**FINAL REPORT**

**FOR 2003-2004 FISCAL YEAR**

**FROM**

**CALIFORNIA AGRICULTURAL AIRCRAFT ASSOCIATION**

**TO**

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PROJECT NUMBER: **03-RS-01**

PROJECT TITLE: Deposition Testing and Pattern Refinement for Spray Swath Analysis and Drift Management

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## INTRODUCTION

When applying agricultural chemicals to crops, whether by ground or air, pattern variability and drift are important. The less variable the spray pattern, the more even the crop production chemical is applied. This minimizes streaking and lack of efficacy. By minimizing drift, adjacent crops, dwellings, and environmentally sensitive areas are not impacted by unwanted pesticide contamination.

The California Agricultural Aircraft Association (CAAA), through its Aerial Deposition Alliance Program (ADAP), has an ongoing program to work with aerial applicators of crop production products. The program is designed to minimize drift, ensure even distribution of products, maintain use of products for aerial use, minimize product performance issues, meet regulatory requirements, and to meet specific label requirements.

To meet these objectives, CAAA employees the CAAA Digital Field Fluorometer, the WRK DropletScan, and the WRK Drift Tower. With the use of these apparatus and software, CAAA and ADAP can monitor and adjust aircraft to meet the goals and objectives necessary for proper application of agricultural crop production products.

## MATERIALS AND METHODS

**Pattern and droplet analysis.** Three helicopters and one airplane were studied. They were a UH-11 (Huey), a Bell OH-58, a Jet Ranger, and an Air Tractor 502A. All were set up to meet physical requirements used to mitigate drift. That is, the booms on the helicopters were no longer than 90% of the rotors and the boom on the airplane was no longer than 75% of the wing span.

Each aircraft was supplied with 100 gallons of water and 8 ounces of Rhodamine dye. The dye fluoresces and can be read by the Fluorometer. The Air Tractor also had a drift retardant added. A string fed system was set up perpendicular to the wind and was 125 feet in length. Three passes were made with each aircraft flying into the wind. The string was wound up after each pass and before the third pass was made, Syngenta water sensitive cards were placed along the string at 5 foot intervals starting 20 feet left of center and continuing to 20 feet to the right of center. After the third pass, the cards were also collected.

The cards were placed on a flat bed scanner and analyzed using the WRK DropletScan System. These were analyzed for Volume Median Diameter (VMD), volume diameter 0.1 (Vd 0.1), volume diameter 0.9 (Vd 0.9), and percent of spray volume < 200 microns. VMD indicates that ½ the spray volume is made up of droplets smaller and ½ the spray volume is made up of droplets that are larger then VMD. Vd 0.1 indicates that 10% of the spray volume is made up of droplets that are smaller and Vd 0.9 indicates that 10% of the spray volume is made up of droplets that are larger. The string was placed on the CAAA Digital Field Fluorometer and each pass was analyzed for coefficient of variation (C.V.) for both a race track and back and forth spray pattern.

**Drift measurement.** Syngenta water sensitive cards were placed perpendicular and downwind to the flight path of the Air Tractor. These were at fifty foot intervals with the first card being fifty feet from the center of the swath out to 250 feet. The swath width was 60 feet so the first card was 20 feet from the edge of the swath.

At 250 feet from the center of the swath, a drift tower was set up. Cards were placed at ground level and at 5 foot intervals up to 30 feet in height.

The aircraft made 4 passes in a race track pattern so as to simulate actual field practices. The nozzles were at 90 degrees (this breaks up the spray droplets) and a drift retardant was added as this is standard practice for the operator.

After the passes were made, the cards were collected and analyzed for both vertical and horizontal drift.

As part of this study, droplet cards were placed in the center of the berm in between the trees and in the center of the isle. There were four cards used in each setting. They were 18 inches above ground level. These cards were analyzed for % coverage. Treatment for these cards occurred as the drift trial was being applied.

This study was conducted on March 15, 2004 in an 8 year old almond orchard. The row spacing was 24 feet and tree spacing was 18 feet. The target swath was 60 feet and the gpa was 10. Nozzle deflection was 90 degrees.

## RESULTS AND DISCUSSION

**Pattern and droplet analysis.** For optimum patterns in aerial applications, the C.V. should be 25% or less. For drift minimization, the Vd.0.1 should be no lower than 200 microns and % of spray volume < 200 microns should not exceed 10%. This information is found in Table 1. For the race track pattern, all tested aircraft met or exceeded the minimum C.V. parameters. The airplane exceeded the parameters for the back and forth flight pattern but this type of aircraft rarely uses this type of pattern. The helicopters all exceeded the minimum back and forth parameters. As opposed to airplanes, helicopters normally use a back and forth pattern. All aircraft met or exceeded the minimum parameters for Vd 0.1 and volume % < 200 microns.

**TABLE 1**

Pattern and Droplet Analysis

| Aircraft | Swath Ft | RT%C.V. | BF%C.V. | VMD | Vd 0.1 | Vd 0.9 | %<200 |
|---|---|---|---|---|---|---|---|
| Huey | 42 | 9 | 12 | 453 | 256 | 684 | 5 |
| OH 58 | 45 | 11 | 11 | 450 | 252 | 622 | 6.5 |
| Jet Ranger | 45 | 18 | 20 | 543 | 284 | 742 | 3.0 |
| Air Tractor | | | | | | | |
| Run 1 | 65 | 22 | 26 | 442 | 213 | 686 | 7.0 |
| Run 2 | 65 | 17 | 38 | 429 | 231 | 568 | 8.1 |

RT = race track, BF = back and forth

Run 1 had a 30 degree nozzle angle and run 2 had a 55 degree nozzle angle

The second run of the Air Tractor had a smaller VMD, a larger Vd 0.1, a smaller Vd.09, and a larger percentage of droplets below 200 microns. This can be directly related to the higher deflection angle of the spray nozzles. As the spray nozzle is moved more into the air stream ( that is increasing the nozzle angle) the greater the wind shear effect on spray droplet size.

**Drift analysis.** The percent coverage for those droplet cards placed on the orchard floor was 8.2. Coverage for cards placed on the berm was 5.8%. The crop canopy was heavier along the berm due to the 18ft tree spacing versus 24 foot row spacing and thus more material was intercepted by the canopy than was intercepted on the orchard floor.

Table 2 depicts the results of the horizontal drift. The further away the cards are from the center of the spray swath, the less the % coverage.

**TABLE 2**
Horizontal Drift

| Distance from Swath Center | 50 ft | 100 ft | 150 ft | 200 ft | 250 ft |
|---|---|---|---|---|---|
| Percent Coverage | 4.54 | .52 | .38 | .33 | .05 |

Vertical drift, was quite low. Table 3 contains vertical drift data. There is a peak of .18% coverage at 15 ft in height. This is probably due to this data point being approximately equal to the release height of the spray.

**TABLE 3**
Vertical Drift

| Height ft | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
|---|---|---|---|---|---|---|---|
| % coverage | .05 | .03 | .03 | .18 | .06 | .08 | .10 |

## CONCLUSIONS

From the aircraft studied, the potential for drift is minimal and the likelihood of a good, efficacious application is present. Also, these aircraft, as configured, are not likely to create a drift problem during application as long as other drift mitigating measures are employed. These measures would include applying when wind speed and direction are favorable and avoiding applying during low level inversion conditions.

From the drift study, downwind drift can and does occur. However, under the conditions of this study, downwind drift was minimal and potential damage to crops, dwellings, and the environment would probably not occur.

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