

Objectives

Two research studies were conducted to evaluate the effects of three management practices on pesticide concentrations in alfalfa field runoff, namely chlorpyrifos and lambda-cyhalothrin. The management practices consisted of:

1. A conventional irrigation ditch that was dredged to remove vegetation.
2. A specially constructed vegetated irrigation ditch that was planted with perennial grasses. (chlorpyrifos study)
3. A standard irrigation ditch that was not dredged or treated to remove weedy vegetation. (lambda-cyhalothrin study)

Study Sites

Both study sites were commercial alfalfa fields near the cities of Crow's Landing and Patterson in the San Joaquin Valley of California (Fig. 1).

Chlorpyrifos Site

The 75-acre field, which was divided into 10 irrigation sets that were rotated every 12 hours, took 5 days to irrigate. Tail-water leaving the site drained into a small creek, which flowed through a pipe into a tributary of the San Joaquin River.

Lambda-Cyhalothrin Site

The 35 acre-field, which was divided into 6 irrigation sets that were rotated every 12 hours, took 4 days to irrigate. Tail-water leaving the site drained variably into either a re-circulation system or the San Joaquin River.

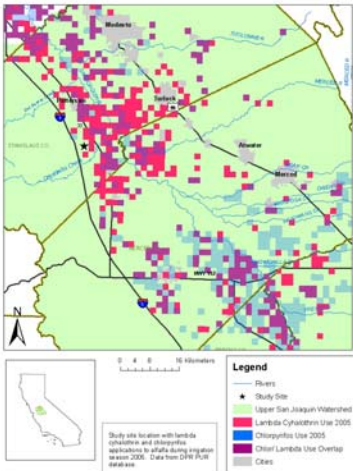


Figure 1. 2005 chlorpyrifos and lambda-cyhalothrin use data.



Figure 2. Collecting runoff water in a vegetated ditch

Photo by K.Goh

Materials and Methods

A. Pesticide Application

1. Chlorpyrifos (Lorsban® 4E, Dow AgroSciences LLC) and a binder/spreader adjuvant was aerially applied at a rate of 1 pint per acre, which is the low end of label rates for worm control, and allows a 14-day pre-harvest interval. (Dow AgroSciences, 2004).
2. Lambda-cyhalothrin (Warrior® with Zeon Technology, Syngenta) was aerially applied at a rate of 2 ounces per acre, which is the low end of label rates for worm control, and allows a 7-day pre-harvest interval (Syngenta 2006).

B. Samples

Water samples were collected at the inflow and outflow points of each irrigation canal. Sampling began when a sufficient amount of water was available for complete submersion of the sample bottles. Runoff samples were collected at 30 minute intervals for a duration of 3-4 hours.

Water was collected directly into 1 liter amber glass bottles and capped with Teflon® lined lids (Fig. 2). Samples were stored on wet ice for transport to the lab for analysis.

C. Chemical Analysis

All chemical analyses were conducted by the California Department of Fish and Game, Fish and Wildlife Water Pollution Control Laboratory. The water samples were extracted *in toto*, without filtration. An extracting solvent was used to rinse the sample bottles containing lambda-cyhalothrin to ensure complete removal of any pesticide adsorbed to the glass container. Chlorpyrifos and lambda-cyhalothrin have a reporting limit of 0.05 µg/L and 0.005 µg/L, respectively.

Results

A. Chlorpyrifos

Chlorpyrifos concentrations in the irrigation runoff were variable and ranged from 0.22 µg/L to 1.67 µg/L. In general, concentrations were lower in the vegetated ditch than at the inflow or in the conventional ditch (Fig. 3). There was no consistent trend in chlorpyrifos concentration for irrigation lag times of up to 144 h (Fig. 4), indicating that delaying irrigation for up to six days after application is not an effective management practice for reducing chlorpyrifos off-site movement to surface water in California flood irrigated alfalfa.

Paired t-tests were used to compare changes in chlorpyrifos concentrations between the inflow site and outflow point of each ditch (Fig. 5). There was no significant difference in concentrations between paired samples at the inflow and the end of the conventional ditch (two tailed, $\alpha=0.05$, $t=1.19$, $P=0.247$).

There was a significant difference in concentrations between paired samples at the inflow and the vegetated ditch (two tailed, $\alpha=0.05$, $t=6.20$, $P=0.000$). Concentrations were lower at the end of the vegetated ditch, indicating that the ditch was effective in reducing off-site movement of chlorpyrifos (Fig. 5).

B. Lambda-Cyhalothrin

Lambda-cyhalothrin concentrations in the irrigation runoff ranged from 0.018 µg/L to 0.077 µg/L. The concentrations of pesticide were lower in the vegetated ditch than at the inflow or the conventional ditch (Fig. 6). Paired t-tests were used to compare changes in lambda-cyhalothrin concentrations between the inflow site and outflow point of each ditch (Fig. 5). There was no significant difference in concentrations between paired samples at the inflow and the end of the conventional ditch (two tailed, $\alpha=0.05$, $t=1.63$, $P=0.118$).

There was a significant difference in concentrations between paired samples at the inflow and the vegetated ditch (two tailed, $\alpha=0.05$, $t=5.54$, $P=0.000$). Concentrations were lower at the end of the vegetated ditch, indicating that the ditch was effective in reducing off-site movement of lambda-cyhalothrin (Fig. 5).

On average, the median concentration reduction at the end of the vegetated ditch was about 25%.

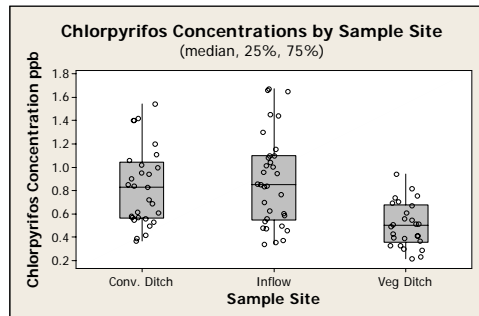


Figure 3. Chlorpyrifos concentrations at each sample site.

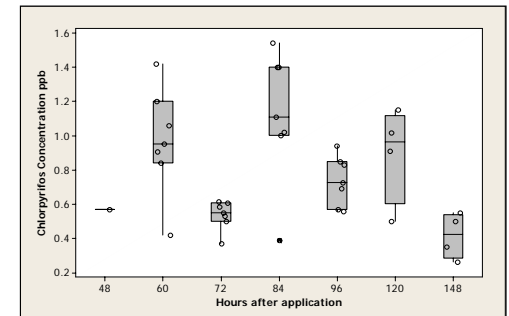


Figure 4. Chlorpyrifos concentrations in conventional ditch vs. hours after application.

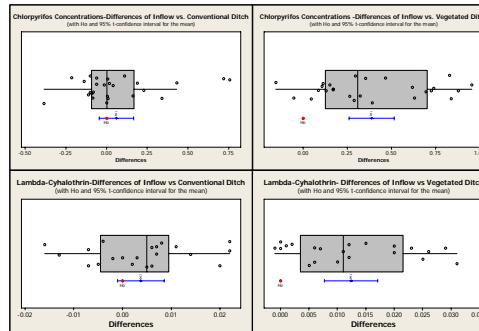


Figure 5. Differences between inflow and treatment ditches for chlorpyrifos and lambda-cyhalothrin.

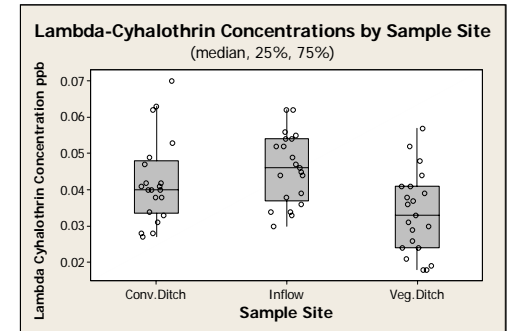


Figure 6. Lambda-cyhalothrin concentrations at each sample site.

Acknowledgments

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References:

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