

REDUCING IMPACT OF DORMANT SPRAYS

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SUMMARY

The research in this study to reduce toxicity to non-target organisms and maintain water quality focused on assessing efficacy and impacts of alternatives to dormant spraying of chlorpyrifos and diazinon and practices to mitigate runoff by bioassays of target and non-target organisms. This involved refining methodologies to quantify infiltration and runoff, and collecting experimentally controlled runoff water samples.

Three runoff studies were carried out during the winter of 2001-2002. They included the 319(h) Project in and around Gridley in Butte County, the Prop 13 Project in three regions of Glenn County, and the CALFED Project in Sutter County (and to a lesser extent in Yuba County too). The University of California, Davis, Pesticide Water Quality Team (UC Team) was headed by Dr. Frank Zalom. The UC Team built and installed the autosampling units in the orchards, helped to monitor them, collect runoff and rainfall data, analyze samples, and remove the units at the end of the study season.

This grant was a modest request to assist the chemical analyses, to involve growers in the research and to provide a direct link to access research results.

OBJECTIVE

The research focuses on assessing efficacy and impacts of alternatives to dormant season uses of chlorpyrifos and diazinon and practices that can mitigate runoff. This is accomplished through bioassays of target and non-target organisms. The biological objective has required that methodologies be refined to quantify infiltration and runoff, and to collect experimentally controlled runoff water samples.

PROCEDURE

319(h) Project

This project was to compare the amount of runoff from orchards with different floor vegetation and tillage situations following winter storm events. It compared the diazinon concentration of runoff from tree rows that had been irrigated immediately after pesticide spraying to that before storm events to determine if infiltration of spray residue can be enhanced by post-spray irrigation.

CALFED Project

The CALFED project compared the diazinon concentration of runoff from areas sprayed early in the dormant season with that of areas sprayed in mid-season and late season to determine if soil

infiltration of residual spray is enhanced by earlier rainfall events that occur prior to the ground becoming saturated in late season.

Study Design:

Three replicate areas of prune orchard were dormant sprayed as follows:

Early spray applied January 12, 2002.

Mid spray applied February 2, 2002.

Late spray applied February 28, 2002.

Within each of the 9 replicated areas:

One autosampler unit was set up in the middle of the treated rows.

Other autosampler units were placed at 50 meters from the top of the field.

Sample Collection and Analysis:

Following each significant storm event:

1. Runoff volume measurements were to be taken at each sampler unit.
2. Compositing water samples were to be collected at each sampler unit for diazinon analysis and bioassay.
3. Samples from rows not yet treated were to serve as controls for those that were previously sprayed.

RESULTS AND CONCLUSION

Unfortunately, there was an abnormal rainfall pattern. Heavy rains came early, primarily from November through early January, unlike more typical winters when large rainfall events occurred during January and February. Only one significant storm occurred on March 11 sufficient to cause measurable runoff. The only runoff collection was at the study site in the CALFED Project area where 1.5 inches of rain fell on 3/11. The second largest amount of rain from the 3/11 storm (1.0 inch) was at the 319(h) study site and was too low to generate surface flow. Thus, the hypotheses for the 319(h) and Prop 13 studies were unable to be tested. (Further information on the design of these projects may be found in the report of team leader Dr Frank Zalom.)

The CALFED Project study compared diazinon concentration in runoff from early, middle and late spray applications. The hypothesis was that applications would infiltrate more into the soil as a result of smaller storm events and would be less available for incorporation into runoff from later and larger storm events when the soil was more likely to be already saturated.

CALFED Project Data:**Spray Dates, Rainfall Measured On-site, and Runoff Samples Collected**

January 12	Early diazinon spray applied to plots 3, 6, and 9
January 25-27	0.37 inches of rain
January 27-28	0.40 inches of rain
February 2	Middle diazinon spray applied to plots 2, 5, and 8
February 17	0.12 inches of rain
February 20	0.50 inches of rain
February 28	Late diazinon spray applied to plots 1, 4, and 7
March 6	0.75 inches of rain
March 7	Runoff collected from Plot 4 sampler only
March 8	0.50 inches of rain
March 11	1.50 inches of rain
March 11	Runoff from all plot samplers except #8 (malfunction)

Cumulative Rainfall After Spraying and Until Soil Saturation Sufficient for Runoff:

Early (Plots 3, 6, and 9)	4.14 inches
Mid (Plots 2, 5, and 8)	3.37 inches
Late (Plots 1, 4, and 7)	1.98 inches

Diazinon Levels and Toxicity (ppb)

Plots with Runoff	Date	Diazinon	NOEC*	LOEC*
3 (early)	3/11	3.12	<5	5
3 (early duplicate)	3/11	2.97	5	10
6 (early)	3/11	5.57	<5	5
9 (early)	3/11	2.72	10	20
2 (mid)	3/11	9.44	2.5	5
5 (mid)	3/11	13.47	2.5	5
8 (mid)	ND			
1 (late)	3/11	32.02	0.625	1.25
4 (late)**	3/7	91.39	0.25	0.5
4 (late)	3/11	34.91	0.625	1.25
7 (late)	3/11	27.03	0.625	1.25

* Percent concentration of runoff sample toxic to *Ceriodaphnia dubia*. The lower the % the more toxic the sample. NOEC = no effect concentration, LOEC = lowest effect concentration.

** Note that this is runoff from rain on 3/7 versus the other units that only had runoff on 3/11. Also note how much lower the diazinon concentration was from this unit on 3/11.

Average Diazinon Concentrations for 3/11 Runoff:

Early (n=4) =	3.60 ppb
Mid (n=2) =	11.46 ppb
Late (n=3) =	31.32 ppb

Runoff Volumes (in Gallons) as Measured by Autosamplers:

Plot#	Runoff from 3/7 Storm	Runoff from 3/11 Storm
3 (early)	0	1387
6 (early)	17	910 (1% collection tube damaged)
9 (early)	0	66 (sandy soil site, low runoff)
2 (mid)	0	132 (pump failure initially)
5 (mid)	0	1012
8 (mid)	0	0 (pump malfunctioned)
1 late)	30	1399
4 (late)	246	

Discussion of CALFED Monitoring Study Data:

The trend was for the diazinon concentration and toxicity to *Ceriodaphnia dubia* to be lower for runoff from plots treated earlier rather than later in the season. This supports the idea that rain falling on ground residues of diazinon results in infiltration rather than runoff of the pesticide. But, the data are not yet sufficient to recommend growers shift to earlier dormant applications; rainfall patterns were unusual and the work needs to be repeated during more typical rainfall winters. Also, there is a potential for the trees to be “burned” as a result of the application of oils that are a normal component of dormant sprays. The factors that result in this phytotoxicity are unclear and more research is needed to define them.