



**Department of Pesticide Regulation
Environmental Monitoring Branch
1001 I Street
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Study #235: Constructed Vegetated Ditches as a Best Management Practice in Irrigated Alfalfa

I. INTRODUCTION

This study is part of a larger PRISM grant project designed to demonstrate the use of several best management practices (BMPs) to reduce chlorpyrifos loading in return water from irrigated crops in the Orestimba Creek 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). This study demonstrates constructed vegetated ditches as a potential BMP for reducing offsite movement of chlorpyrifos to surface water in alfalfa.

II. OBJECTIVE

The objective of this study is to determine the difference in chlorpyrifos load between the inflow and outflow points of a vegetated ditch. Total load of off-site chlorpyrifos relative to applied chlorpyrifos will be estimated. Discharge water volume and dissolved chlorpyrifos concentrations will be measured at the inflow and outflow of the vegetated ditch to determine chlorpyrifos fluxes.

III. PERSONNEL

This is a cooperative study between several entities, including the Department of Pesticide Regulation, under the direction of the San Luis and Delta-Mendota Water Authority. Funds for this project are provided by the California State Proposition 13 (2000 Water Bond) PRISM Grant Program. The vegetated ditch system was designed and constructed by staff from Ducks Unlimited. DPR Environmental Monitoring Branch staff - under the general direction of Kean S. Goh, Agricultural Program Supervisor IV - is responsible for collecting and transporting samples for chemical analysis. Key personnel are listed below:

Project Leader:	Sheryl Gill
Field Coordinator:	Student/ Scientific Aide
Senior Scientist:	Frank Spurlock
Chemists:	California Department Fish and Game

Questions regarding this study should be directed to Sheryl Gill, Environmental Research Scientist at (916) 324-5144, sgill@cdpr.ca.gov.

IV. STUDY PLAN

The study site is a 40-acre section of an alfalfa field near Crow's Landing in the San Joaquin Valley. Chlorpyrifos is typically applied to alfalfa in this region several times during the irrigation season (April-Sept.) to control weevils and armyworms. This study demonstrates vegetated ditches as a BMP in alfalfa and compares chlorpyrifos flux in irrigation runoff before and after it flows through a 200-meter long constructed vegetated ditch. Monitoring will take place during the first irrigation events following two separate chlorpyrifos applications.

Irrigation events at the site typically last 2 to 3 days and result in several discrete runoff episodes that last 3-4 hours each. Runoff samples will be collected every half hour during each episode.

Samples per Application Event		
Background Soil		
	field	4
	ditch	6
Irrigation Source		
		4
Deposition		
	field	6
	ditch	6
	ditch soil	4
	tank	1
Runoff		
	inflow	32
	outflow	32
	total	95

Background Soil and Water Samples

Ten composite soil samples will be taken from the field and the vegetated ditch prior to application to quantify potential residual chlorpyrifos present from previous applications. Four samples of the irrigation source water will also be taken, one during each of the irrigation sets.

Background soil sample collection will follow DPR SOP # FSSO002.00 (Garretson, 1999) and ditch sediment sampling will follow DPR SOP # FSWA016.00, Procedure for collecting sediment for pesticide analysis (Mamola, 2005).

Deposition Samples

Twelve mass deposition samples will be collected from the field and vegetated ditch during the application. Additionally, four composite soil samples will be collected from the ditch following application, just prior to the first flush of irrigation water. Deposition

data will be used in mass balance estimations and to determine if aerial drift into the vegetated ditch occurred during application. Samples will be collected following DPR SOP #FSOT005.00, Mass Deposition Sampling Using Mass Deposition Sheets (J. Walters, 2003).

One tank sample of the pesticide mixture will be taken.

Irrigation Return Water Samples

Samples of the irrigation return water will be taken every half hour during each runoff episode. Samples will be collected at the points where the irrigation water enters and exits the vegetated ditch.

Water samples will be collected using ISCO® autosamplers, as per DPR SOP #EQWA005.00, Instructions for operating ISCO® samplers when collecting surface water (Jones, 2000). Autosamplers will be placed at the point of inflow and the point of outflow of the vegetative ditch. Samples will be collected starting at the beginning of the runoff event and will continue through the duration of the irrigation event.

Discharge Measurements

Irrigation inflow will be estimated based on water district measurements. An easily visible flow gauge is present at the site.

Runoff volume will be measured using v-notch weirs equipped with transducers. Transducers will be connected to dataloggers that will record height every 10 minutes, at the time of water sample collection, from both the inflow and outflow sampling points. More frequent discharge measurements may be conducted if it is determined that water levels fluctuate greatly in short periods. Water height will be converted to volume using the Kindsvater-Shen or a similar equation (USBR, 1997).

V. CHEMICAL ANALYSIS AND QUALITY CONTROL

Samples will be kept cold within the autosampler using block ice until collected for delivery to the lab. Collections will occur at the end of each irrigation event. All sample containers will be sealed with Teflon-lined lids. Samples will be transported and stored on wet ice or refrigerated at 4°C until extraction for chemical analysis. Transporting of samples will follow DPR SOP #QAQC004.01, Transporting, packaging and shipping samples from the field to the warehouse or laboratory (Jones, 1999). A chain-of-custody record will be completed and accompany each sample.

The California Department of Fish and Game, Fish and Wildlife Water Pollution Control Laboratory will conduct chemical analysis of all water and sediment samples. Quality control (QC) will be conducted in accordance with SOP QAQC001.00 (Segawa, 1995) and will include general continuing QC. Ten percent of the total number of samples will be submitted with field samples as blind spikes. Comprehensive chemical analytical methods will be provided in the final report.

VI. DATA ANALYSIS

Total load will be estimated as a fraction of chlorpyrifos applied to the field. Discharge water volume and dissolved chlorpyrifos concentrations measured at the inflow and outflow of the vegetated ditch will be used to determine chlorpyrifos fluxes. The effect of the constructed vegetated ditch will be determined as the difference between flux of chlorpyrifos entering and exiting the ditch. Deposition and background samples will be used for mass balance estimation.

VII. BUDGET

	Number	Cost	Total
Soil Samples	28	400	11,200.00
Water Samples	138	250	34,500.00
Deposition	24	300	7,200.00
QC	35	250	8,750.00
			<u>61,650.00</u>

VIII. LITERATURE CITED

Cooper, CM, MT Moore, ER Bennet, S Smith, JL Farris, CD Milam, and FD Sheilds Jr. 2004. Innovative uses of vegetated drainage ditches for reducing agricultural runoff. *Water Science and Technology*. 49 (3): 117-123.

Garretson, Cindy. 1999. Soil Sampling, Including Auger and Surface Soil Procedures. CA Dept. of Pesticide Regulation. Environmental Monitoring Branch. SOP # FSSO002.00 - Available on-line:
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Mamola, Michael. 2005. Procedure for collecting sediment for pesticide analysis. CA Dept. of Pesticide Regulation. Environmental Monitoring Branch. Available online:
<http://www.cdpr.ca.gov/docs/empm/pubs/sops/FSWA016.pdf>

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USBR. 1997. U.S. Department of the Interior, Bureau of Reclamation. Water Measurement Manual. 3ed. Available on-line:
http://www.usbr.gov/pmts/hydraulics_lab/pubs/wmm/.

Walters, J. SOP FSOT005.00 Mass Deposition Sampling Using Mass Deposition Sheets. Available online: <http://www.cdpr.ca.gov/docs/empm/pubs/sopfield.htm>.

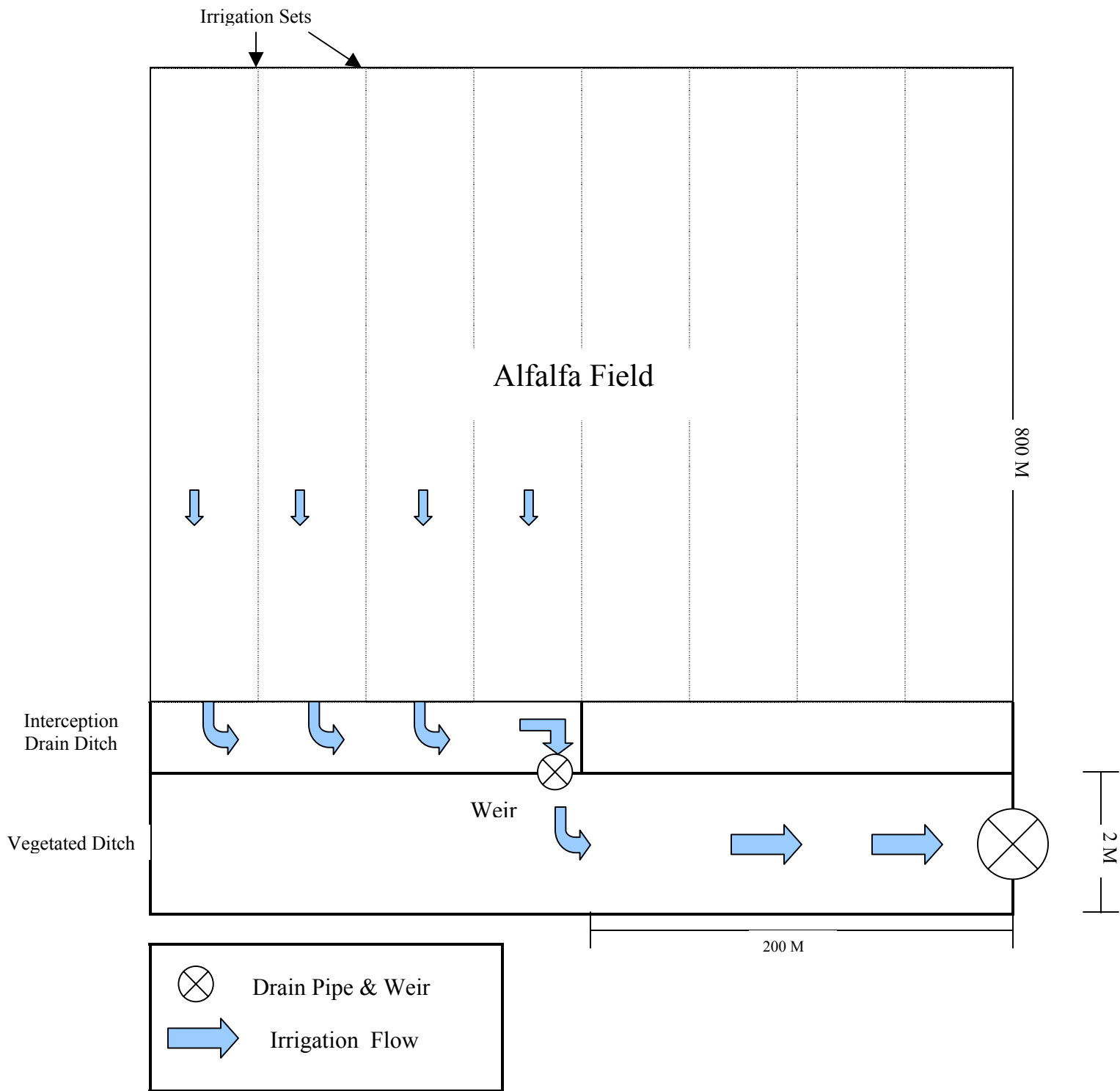


Figure 1. Schematic not drawn to scale. Half of the 75 Acre field drains to interception ditch and then through a weir to the vegetated ditch. Water samples will be collected at the drainage pipes at the inflow and outflow of the vegetated ditch. Each irrigation set is flooded independently, resulting in four discrete runoff events.