Department of Pesticide Regulation

Mary-Ann Warmerdam
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MEMORANDUM

Arnold Schwarzenegger
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TO: Kean S. Goh, Ph.D.
Environmental Program Manager I (Supervisor)
Environmental Monitoring Branch

FROM: Sheryl Gill, Staff Environmental Scientist *Original Signed By*
Rick Bergin, Environmental Scientist
Environmental Monitoring Branch
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DATE: January 4, 2008

SUBJECT: RESULTS FOR STUDY 242: VEGETATED DITCHES AS A MANAGEMENT PRACTICE FOR REDUCING OFFSITE MOVEMENT OF LAMBDA CYHALOTHRIN IN IRRIGATED ALFALFA.

I. INTRODUCTION

This study is part of a larger Pesticide Research and Investigation of Source and Mitigation Grant Program project designed to demonstrate the use of several best management practices to reduce pesticide loading in return water from irrigated crops in the San Joaquin River watershed.

Previous research indicates that irrigation ditch vegetation may play an important role in reduction of pesticides in runoff from agricultural fields (Cooper *et al*., 2004; Gill 2006). This study demonstrates a vegetated tailwater return ditch as a potential best management practice for reducing offsite movement of lambda cyhalothrin to surface water in irrigated alfalfa.

II. STUDY OBJECTIVE

This study was designed to evaluate the effects of two management practices on lambda cyhalothrin concentrations in irrigation runoff from alfalfa. The management practices included (1) a conventional irrigation return ditch that was dredged and treated with herbicides to remove vegetation during the irrigation season and (2) a standard irrigation return ditch that was not treated or dredged during the irrigation season, resulting in a dense growth of annual and perennial weeds (Figure 1).

The evaluation was based on lambda cyhalothrin concentrations in whole-water (unfiltered) irrigation runoff samples collected at the inflow and outflow points of both the standard and vegetated ditches. The effect of the management practices was determined by concentration differences in runoff water entering and exiting the ditches.

III. STUDY DESIGN

Study Site

The study site is a 35-acre commercial alfalfa field near the cities of Crow's Landing and Patterson in the San Joaquin Valley of California (Figure 2). The soil at the site is on the boundary of Stomar clay loam and Capay clay (USDA, 1997). Lambda cyhalothrin is commonly applied to alfalfa in the region during the irrigation season to control several species of weevils and worms.

The study site is divided into six irrigation sets that are rotated every 12 hours, and takes a total of 4 days to irrigate. Tailwater leaving the field drains either into a re-circulation system or the San Joaquin River.

Sampling Frequency and Location

Irrigation at the site began 36 hours after an aerial application of lambda cyhalothrin. Each sampling event represented the first flush of water leaving the field from each of five irrigation sets. Runoff samples were collected at 30-minute intervals at four sampling sites (described below, Figure 3) during each set.

Three sets of sediment samples were collected from the bottoms of the ditches (Figure 3). Samples were collected after water runoff slowed or stopped following irrigation sets one, two and four.

Field Edge, Site A

Represented the edge of the treated field at the location where tailwater entered the ditch system.

Inflow, Site D

Represented the inflow location for both the vegetated and conventional ditches. A weir was placed within this intersection to control the movement of water. Sample collection took place just upstream of this weir.

Vegetated Ditch Outflow, Site G

Represented the outflow location for the vegetated ditch. Sample collection took place upstream of the canal that returns water to the recycling pond.

Standard Ditch Outflow, Site J

Represented the outflow location for the conventional ditch. Sample collection took place upstream of the canal that returns water to the recycling pond.

Sediment Samples, Sites A-J
In addition to the four primary sites, sediment from the ditch bottom was also collected every 135 meters along the length of each ditch.

Ditches

Vegetated Ditch
The vegetated ditch was a standard irrigation ditch that was not dredged or treated to remove vegetation. The ditch measured 101cm wide, 63 cm deep, and 354 meters long. The ditch was populated with resident grasses and weeds that occur in fallow agricultural areas.

Conventional Ditch
The conventional ditch measured 125 cm wide, 70 cm deep, and 325 meters long. The ditch was devoid of any vegetation, allowing the free movement of water down its length.

IV. MATERIALS AND METHODS

Application
The field was treated by air on the morning of July 9, 2007, with lambda cyhalothrin (Warrior® with Zeon Technology, Syngenta) at a rate of 2 ounces per acre, which is the low end of label rates for worm control. This product allows for a 7-day pre-harvest interval for hay (Syngenta 2006).

Runoff Samples
Whole water runoff samples were collected by hand or with a grab pole directly into 1-L amber glass bottles and sealed with Teflon-lined lids. Samples were stored on wet ice then refrigerated at 4ºC until extraction for chemical analysis. Samples were collected following DPR SOP #FSWA008.00 Sampling for Surface Water Runoff in Agricultural Fields (Spurlock, 1999).

Suspended Sediment
Suspended sediment measurements were performed on companion samples collected at the same sampling locations and times as the runoff samples. Samples were stored on wet ice then refrigerated at 4º C. Measurement was conducted within seven days of collection by vacuum filtration of the samples and subsequent oven drying of the filtrate collected on tared, rinsed, and oven-dried filters following Environmental Protection Agency (EPA) Method 160.2 Non-Filterable Residue (Gravimetric, Dried at 103-105°C) (EPA, 1971).

Sediment
Sediment samples were collected independently of the water samples in pint-sized mason jars. The sediment was stored on wet ice then frozen at 0ºC until extraction for chemical analysis. Samples were collected following DPR SOP FSWA016.00, Procedure for Collecting Sediment Samples for Pesticide Analysis (Mamola, 2005).

Chemical Analysis and Quality Control

Collection and transport of samples followed DPR SOP #QAQC004.01, Transporting, packaging, and shipping samples from the field to the warehouse or laboratory (Jones, 1999). A chain-of-custody record was completed and accompanied each sample.

The California Department of Fish and Game, Fish and Wildlife Water Pollution Control Laboratory (WPCL) conducted chemical analysis of all water. Quality control (QC) was conducted in accordance with DPR SOP # QAQC001.00, Chemistry Laboratory Quality Control (Segawa, 1995) and included general continuing QC.

V. RESULTS AND DISCUSSION

Runoff Samples

Lambda cyhalothrin concentrations in the irrigation runoff ranged from 0.018 µg/L to 0.077 µg/L (Table 1). Mean lambda cyhalothrin concentrations in each irrigation set were lower at the vegetated ditch outflow (site G) than at the inflow (site D) or the conventional ditch outflow (site J) (Figures 4 and 5, Table 2).

Paired t-tests (Figure 6) were used to compare changes in lambda-cyhalothrin concentrations between the inflow site and outflow point of each ditch. There was no significant difference in concentrations between paired samples at the inflow and the end of the conventional ditch (two tailed, $\alpha=0.05$, $t=1.63$, $P=0.118$). The conventional ditch was not effective in reducing lambda cyhalothrin concentrations in the alfalfa runoff.

In contrast, there was a significant difference (Figure 7) in concentrations between paired samples at the inflow and the vegetated ditch (two tailed, $\alpha=0.05$, $t= 5.54$, $P<0.001$). Concentrations were lower at the end of the vegetated ditch, indicating that the ditch was effective in reducing off-site movement of lambda-cyhalothrin. The reductions in lambda cyhalothrin concentration were calculated as $\textit{reduction}=(C_{inflow} - C_{outflow})/C_{inflow}$. A probability plot of the range of expected concentration decreases for the vegetated ditch (Figure 5) shows the median reduction was approximately 25% with the 25th and 75th percentiles falling at 11% and 46%, respectively.

Suspended sediment concentrations were variable and ranged from 0.00095 g/L to 0.0417 g/L (Table 3). The amount of suspended sediment was roughly the same for each sample site (Figure 8) and the means for each irrigation event were not statistically different from each other (Table 4).

Paired t-tests were used to compare changes in suspended sediment concentrations between the inflow site and outflow point of each ditch. Suspended sediment in the vegetated ditch was not significantly different (two tailed, $\alpha=0.05$, $T=1.54$ $P=0.140$) than in the conventional ditch indicating that there was no treatment effect on the amount of suspended sediment present in runoff from the test ditches. This result is not unexpected given that the sediment concentrations at the inflow site were low to begin with and that in general, runoff from alfalfa fields contains relatively low levels of suspended sediment. It is likely that recent dredging and ditch modifications resulted in freshly disturbed soil being exposed to flowing water, therefore the sediment measurements did not reflect actual sediment off the field, but likely sediment suspended from ditch bottom/sides.

Sediment

Lambda cyhalothrin concentrations in the sediment ranged from 1.38 ng/g dry weight to 59.3 ng/g dry weight (Table 5). The median concentration of lambda cyhalothrin in the vegetated ditch was approximately 8 times higher than in the conventional ditch (Figure 9 and Table 6). In conjunction with the decrease in whole water concentrations observed in the vegetated ditch, the high sediment concentrations reflect the increased partitioning of the pyrethroid relative to the bare ditch

Quality Control

Water samples were extracted within 3 days of collection. Pesticide free North Fork American River water with 0.5g of added sediment was spiked with lambda cyhalothrin at 0.10 ppb by the chemist, and then extracted and analyzed with each batch of samples (Table 7). These matrix control spikes and matrix blanks were conducted to assess lab accuracy. All lab blanks had no detectable residues. Recoveries of matrix spikes ranged from 66.0% to 104% with an average recovery of 92.8%. Recovery results were compared to control limits developed from validating the method with American River water spiked with analyte then multiplying the standard deviation of the mean recovery ±3X (Table 8). For lambda cyhalothrin there were no samples beyond the control limits and 2 beyond the warning limits.

The surrogate dibromooctafluorobiphenyl was added to every sample and every lab matrix QC sample. The mean recovery of the surrogate in the matrix QC spikes was 95.3% and a SD of 7.82, whereas the field sample surrogate result mean was 89.8% and a SD of % 11.1 (Table 7). The percent difference of 2.94% between the two means was low considering the matrix effects of the dirty field water versus the cleaner American River matrix water. The surrogate was beyond the upper control limit one time.

A WPCL chemist in another section of the lab fortified matrix blind spikes (Table 9). The matrix water was the same North Fork American River water used for matrix spikes. The blind spikes were given to the Department of Pesticide Regulation (DPR) staff, relabeled, and then intermingled and delivered with field samples. The blind spikes were extracted and analyzed with field samples over several days. Samples were extracted within four days of the spiking procedure. The recoveries ranged from 48.4 to 72.5 %, with only two falling within the control limits. There were three or more potential contributions to low blind spike recoveries. The average recovery of lambda cyhalothrin in the method validation with American River water was 85%. When that average recovery is coupled with known dissipation there would be further loss. The blind spikes were spiked 1 to 3 days prior to field sample collection. Extraction occurred up to 4 days after spiking. Storage stability data show at least an 11 to 12 % loss of lambda cyhalothrin at 4 days (CDFA, 2006). Blind spikes submitted later to WPCL had lower recoveries. In addition, some of the blind spikes were diluted 10 to 100 times to bring them into the range of instrument calibration. Those with greater dilution had lower recoveries. We expect that the recoveries of field samples were greater than the blind spikes; however, potential losses associated with dilution will need to be further investigated. The surrogate was added to these samples following the same procedure as field samples The surrogate recovery in the blind spikes averaged 89.6%, which was similar to the field samples.

Sediment from the American River near WPCL was spiked with lambda cyhalothrin and dibromooctafluorobiphenyl surrogate and analyzed along with batches of samples as laboratory control spikes (Table 10). Two field samples were randomly selected and splits were spiked as matrix spikes. These laboratory control and matrix spikes had an average recovery of 102% and 97.2% for the lambda cyhalothrin and surrogate, respectively. The percent difference between both laboratory and matrix spikes and the spike duplicates ranged from 0.437 to 11.5%difference for the lambda cyhalothrin recoveries (Table 11).

<u>Quality Assurance</u>
A quality assurance (QA) audit was conducted by the project QA officer on the second and third days of sampling in order to evaluate field operations for study. Results of that audit are reported in Appendix A.

Statistical analysis was performed using MINITAB® Statistical Software (MINITAB, 2003).

VI. ACKNOWLEDGEMENTS

This is a cooperative study between several entities, including DPR, the Department of Fish and Game, and the Coalition for Urban and Rural Environmental Stewardship under the direction of the San Luis and Delta-Mendota Water Authority. Funds for this project were provided by the California State Proposition 13 (2000 Water Bond) PRISM Grant Program. DPR's Environmental Monitoring Branch staff, under the general direction of Dr. Kean S. Goh, Environmental Program Manager I (Supervisor), was responsible for collecting and transporting samples for chemical analysis.

The California Department of Fish and Game WPCL conducted chemical analysis of all water and sediment.

VII. REFERENCES

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Appendix A

Date: August 30, 2007
To: Sheryl Gill, Project Leader
From: Carissa Ganapathy, Quality Assurance Officer *Original Signed By*
Subject: QUALITY ASSURANCE AUDIT FOR STUDY #242

I conducted a Quality Assurance audit to evaluate field operations for the vegetative ditch study on July 11-12, 2007. It was on the second and third day of irrigation runoff sampling. I observed sampling events two and three at all sampling locations: inflow ditch, inflow into the two ditches, nonvegetative ditch and vegetative ditch.

Adherence to Protocol and the Quality Assurance Project Plan

Sampling operations were handled appropriately with respect to the Quality Assurance project Plan (QAPP). The following information is for documentation of the audit and suggestions for future studies.

The protocol on site was an earlier version describing the original design. The original field was reconstructed and no longer fulfilled study needs so another field was found for the study at the last minute. The new field had a different configuration but seemed adequate for the study objectives. For future studies, the protocol should be revised prior to sampling according to the new SOP ADMN003.01.

There was greater flow through the standard ditch than the vegetative ditch. The study leader was well aware and it may only have a small affect results or no affect. A transducer was used to record flow at the end of the vegetative ditch. Also there was no end to the runoff between the irrigation of successive rows, so it was difficult to have separate irrigation intervals as was described in the protocol.

The lambda cyhalothrin treatment was not verified, however, according to the study leader if the inflow ditch runoff is positive then the outcome of the test ditches is based on the inflow sample results. Samples taken at the sampling site prior to the test ditch split point will show any loss between the inflow and the separation point. The laboratory results are currently pending.

Following Standard Operating Procedures

DPR SOPs for the type of field sampling conducted were on site and were followed.

Concurrently with sampling for this study the Environmental Monitoring Branch approved two new SOPs that cover preparing and approving protocols (ADMN003.01) and preparing and approving study memoranda and reports (ADMN007.00). These are now department standards and should be referred to in any new QAPP. ADMN003.01 has a section on amendments, revisions and deviations that should be followed in future studies and will be part of future audits.

Sample integrity

Sample bottles were clean, pre-labeled, and organized prior to sampling. The bottles and ice chests were set on tarps to prevent them from getting contaminated. When I was observing, gloves were changed between sampling periods. Because high levels of lambda cyhalothrin were expected in the samples, care was taken not to contaminate equipment that may be used for future low residue studies. The outsides of the bottles were rinsed with water prior to placing the samples into Styrofoam containers and the ice chests. Samples were put in the ice chest immediately, on wet ice. Field blanks and field replicates were collected at the site.

Paperwork and Chain of Custody

The Chain of Custodys was complete and accurate, and samples were checked into the field warehouse appropriately. Field data sheets were filled out on site noting sample numbers with associated flow rates through the weir and time. Some sample bottles were labeled with the wrong study number, but the sample numbers were not duplicated and therefore the error did not affect sample quality.

The inspection sheets, QAPP, notes and protocol used for the inspection will be stored in my files and is available for inspection.

cc: Kean S. Goh, Ph.D., DPR Environmental Program Manager I (Supervisor)

Figure 1. Conventional return ditch with no vegetation (Left) and a fallow ditch, vegetated with weeds (Right).

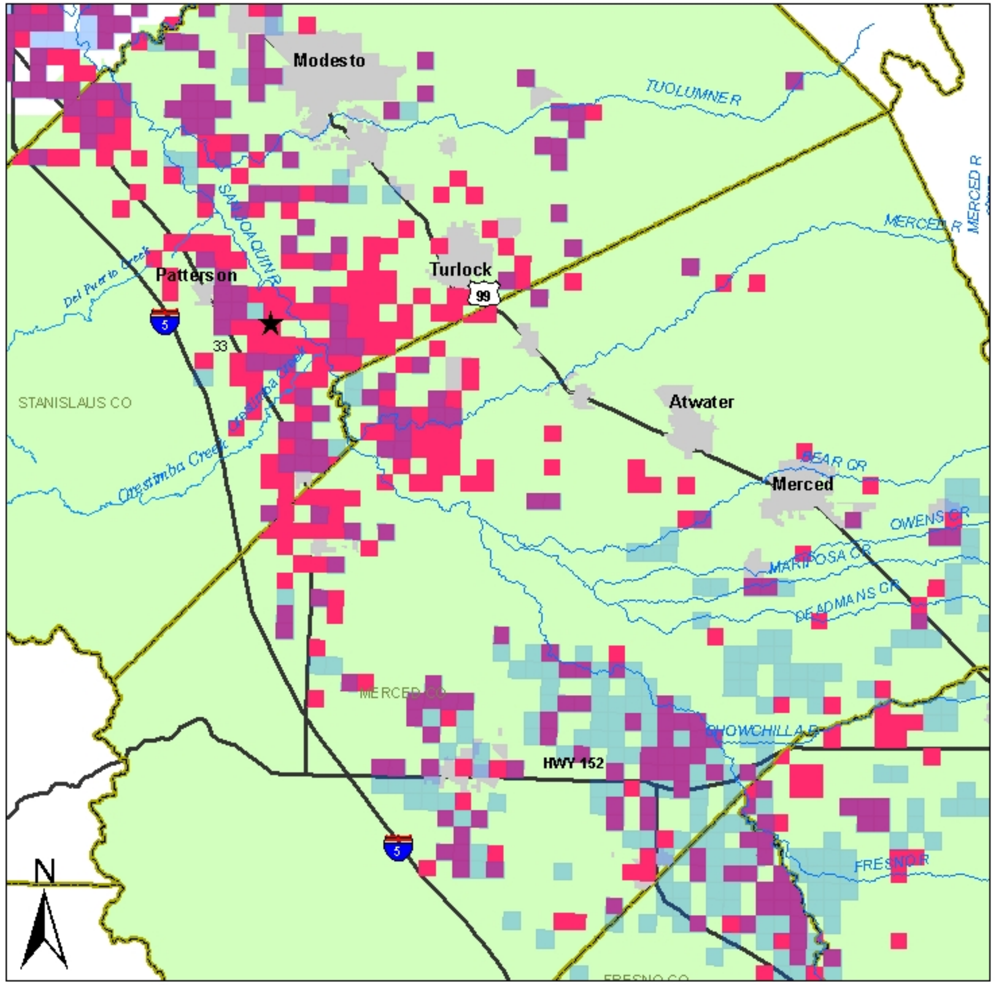

Figure 2. Study site location with lambda cyhalothrin and chlorpyrifos applications to alfalfa during irrigation season 2005. Data from DPR PUR database.

Figure 3. Map of study site

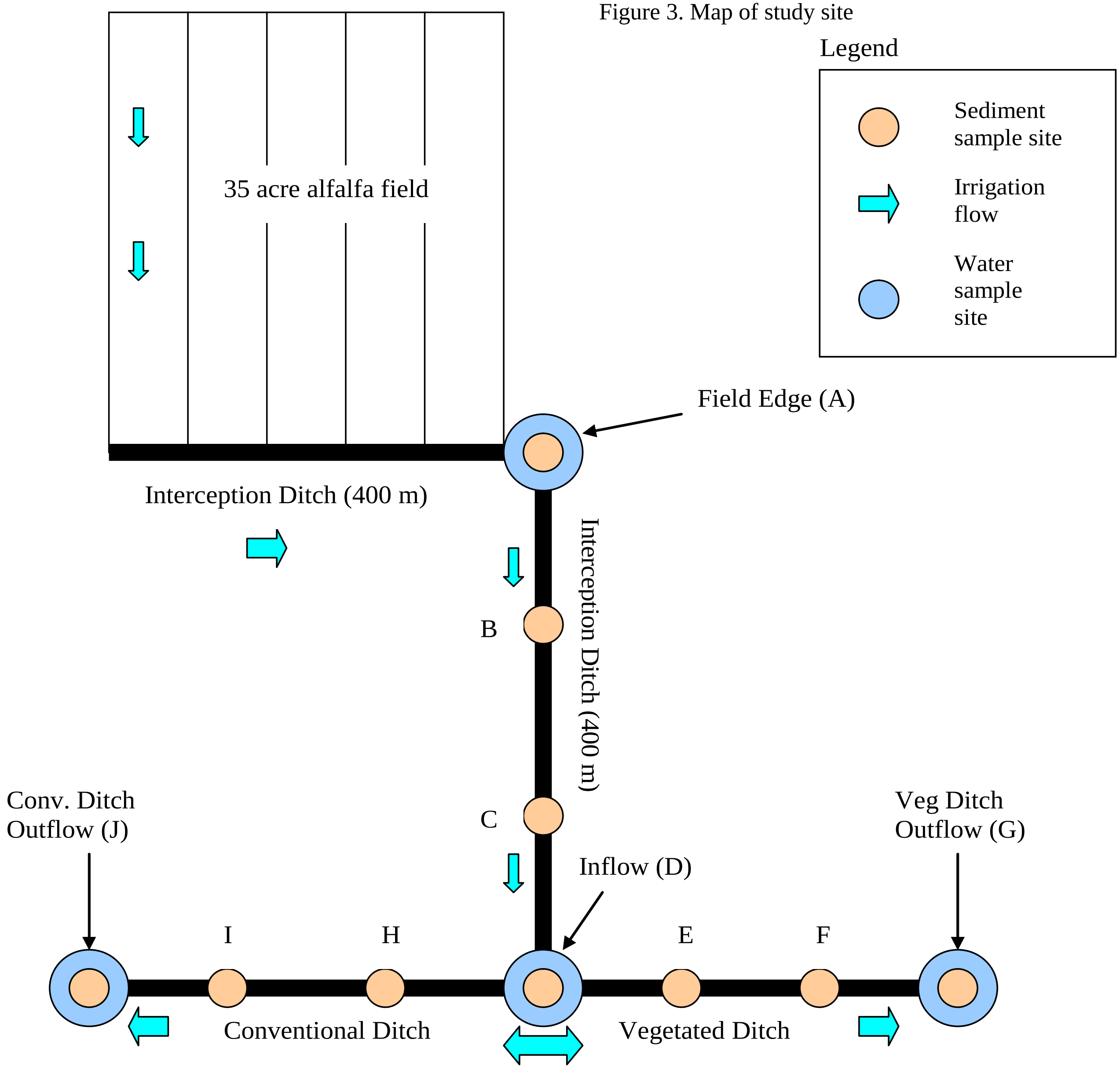

Figure 4. Lambda cyhalothrin concentrations by sample site.

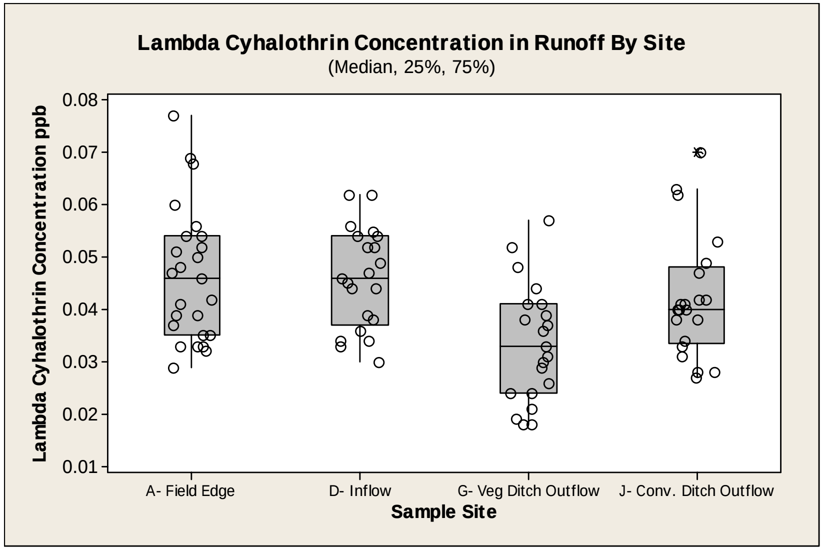

Figure 5. Probability plot of fraction lambda cyhalothrin reduced between inflow and vegetated ditch.

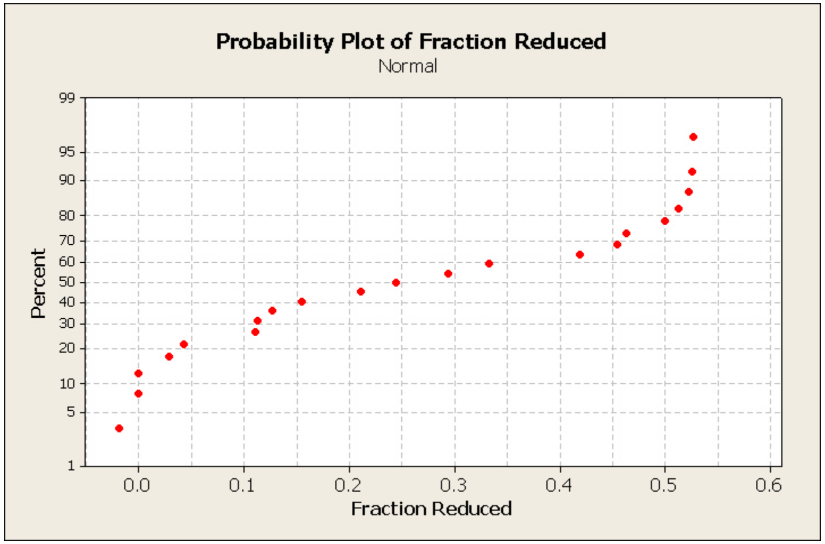

Figure 6. Differences in lambda cyhalothrin concentrations between inflow and conventional ditch.

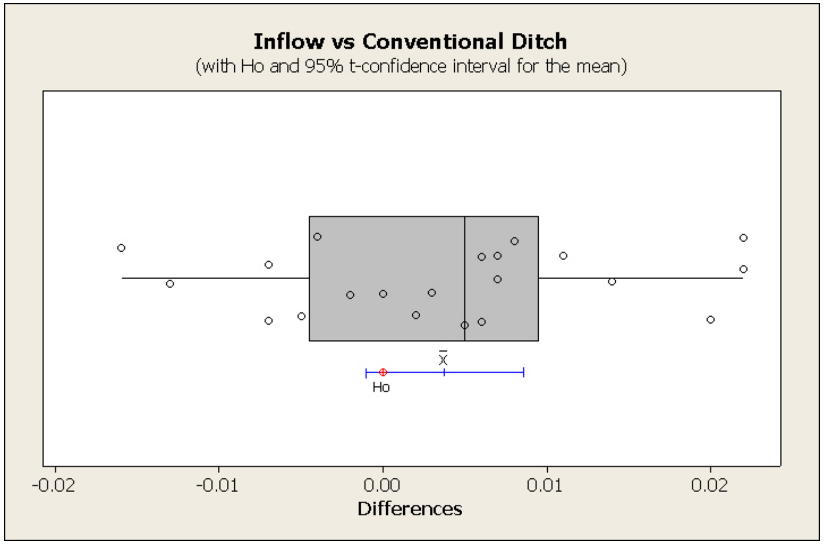

Figure 7. Differences in lambda cyhalothrin concentrations between inflow and vegetated ditch.

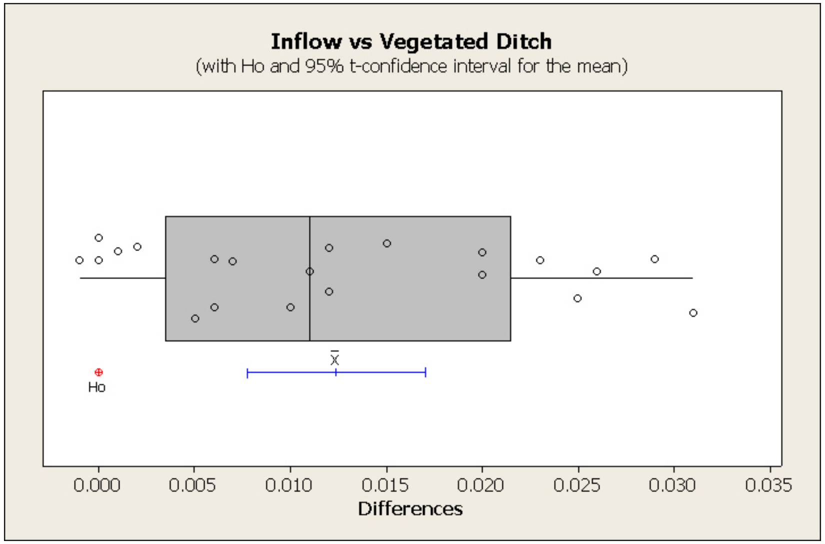

Figure 8. Total suspended sediment by sample site.

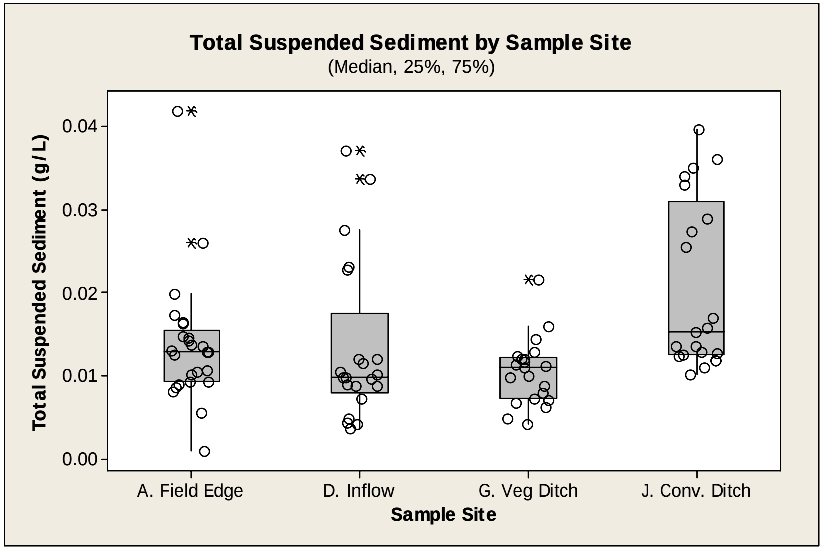

Figure 9. Lambda cyhalothrin concentrations in sediment at each sample site.

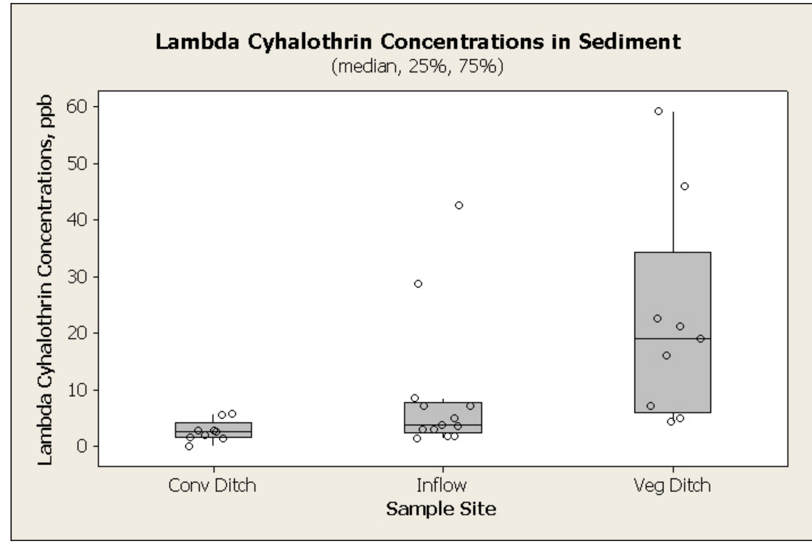

Table 1. Whole water lambda cyhalothrin concentrations in runoff samples.

Edge of Field (Site A)		Inflow (Site D)		Vegetated Ditch (Site G)		Conventional Ditch (Site J)	
Conc. (µg/L)	Irrigation Set	Conc. (µg/L)	Irrigation Set	Conc. (µg/L)	Irrigation Set	Conc. (µg/L)	Irrigation Set
0.046	1	0.046	1	0.044	1	0.053	1
0.077	1	0.049	1	0.037	1	0.062	1
0.054	1	0.054	1	0.048	1	0.070	1
0.048	1	0.056	1	0.057	1	0.063	1
0.047	1	0.052	1	0.052	1	0.049	1
0.051	2	0.047	2	0.041	2	0.047	2
0.05	2	0.052	2	0.041	2	0.041	2
0.054	2	0.045	2	0.038	2	0.040	2
0.042	2	0.044	2	0.039	2	0.042	2
0.039	2	0.055	3	0.026	3	0.033	3
0.052	3	0.062	3	0.036	3	0.040	3
0.068	3	0.054	3	0.029	3	0.040	3
0.056	3	0.062	3	0.031	3	0.042	3
0.069	3	0.034	4	0.033	4	0.027	4
0.06	3	0.034	4	0.024	4	0.028	4
0.039	4	0.036	4	0.024	4	0.028	4
0.033	4	0.030	4	0.030	4	0.034	4
0.035	4	0.038	5	0.018	5	0.031	5
0.033	4	0.033	5	0.018	5	0.038	5
0.032	4	0.044	5	0.021	5	0.038	5
0.029	5	0.039	5	0.019	5	0.041	5
0.041	5						
0.037	5						
0.033	5						
0.035	5						

Table 2. Treatment mean and SE of lambda cyhalothrin concentrations in runoff samples

	Edge of Field (Site A)		Inflow (Site D)		Vegetated Ditch (Site G)		Conventional Ditch (Site J)	
Irrigation Event	Mean Conc. ± SE (µg/L)	N	Mean Conc. ± SE (µg/L)	N	Mean Conc. ± SE (µg/L)	N	Mean Conc. ± SE (µg/L)	N
1	0.054 ± 0.006	5	0.051 ± 0.002	5	0.047 ± 0.003	5	0.059 ± 0.004	5
2	0.047 ± 0.003	5	0.047 ± 0.002	4	0.040 ± 0.001	4	0.043 ± 0.002	4
3	0.061 ± 0.003	5	0.058 ± 0.002	4	0.031 ± 0.002	4	0.039 ± 0.002	4
4	0.034 ± 0.001	5	0.034 ± 0.001	4	0.028 ± 0.002	4	0.029 ± 0.002	4
5	0.035 ± 0.002	5	0.039 ± 0.002	4	0.019 ± 0.001	4	0.037 ± 0.002	4

Table 3. Suspended sediment concentrations in runoff samples.

Edge of Field (Site A)		Inflow (Site D)		Vegetated Ditch (Site G)		Conventional Ditch (Site J)	
Conc. (g/L)	Irrigation Set	Conc. (g/L)	Irrigation Set	Conc. (g/L)	Irrigation Set	Conc. (g/L)	Irrigation Set
0.01066	1	0.00870	1	0.01205	1	0.01101	1
0.01376	1	0.01018	1	0.01444	1	0.01183	1
0.01458	1	0.00957	1	0.01112	1	0.01288	1
0.01466	1	0.00413	1	0.01095	1	0.01358	1
0.0162	1	0.00481	1	0.00994	1	0.01515	1
0.01278	2	0.02277	2	0.02146	2	0.03295	2
0.01278	2	0.01204	2	0.01283	2	0.03958	2
0.04179	2	0.01190	2	0.01593	2	0.01350	2
0.01305	2	0.01043	2	0.01224	2	0.01185	2
0.01255	2	0.00365	3	0.00793	3	0.03408	3
0.00095	3	0.00724	3	0.00708	3	0.01694	3
0.00865	3	0.00433	3	0.01131	3	0.01259	3
0.01003	3	0.00868	3	0.00724	3	0.01007	3
0.01649	3	0.03702	4	0.01172	4	0.03607	4
0.01352	3	0.00894	4	0.01196	4	0.01224	4
0.00799	4	0.00980	4	0.00625	4	0.01571	4
0.00925	4	0.00973	4	0.00879	4	0.01258	4
0.01727	4	0.01149	5	0.00485	5	0.02545	5
0.0055	4	0.02301	5	0.00970	5	0.02734	5
0.01421	4	0.02749	5	0.00663	5	0.02895	5
0.01048	5	0.03361	5	0.00420	5	0.03504	5
0.00923	5						
0.00886	5						
0.026	5						
0.01981	5						

Table 4. Treatment mean and SE of suspended sediments in runoff samples.

	Edge of Field (Site A)		Inflow (Site D)		Vegetated Ditch (Site G)		Conventional Ditch (Site J)	
Irrigation Event	Mean Conc. ± SE (g/L)	N	Mean Conc. ± SE (g/L)	N	Mean Conc. ± SE (g/L)	N	Mean Conc. ± SE (g/L)	N
1	0.014 ± 0.001	5	0.007 ± 0.001	5	0.012 ± 0.001	5	0.013 ± 0.001	5
2	0.019 ± 0.006	5	0.014 ± 0.003	4	0.016 ± 0.002	4	0.025 ± 0.007	4
3	0.010 ± 0.003	5	0.006 ± 0.001	4	0.008 ± 0.001	4	0.018 ± 0.005	4
4	0.011 ± 0.002	5	0.017 ± 0.007	4	0.010 ± 0.001	4	0.019 ± 0.006	4
5	0.015 ± 0.003	5	0.029 ± 0.002	4	0.006 ± 0.001	4	0.029 ± 0.002	4

Table 5. Lambda cyhalothrin concentrations in sediment.

	Lambda cyhalothring concentrations (ng/g dry wt)			
Site	1	2	3	4
A	7.13	42.6	28.7	
B	1.38	8.51	7.06	
C	1.89	3.61	4.88	
D	1.83	2.98	3.76	3.06
E	7.07	4.87	4.45	
F	21.2	19	16	
G	22.6	46	59.3	
H	1.96	2.71	5.54	
I	1.43	2.5	2.82	
J	1.6	ND*	5.83	

*ND- Non-detect, below method detection limit of 2ng/g

Table 6. Treatment means and SE of lambda cyhalothrin in sediment samples.

Inflow		Vegetated Ditch		Conventional Ditch	
Mean Conc. ± SE (ng/g)	N	Mean Conc. ± SE (ng/g)	N	Mean Conc. ± SE (ng/g)	N
9.03 ± 3.42	13	22.28 ± 6.28	9	2.71 ± 0.63	9

Table 7 . Quality Control Samples for Water analysis.

Sample Identification	Lambda Cyhalorthrin Spike level	Amount recovered*	Lambda Cyhalothrin percent recovery	Surrogate** Recovery in spike	Surrogate% recovery in samples in set
1,2,3,4,5,25,26,(27),28,29, 30,49,50,51,52,(54),73,74, (75),76,77,78	0.010	0.0097	96.8	93.5	
		0.0100	100	103	
		0.0066	66.0	87.2	
		0.0074	74.0	89.1	
Average			84.2	93.2	98.9
Standard deviation			16.8	7.05	10.0
6,7,8,9,10,31,32,33,34,55, 56,57,11,12,13,14,35,36,3 7,38,(39),60,61,16,18,19,2 0,40,41,43,44,96,65,58,79 ,80,81,82,(83),84,59,62,63 ,85,86,87,88,(89),(21),(46) ,66,90,92,93	0.010	0.0088	87.6	96.1	
		0.0100	100	110	
		0.0090	90.2	92.7	
		0.0093	93.0	98.1	
		0.0091	91.4	81.4	
		0.0093	93.0	87.9	
Average			92.5	94.4	84.5
Standard deviation			4.18	9.74	8.54
22,23,97,101,98,45,47,48, 100,68,69,70,71,94,95,96, 99	0.010	0.01040	104	95.6	
		0.00994	99.4	101	
Average			101.7	98.3	96.2
Standard deviation			3.24	3.82	9.02
		Average of all QC	92.8	95.3	89.8
		Standard Deviation of all QC	11.2	7.82	11.1

All blank QC samples were none detected.

*Needed more significant figures to see complete results

** Surrogate Dibromooctafluorobiphenyl was spiked into every sample and QC sample at 0.20ppb.

() numbers in perenthesis are blind spikes

Table 8. Control limits established from validation*.

Control Limits	Lambda cyhalothrin	Surrogate**
Upper Control Limit	114	103
Upper Warning Limit	104	95.4
Lower Warning Limit	66.9	66.0
Lower Control limit	57.5	58.6

* American River water was fortified with 0.5g of sediment and pyrethroid analytes, extacted and analyzed.
These are the control limits established by multiplying the mean times 2 and 3X the standard deviation.
** The surrogate is dibromooctafluorobiphenyl.

Table 9. Blind spike summary.

DPR Sample #	54	75	83*	39**	89*	21*	46
DFG Lab #	359-07-17	359-07-20	366-07-42	366-07-22	366-07-52	366-07-53	366-07-54
Date Spiked	7/10/2007	7/10/2007	7/10/2007	7/10/2007	7/10/2007	7/10/2007	7/10/2007
Date Extracted	07/12/07	07/12/07	07/14/07	07/14/07	07/14/07	07/14/07	07/14/07
Days from spike to extraction	2	2	4	4	4	4	4
Date Analyzed	7/14/2007	7/14/2007	7/14/2007	7/14/2007	7/16/2007	7/16/2007	7/16/2007
Lambda Cyhalothrin recovere	0.103	0.145	0.968	0.300	2.18	1.73	0.204
Spike level	0.15	0.2	2.0	0.60	4.0	3.5	0.35
Percent recovery	68.7	72.5	48.4	50.0	54.5	49.4	58.3
Within control limit?	yes	yes	LCL	LCL	LCL	LCL	LWL
Surrogate***(% Recovery)	89.9	101	83.1	78.2	96.3	90.7	87.9
Average recovery of blind	57.4						
Average recovery of surrogate	89.6						

*1/100 dilution required
**1/10 dilution required
***The surrogate dibromooctafluorobiphenyl was added to all samples analyzed

Table 10. Sediment Quality Control Results									
WPCL Lab#	Sample Number	Date Collected	Date Received	Date Extracted	Date Analyzed	Results Lambda Cyhalothrin	% Recovery	Results Dibromo-octafluoro-biphenyl	Surrogate (% Recovery)
505-BLK-1				9/25/2007	10/12/2007	ND			89.0
505-BLK-2				10/1/2007	10/12/2007	ND			98.0
Amount spiked						**8.00**		**4.00**	
505-LCS-1				9/25/2007	10/12/2007	8.64	108	4.20	105
505-LCSD-1				9/25/2007	10/12/2007	7.48	93.5	4.28	107
505-LCS-2				10/1/2007	10/12/2007	8.72	109	3.90	97.5
505-LCSD-2				10/1/2007	10/12/2007	7.24	90.5	3.60	90.0
505-8MS*	707	7/11/2007	8/31/2007	9/25/2007	10/12/2007	8.32	104	3.56	89.0
505-8MSD	707	7/11/2007	8/31/2007	9/25/2007	10/12/2007	6.61	82.6	3.20	80.0
505-30MS	732	7/13/2007	8/31/2007	10/1/2007	10/12/2007	9.20	115	4.08	102
505-30MSD	732	7/13/2007	8/31/2007	10/1/2007	10/12/2007	9.12	114	4.28	107
					Mean Recovery of QC		102	Surrogate mean	97.2
					Standard deviation of QC		11.8	Surrogate SD	9.94
					Average Surrogate recovery for field samples				89.8
					SD of surrogate added to all samples				11.1

Table 11. Sediment Quality Control Percent Difference of Duplicate Spikes			
WPCL Lab#	Duplicate	% Difference Lambda Duplicates	% Difference Surrogate Duplicates
505-LCS-1	505-LCSD-1	7.20	0.943
505-LCS-2	505-LCSD-2	9.27	4.00
505-8MS	505-8MSD	11.5	5.33
505-30MS	505-30MSD	0.437	2.39

*Two field samples were overspiked with lambda cyhalothrin as field matrix spikes and duplicate spikes.