

Alfalfa Weevil Management and Insecticide Resistance

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Managing alfalfa weevils: resistance



How does insecticide
resistance develop?



OCF Realty

Insecticide resistance

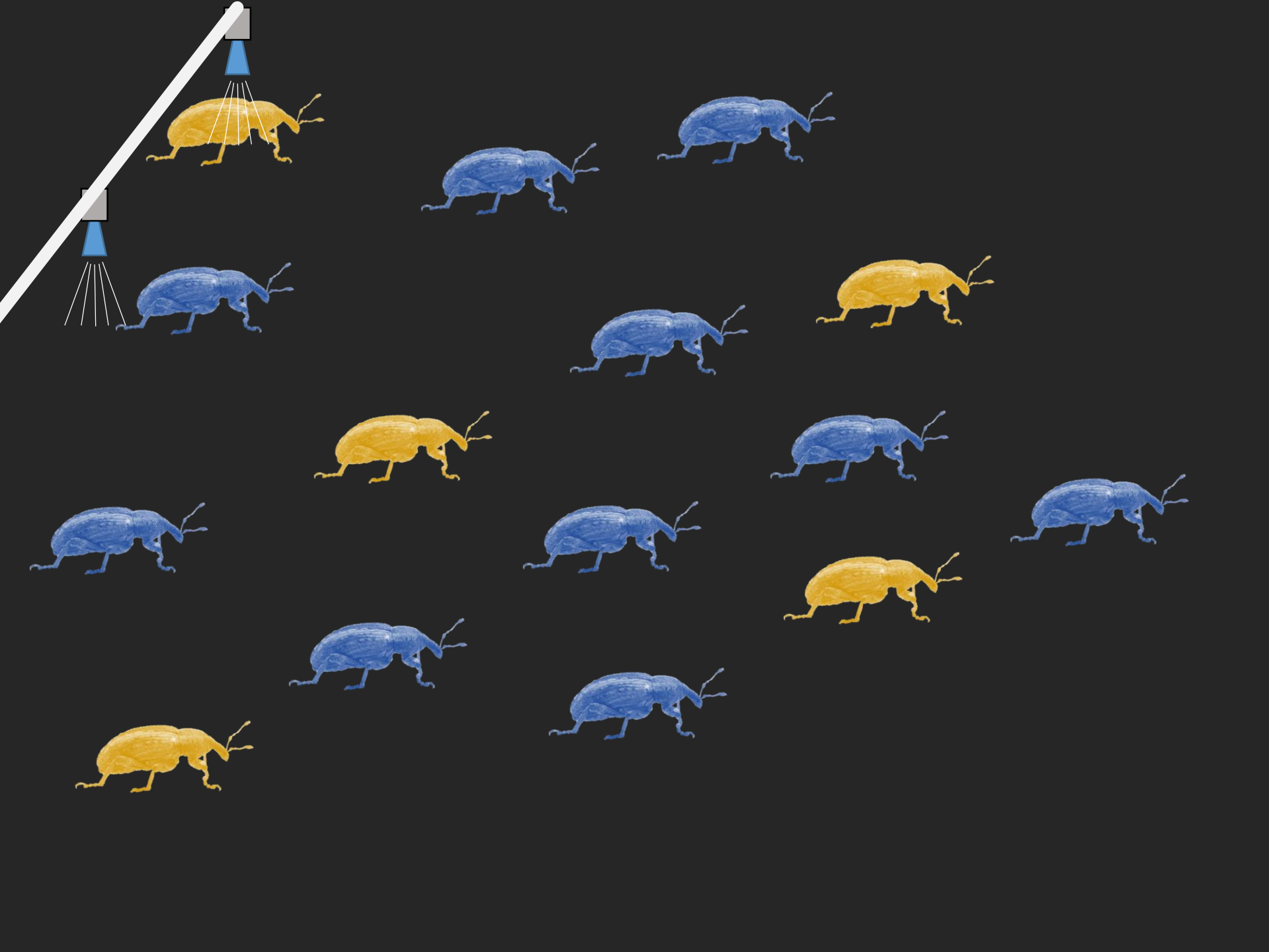
Insecticide
use



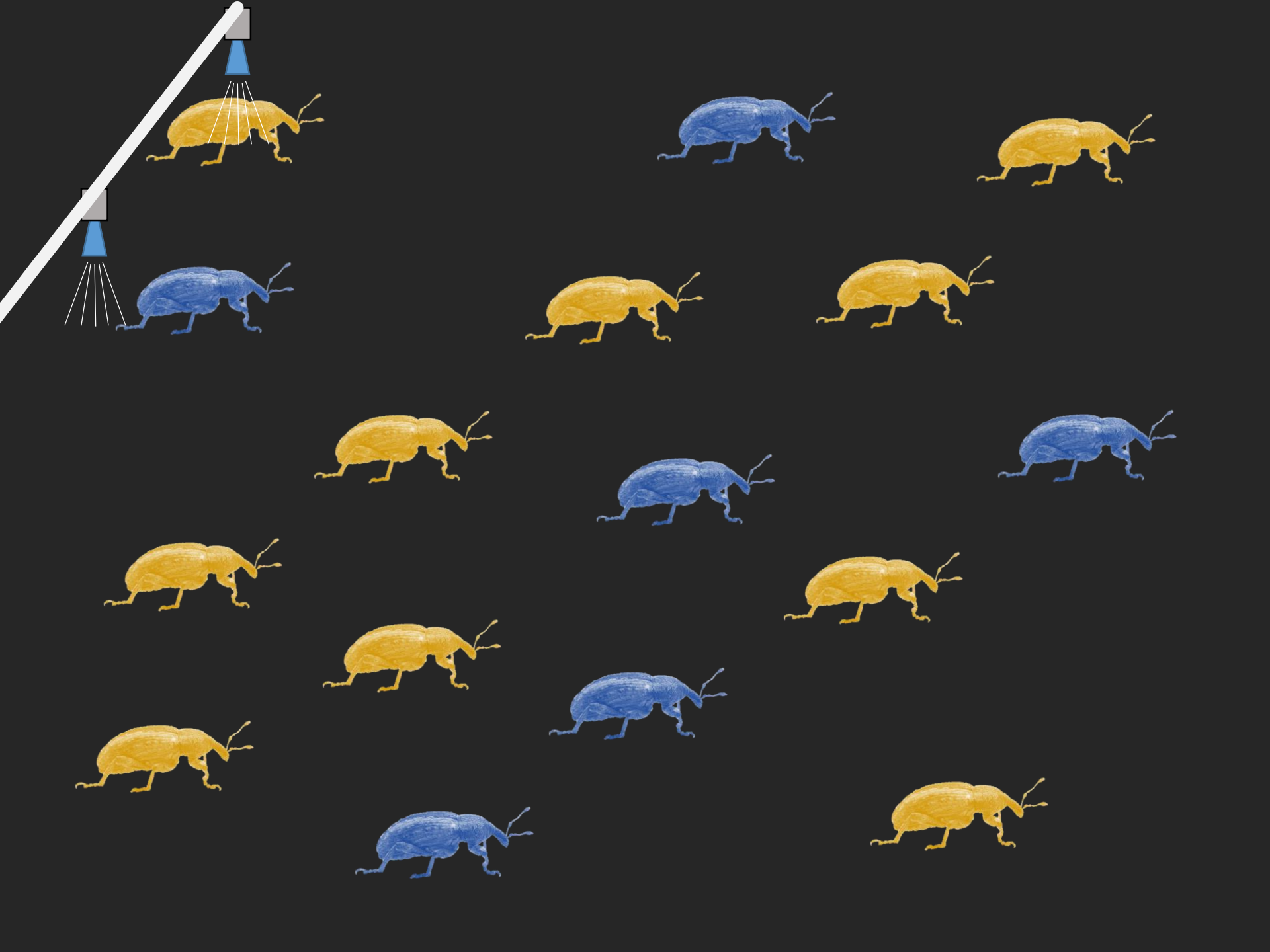
Pest
genetics



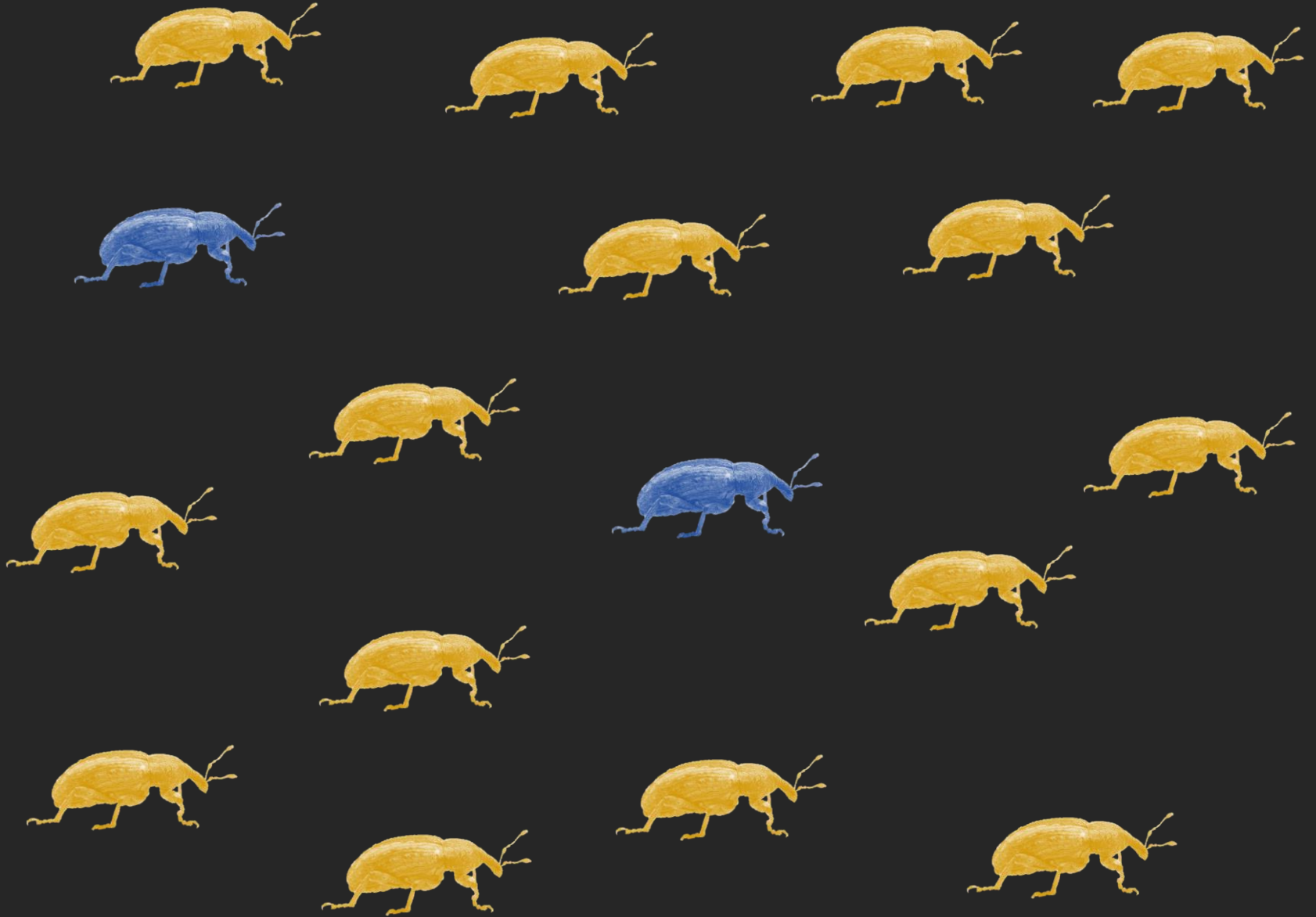




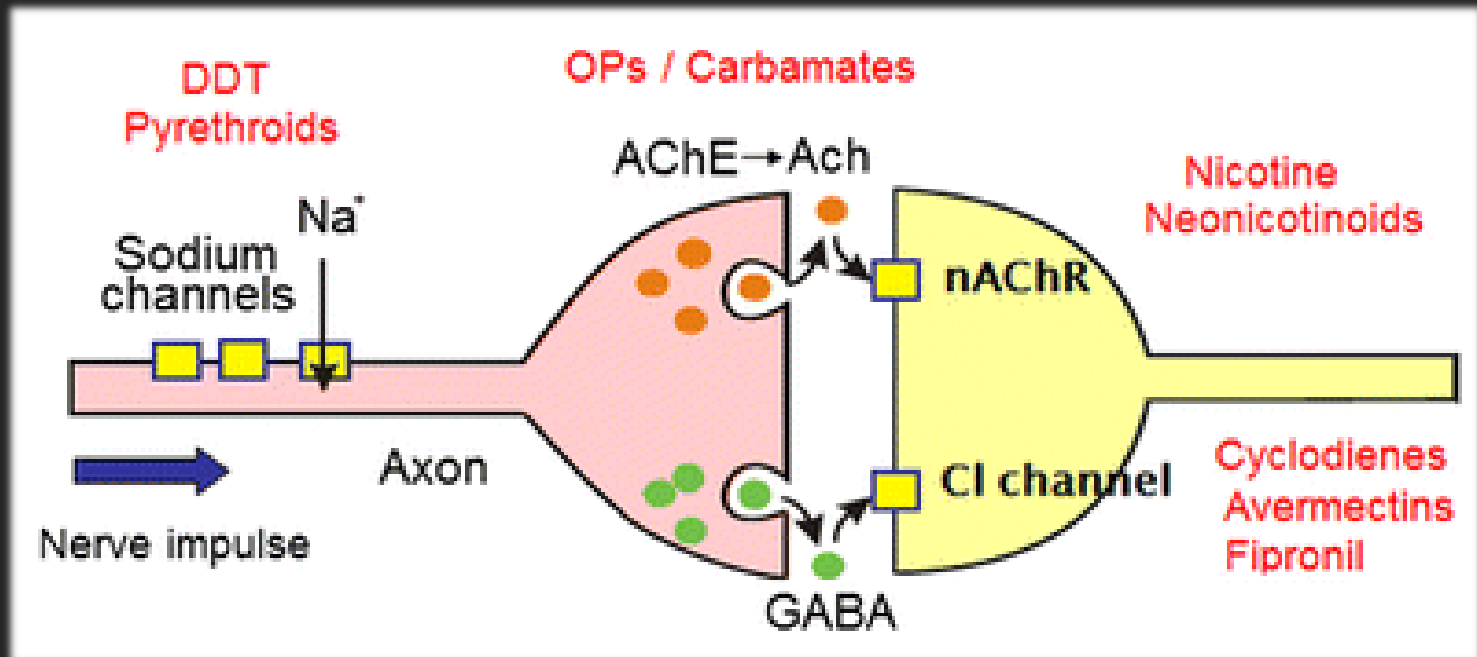








Insecticide Resistance Action Committee created mode of action groupings



3

SODIUM CHANNEL MODULATORS

GROUP 3 INSECTICIDE



A PYRETHROIDS, PYRETHRINS



B DDT, METHOXYCHLOR



4

NICOTINIC ACETYLCHOLINE RECEPTOR (NACHR) COMPETITIVE MODULATORS



A NEONICOTINOIDS



Acetamiprid, Clothianidin, Dinotefuran, Imidacloprid, Nitenpyram, Thiacloprid, Thiamethoxam

B NICOTINE



C SULFOXIMINES



D BUTENOLIDES



E MESOIONICS



Cross resistance

Insecticides are
grouped by their
mode of action
(MoA)

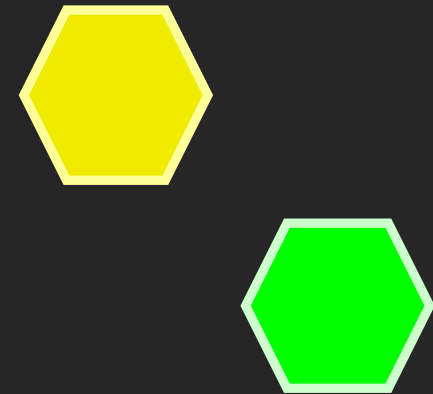
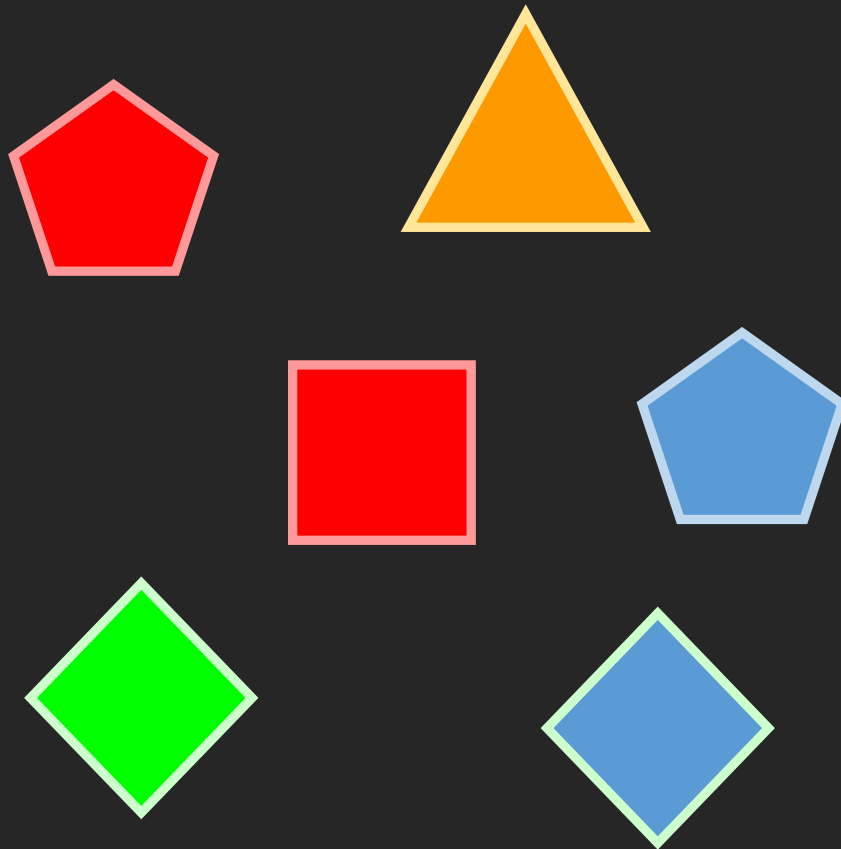
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graph LR; A[Insecticides are grouped by their mode of action (MoA)] --> B[How resistance develops]; A --> C[How we can prevent resistance from developing];
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The diagram consists of three rounded rectangular boxes. The leftmost box is light blue and contains the text 'Insecticides are grouped by their mode of action (MoA)'. Two arrows originate from the right side of this box. The top arrow points to a dark blue box containing the text 'How resistance develops'. The bottom arrow points to a dark blue box containing the text 'How we can prevent resistance from developing'.

How
resistance
develops

How we can
prevent resistance
from developing

Loss of AIs puts pressure on remaining ones and any *possible* new ones





Insecticide resistance in weevils in CA and across the Western US



Nothing new: see 1960's Utah

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; Bissell 1963) and personal correspondence indicate that in many

...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.

	STAND COUNT PER ACRE	YIELD-BUSHEL/S Acre CORRECTED TO 15.5% MOISTURE
HEPTACHLOR	14,300	138.0
CHECK	12,800	102.6
INCREASE WITH HEPTACHLOR	1,500	35.4

Orland Manternach Farm, Cascade Ia. Ten pounds of 25% granular Heptachlor per acre, applied broadcast with a fertilizer spreader. Test on third year corn land not treated previously.

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 **VELSICOL CHEMICAL CORPORATION**
320 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!

MORE PROTECTION PER POUND!

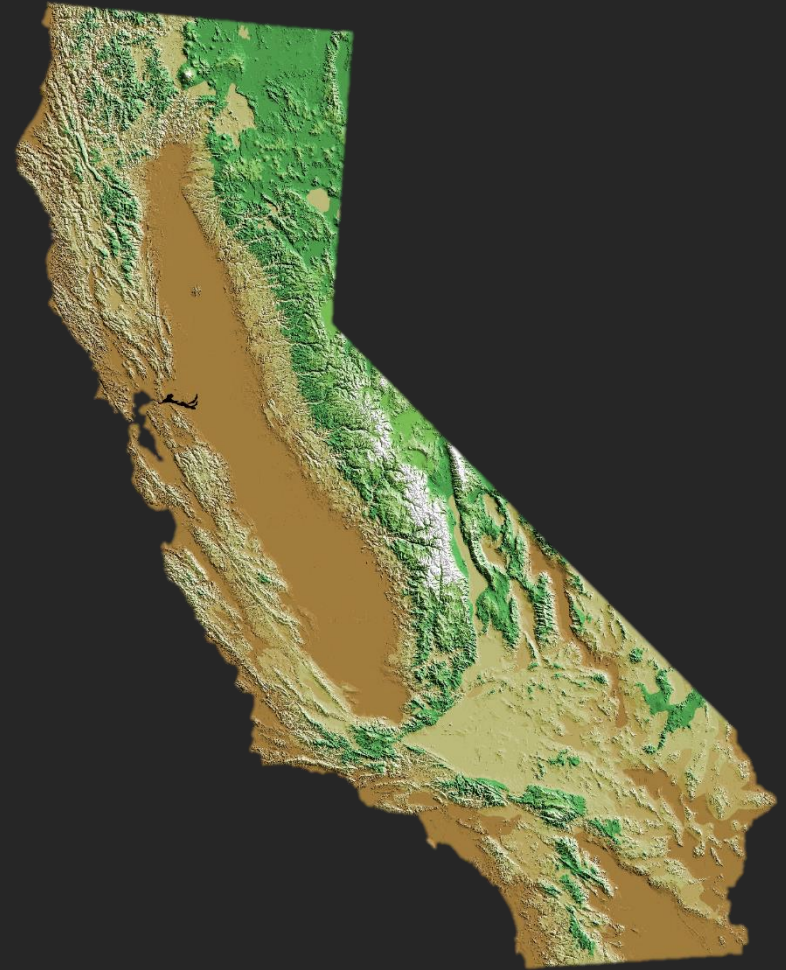
Resistance can disrupt weevil management

- | | | |
|----|---|-----------------|
| A. | INDOXACARB
(Steward EC)
MODE-OF-ACTION GROUP NUMBER ¹ : 22A | 6.7–11.3 fl oz |
| B. | LAMBDA-CYHALOTHRIN*
(Warrior II with Zeon)
MODE-OF-ACTION GROUP NUMBER ¹ : 3A | 1.28–1.92 fl oz |
| C. | BETA-CYFLUTHRIN*
(Baythroid XL)
MODE-OF-ACTION GROUP NUMBER ¹ : 3A | 1.6–2.8 fl oz |
| D. | CHLORPYRIFOS*
(Lorsban Advanced)
MODE-OF-ACTION GROUP NUMBER¹: 1B | 1–2 pt |
| E. | MALATHION
(Malathion 8-E)
MODE-OF-ACTION GROUP NUMBER ¹ : 1B | 1–1.25 pt |
| F. | SPINOSAD
(Entrust SC)#
MODE-OF-ACTION GROUP NUMBER ¹ : 5 | 2–4 fl oz |

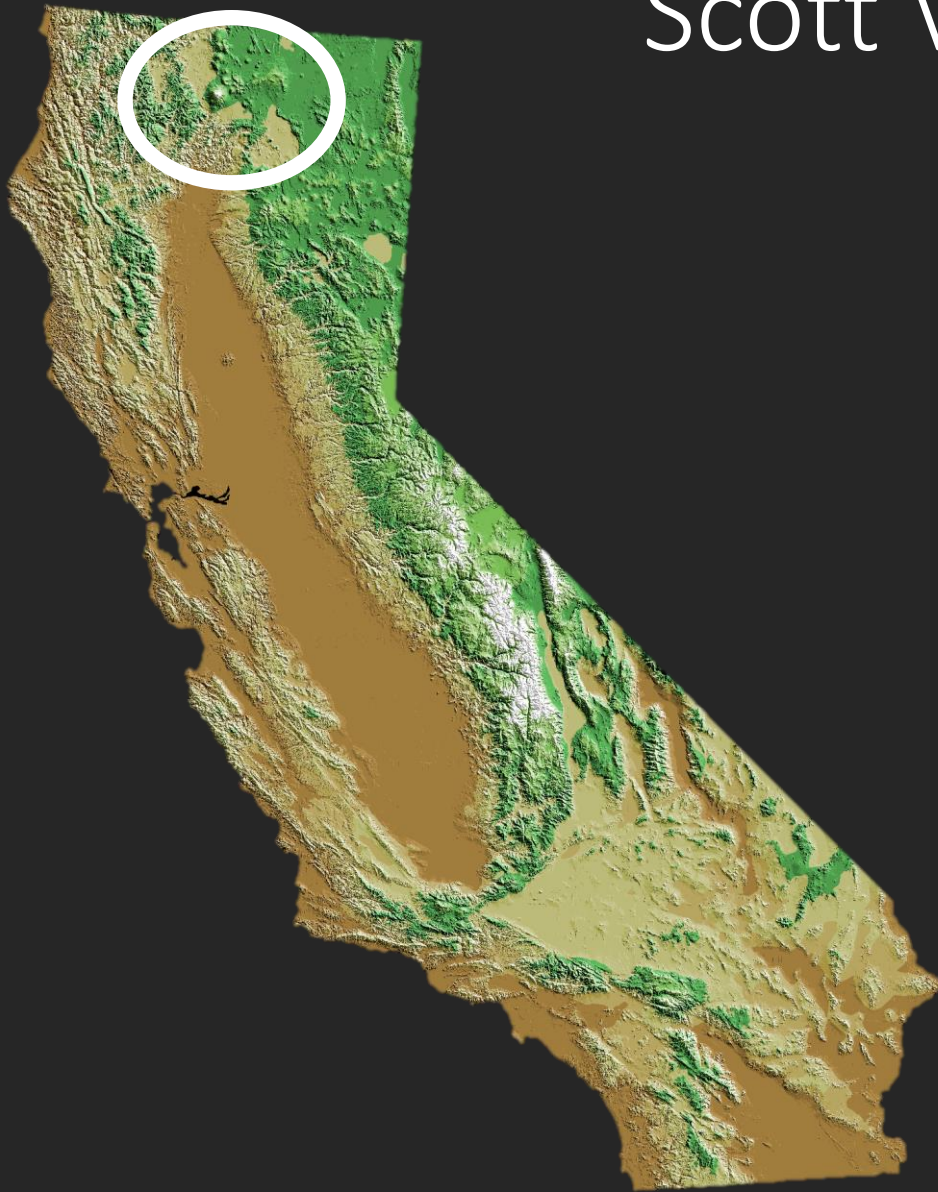
Unfortunately, few new insecticides
in the pipeline for alfalfa [weevil]



In California, insecticide resistance in weevils is clearly an issue and may be growing worse



Scott Valley: 2016



ALFALFA & FORAGE NEWS

News and information from UC Cooperative Extension about alfalfa and forage production.



Alfalfa Weevil Resistance to Pyrethroid Insecticides found in Intermountain Alfalfa Fields



Author: Steve Orloff

Author: Larry Godfrey

Author: Kevin Goding

Author: Laurie Askew

Author: Daniel H Putnam

Published on: May 12, 2016

"May you live in interesting times..."

-Reported to be a Chinese curse

Search

Subs

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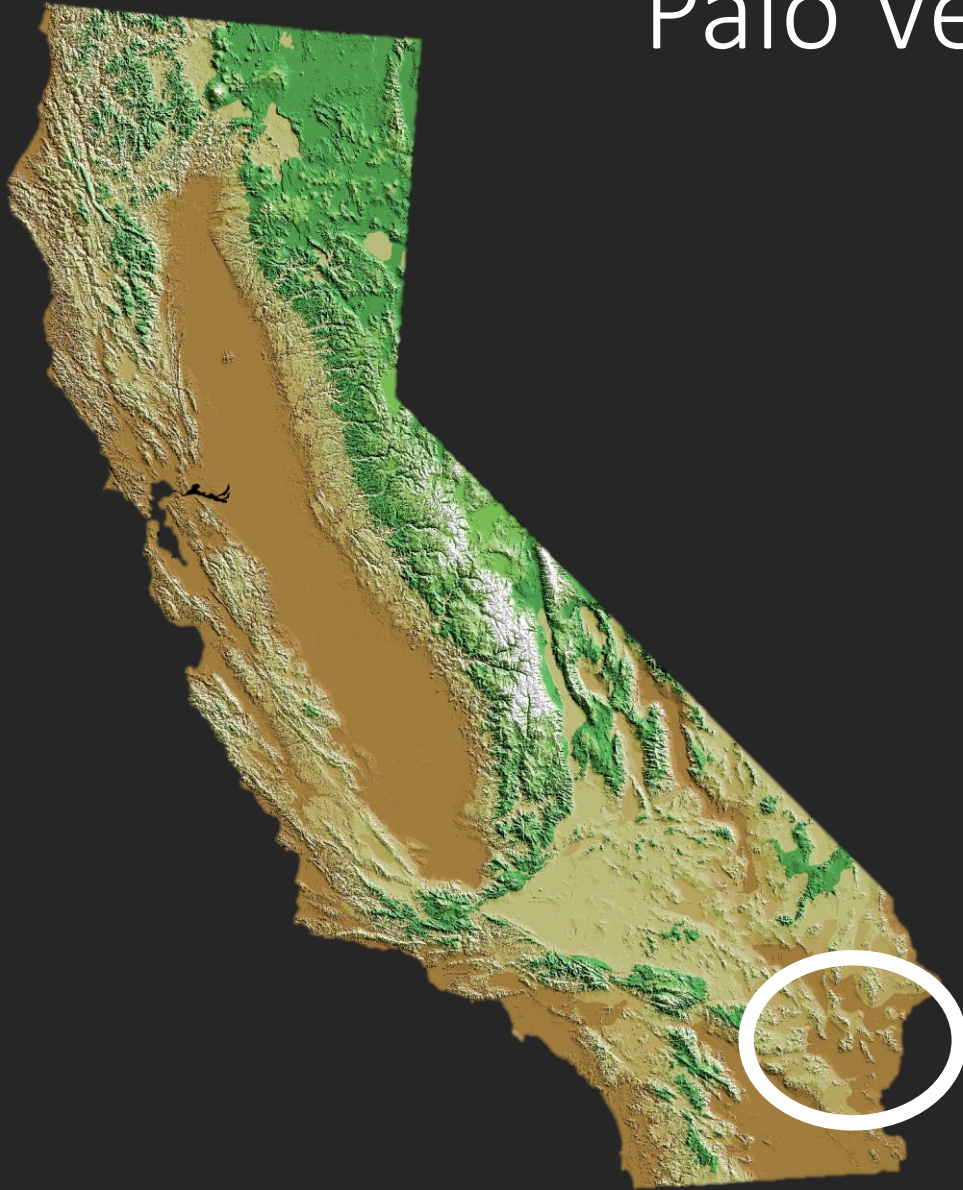
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- DF

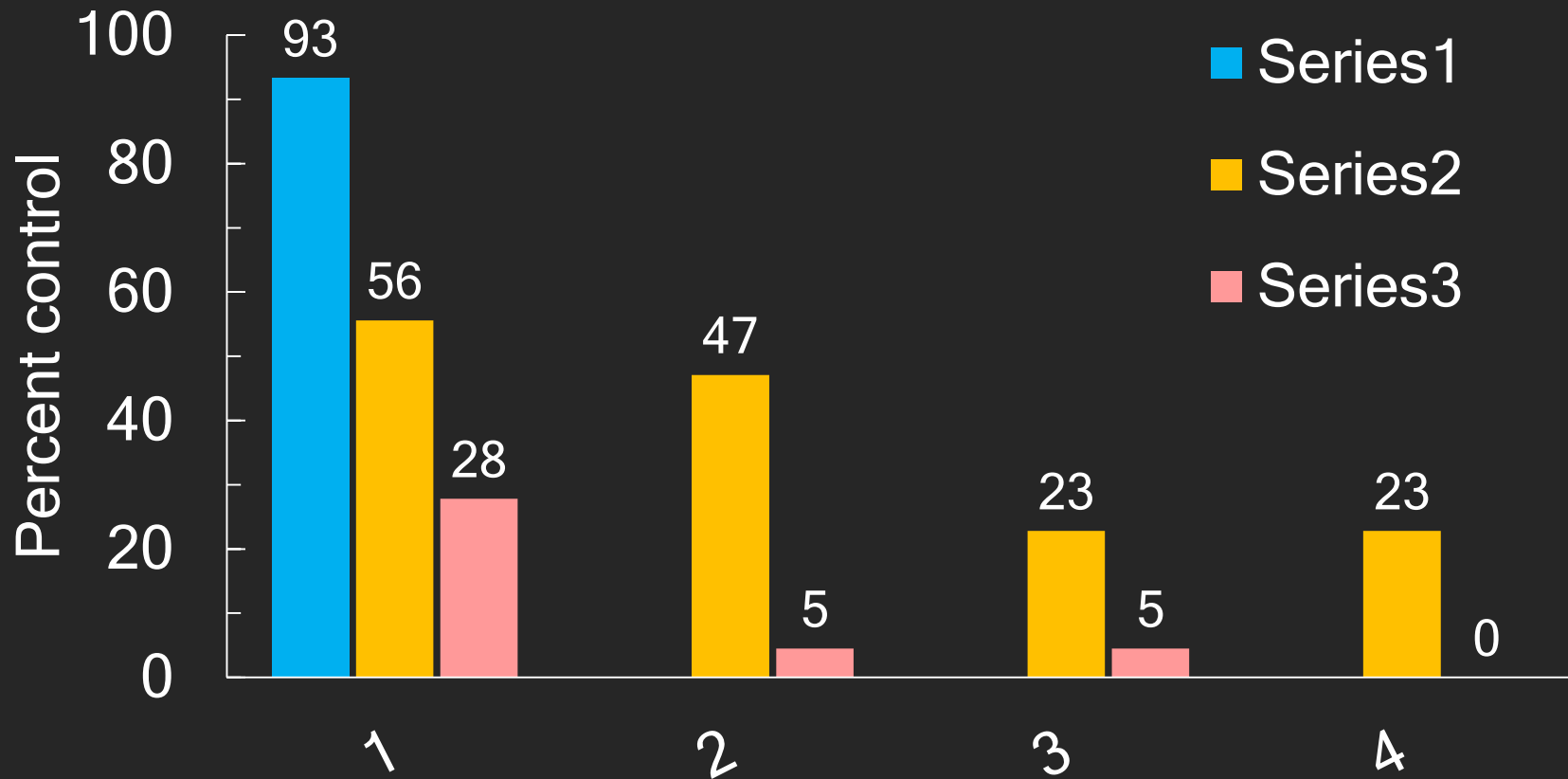


Field	Insecticide rate				
	0.25×	0.5×	Recommended (1×)	2×	4×
	% Mortality				
Conventional field 1	5%	8%	5%	10%	23%
Conventional field 2	0%	5%	10%	13%	23%
Conventional field 3	23%	3%	3%	10%	35%
Conventional field 4	0%	0%	15%	8%	23%
Conventional average	7%	4%	8%	10%	26%

Palo Verde Valley: 2018

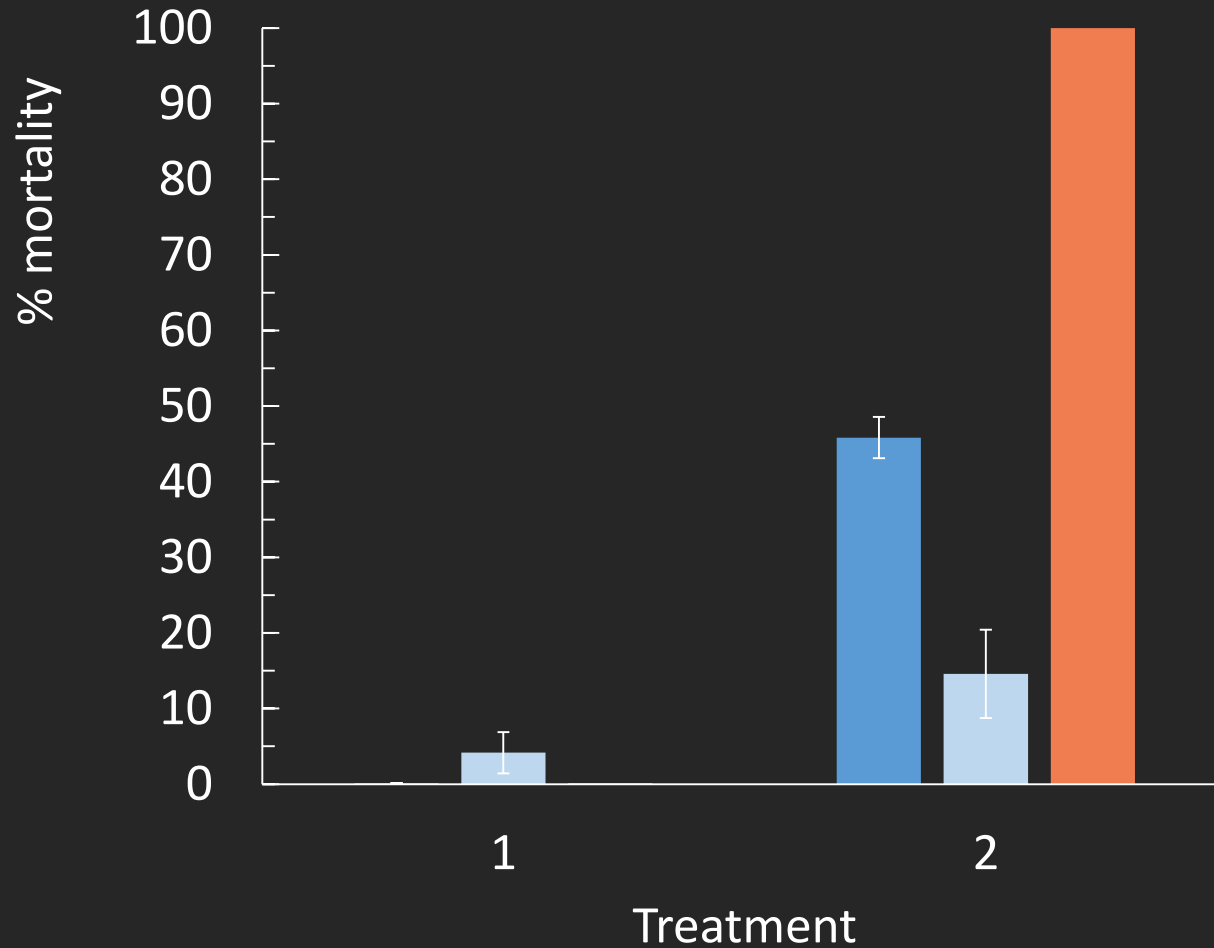


History of greater pyrethroid use →
poorer control with pyrethroids

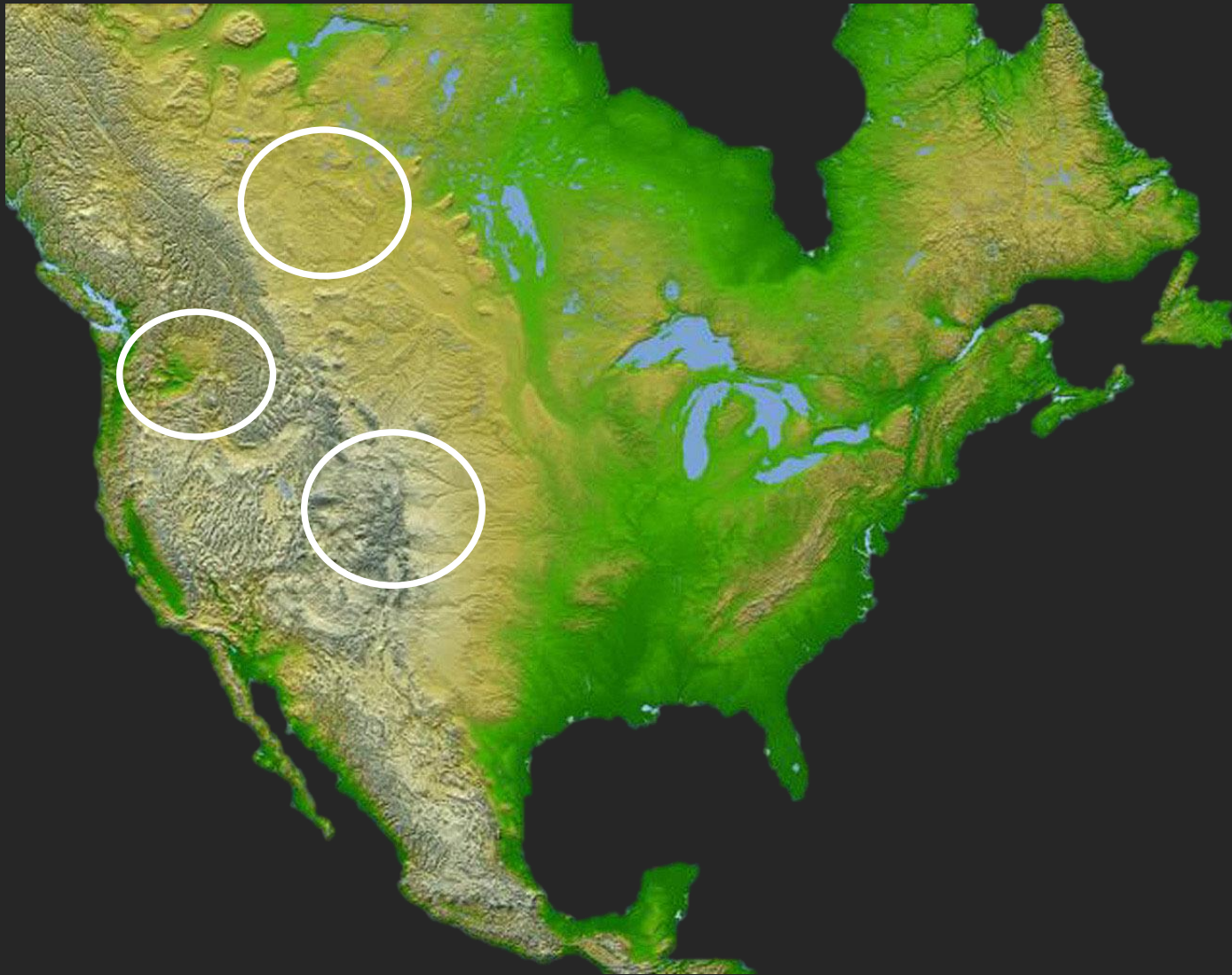


Scott Valley: 2018

Series1 Series2 Series3



“We’ve had to learn to live with higher levels”



Do not appear to be substantial issues with resistance for other alfalfa pests, *thus far*



UC Statewide IPM Project
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How can we reduce the likelihood that insecticide resistance will develop?

IPM

- Without insecticides, no selection pressure
- Alternative tactics



Good basic agronomic practices + cultural practices targeting key pests



Good basic agronomic practices + cultural methods

- Goal: Vigorous crop

- Good variety
- Proper irrigation
- Good nutrient management
- Proper cutting schedule
- Good weed management
- Avoid herbicide injury



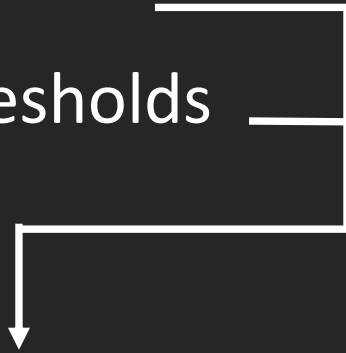
- Cultural controls

- Early cutting (?)
- Delayed cutting/regrowth (?)



With insecticides, follow the principles of IPM

- Monitor pests
- Use action thresholds

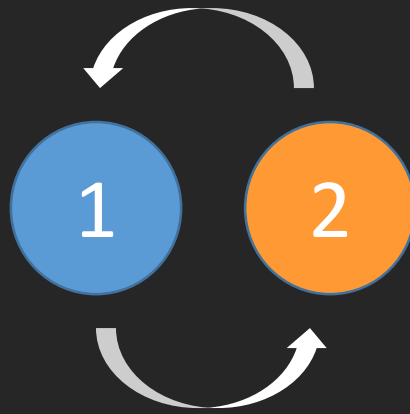
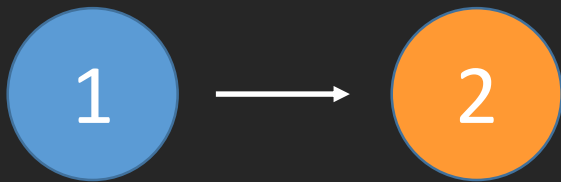


ONLY NECESSARY APPLICATIONS

- Follow best practices for applications
- Follow label recommendations for rates
- Monitoring to detect issues + communication

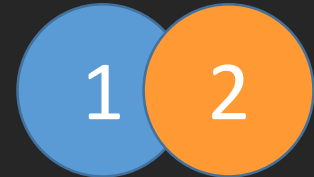


How to best use insecticides with different MoAs to manage resistance?



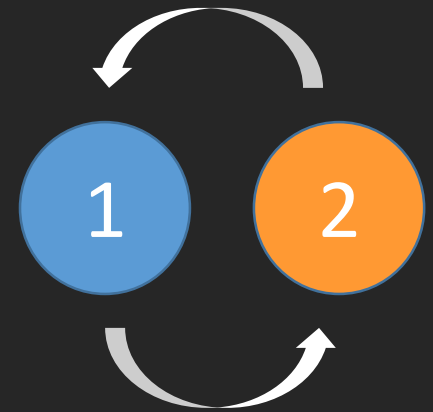
What about mixtures of MoAs?

- Generally not recommended
- Rely on “redundant killing”
- In practice, risk of selecting for resistance to BOTH
- Issues with dispersing pests where single insecticides and mixtures are used across landscape
- OK for: treatments following thresholds AND IF each insecticide has activity against only one pest



Rotating MoAs is most favored

- Rotate between insecticides with different group #s
- Try to target different generations of the pest with materials with different group #s



- Very limited options
- Pyrethroid → pyrethroid → pyrethroid → pyrethroid → pyrethroid = BAD
- Rotate between groups
- Ideally, follow a plan at the farm/landscape level (dispersal)
 - Same material in adjacent fields, different materials across the landscape



A.	INDOXACARB (Steward EC)	6.7–11.3 fl oz
	MODE-OF-ACTION GROUP NUMBER ¹ : 22A	
B.	LAMBDA-CYHALOTHRIN* (Warrior II with Zeon)	1.28–1.92 fl oz
	MODE-OF-ACTION GROUP NUMBER ¹ : 3A	
C.	BETA-CYFLUTHRIN* (Baythroid XL)	1.6–2.8 fl oz
	MODE-OF-ACTION GROUP NUMBER ¹ : 3A	
D.	CHLORPYRIFOS* (Lorsban Advanced)	1–2 pt
	MODE-OF-ACTION GROUP NUMBER ¹ : 1B	
E.	MALATHION (Malathion 8-E)	1–1.25 pt
	MODE-OF-ACTION GROUP NUMBER ¹ : 1B	
F.	SPINOSAD (Entrust SC)#	2–4 fl oz
	MODE-OF-ACTION GROUP NUMBER ¹ : 5	

Conclusions

- Keep tools in the toolbox
- Start with good agronomic practices
- Follow basics of IPM
- Rotate MoAs, pay attention to group #s
- We **CAN** delay resistance



Acknowledgements

- Rachael Long (UC ANR – Yolo, Solano, Sacramento)
- Dan Putnam (UC Davis)
- Nick Clark (Kings, Tulare, Fresno)
- Rob Wilson (Intermountain REC, Siskiyou)
- Giuliano Galdi (Siskiyou)
- Michael Rethwisch (Imperial)
- Jasmin Ramirez Bonilla (UCD)
- Kevin Goding (UCD)
- Treanna Pierce (UCD)

New Project!



RAW (Resistant Alfalfa Weevils)



Questions?

