Pyrethroid Runoff Issues in the Salinas Valley

Donald Weston

University of California, Berkeley

Issues to be covered

- Agricultural pyrethroid results from Central Valley
- Results from studies in Salinas creeks
- Management practices to reduce pyrethroid loss to surface water bodies

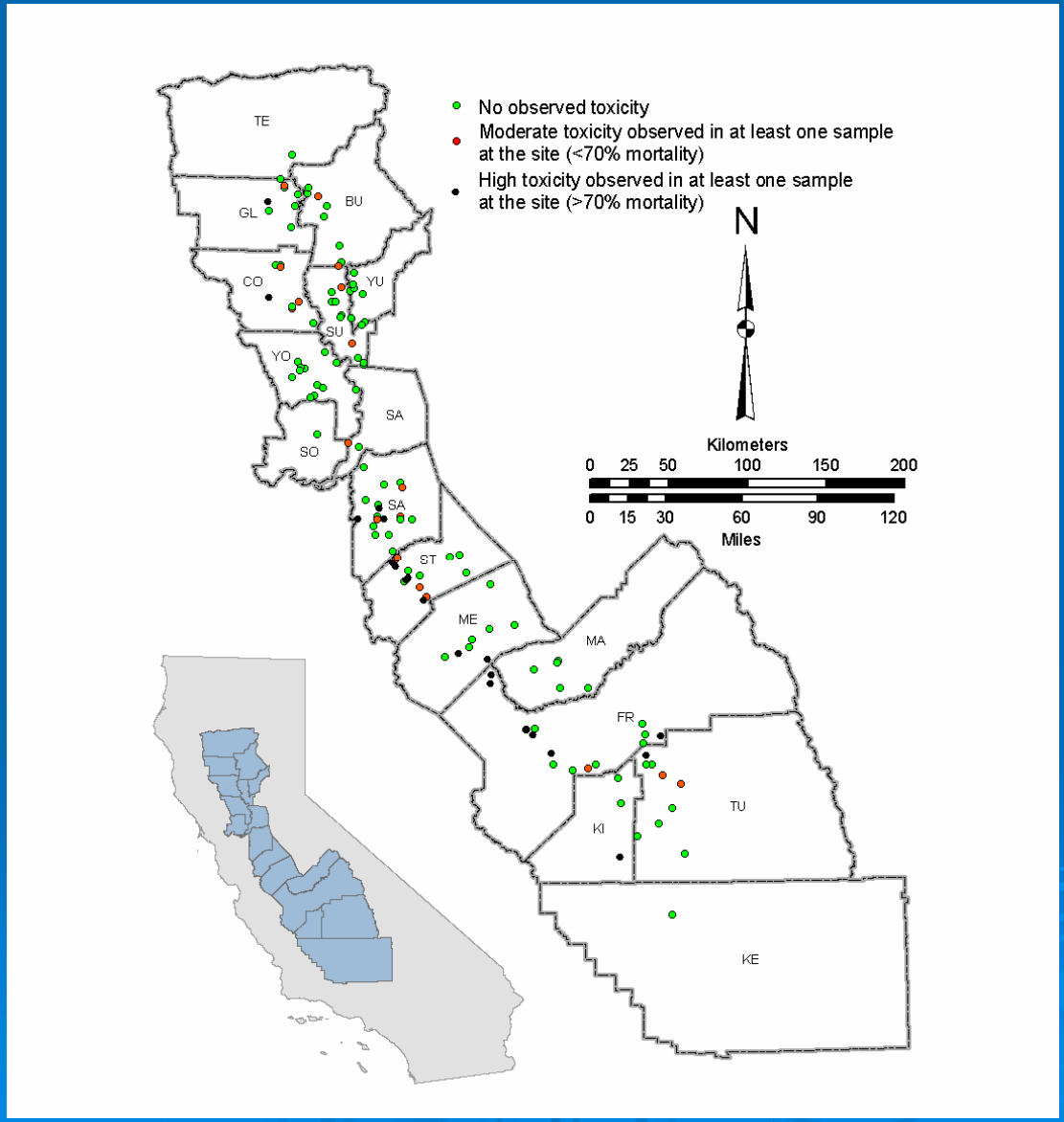
Our Central Valley agricultural data set:

230 samples for toxicity testing using the crustacean Hyalella azteca

210 of these also with analytical data for pesticides (8 pyrethroids, chlorpyrifos, 20 organochlorines)

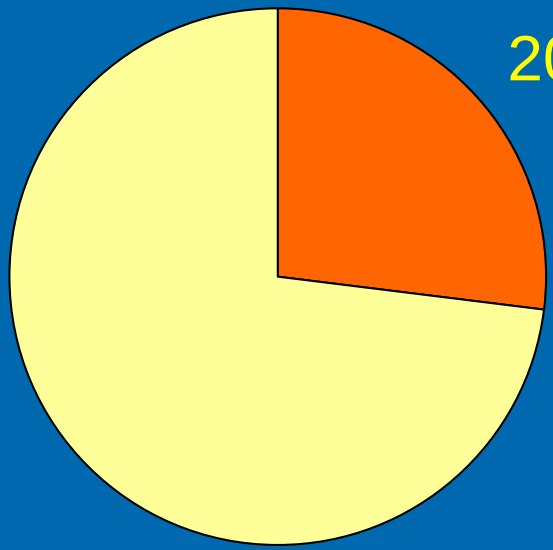
127 sites represented in 17 Central Valley counties

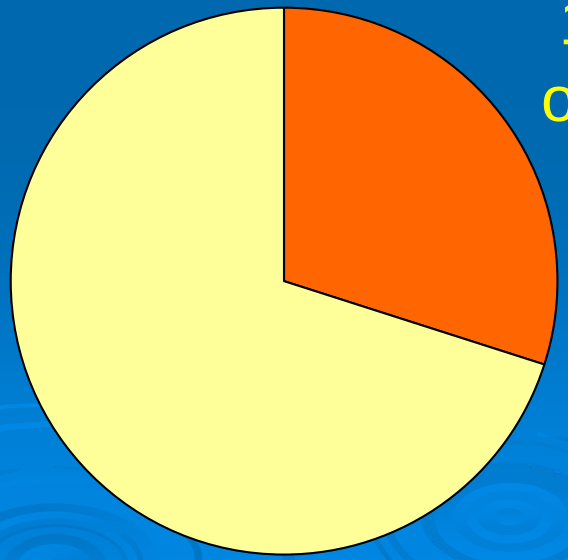
Hyalella azteca sediment toxicity in agricultural water bodies, Central Valley, CA



Frequency of acute Hyalella toxicity

27% of
200 samples
toxic





29% of
127 sites toxic
on at least one
occasion

Frequency of toxicity in various water body types

- Unnamed drains = 41% (of 34 sites)
- Named drains = 24% (of 17 sites)
- Canals = 13% (of 8 sites)
- Sloughs = 11% (of 28 sites)
- Creeks = 26% (of 27 sites)
- Rivers = 27% (of 11 sites)

Identifying the contributors to sediment toxicity.

$$\text{Toxicity Unit (TU)} = \frac{\text{Actual conc. in sediment}}{\text{Published Hyalella LC50 conc.}}$$

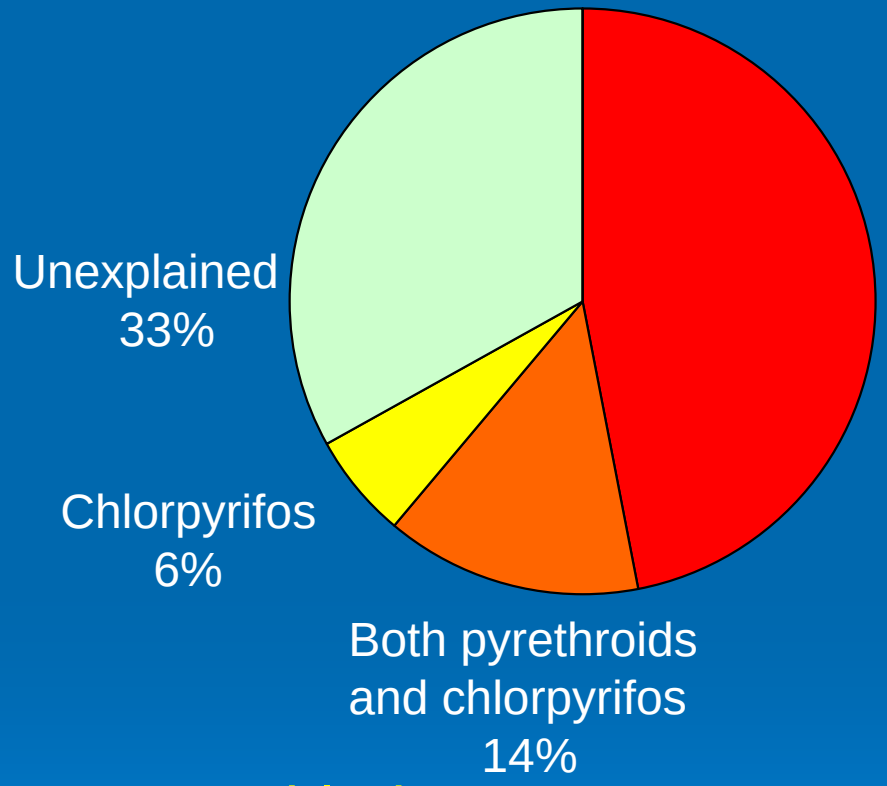
TUs calculated on an organic carbon normalized basis

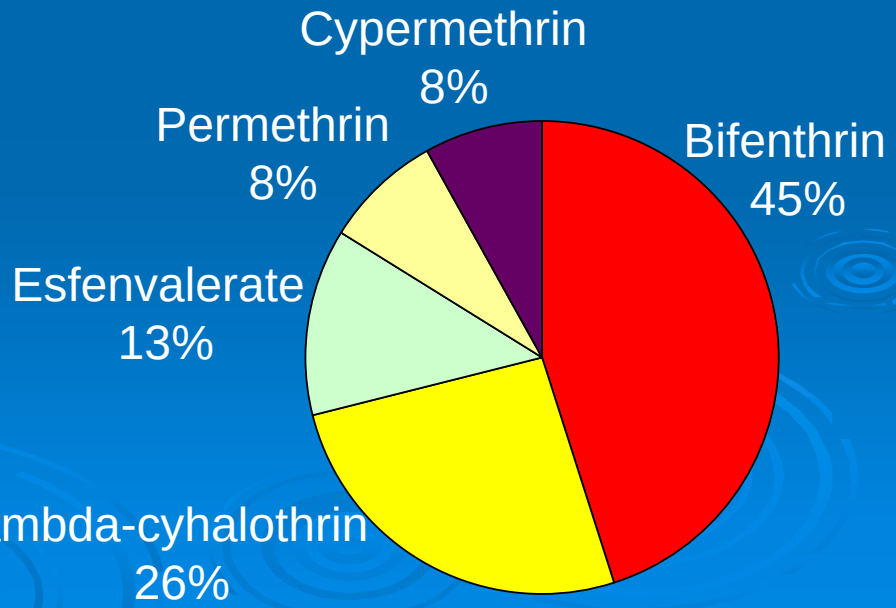
Assume additivity to get sum of pyrethroid TUs.

0.5 TU used as a threshold for potential toxicity

What could be causing the toxicity?

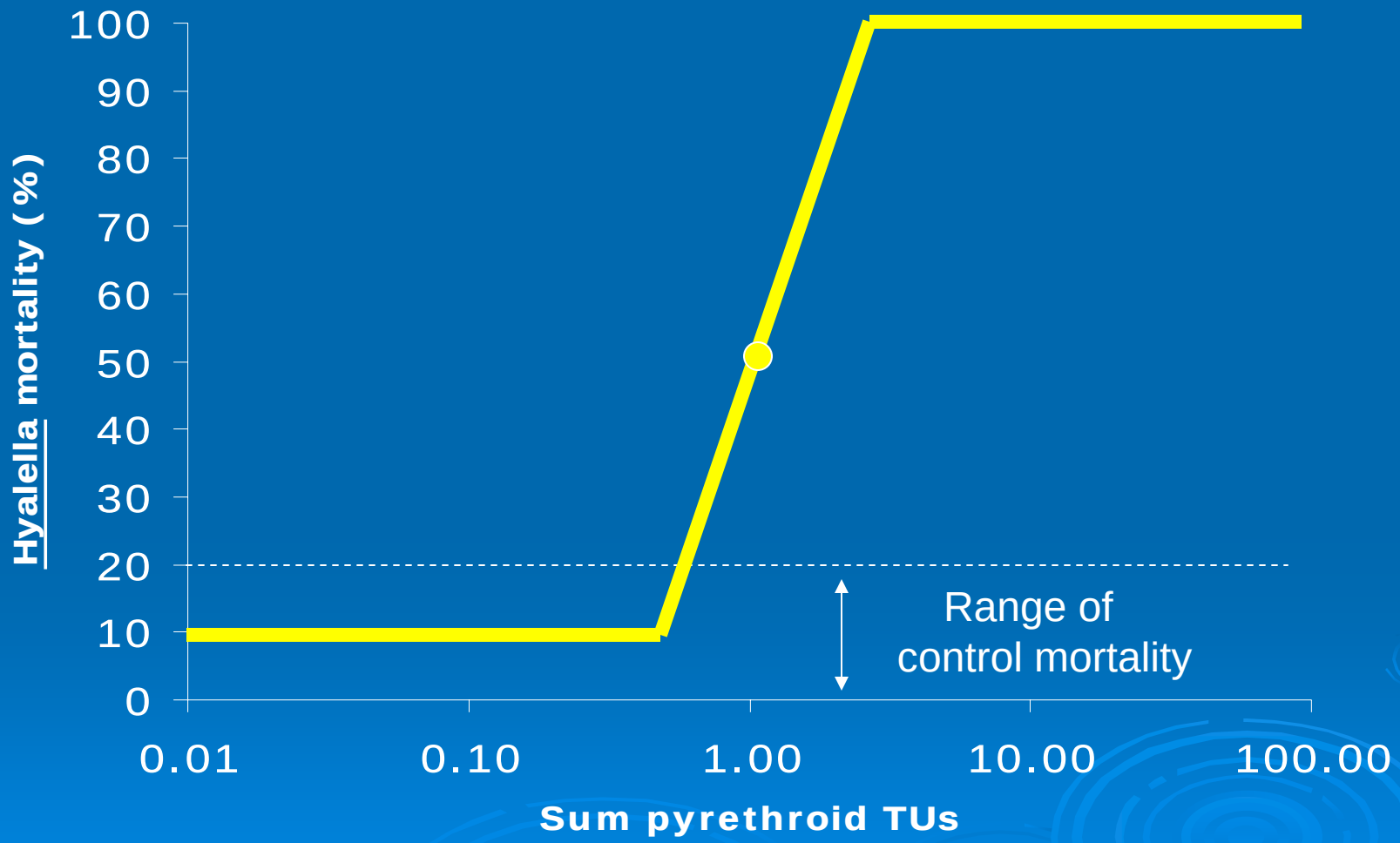
(% of toxic samples with at least 0.5 TU)

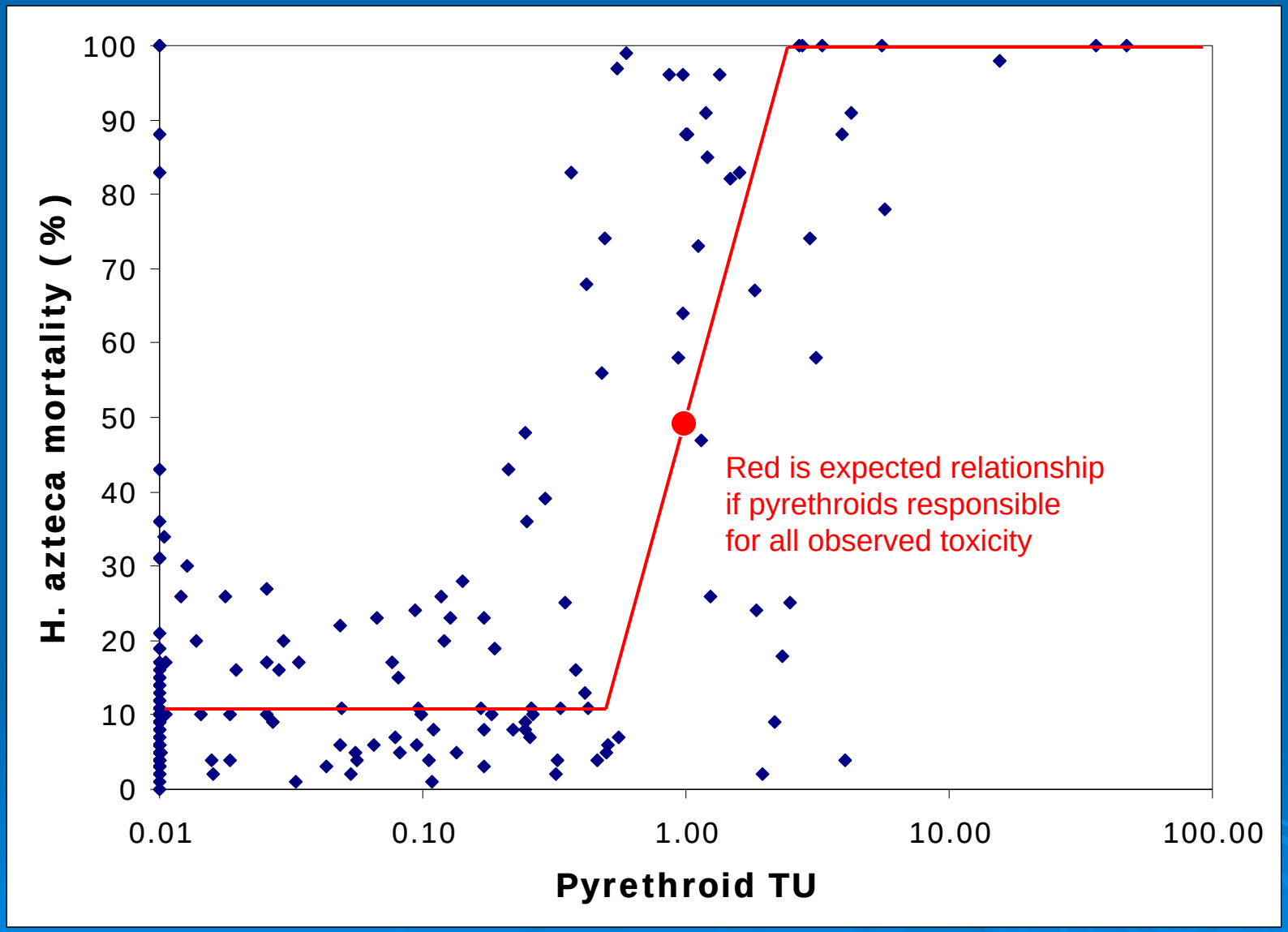




Organochlorines NEVER with more than 0.5 TU in any toxic sample.

Theoretical relationship between pyrethroid concentration and toxicity




H. azteca mortality (%)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.10
1.00
10.00
100.00
Pyrethroid TU
Red is expected relationship
if pyrethroids responsible
for all observed toxicity

Second line of evidence…

- Temperature -reduced temperature makes pyrethroids more toxic
- Piperonyl butoxide (PBO) - PBO addition makes pyrethroids more toxic

TIE evidence for pyrethroid-related toxicity

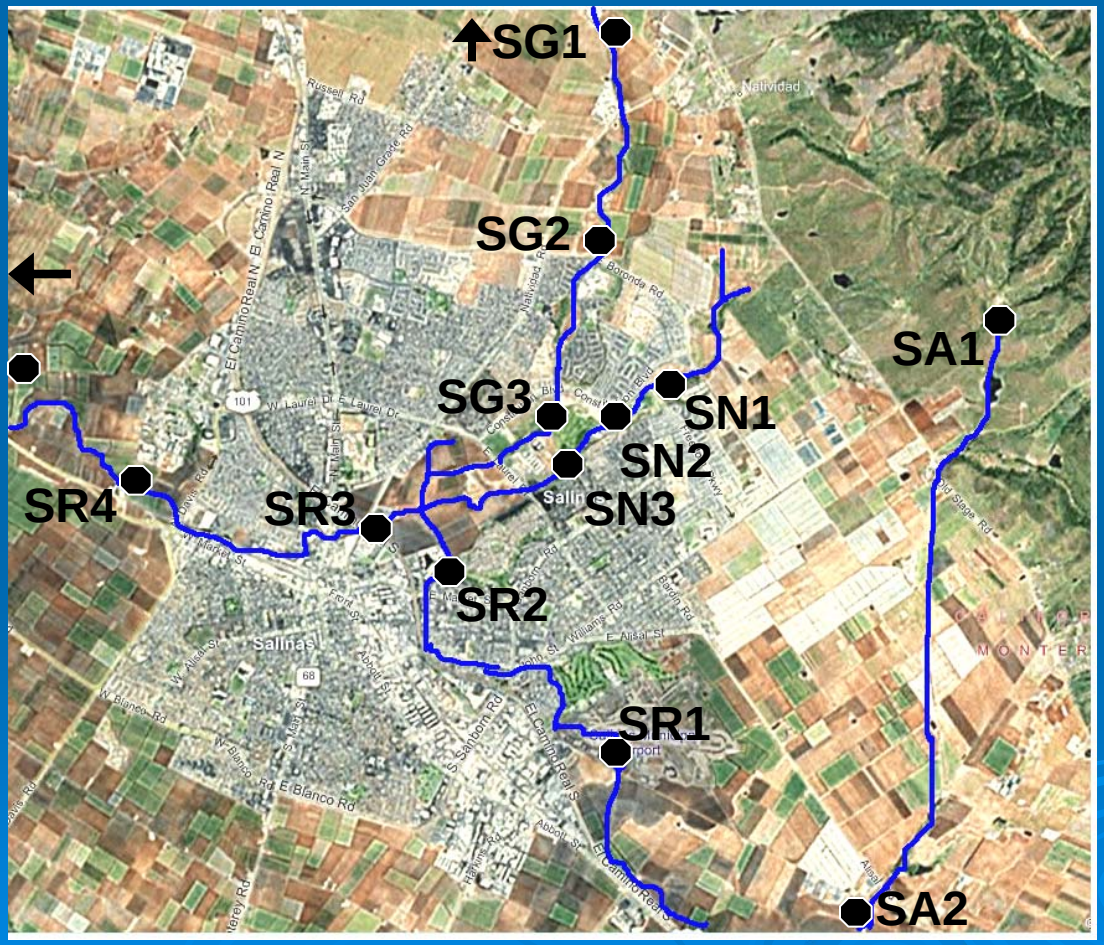
Pyrethroids implicated by:

Smpl. #	TU	Temp. TIE	PBO TIE
CS15	yes	yes	yes
SED40	yes	yes	yes
CS12	yes	yes	yes
GSLI	yes	yes	yes
O21	yes	yes	yes

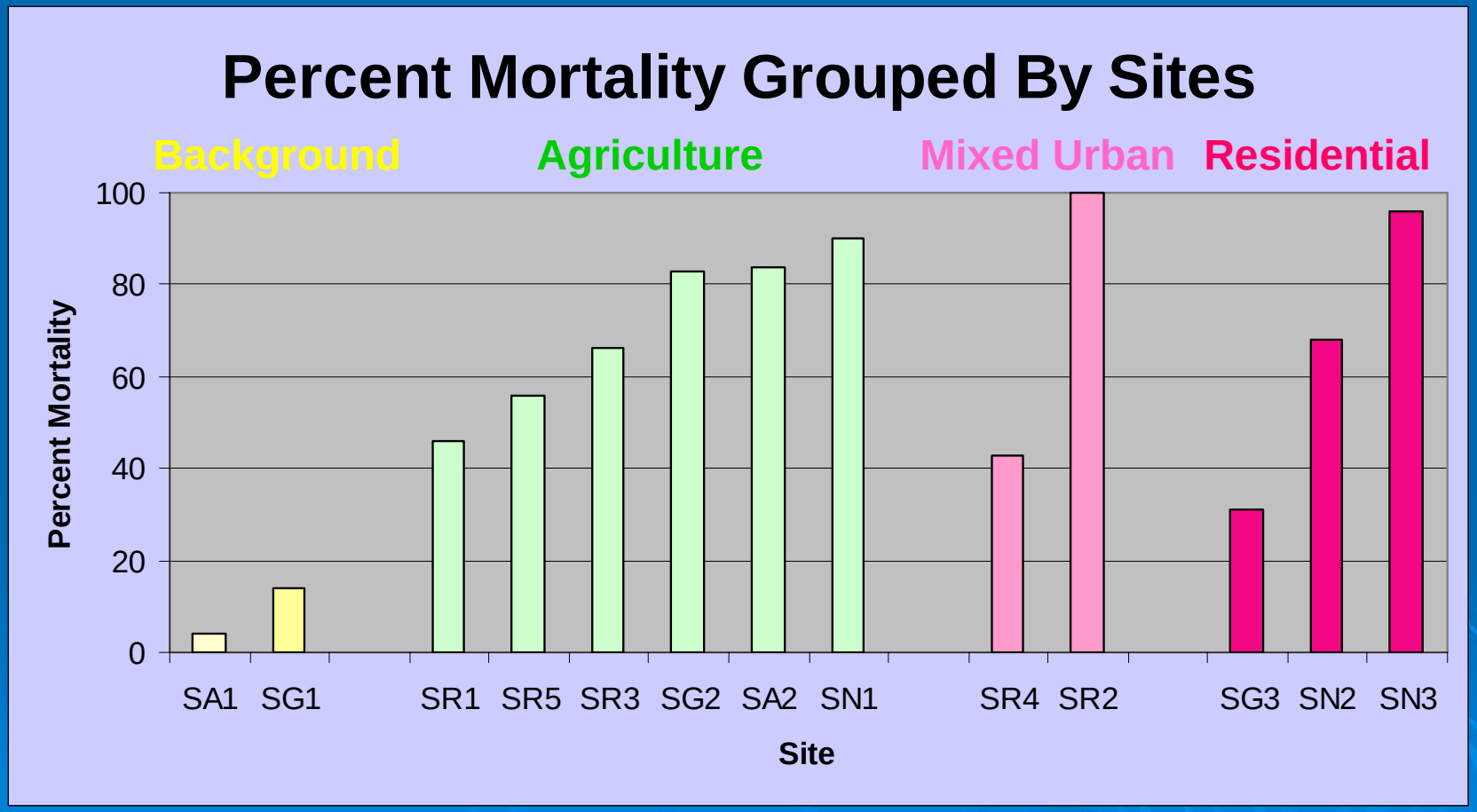
Pyrethroids implicated by:

Smpl. #	TU	Temp. TIE	PBO TIE
SRCP	yes	---	yes
HP	yes	yes	---
SDMA	yes	yes	---
SED11	yes	yes	---
SN1	yes	no	no
FT19	no	yes	no

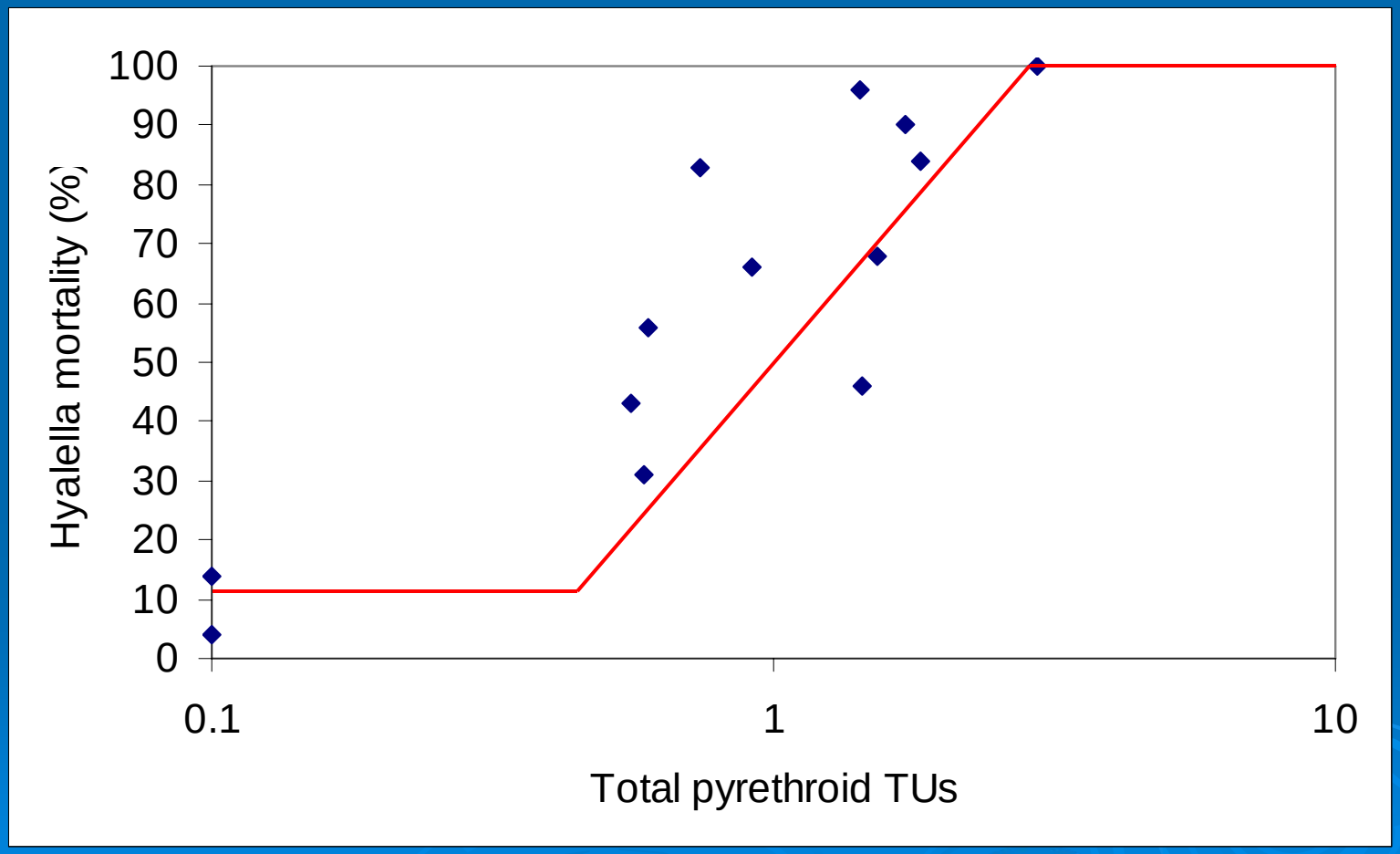
Salinas creek study



Results: Toxicity Tests



TU vs. mortality relationship: Salinas



Pyrethroids contributing most to the toxicity of Salinas creeks

Agricultural areas

- Esfenvalerate
- Permethrin
- Lambda-cyhalothrin

Urban areas

- Bifenthrin
- Cypermethrin
- Cyfluthrin

Approximate current use of pyrethroids in California

Reported non-ag. use by professional applicators = 700,000 lb/yr

Reported agricultural use = 300,000 lb/yr

Estimated retail sales = 100,000 lb/yr

TOTAL = About 1,100,000 lb/yr statewide

Mitigation

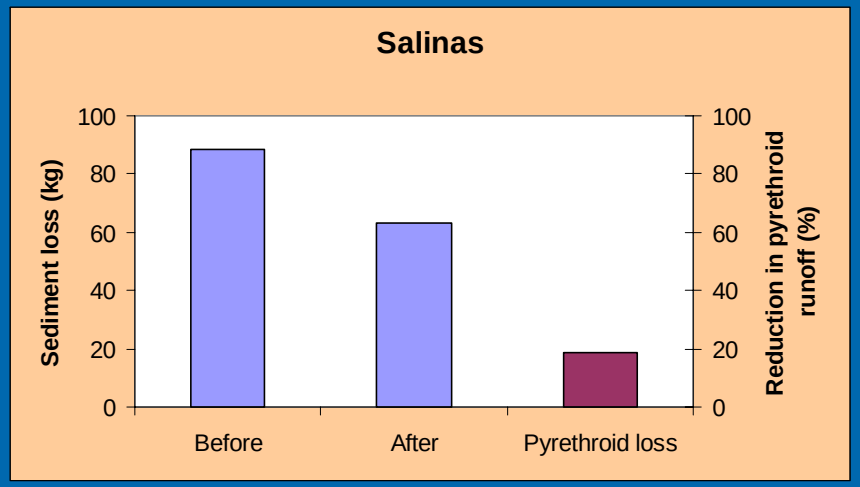
- Pyrethroids are extremely particle-associated and insoluble in water.
- Techniques that reduce sediment transport, especially the finest particles, should be effective mitigation for pyrethroids.

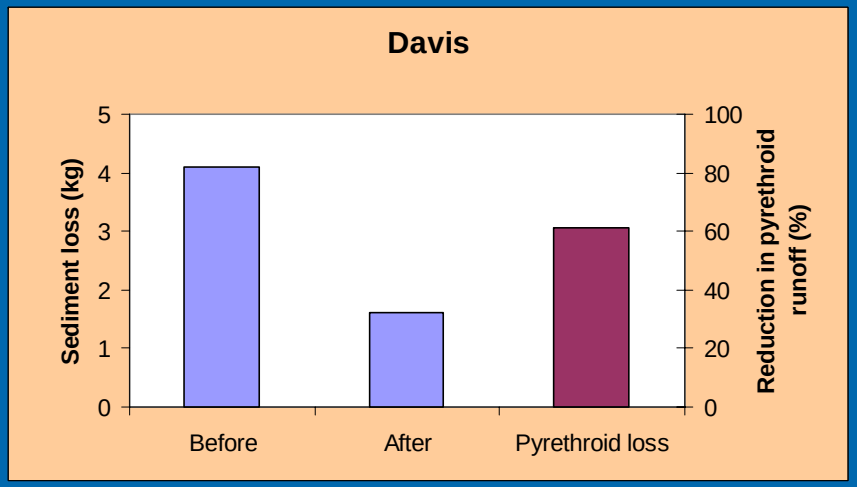
Basic study design

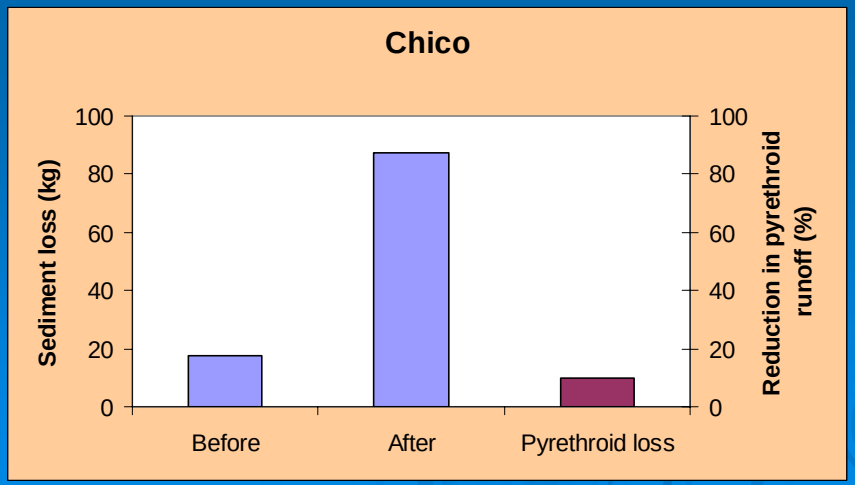
	Salinas	Davis	Chico
Plant 4 plots of 0.7 acres each	Lettuce	Tomatoes	Beans
Cultivate			
Apply pesticide	Permethrin (Pounce)	Lambda-cyhalothrin (Warrior)	Zeta-cypermethrin (Mustang)
Irrigate	Sprinklers	Furrow flooding	Furrow flooding
Test management practices	Simple ditch Sediment trap Vegetated ditch Polyacrylamide		
Cultivate and repeat: 3-4 cycles			

Simple ditch

Simple ditch

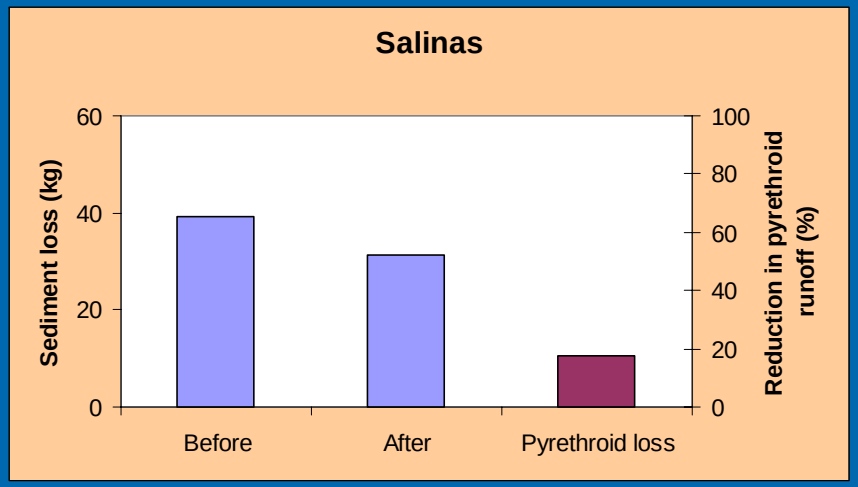


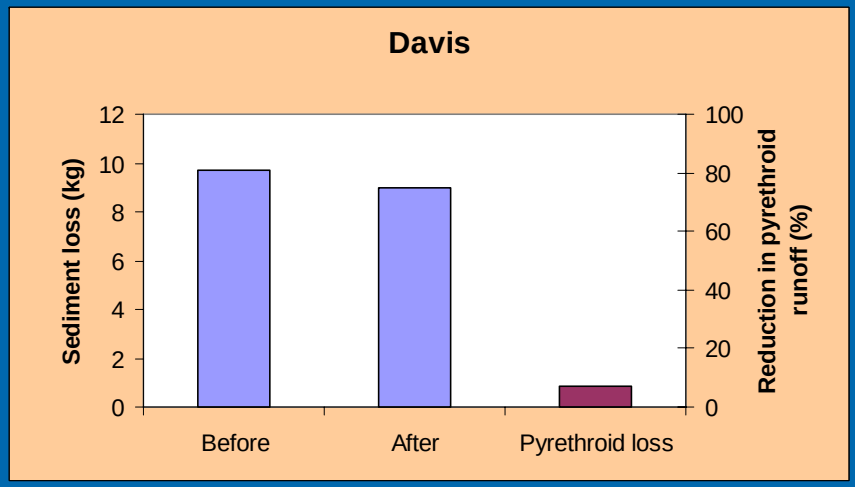


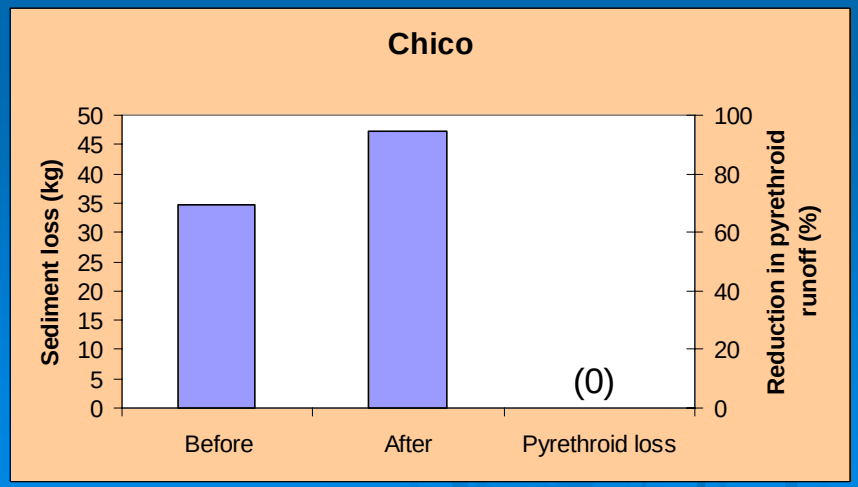


Sediment trap

Sediment trap

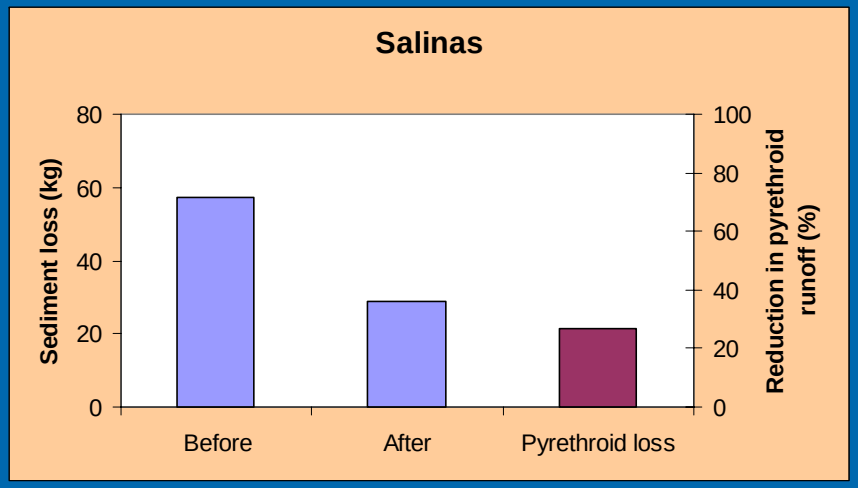


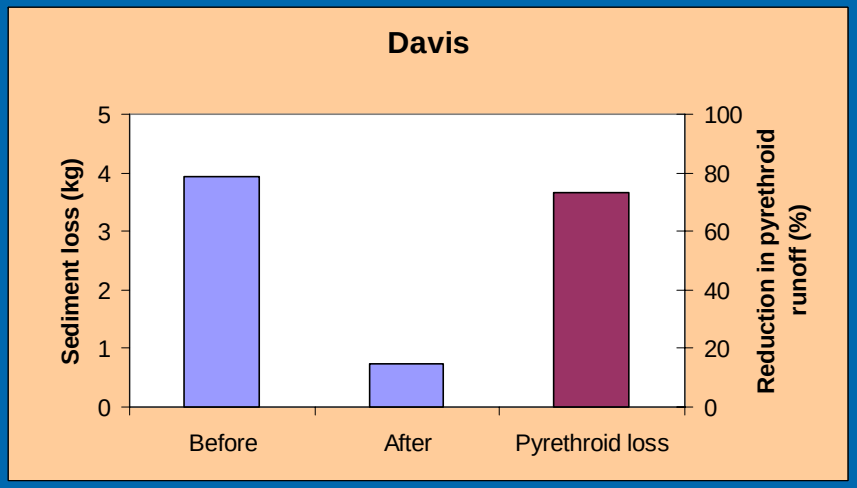




Vegetated ditch

Vegetated ditch





Polyacrylamide (PAM)

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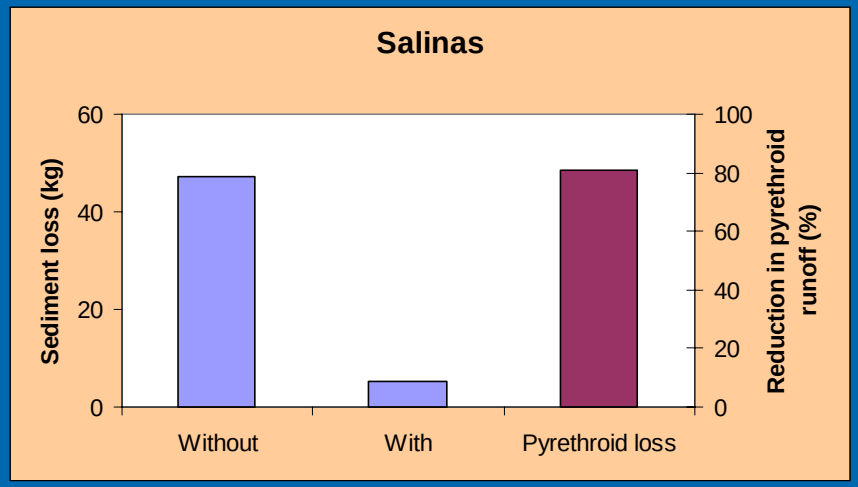

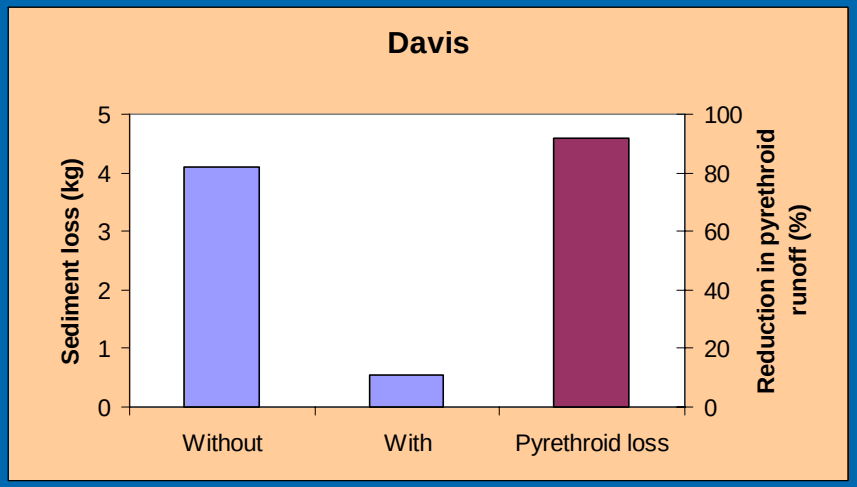

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