

Mitigating Pesticides Impacts on Water Quality

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Central Coast Water Quality Impairments:

- nutrients (P and N)
- sediments
- pesticides
- aquatic toxicity
- bacterial pathogens
- salts

Aquatic Toxicity Test Organisms

Water column toxicity



Ceriodaphnia dubia
(water flea)

sediment toxicity



Hyaella azteca

Elkhorn Slough



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Regulatory Process

Federal Clean Water Act:

- 303d list of impaired water bodies

- Total Maximum Daily Load

State Porter Cologne Water Quality Control Act:

- Discharge Permit

- Agricultural Discharge Waiver
(Agricultural Order)

Chlorpyrifos and Diazinon

TMDL for lower Salinas watershed
(chlorpyrifos, diazinon) approved May 5, 2011

Water quality targets:

Chlorpyrifos:

Acute¹ toxicity, 25 ppt (ng/L)

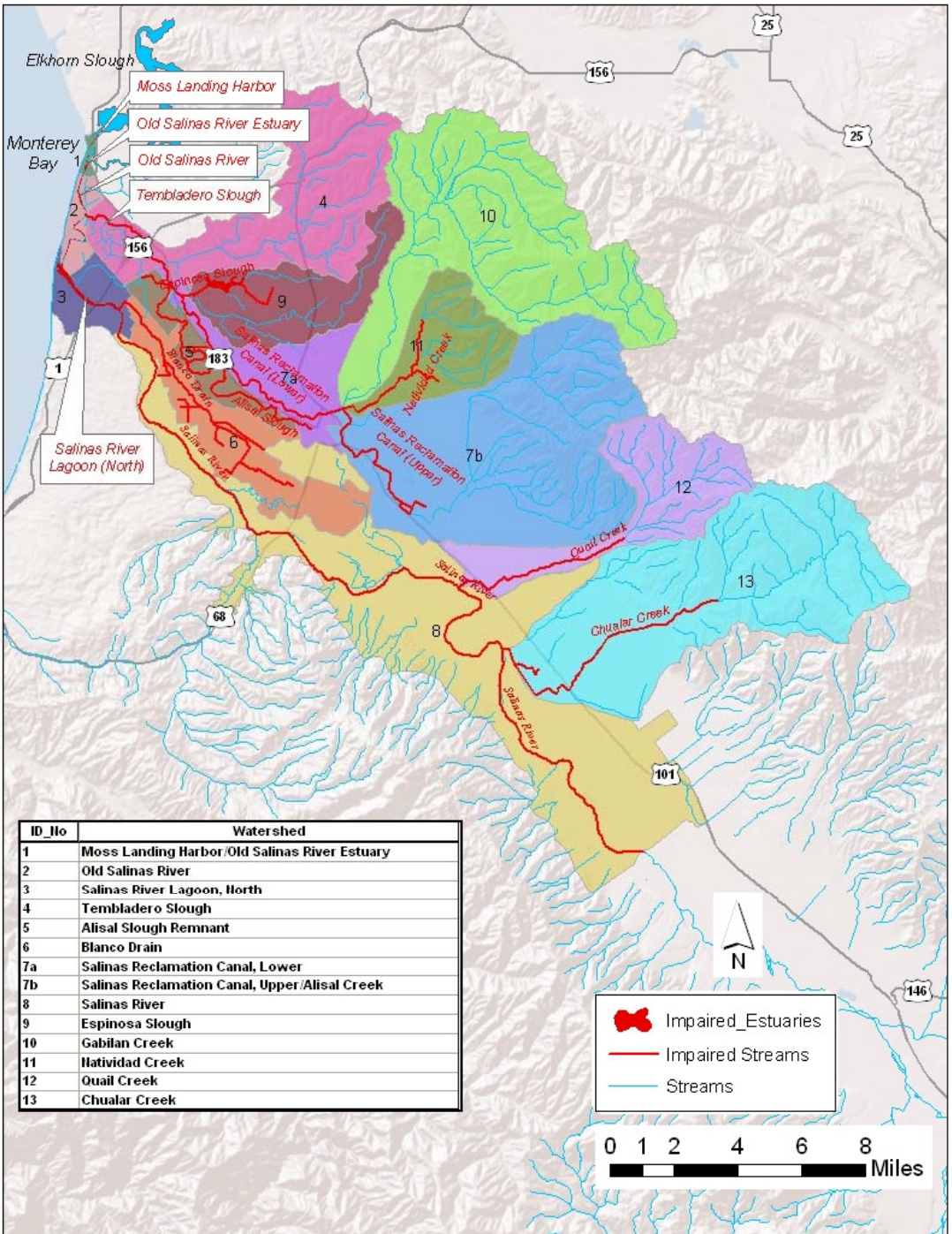
Chronic² toxicity 15 ppt (ng/L)

Diazinon:

Acute toxicity, 160 ppt (ng/L)

Chronic toxicity 100 ppt (ng/L)

1. 1 hour average
2. 4 day average



Lower Salinas OP Pesticide TMDL area

Updated Ag Order (Sept, 2011)

16. **Tier 3** – Applies to all Dischargers whose se individual farm/ranch meets one the following sets of criteria *(3a) or (3b)*:
- 3a. Discharger grows crop types with high potential to discharge nitrogen to groundwater (as defined in Attachment A) at the farm/ranch, and ~~operation~~ farm/ranch total irrigated acreage is *greater than or equal to* ~~1000~~ 500 acres;
 - 3b. Discharger applies chlorpyrifos and diazinon at the farm/ranch, and ~~operation~~ the farm/ranch discharges irrigation or stormwater runoff to a waterbody listed for toxicity or pesticides on the 2010 List of Impaired Waterbodies (Table 1);

Pyrethroid Pesticides

- Cause of sediment toxicity in the Lower Salinas Watershed
- Label Re-evaluation EPA/DPR
- Vegetative Buffer requirement (10 ft) between field and aquatic habitat

Code 96

RESTRICTED USE PESTICIDE
Due to Toxicity to fish and aquatic organisms
For retail sale to and use only by certified applicators or persons under their direct supervision, and only for those uses covered by the certified applicator's certification.



25 WP Insecticide

PRECAUTIONARY STATEMENT
Hazards to Humans (& Domestic Animals)
Warning
Causes substantial but temporary eye injury. Irritates skin and clothing. Harmful if swallowed. Wash thoroughly after handling and before eating, drinking, or using cosmetics. Remove and wash contaminated clothing.

BUFFER ZONES

Vegetative Buffer Strip

Construct and maintain a minimum 10-foot-wide vegetative filter strip of grass or other permanent vegetation between the field edge and down gradient aquatic habitat (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or natural ponds; estuaries; and commercial fish farm ponds).

Only apply products containing permethrin onto fields where a maintained vegetative buffer strip of at least 10 feet exists between the field and down gradient aquatic habitat.

For guidance, refer to the following publication for information on constructing and maintaining effective buffers: *Conservation Buffers to Reduce Pesticide Losses*. Natural Resources Conservation Services. USDA, NRCS. 2000. Fort Worth, Texas. 21pp.

<http://www.in.csusda/v/technical/agronom/newconbuf.pdf>

Vegetated buffers may not be a suitable practice for vegetable and row crops



Evaluation of Management Practices for reducing impacts of Pyrethroid Pesticides on Water Quality

- Don Weston, UC Berkeley
- UC Farm Advisors and Specialists
- 3 locations (UC Davis, Salinas, Chico)

Non-Vegetated Ditch (Control)



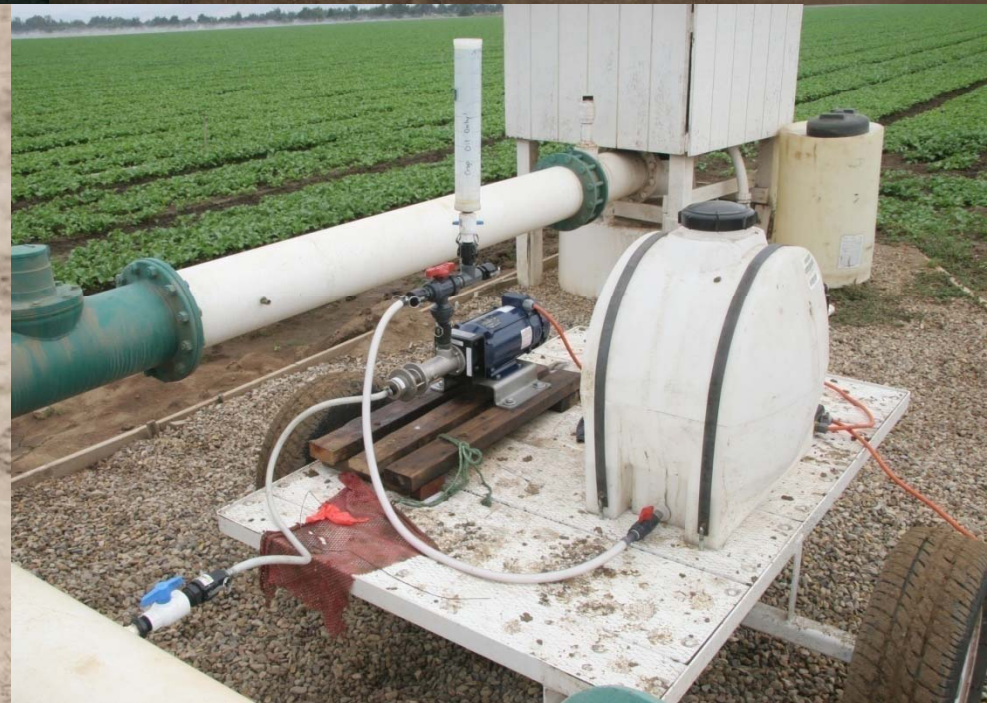
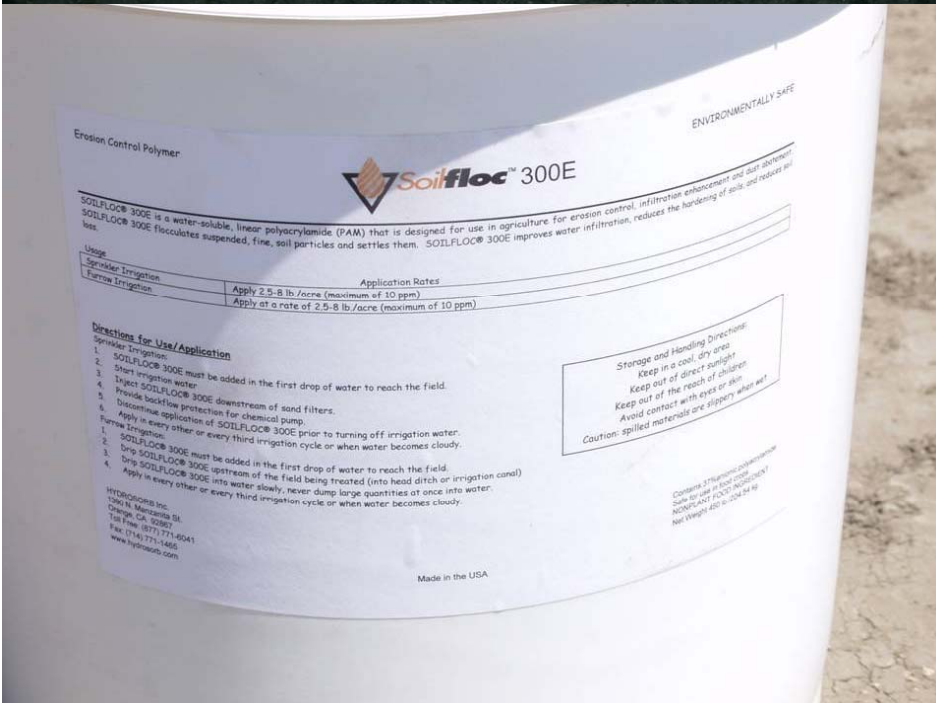
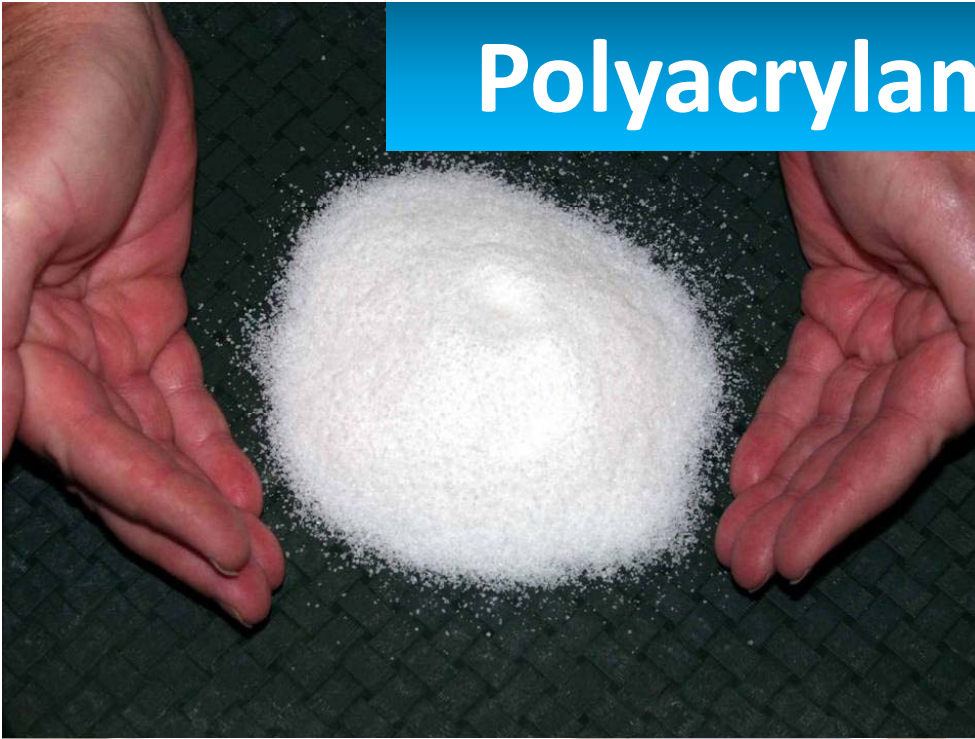
Vegetated Ditch

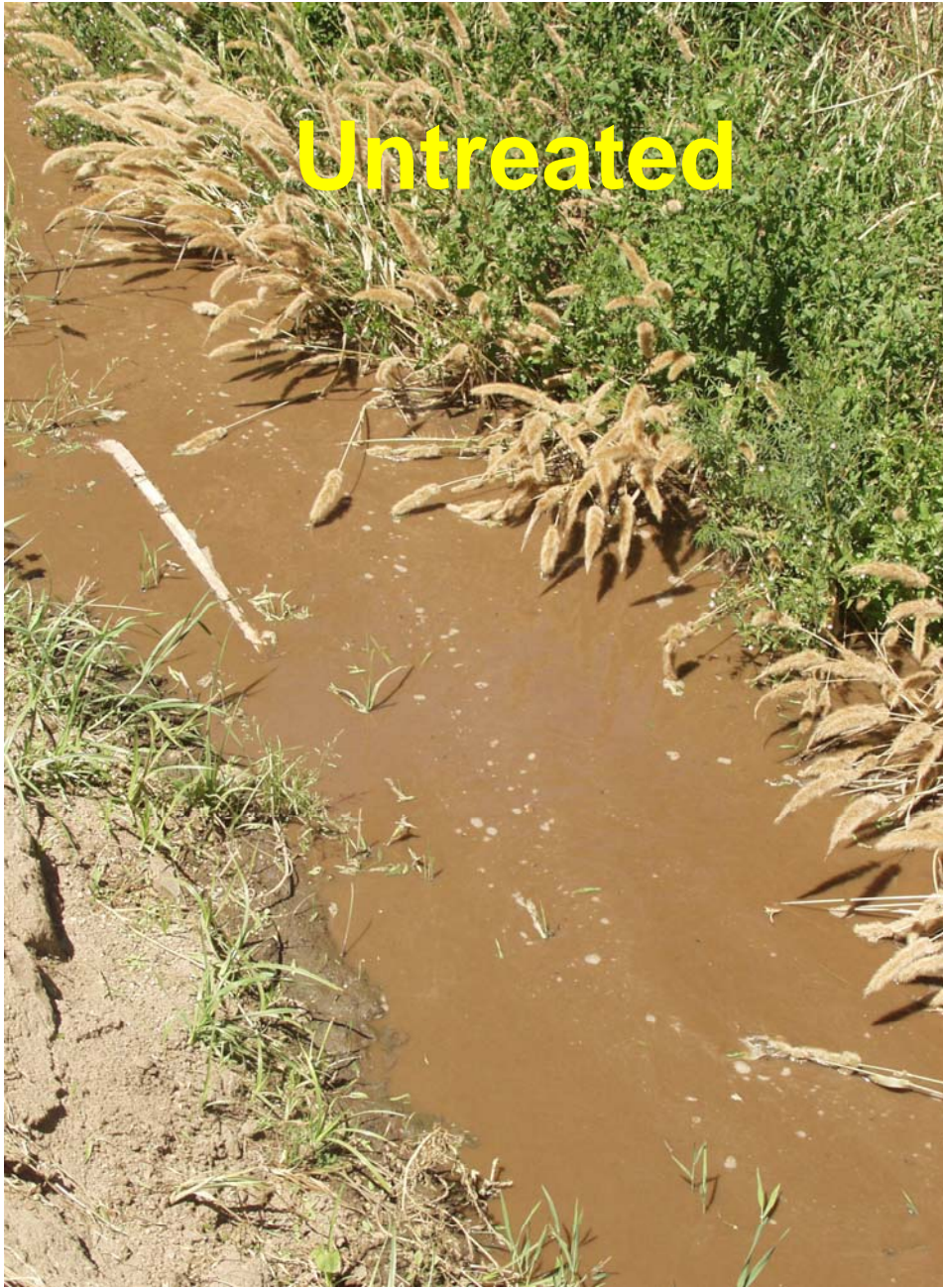


Sediment Trap



Polyacrylamide (PAM)





Untreated



PAM-treated

Mitigation practices for control of pyrethroids: Results

Sediment traps did not reduce pyrethroid or sediment concentration in the run-off

PAM reduced pyrethroid concentration in run-off by 80 to >95%

Vegetated ditches reduced pyrethroid concentrations the most at sites with low concentration of sediments in run-off

Reduction in pyrethroid concentration in run-off

Location	bare ditch	sediment trap	vegetated ditch	PAM
-- % reduction in pyrethroid concentration ---				
Salinas	19	18	27	81
Davis	61	10	73	92
Chico	10	0	42	99
AVG	30	9	47	91

Can PAM reduce Chlorpyrifos
concentration in irrigation run-off?

Koc of select Pesticides

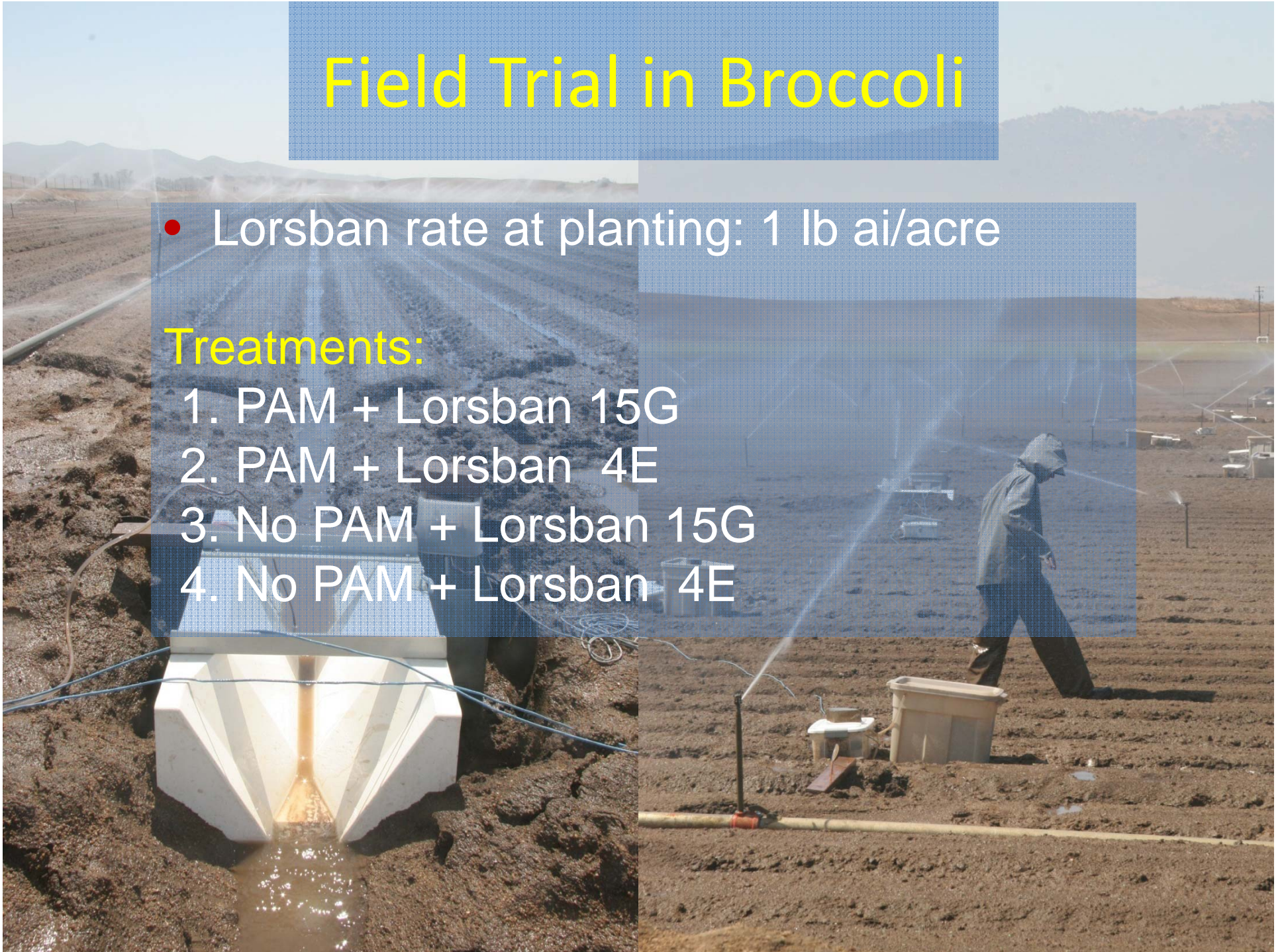
Diazinon	1000 ml/g
Chlorpyrifos	6070 ml/g
Permethrin	100,000 ml/g
Bifenthrin	240,000 ml/g
DDT	2,000,000 ml/g

Field Trial in Broccoli

- Lorsban rate at planting: 1 lb ai/acre

Treatments:

1. PAM + Lorsban 15G
2. PAM + Lorsban 4E
3. No PAM + Lorsban 15G
4. No PAM + Lorsban 4E



PAM effects on Chlorpyrifos

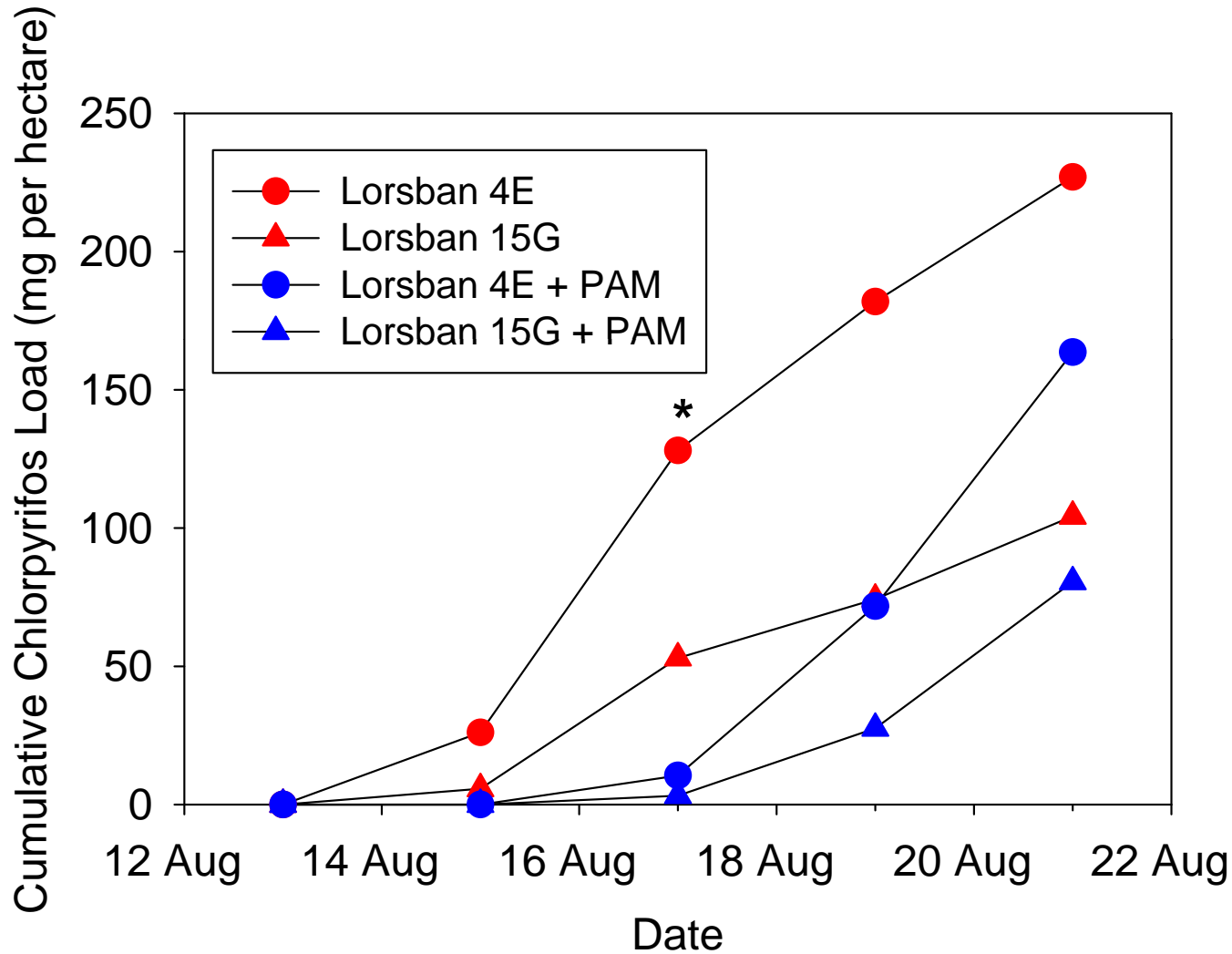
Results

PAM did not reduce the concentration of chlorpyrifos in irrigation run-off.

PAM reduced run-off, thereby reducing the load of chlorpyrifos leaving the field.

Lowest concentration of chlorpyrifos was measured in run-off from plots treated with the granular Lorsban formulation.

PAM and pesticide formulation effects on cumulative chlorpyrifos load in run-off



* = statistically significant at P < 0.10 level

Other strategies for mitigating pesticide water quality impacts

- Minimize irrigation run-off
- Retain, treat, and/or dispose run-off

Low distribution uniformity can increase run-off



Irrigation Requirement = Crop Requirement/DU

1 inch/.85 = 1.2 inches

1 inch/.5 = 2 inches



Irrigation method	1993	2010
	----- % of acres -----	
Furrow	2	1
Sprinkler ¹ /furrow	64	21
Hand move sprinklers	23	17
Solid set sprinklers	5	6
Linear move sprinklers	3	1
Sprinkler ¹ /drip	3	48

¹. Sprinklers are used for establishing the crop (approximately 0 to 25 days after planting)

Drip Establishment of Vegetable Crops

- Eliminate sprinklers
- Eliminates run-off
- Reduces costs
- Success depends on soil type and placement of tape



Drip on cole crops



Retention Pond



Vegetated Treatment System (Pennywort)



Retention Basin



Vegetated Waterway



Compost Socks



Landguard™ Enzyme



- Developed by CSIRO (Australian Government)
- Enzyme developed to degrade OP pesticides
- Originally used to breakdown Diazinon in sheep dip
- Used for winter dormant sprays
- Efficacy on central coast for diazinon and chlorpyrifos in irrigation run-off

Management strategies for sediment bound pesticides

- Minimize irrigation run-off
- Settle suspended sediments in retention basins
- Use PAM to minimize suspended sediments
- Use vegetated ditches to remove suspended sediments

Management strategies for water soluble OP pesticides

- Minimize irrigation run-off
- apply tail water to non-cropped area
- Enzyme treatment (Landguard)

More Info on the Fate of Pesticides in the Environment

- Extoxnet
- Win-PST (USDA-NRCS)
- UCIPM

Questions?

