California Department of Food and Agriculture

Environmental Monitoring & Pest Management

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# FIELD EXPERIMENT TO DETERMINE MASS DEPOSITION OF A DORMANT SPRAY PESTICIDE APPLIED WITH AND WITHOUT HEAVY OIL TO ALMOND BRANCHES

## I. INTRODUCTION

The California Department of Food and Agriculture has recently completed a study showing that both fog and dry deposition are transport mechanisms for inadvertent pesticide residues found on row crops in Stanislaus County. Local and regional applications of dormant spray pesticides to orchards in the region are considered to be the primary source of these pesticide residues. It is not known exactly how the pesticides get from the orchards into fog or air to be subsequently deposited on row crops. An immediate concern, however, is determining whether the problem of inadvertent residues can be mitigated by agricultural practices.

Dormant spray pesticides are typically applied with high volume spray equipment, either mixed with dormant spray oil or without the oil. The proportion of pesticide impacting tree surfaces is unknown but has been estimated to be from 20 to 50 percent of the total application amount. The effect of oil on the amount of pesticide deposited on tree surfaces is also unknown. It has been suggested that oil-containing droplets are deposited closer to the point of application than those droplets containing no oil. If oil results in greater mass deposition of pesticide on orchard surfaces (tree branches and soil), then there would be less pesticide immediately introduced into the air, either in the form of vapor or particulate. This is one possible route by which pesticides may get into fog or air.

## II. OBJECTIVES

The objective of this experiment is to determine whether oil has any effect on the mass deposition of dormant spray pesticide on orchard surfaces. We will also test the feasibility of using surrogate surfaces to measure deposition in future dormant spray field experiments.

## III. PERSONNEL

These experiments will be conducted by the California Department of Food and Agriculture's (CDFA) Environmental Hazards Assessment Program (EHAP). Key EHAP personnel are listed below:

Bonnie Turner - Project leader

Sally Powell - Experimental design/statistical analysis

David Gonzalez - Field coordinator

Nancy Miller - Lab liaison

Jane White - Chemical methods/analysis

Public/agency liaison - Madeline Ames

All questions concerning this project should be directed to Madeline Ames at 916-324-8916 or ATSS 454-8916.

## IV. EXPERIMENTAL DESIGN/STATISTICAL ANALYSIS

Applications of diazinon (or another dormant spray pesticide) will be made to almond branches and surrogates in a simulated orchard experiment under two conditions. In one treatment the pesticide will be mixed with oil and water, in the other it will be mixed with water only. All other aspects of the applications will be made as nearly identical as possible. The purpose of using an experimental situation is to control extraneous factors (such as differences among sprayers, application techniques, and orchard surfaces) that might result in apparent, but spurious, differences between the treatments, while making all the factors that might influence pesticide deposition as much as possible like an actual orchard application.

Mass deposition will be measured on targets consisting of small almond branches of uniform size mounted on structures designed to hold the target branches rigidly at tree-canopy height. Surrogate branches will also be mounted on identical structures. Mass deposition on the simulated orchard floor will be assessed with fallout cards placed on the ground around the structures.

Five replications will be run for each treatment. A replication consists of one pass of the sprayer past the targets. One replication will be run per day, with oil and non-oil conditions on alternating days. Replications will not be run on days with fog, rain, or wind greater than 5 mph. A new tank mixture will be prepared for each replication.

The tank concentration of the pesticide will be similar to what is used in the field for spraying an almond orchard. Tank pesticide concentrations of the oil and non-oil mixtures will be made equal on a volume basis, so that equal masses of pesticide will be discharged under both conditions. The same high-volume sprayer will be used throughout the experiment. One tank sample will be collected before and after each replication.

Figure 1 shows the layout of the branch-holding structures and fallout cards for a replication. Four pairs of structures are placed on one side of the path of the sprayer, at distances representative of the distance of branches from a sprayer in an orchard. One structure of each pair will hold 12 almond branches, the other 12 surrogate branches. In order to simulate the interference to deposition provided by the orchard canopy, scaffolding may be placed between the first and second rows of structures. This will be determined after several trial runs to test deposition distance of the sprayer.

Before the experiment begins, samples of almond branches which will be used as targets will be analyzed to determine background diazinon residue levels. After each experimental run, the target materials will be collected after the sprayed mixture has dried (approximately 1/2 hour after spraying) to allow suspended particles to be deposited and to provide a safe reentry interval. The fallout cards will be composited into two samples per replication. Branches and surrogate branches will each be composited into 16 samples per replication. Branch and surrogate samples from the corresponding locations on adjacent structures will be paired for later comparison.

Air samples will be collected to see whether air concentration of pesticide (vapor and particulate combined) soon after spraying is correlated with mass deposited. One short term high-volume sample will be taken starting approximately 15 minutes after the application is completed. Figure 1 shows the position of the air sampler, which will be set up before sampling begins. One background air sample will be taken just prior to each spray.

Diazinon mass per unit of surface area will be calculated for each branch, surrogate and fallout sample, then averaged to give the mass per surface area of branch, surrogate and ground for each replication. Deposition on ground and branches will be compared for oil and non-oil sprays with a repeated measures analysis of variance (ANOVA) with a treatment factor. The treatment factor is presence or absence of oil, while the repeated measure is surface type (branch or ground). The ANOVA table is given below.

| Source | df | Error term |
|---|---|---|
| Treatment | 2-1 | Reps(Treatment) |
| Reps(Treatment) | 2(5-1) | |
| | | |
| Surface | 2-1 | Reps x Surface(Treatment) |
| Surface x Treatment | (2-1)(2-1) | Reps x Surface(Treatment) |
| Reps x Surf(Treatment) | 2(5-1)(2-1) | |

A significant Surface x Treatment interaction would mean that the relative amount deposited on branches compared to ground was different for oil and non-oil sprays. A significant Treatment main effect would mean that the overall amount of deposition differed for the oil and non-oil sprays.

Analysis of covariance will be done to test whether the ratio of mass deposited on real branches to the mass on surrogate branches is the same for the oil and non-oil sprays. The test of equality of slopes will indicate whether the ratios are equal.

Air samples will be subjected to a separate one-way ANOVA to compare air concentrations after oil and non-oil sprays.

The number of samples collected during the study is divided as follows:

| | |
|---|---|
| Real branches with oil | 20 |
| Real branches without oil | 20 |
| Surrogate branches with oil | 20 |
| Surrogate branches without oil | 20 |
| Tank samples | 20 |
| Fallout cards | 20 |
| Background branches | 10 |
| Air samples (background included) | 20 |
| Total | 150 |

## V. METHODS

Fallout cards will be collected, composited and stored frozen in glass jars before the branch samples are collected.

Almond branch samples will consist of pre-selected almond branches placed at the end of 3' dowelling attached to the main stem of the simulated tree. The surface area of each branch will be measured and recorded before the pesticide application occurs. Each sample (consisting of all 12 branches on one structure) will be collected and stored in a glass jar and kept frozen until extraction. The same procedures will be used for the surrogate branches.

Hi-volume air samples will be collected using 125 ml XAD-2 resin traps at a flow rate of approximately 1 $m^3$ $min^{-1}$. Samples will be frozen until extraction.

Chains of custody will accompany all samples generated for this study.

## VI. ANALYTICAL METHODS

The CDFA Chemistry Lab will be responsible for developing methods for analysis of diazinon in branches, fallout cards and resin using gas chromatography. No interlaboratory quality control is planned since the samples are not appropriate for splitting. In-house quality control will consist of additional matrix spikes for each extraction set.

## VII. TIMETABLE

The experiment will take place during January, the final month of dormant spraying. If chemical analysis is completed by April 30, a draft report should be ready for review by August, 1990.