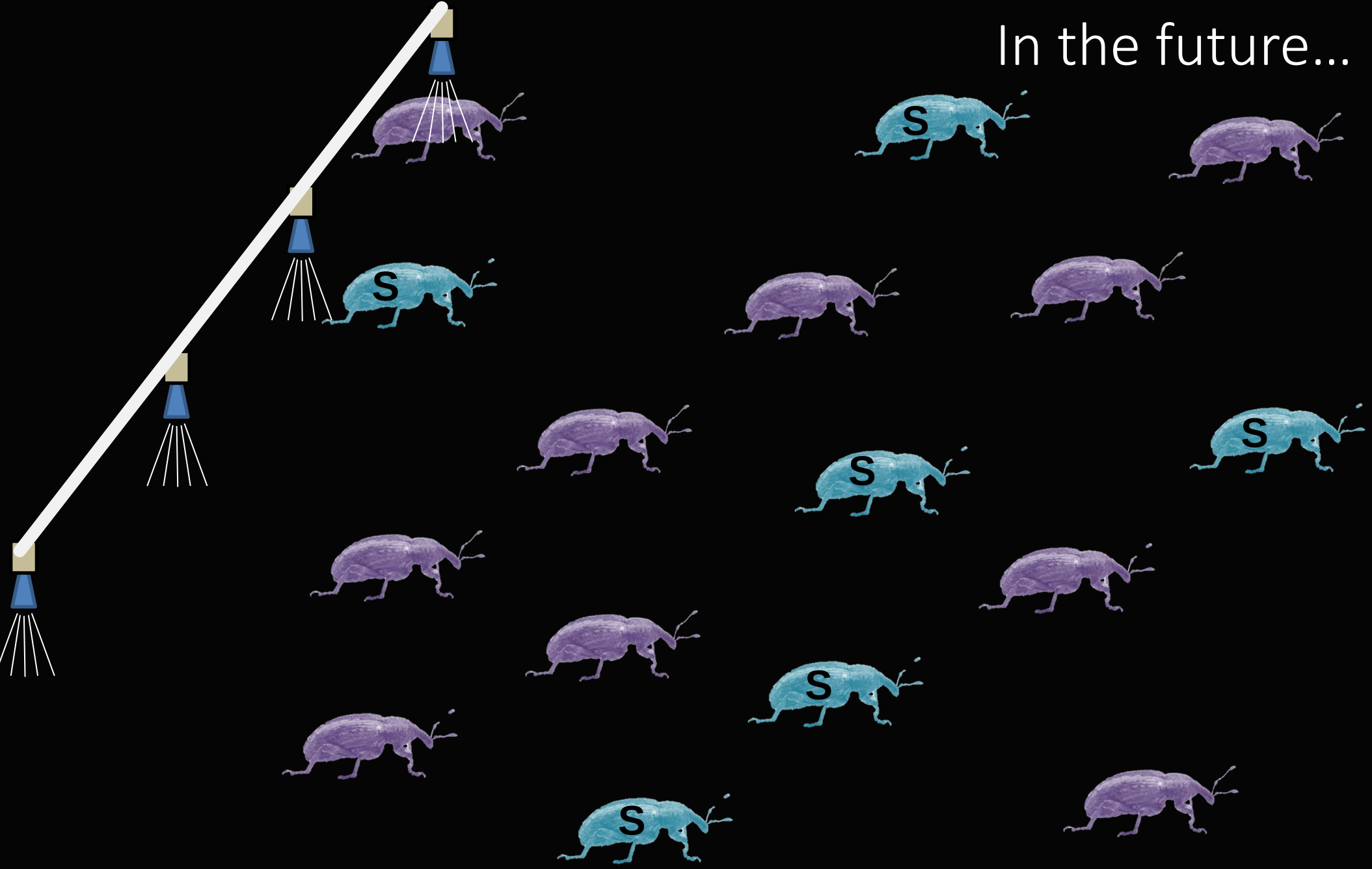
Resistance is genetic



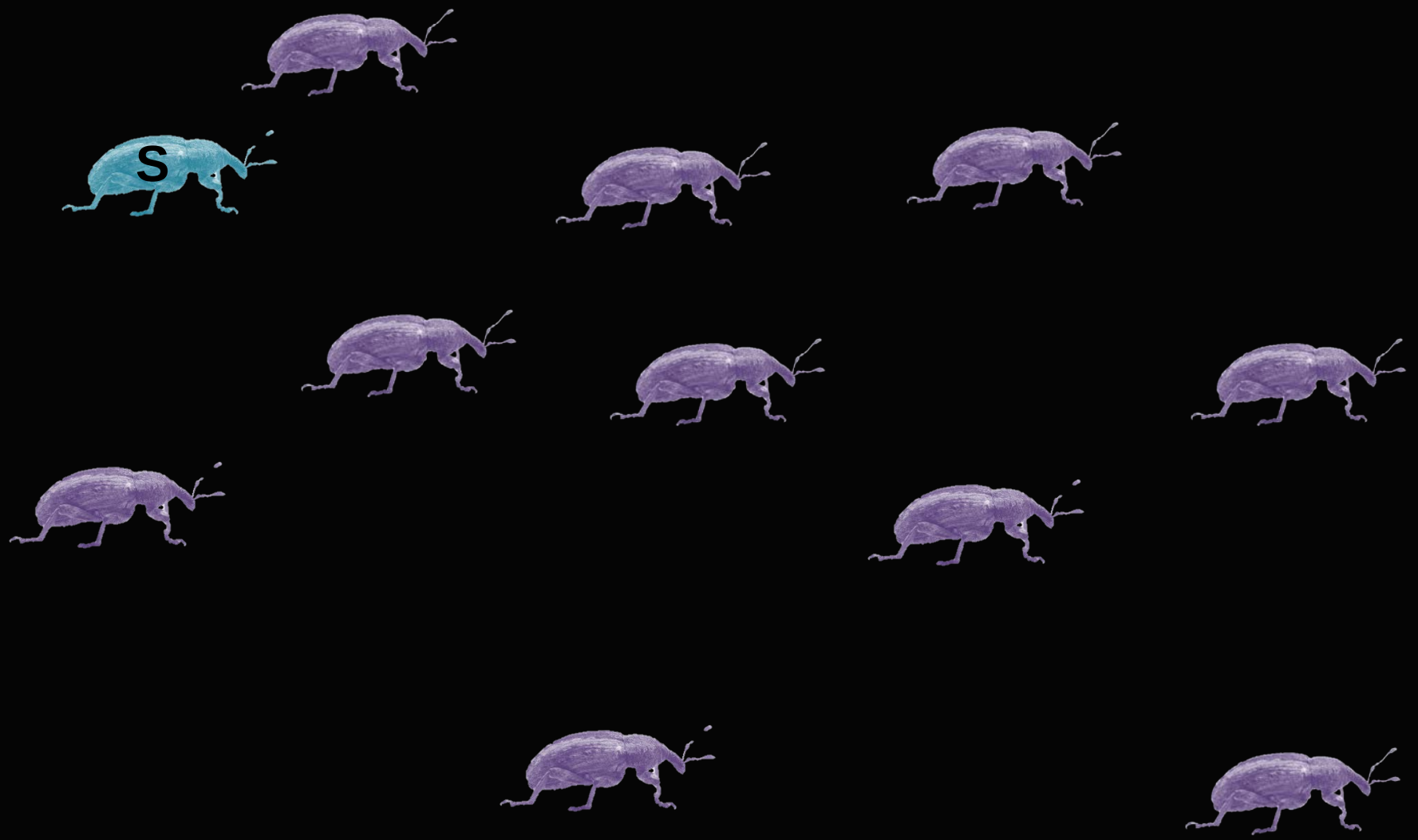
S is Susceptible

Mating

In the future…



Resistance is now common

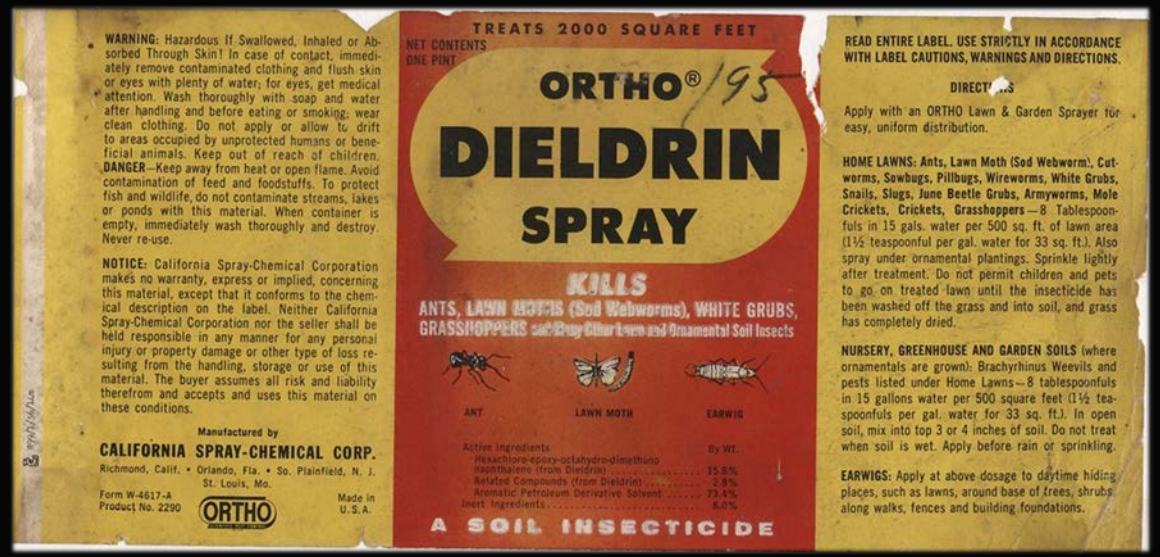


Insecticide resistance is not a new issue

Resistance of the Alfalfa Weevil to Heptachlor[1]

V. E. Adler and C. C. Blickenstaff
Entomology Research Division, Agr. Res. Serv.,
USDA., Beltsville, Md.

Reports (USDA 1962, 1963; Bissell and Harding 1963;



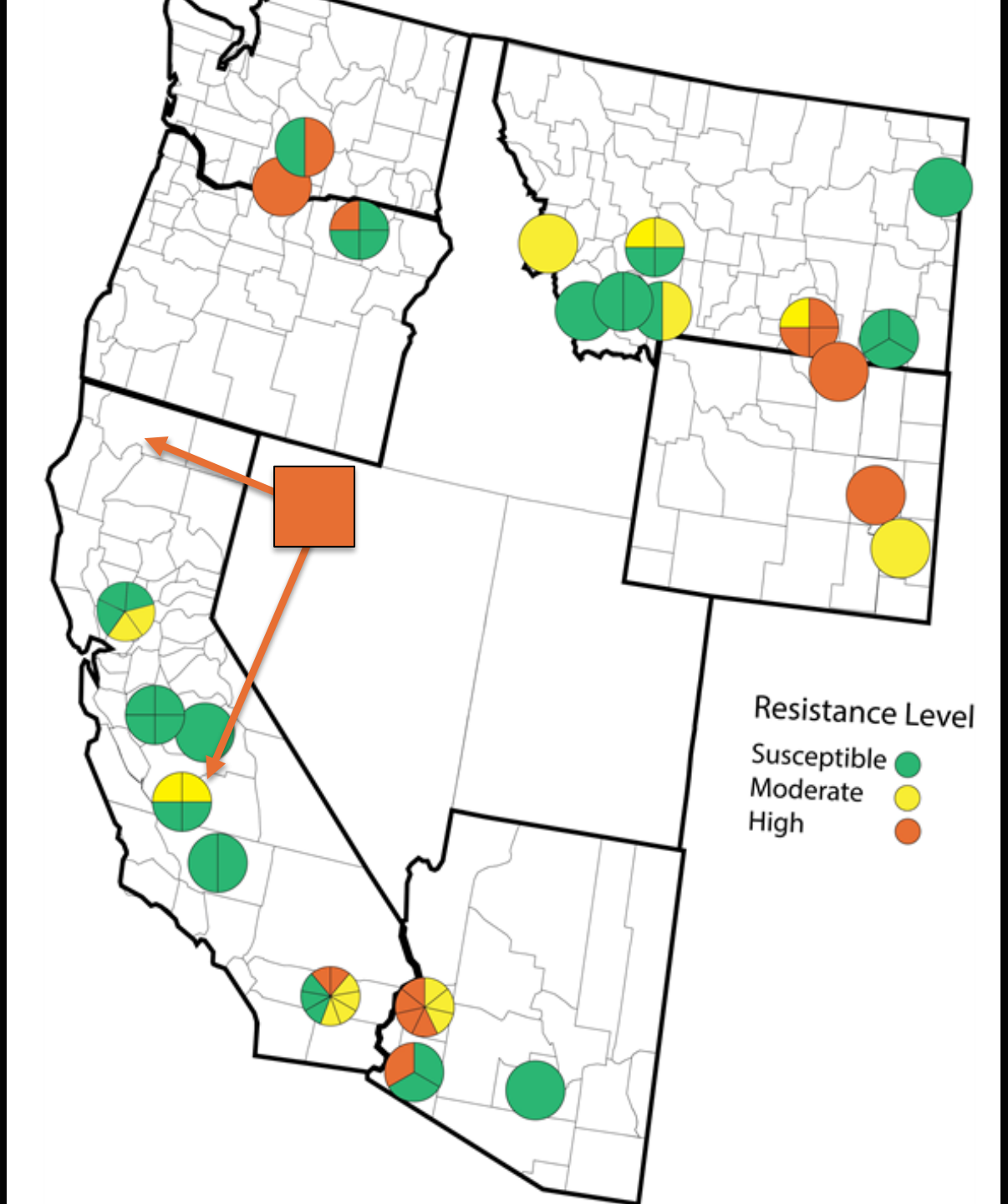
Resistant Alfalfa Weevil

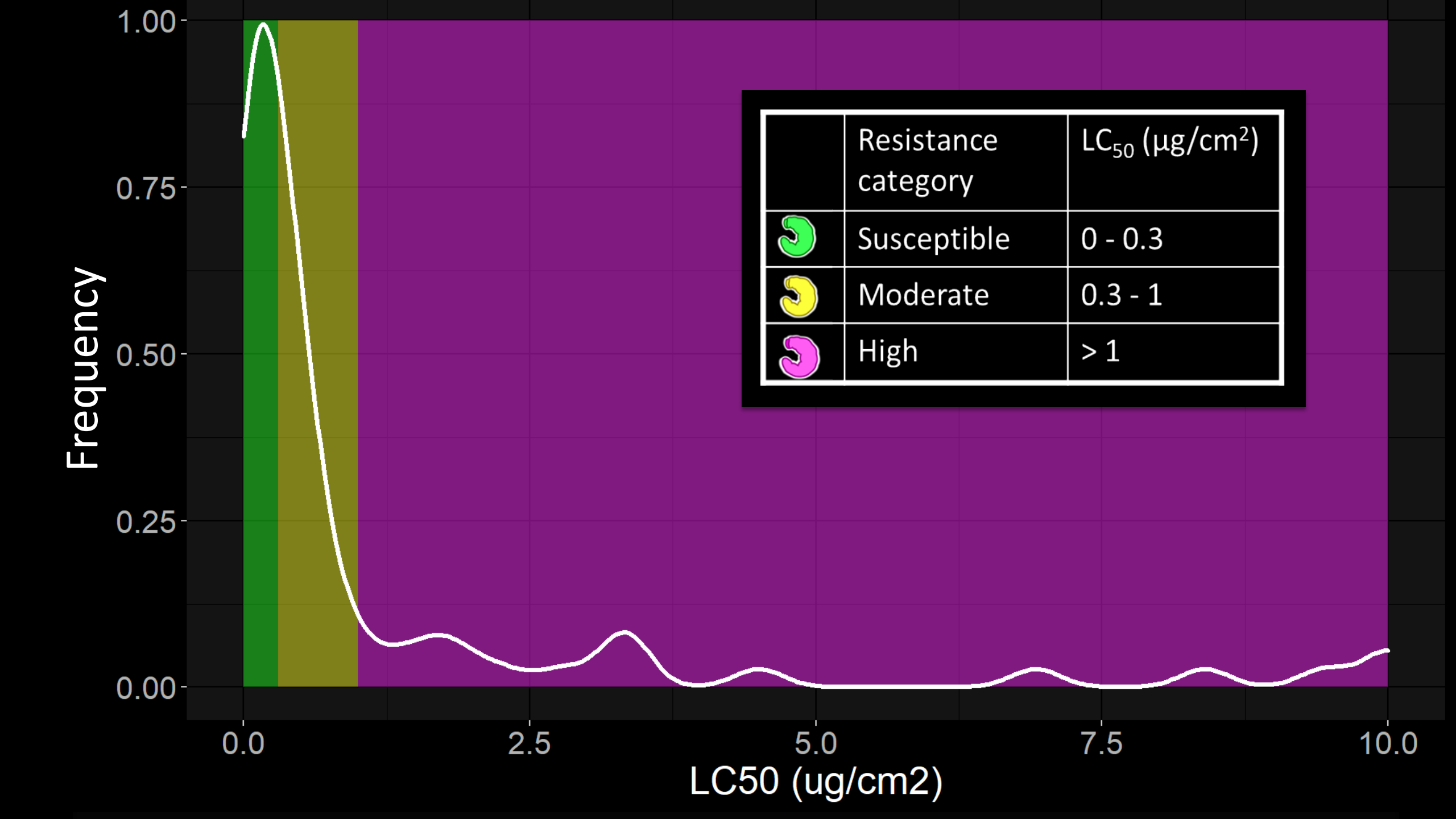
Kevin Wanner

Erika Rodbell

Madi Hendrick

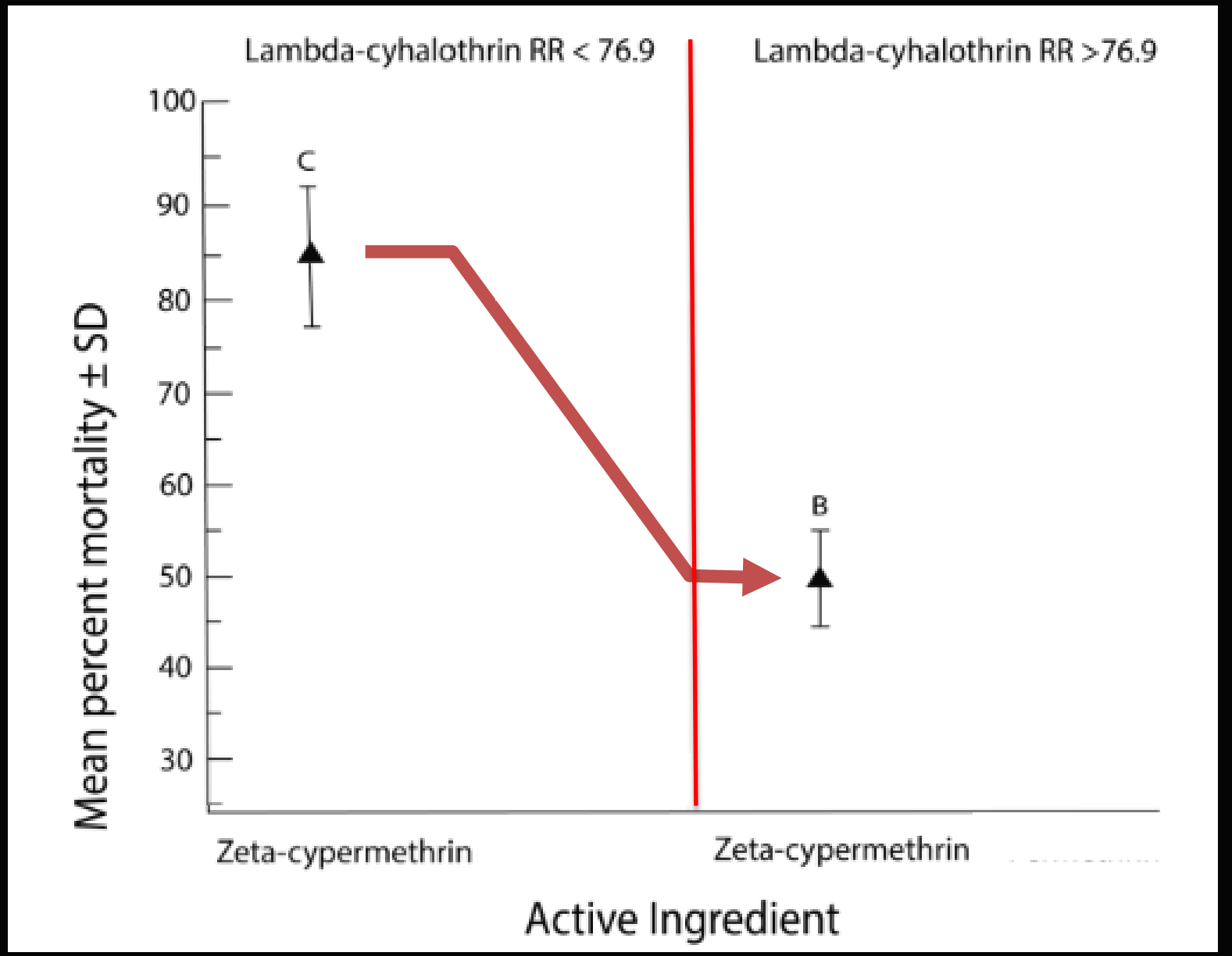
Lambda-cyhalothrin bioassays


Resistance Level
Susceptible
Moderate
High

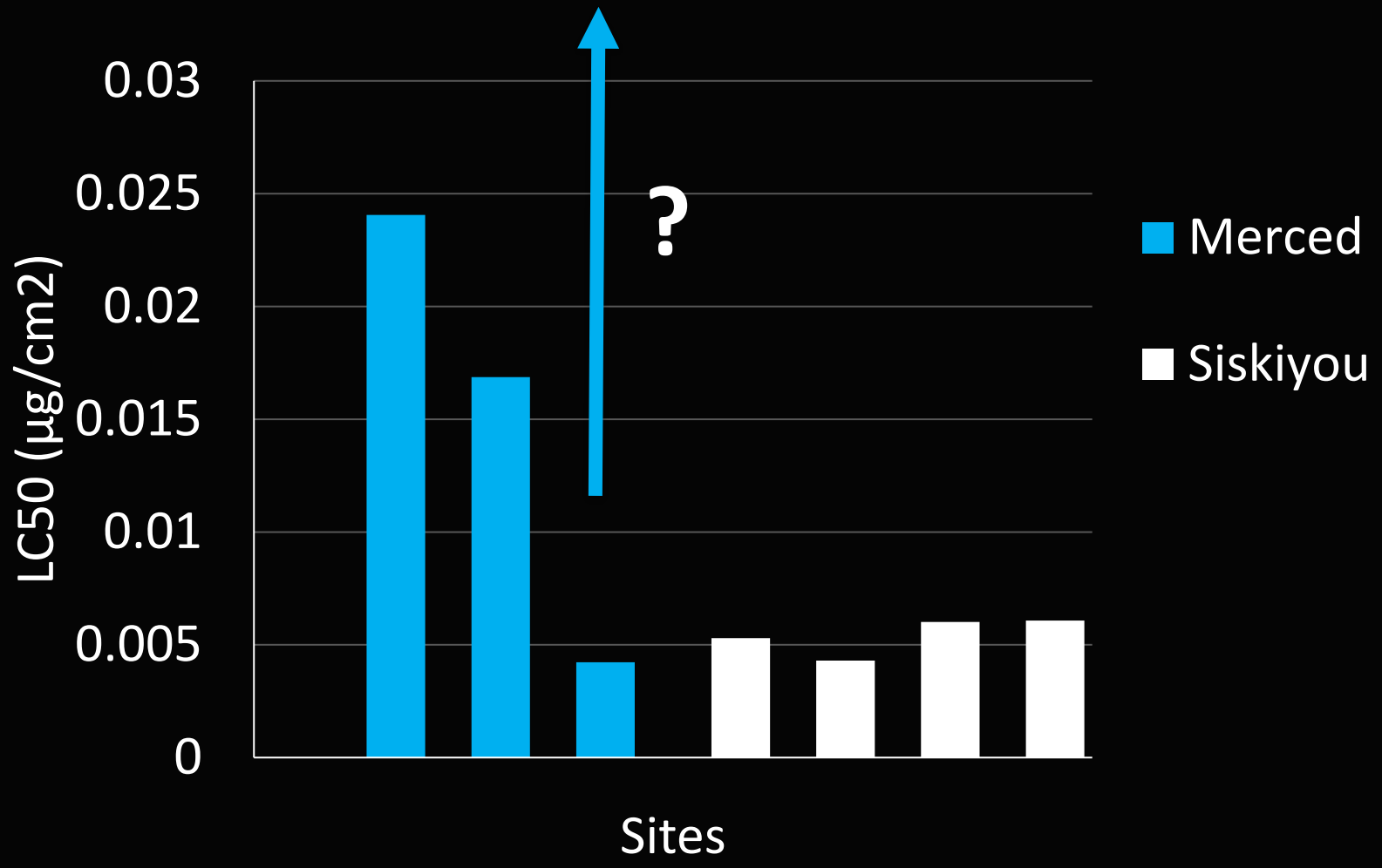

1.00
0.75
0.50
0.25
0.00
Frequency
0.0
2.5
5.0
7.5
10.0
LC50 (ug/cm2)
Resistance category
LC50 (µg/cm2)
Susceptible
0 - 0.3
Moderate
0.3 - 1
High
> 1

What about cross resistance?

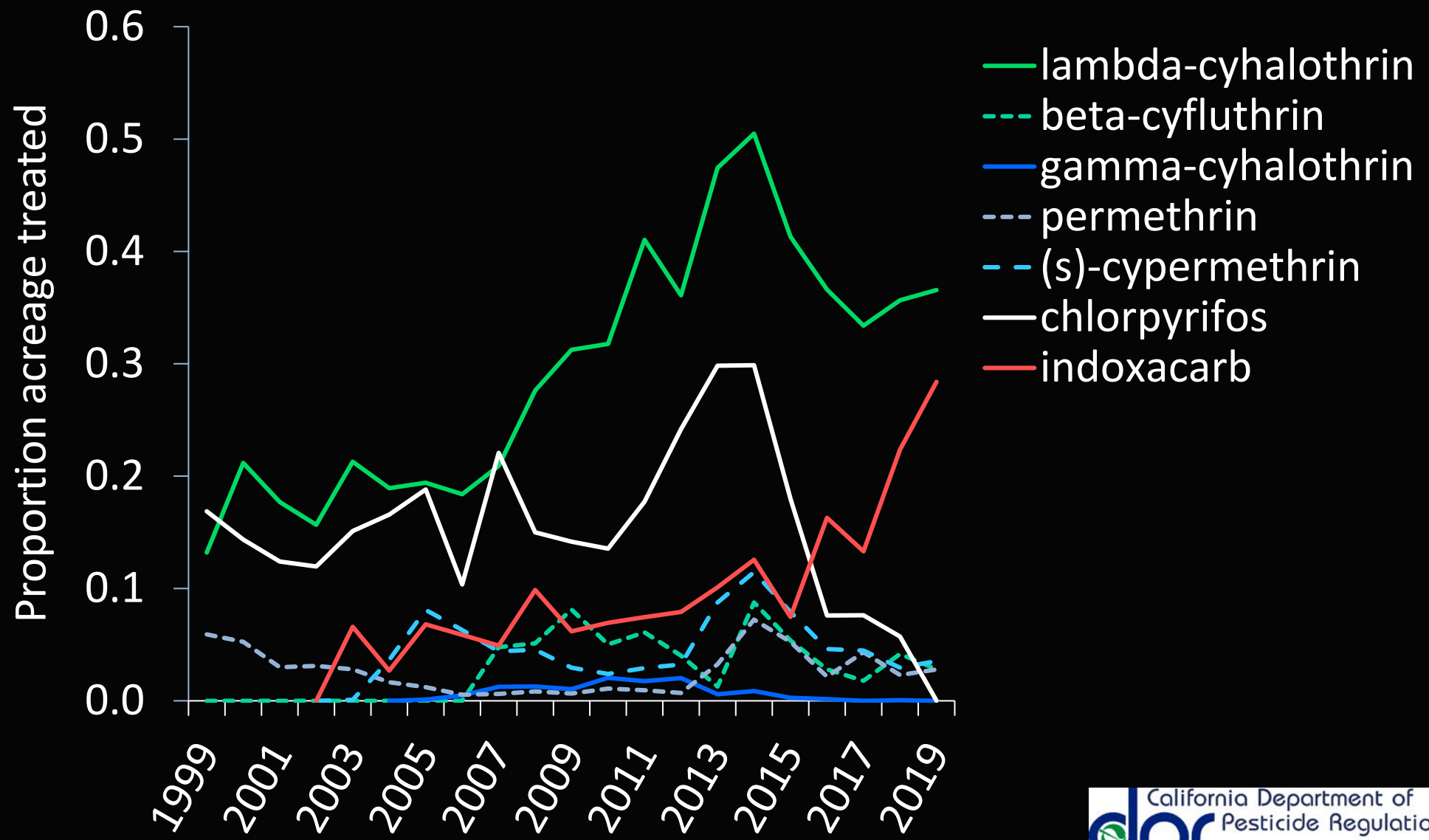
- Cross resistance between lambda-cyhalothrin and zeta-cypermethrin
- Limited cross resistance between lambda-cyhalothrin and permethrin



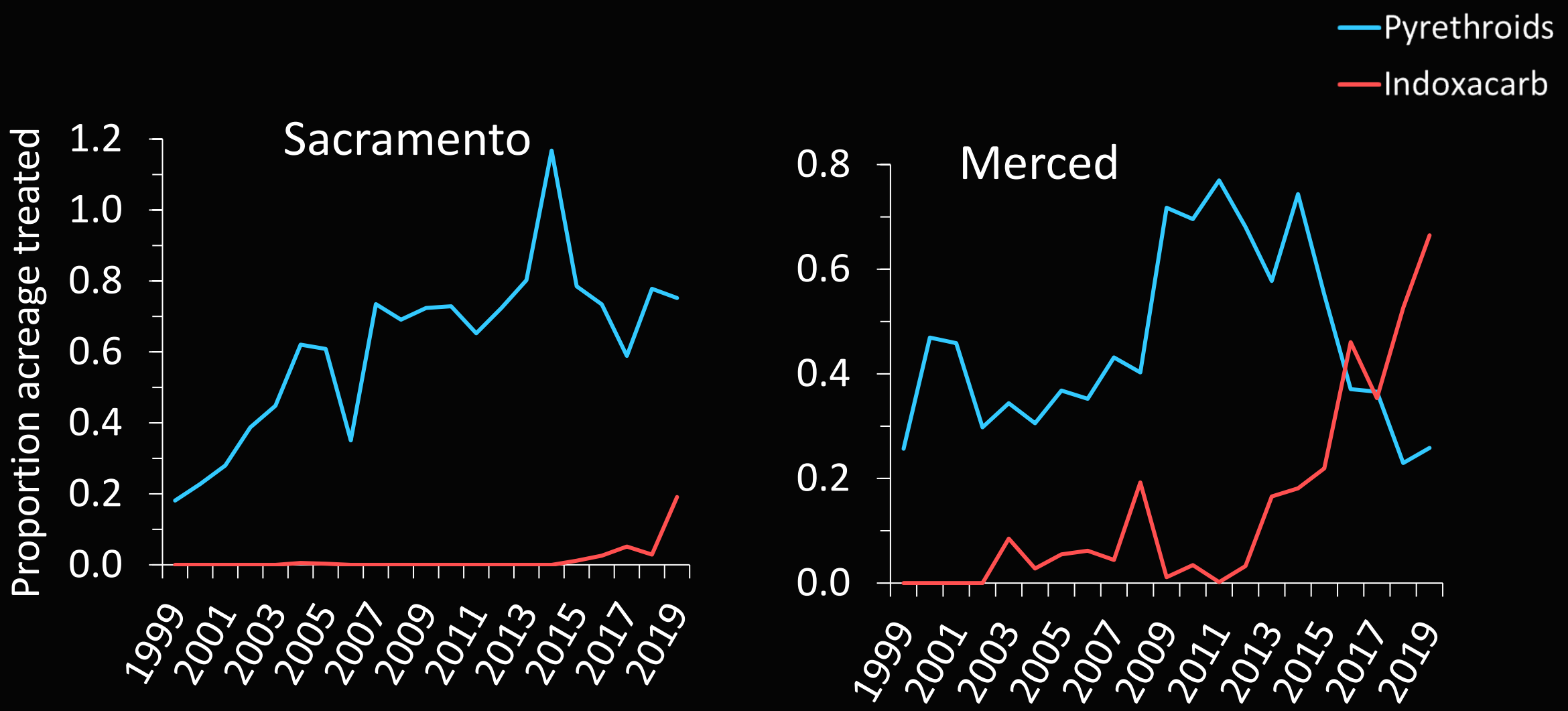
Steward/indoxacarb: opportunity to be proactive



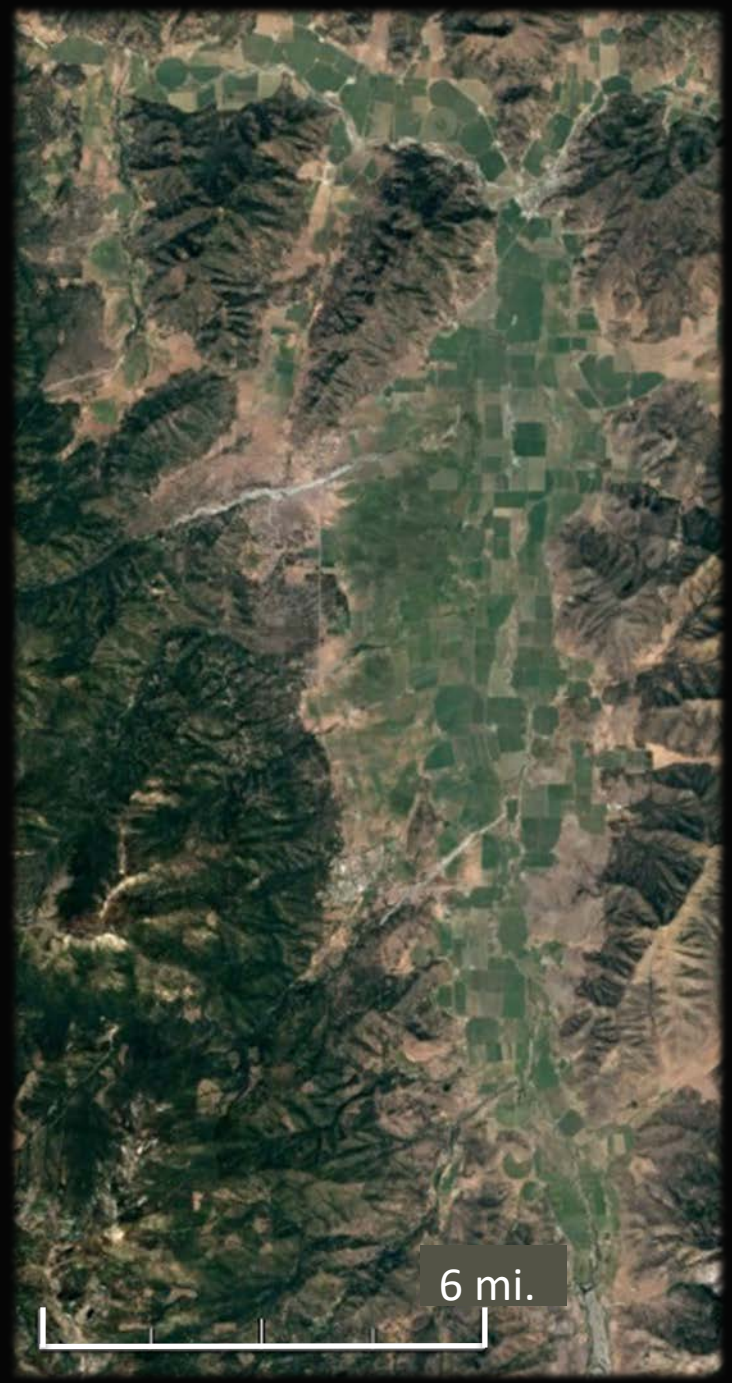
What have we seen in CA?



California Department of Pesticide Regulation


Pyrethroids
Indoxacarb
Sacramento
Merced
Proportion acreage treated
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019

How does resistance spread…
how far, how quickly?




Bowles Farming

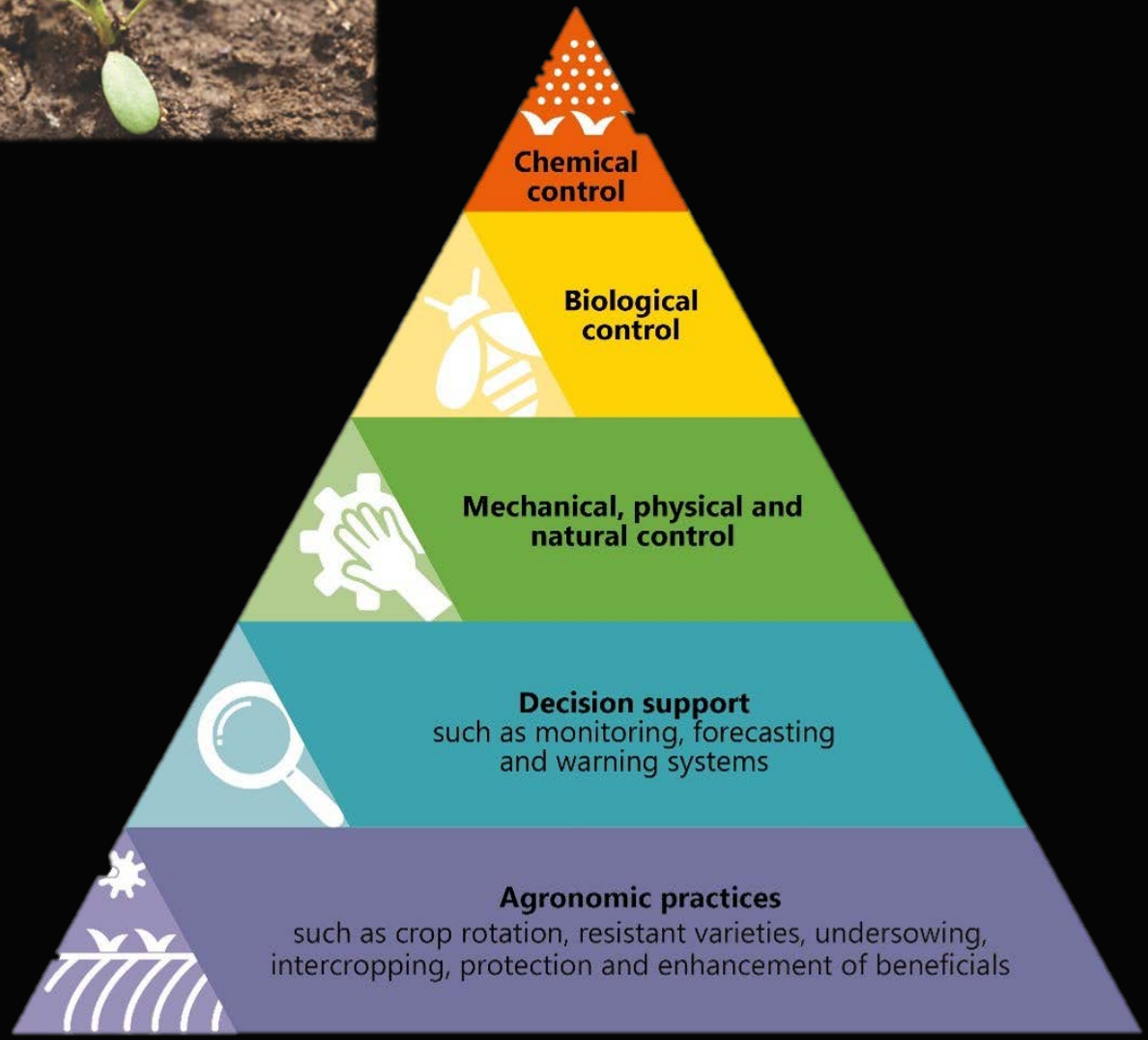
What do we have to look forward to?

- 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

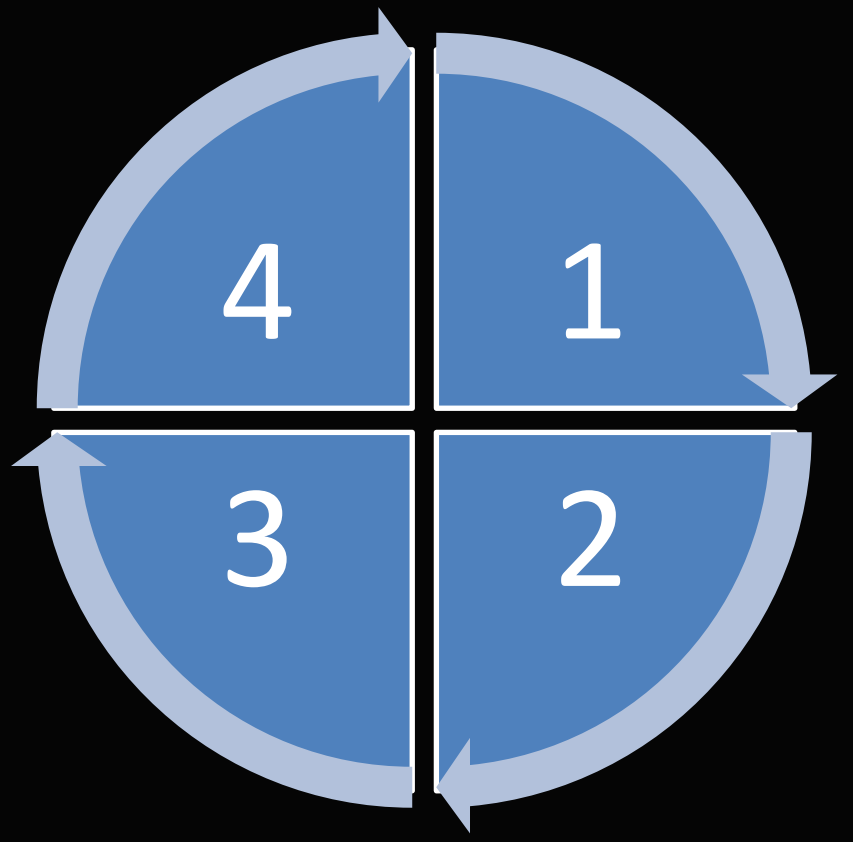
What can we do?

- Vigorous crop
- Cultural controls
- Monitoring/thresholds
  - No spray, no selection

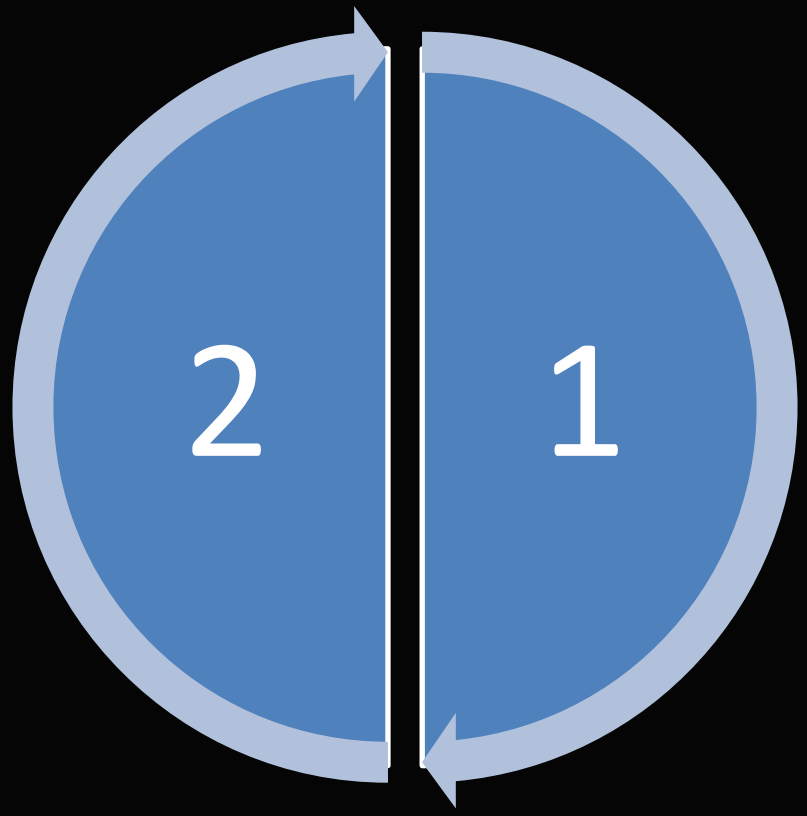
- Best practices for applications
- Rotate modes of actions



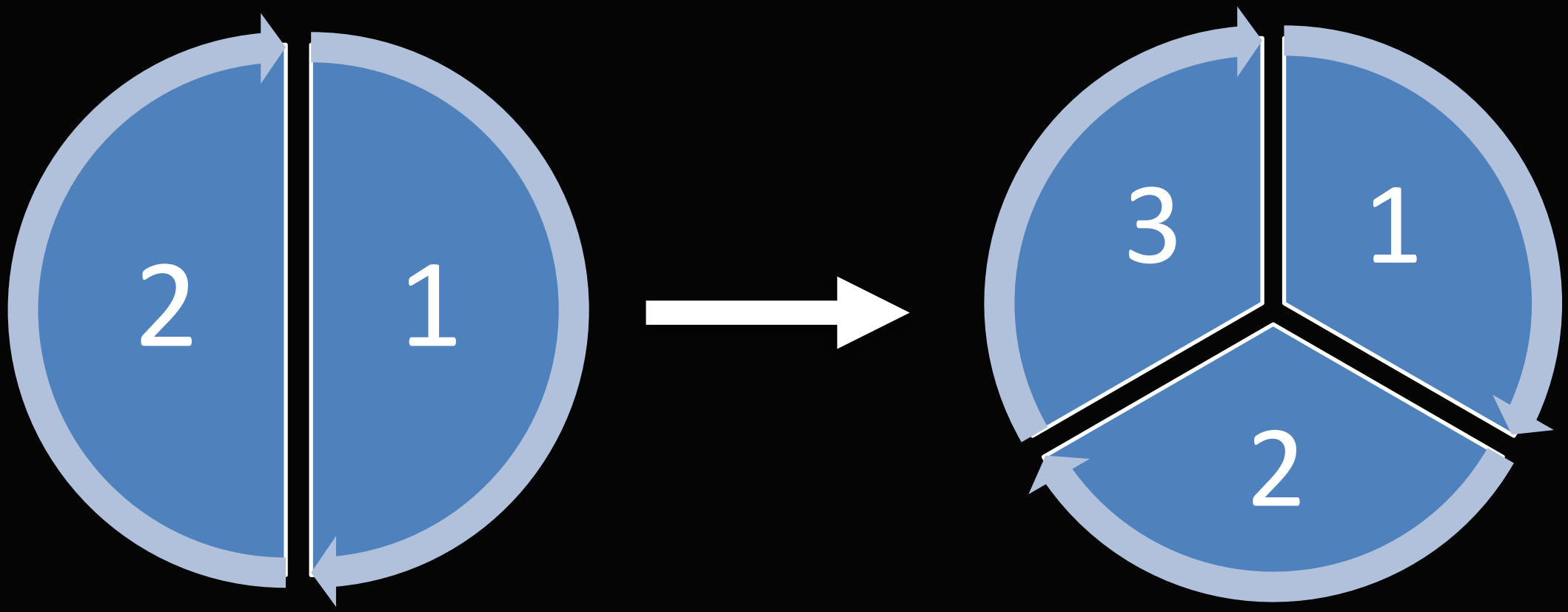
Rotation is necessary



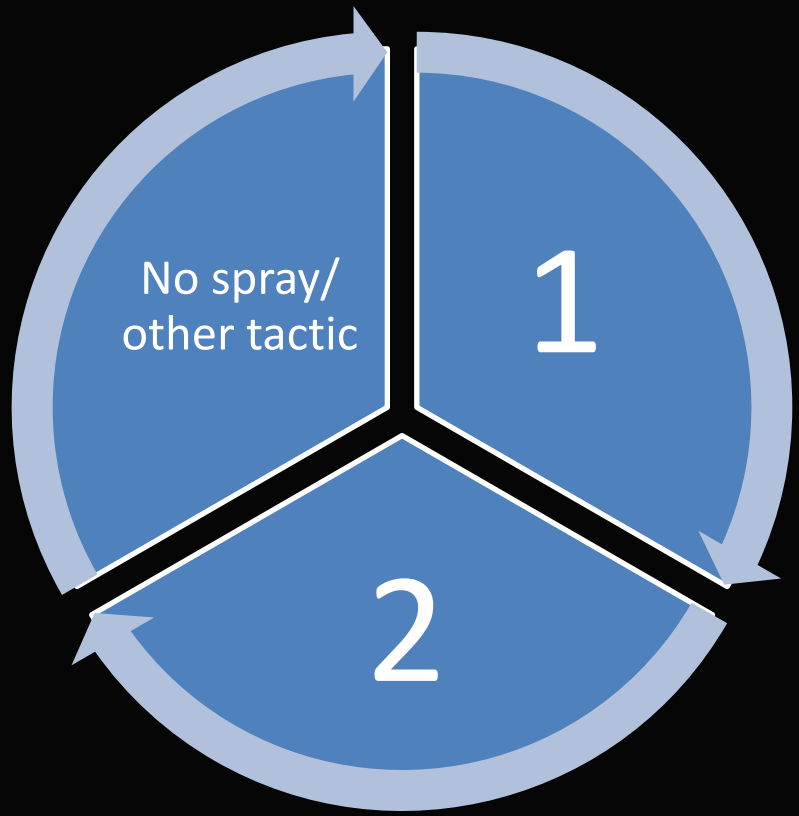
Rotation is necessary

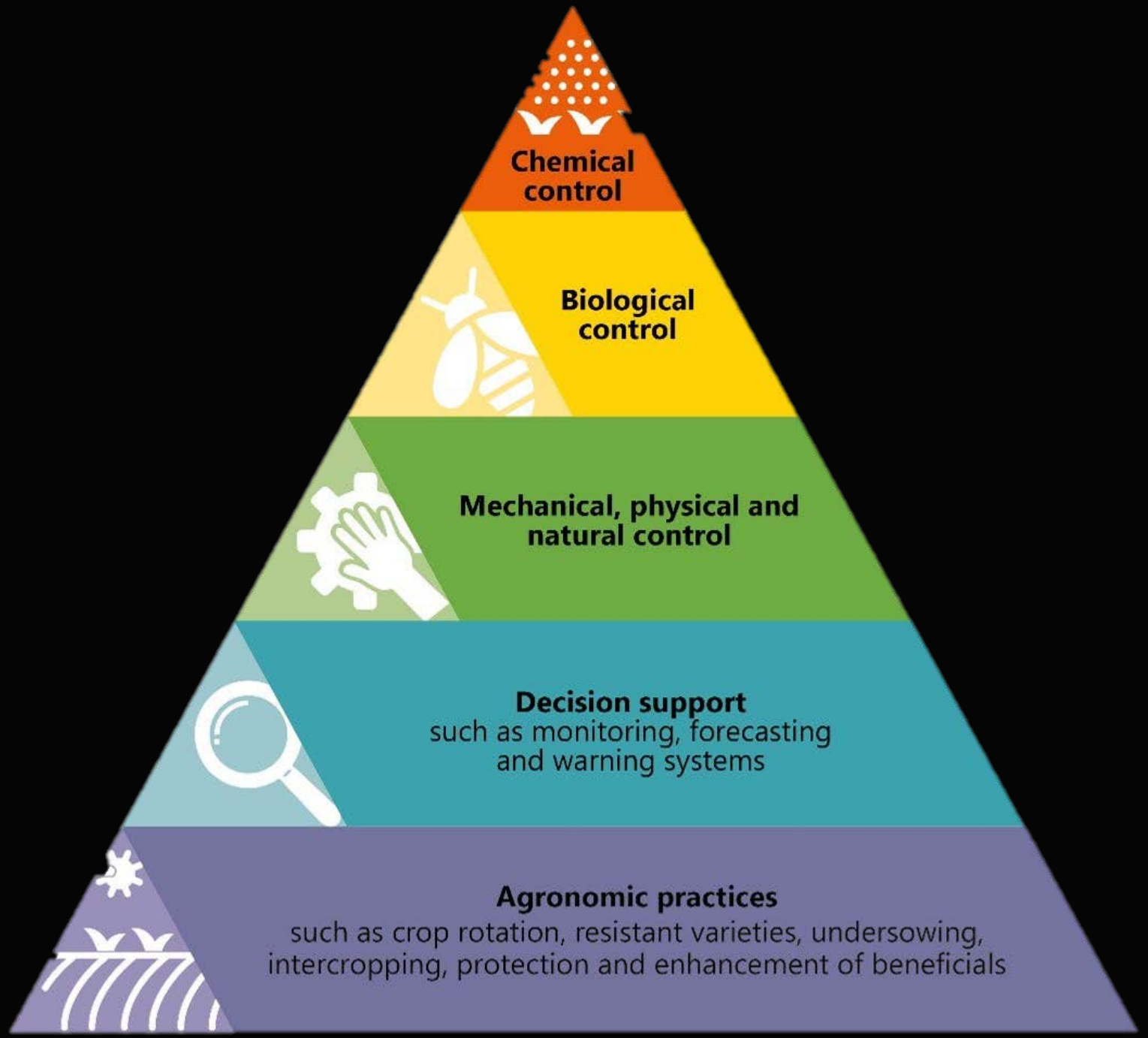


Rotation is necessary

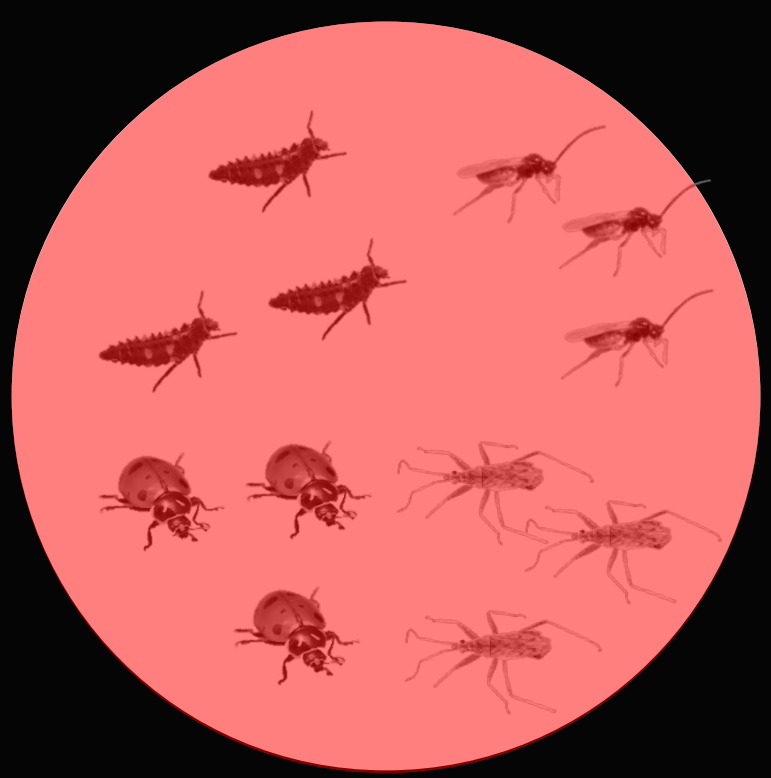


Rotation is necessary

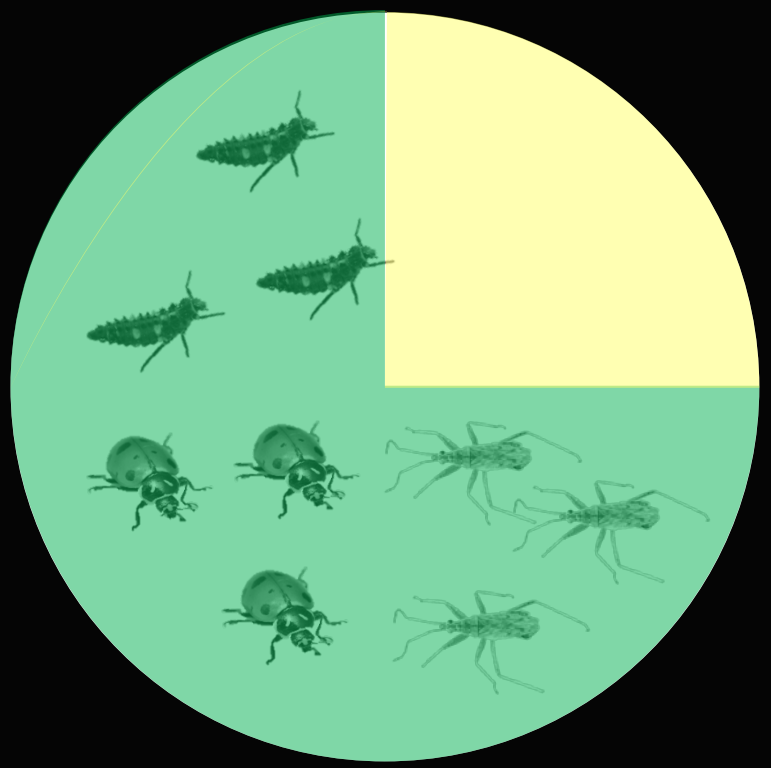



Chemical control
Biological control
Mechanical, physical and natural control
Decision support
such as monitoring, forecasting and warning systems
Agronomic practices
such as crop rotation, resistant varieties, undersowing, intercropping, protection and enhancement of beneficials

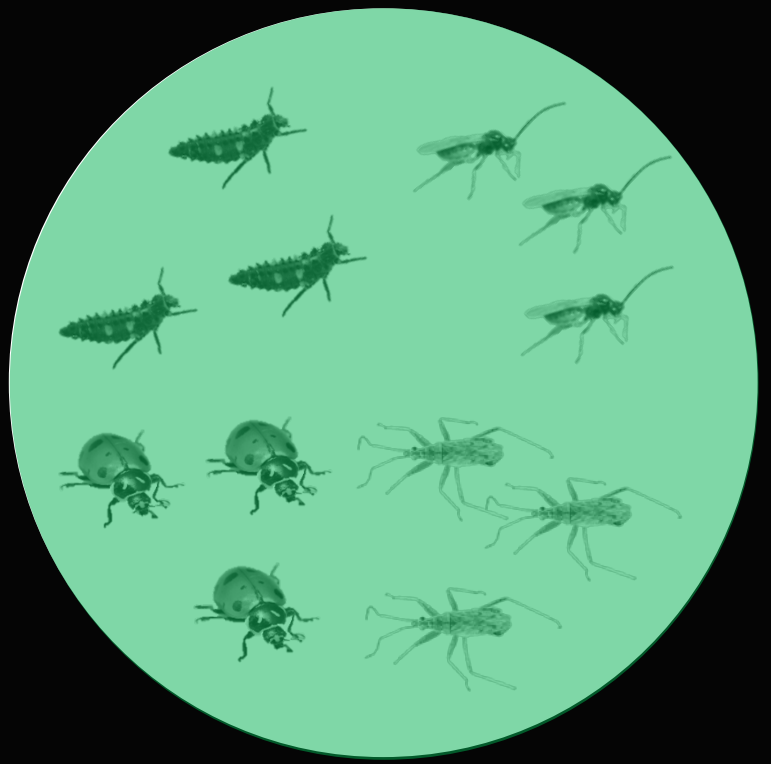
Insecticide selectivity →



Broad-spectrum



Partially safe for NEs



Safe for NEs

Study overview

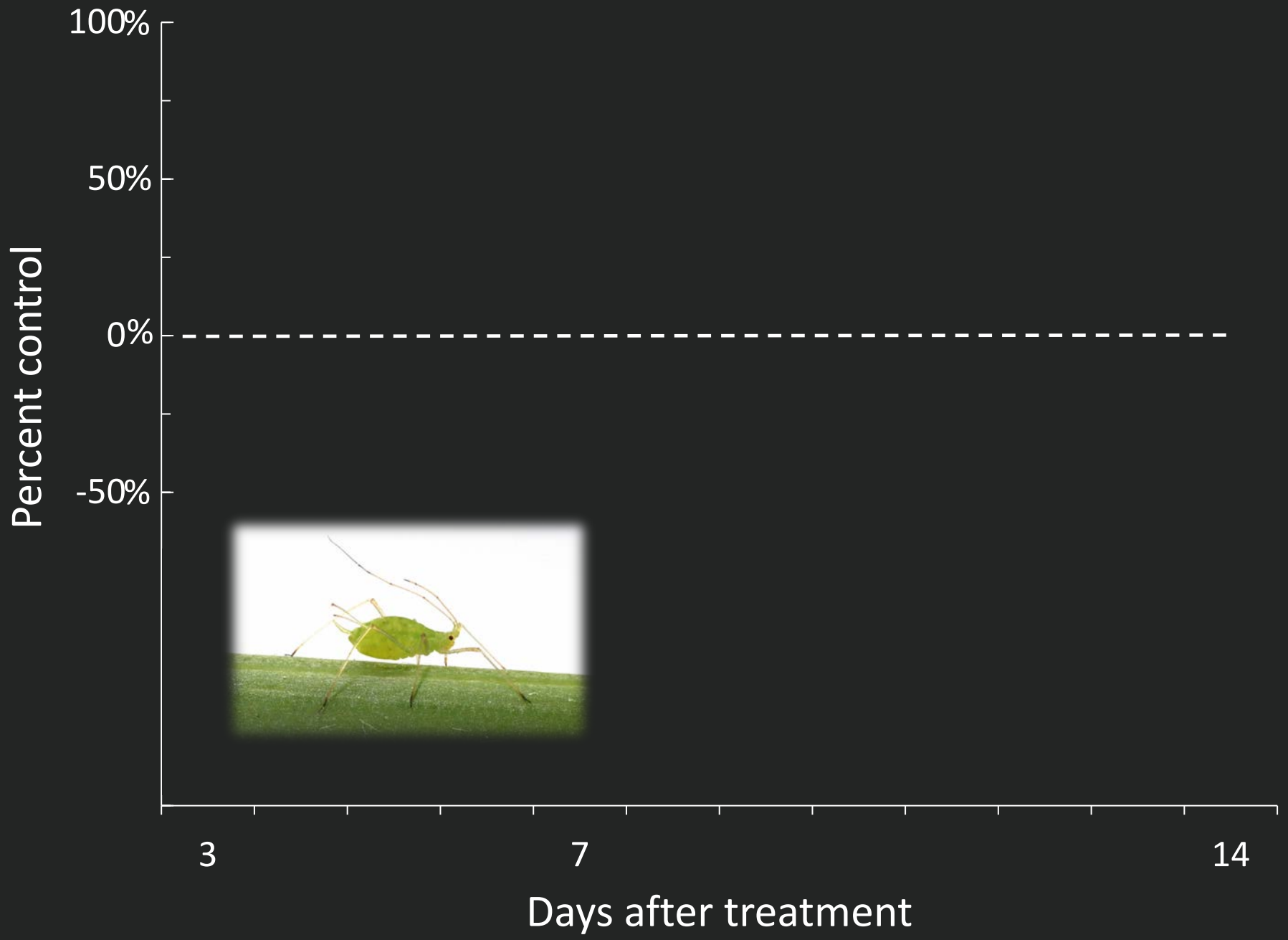
- Broad-spectrum insecticides/mixtures
- More selective materials

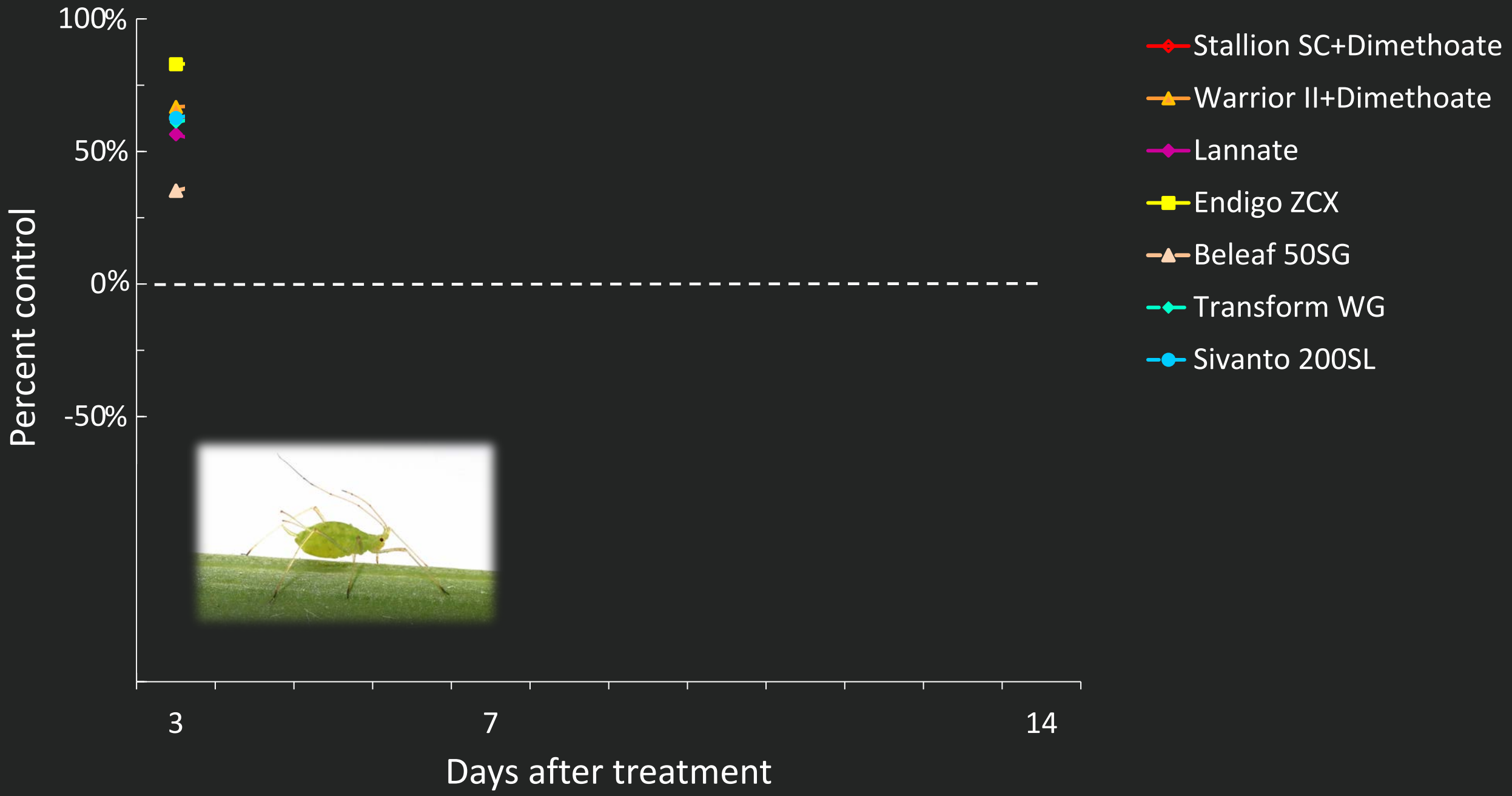
**Some materials are no longer registered or have not yet been registered in CA

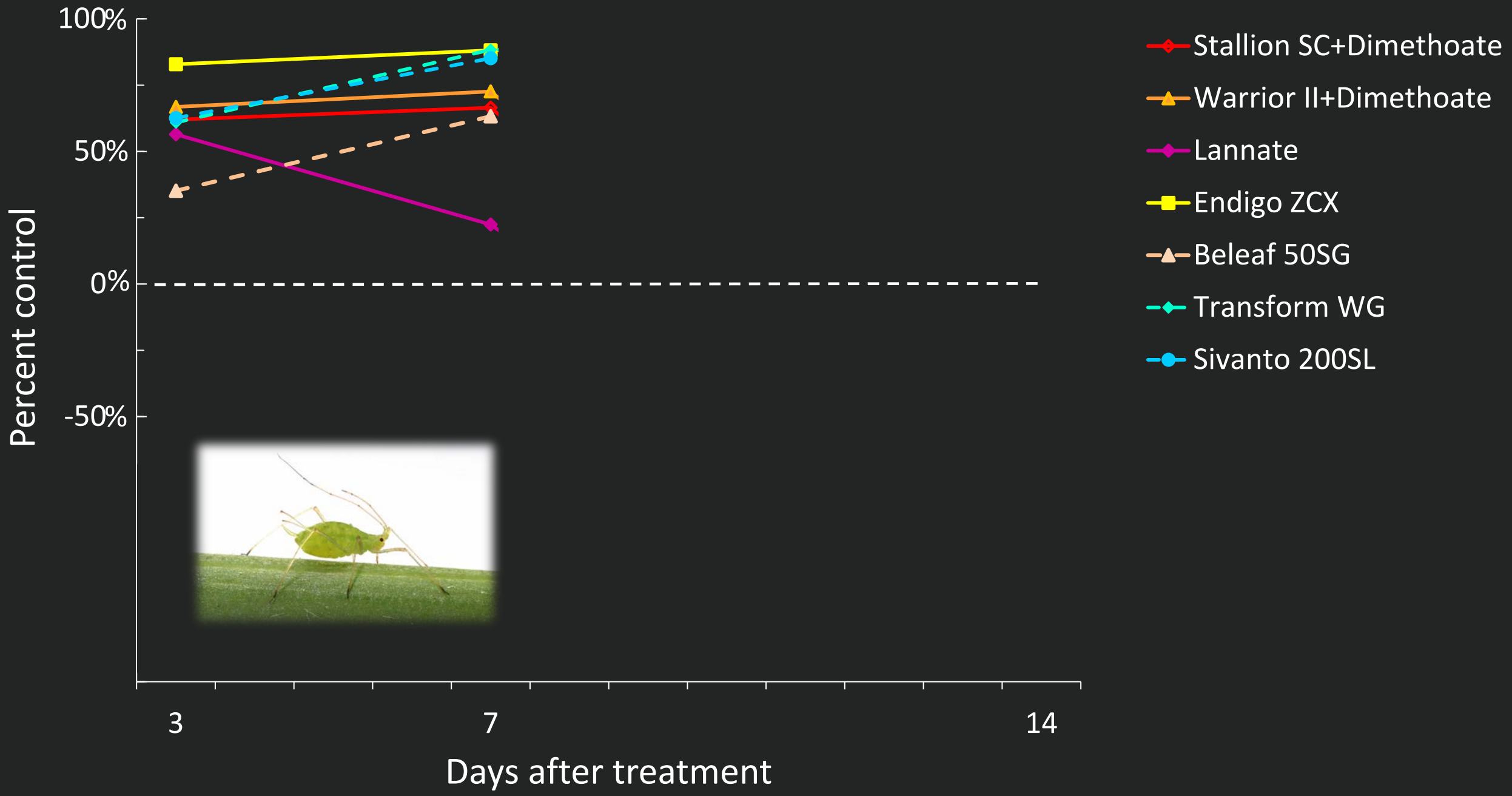
Treatment	Active ingredient	Rate		Mode of action	Group
Stallion SC** + Dimethoate	Zeta-cypermethrin + chlorpyrifos + dimethoate	11.75 + 16	fl oz/A	Pyrethroid / organophosphates	3A / 1B
Warrior II + Dimethoate	Lambda-cyhalothrin + dimethoate	1.92 + 16	fl oz/A	Pyrethroid / organophosphate	3A / 1B
Lannate	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					

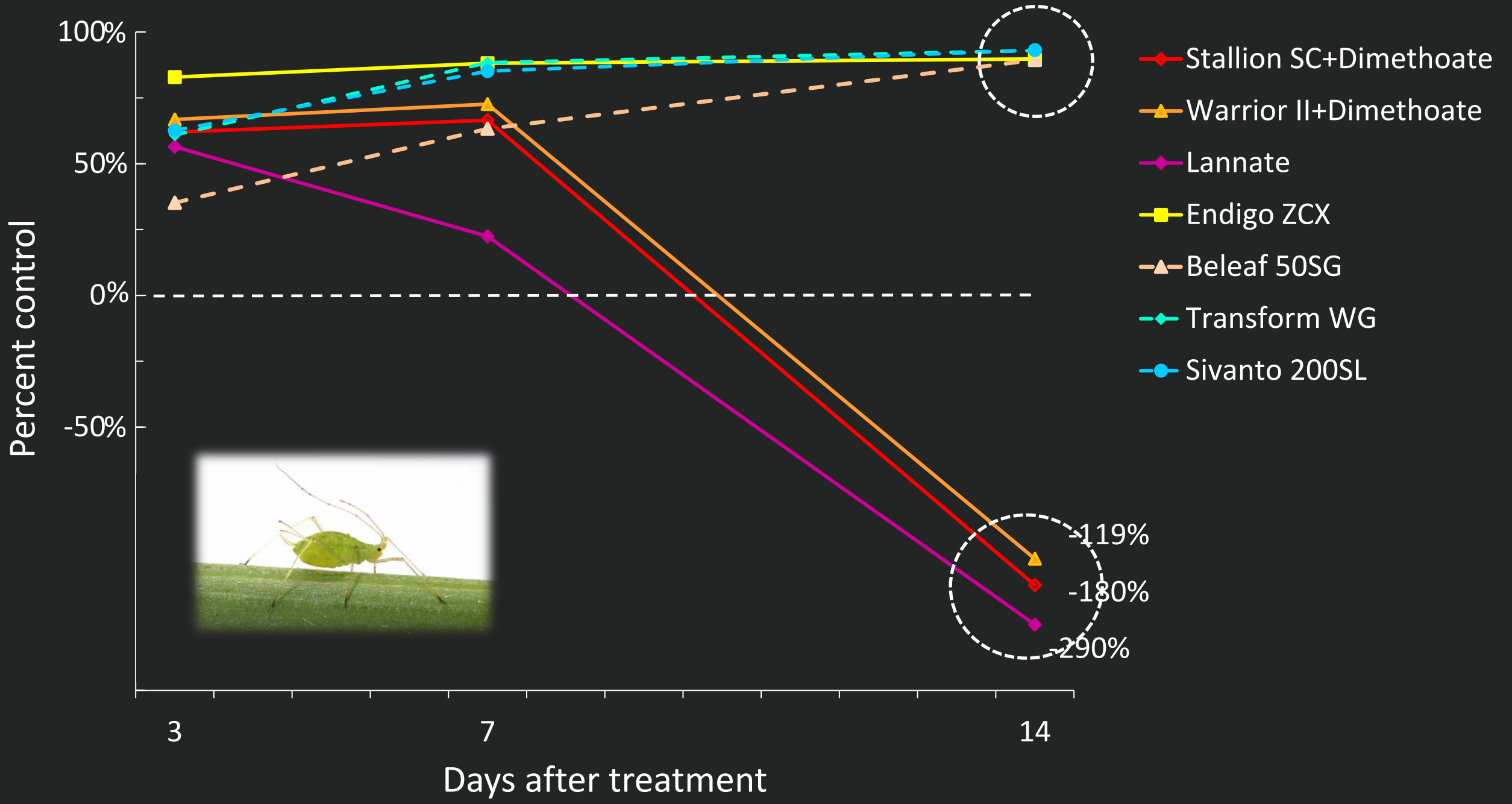
Study overview

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


100%
50%
0%
-50%
Percent control
3
7
14
Days after treatment


100%
50%
0%
-50%
Percent control
3
7
14
Days after treatment
Stallion SC+Dimethoate
Warrior II+Dimethoate
Lannate
Endigo ZCX
Beleaf 50SG
Transform WG
Sivanto 200SL


100%
50%
0%
-50%
Percent control
3
7
14
Days after treatment
Stallion SC+Dimethoate
Warrior II+Dimethoate
Lannate
Endigo ZCX
Beleaf 50SG
Transform WG
Sivanto 200SL


100%
50%
0%
-50%
Percent control
3
7
14
Days after treatment
Stallion SC+Dimethoate
Warrior II+Dimethoate
Lannate
Endigo ZCX
Beleaf 50SG
Transform WG
Sivanto 200SL
-119%
-180%
-290%

What explains these patterns…?

Lady beetle larvae per sweep

4
3
2
1
0

3
7
14

Days after treatment

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

Lady beetle larvae per sweep

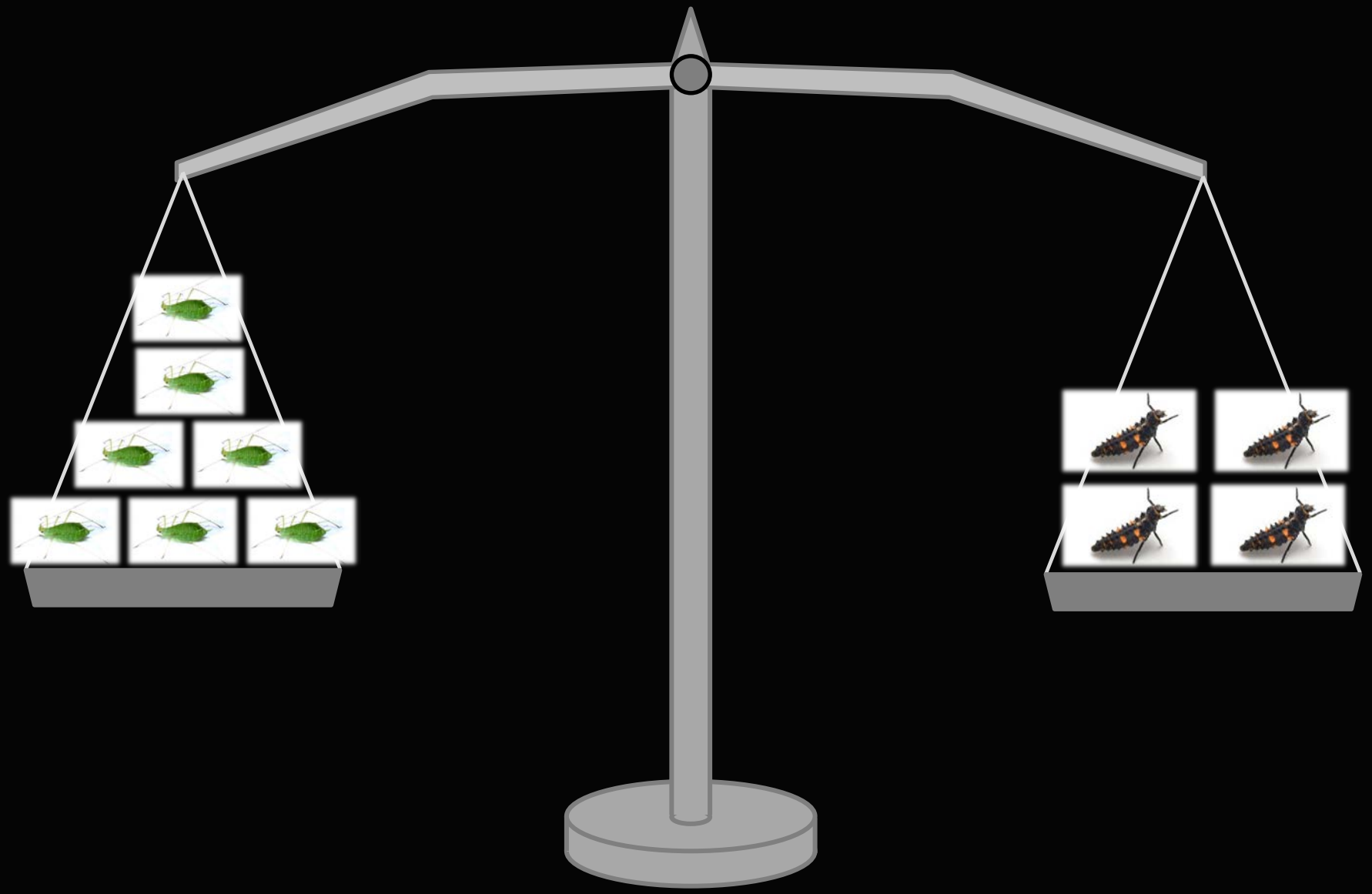
4
3
2
1
0

3
7
14

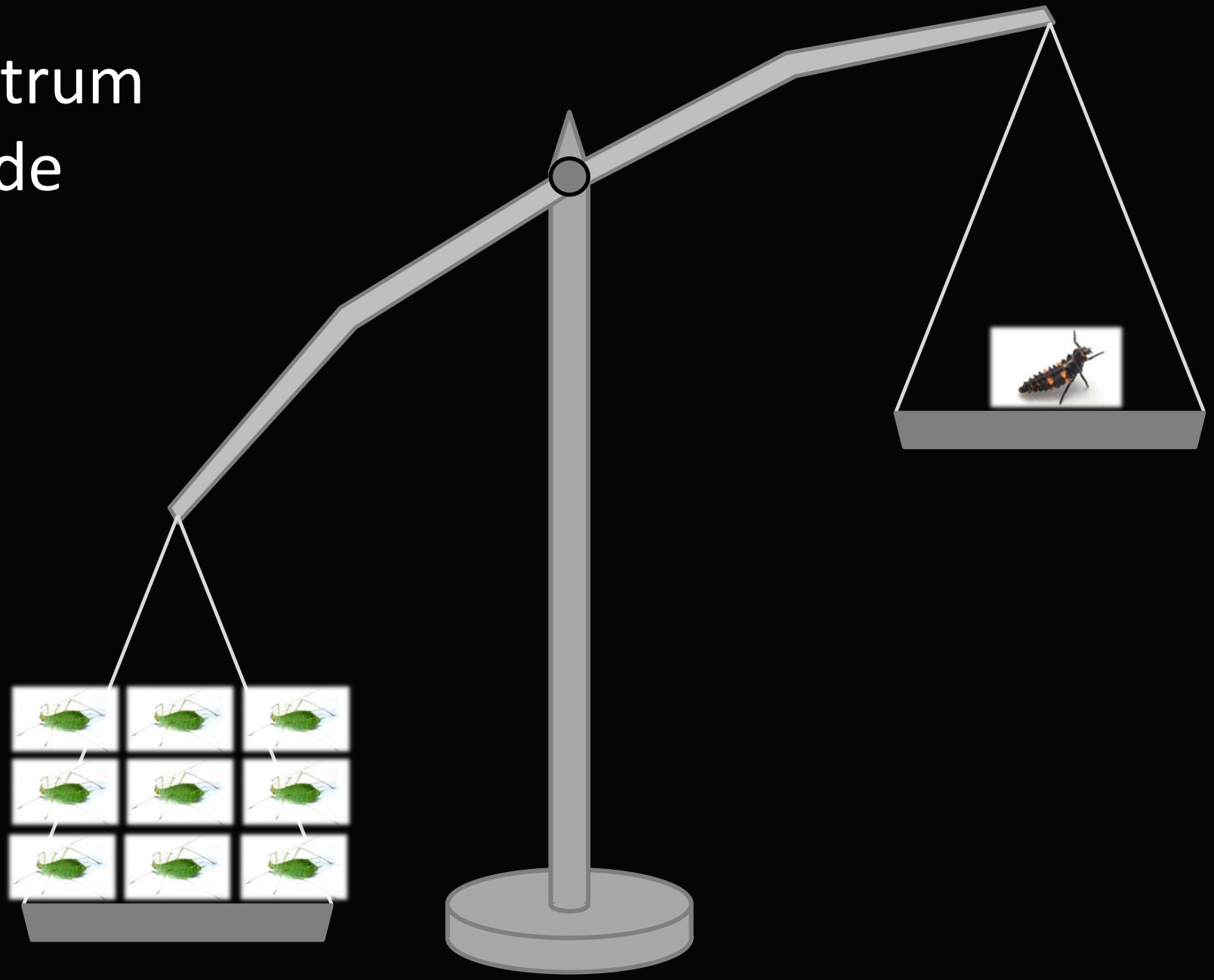
Days after treatment

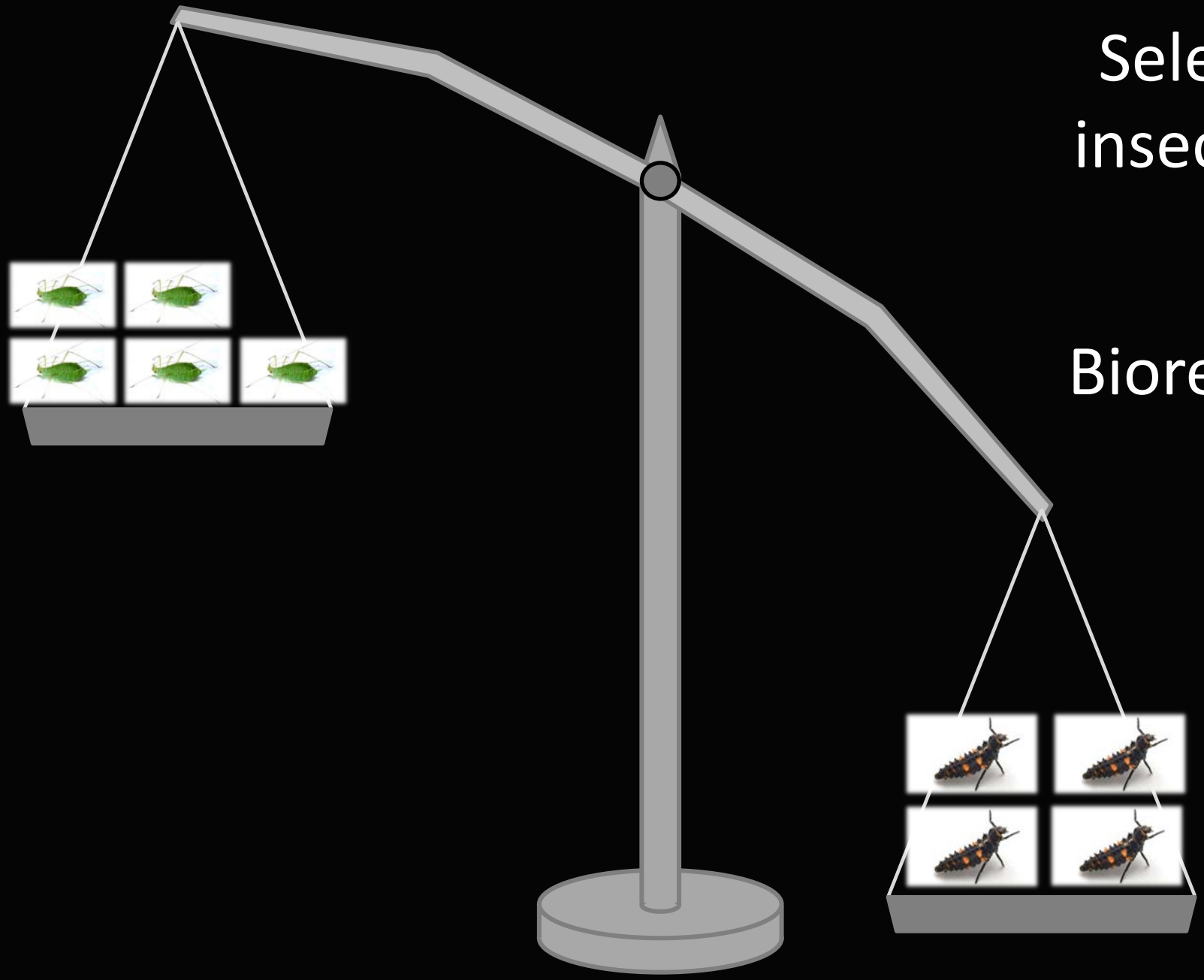
Stallion SC+Dimethoate
Warrior II+Dimethoate
Lannate
Endigo ZCX
Beleaf 50SG
Transform WG
Sivanto 200SL
Untreated

Natural enemy: pest ratios



Broad-spectrum insecticide





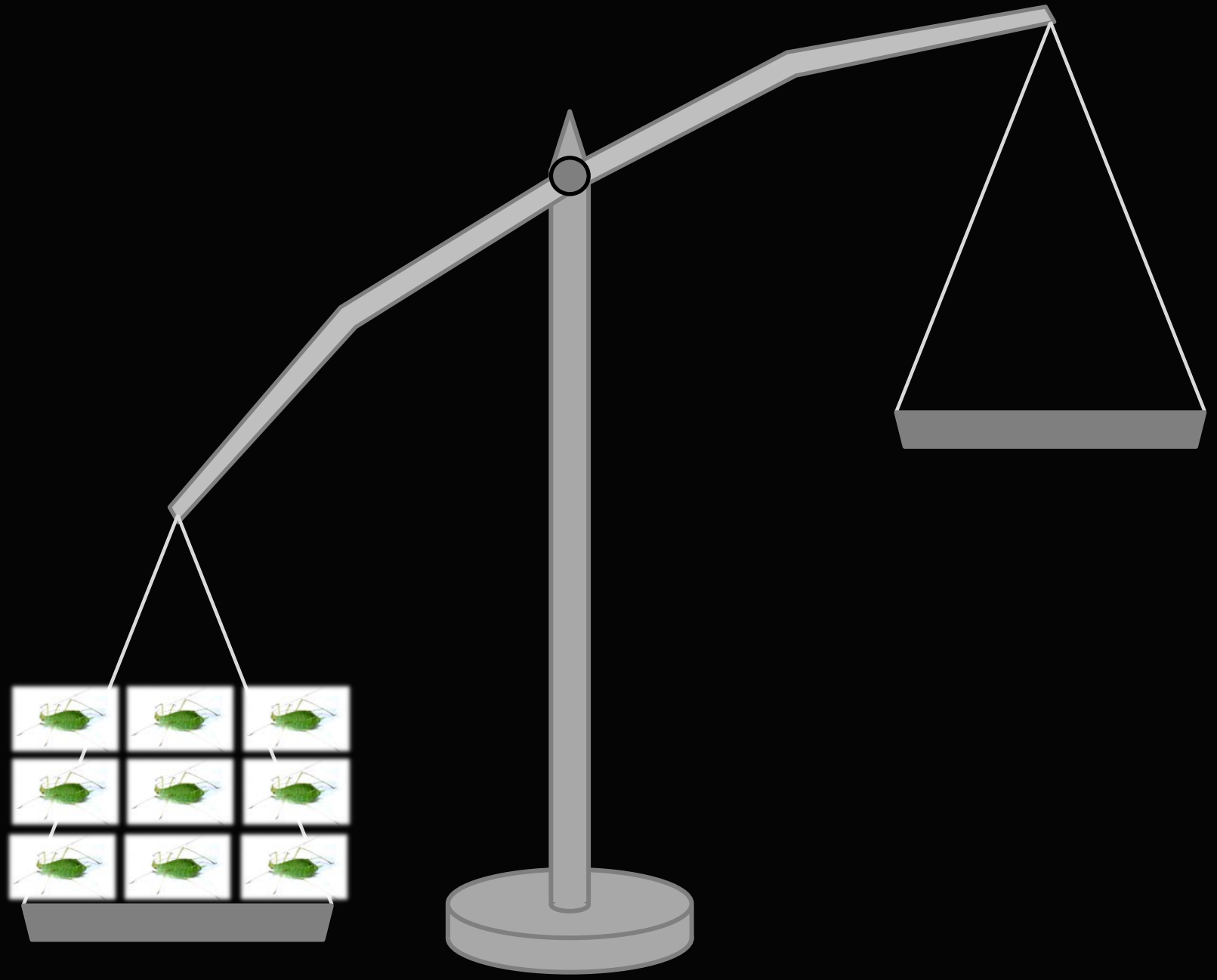
Selective insecticide

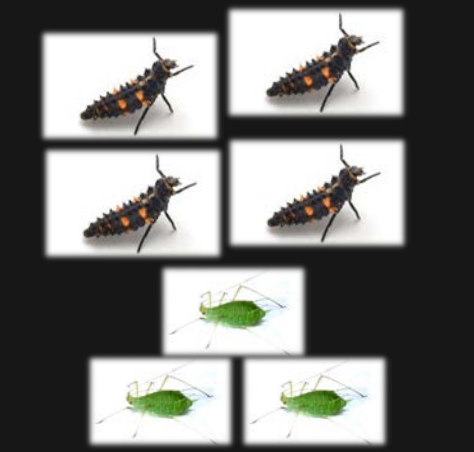
Bioresidual

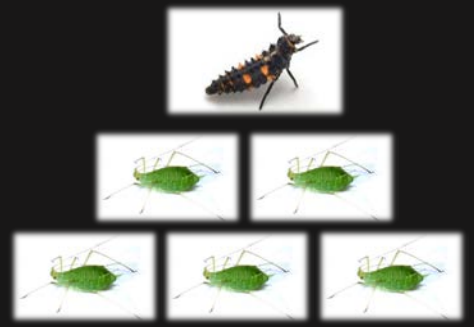
Bioresidual

“Other pest effects”

Direct efficacy

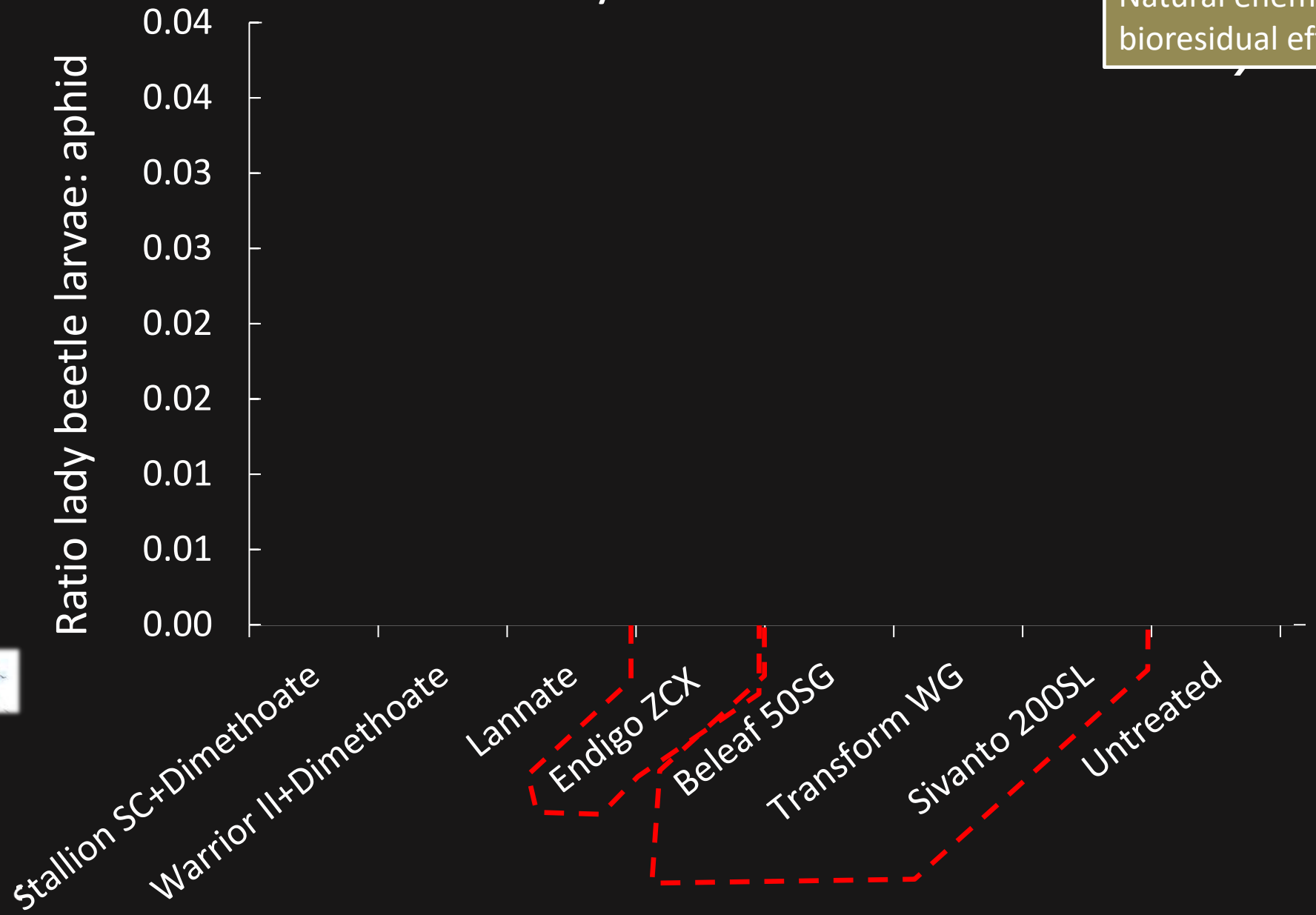


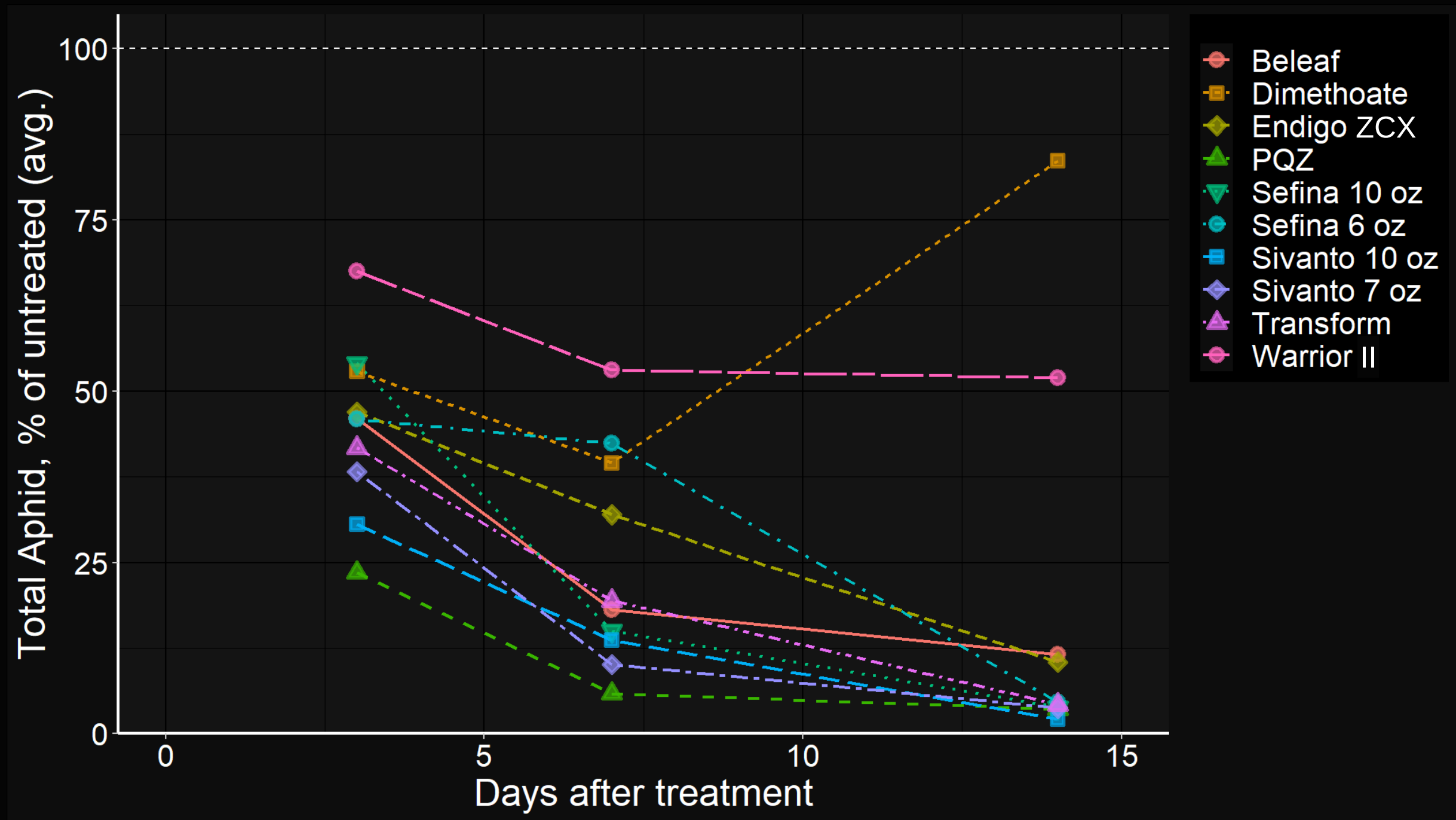


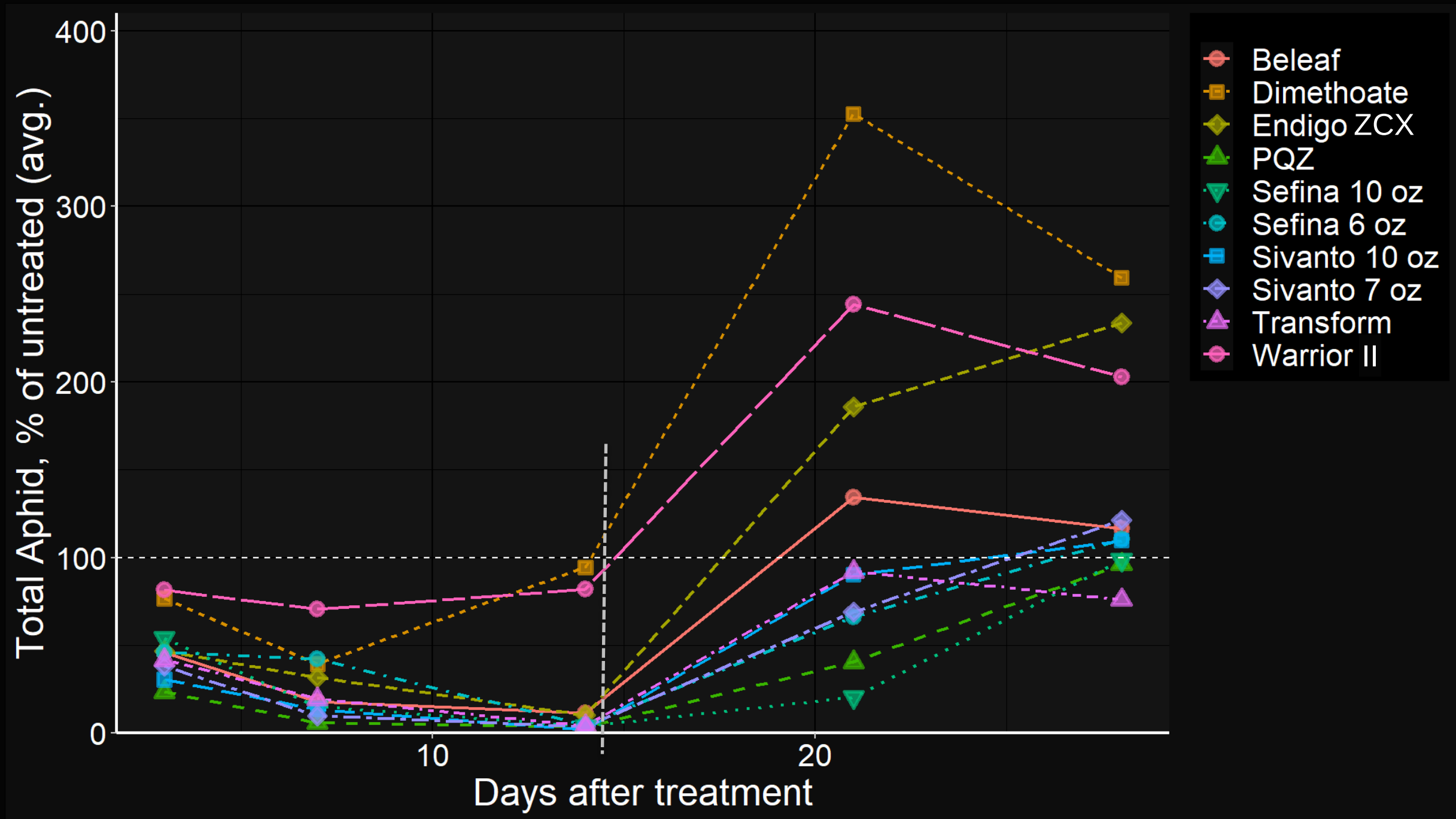


14 days after treatment

Natural enemies provide bioresidual effect



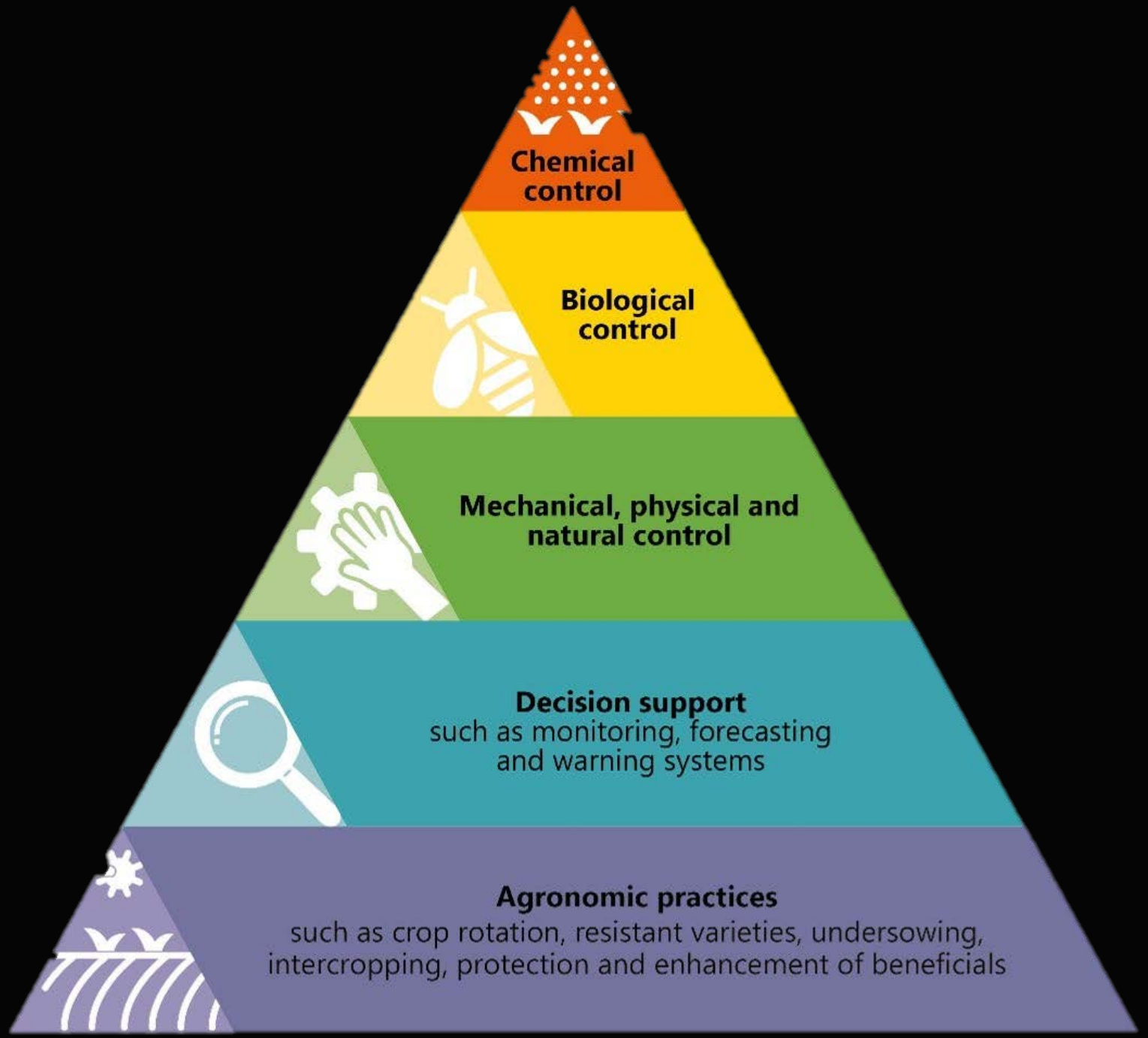

Total Aphid, % of untreated (avg.)
100
75
50
25
0
0
5
10
15
Days after treatment
Beleaf
Dimethoate
Endigo ZCX
PQZ
Sefina 10 oz
Sefina 6 oz
Sivanto 10 oz
Sivanto 7 oz
Transform
Warrior II

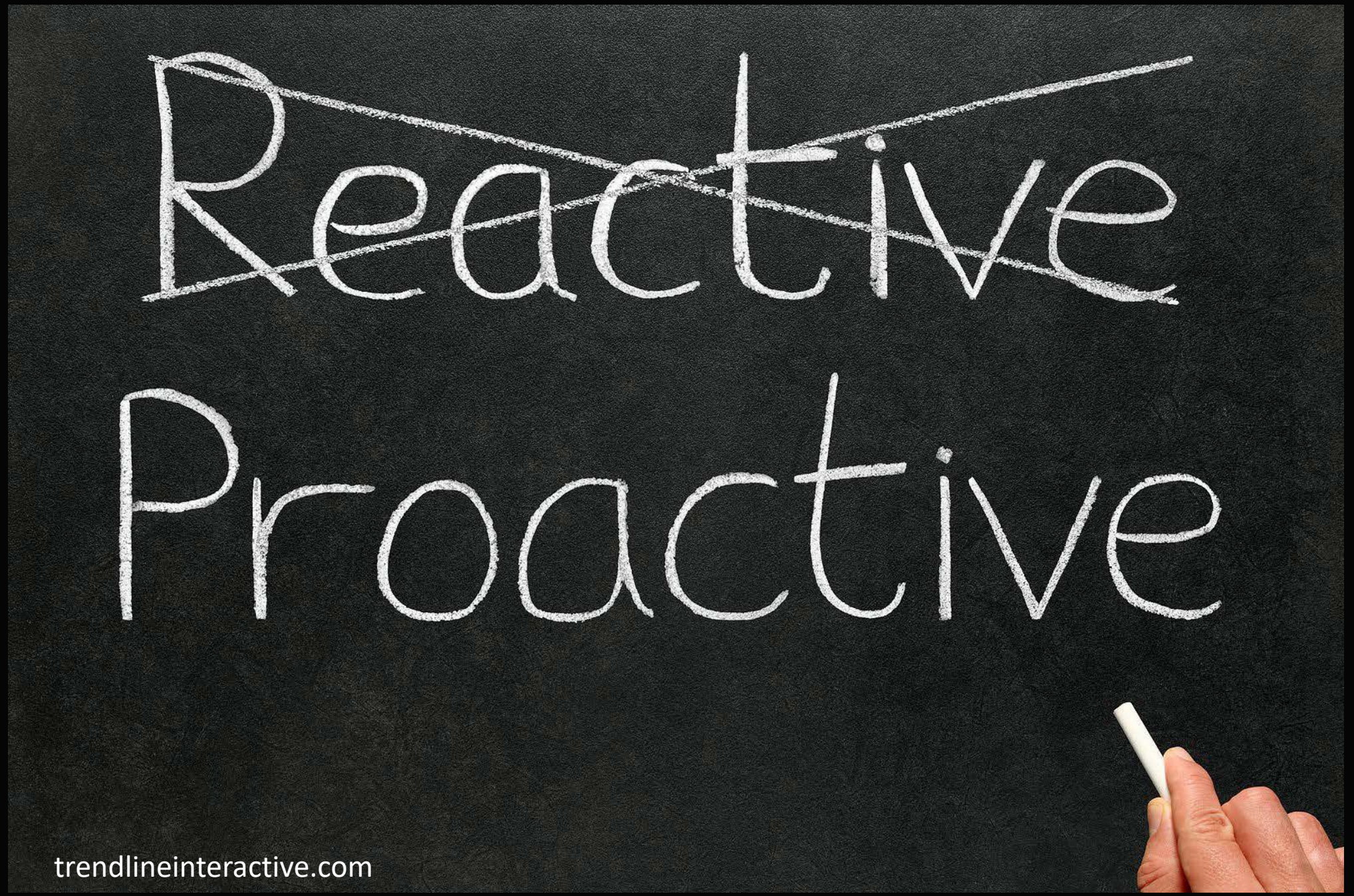

Total Aphid, % of untreated (avg.)
400
300
200
100
0
10
20
Days after treatment
Beleaf
Dimethoate
Endigo ZCX
PQZ
Sefina 10 oz
Sefina 6 oz
Sivanto 10 oz
Sivanto 7 oz
Transform
Warrior II

Tank mixtures

Selectivity

Efficacy


Chemical control
Biological control
Mechanical, physical and natural control
Decision support
such as monitoring, forecasting and warning systems
Agronomic practices
such as crop rotation, resistant varieties, undersowing, intercropping, protection and enhancement of beneficials


Reactive
Proactive
trendlineinteractive.com

Acknowledgements

RAW

RESISTANT ALFALFA WEEVIL

USDA

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- Omir Livneh (UCD)
- Ben Lee (UCD)

- Growers/PCAs

Questions?

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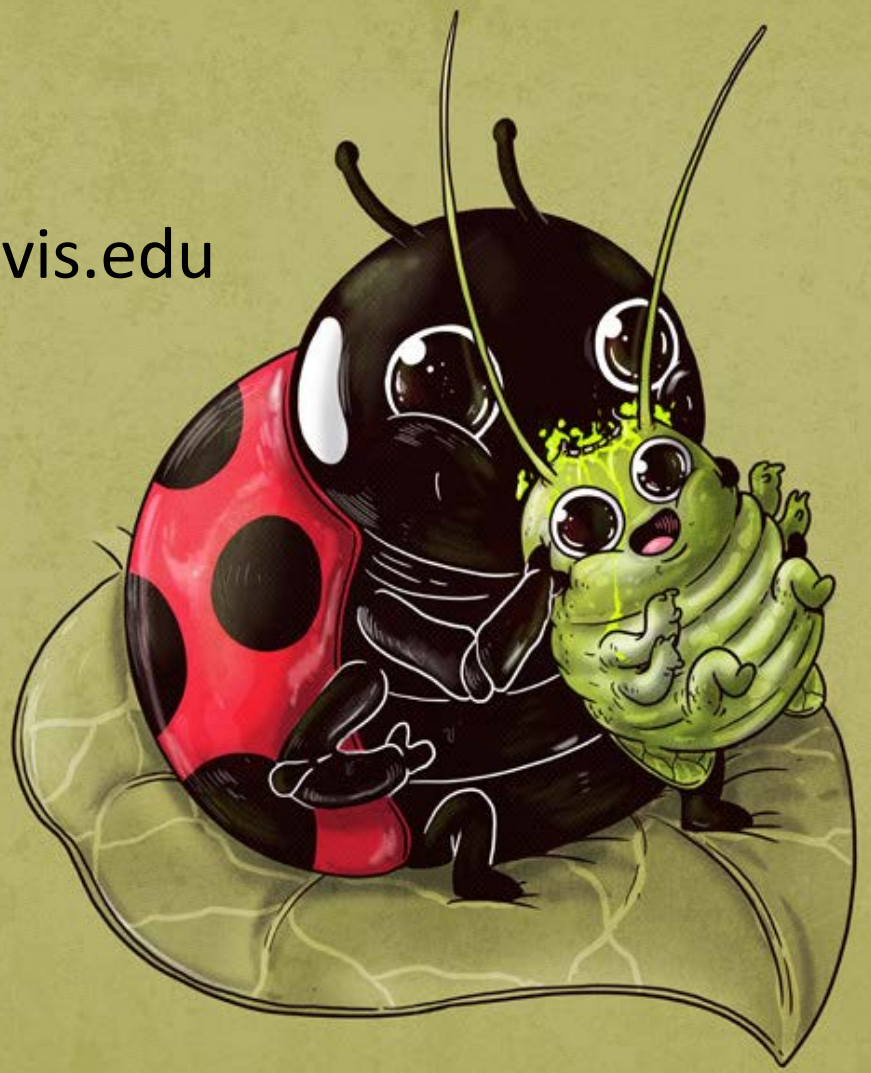

Alex Solis