FINAL REPORT

FOR 2004-2005 FISCAL YEAR

FROM

CALIFORNIA AGRICULTURAL AIRCRAFT ASSOCIATION

TO

ALMOND BOARD OF CALIFORNIA

PROJECT NUMBER: **04-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. One helicopter and eight airplanes were studied. They were a UH-11 (Huey), and 8 fixed wing aircraft. All are used in orchard spraying. All were set up to meet physical requirements used to mitigate drift. That is, the boom on the helicopter was no longer than 90% of the rotors and the booms on the airplanes were 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. 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 than 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. 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. Data from these cards would give an indication of soil contamination by droplets penetrating the crop canopy.

This study was conducted on June 22, 2005 in a 9 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 15. Nozzle deflection was 90 degrees. This was done at the same location as the March 15, 2004 trial. This was to duplicate conditions so a comparison could be made between a full canopy and just emerged leaves. Wind speed in each case was 7 mph.

A second and more detailed drift study was conducted. This involved the use of three different tank mixes with water plus two organosilicon additives, and a liquid fertilizer. One additive was used at .125%v/v while the other was used at 50 fluid oz per 100 gallons. The liquid fertilizer (Urea Ammonium Nitrate [UAN]) was used at the rate of 2.0%v/v. It was a 32% solution. In this trial the three treatments were replicated three times. The % coverage was divided by the total number of passes to obtain a mean % coverage. It was conducted over open ground. Wind speeds ranged from 9 to 15 mph. The course was set up so that the aircraft made four passes over the same flight path. Two passes were made in each direction. After the passes were made, the cards were picked up. The passes were perpendicular to the wind and were over a four hundred foot long track. The horizontal cards were placed downwind and centered on the track. The drift tower was set up 300 feet downwind.

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 back and forth parameters were met or exceeded by four of the planes and four planes had patterns that were marginally acceptable. The helicopter had patterns that were excellent for both types of flight patterns. Most planes use a racetrack pattern while helicopters typically use a back and forth pattern.

All aircraft tested quite well for % of spray volume below 200 microns, minimum Vd 0.1 (200 microns or larger) and overall droplet spectrum.

TABLE 1

Pattern and Droplet Analysis

Aircraft	Swath Ft	RT%C.V.	BF%C.V.	VMD	Vd 0.1	Vd 0.9	%<200
Helicopter	42	10	11	479	254	597	4.4
Plane 1	45	15	30	556	294	808	2
Plane 2	33	13	23	507	249	763	4
Plane 3	45	14	28	535	292	765	3
Plane 4	42	16	37	360	193	568	9.5
Plane 5	42	13	14	416	215	624	6.5
Plane 6	45	14	15	434	221	652	6.3
Plane 7	45	12	15	404	202	605	7.8
Plane 8	45	10	19	391	206	572	8

RT = race track, BF = back and forth

Drift analysis. The percent coverage for those droplet cards placed on the orchard floor was 1.7. Coverage for cards placed on the berm was 2.3%. 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. In the March 2004 trial the coverage was 5.8% on the berm and 8.2% on the orchard floor. This drop in coverage from 2004 to 2005 was a direct result of full canopy versus the trees having just leafed out.

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

2004 vs. 2005

Distance from Swath Center	50 ft	100 ft	150 ft	200 ft	250 ft
Percent Coverage 2004	4.54	.52	.38	.33	.05
Percent Coverage 2005	2.72	.69	.40	.04	.01

While horizontal drift was mostly reduced to some degree, it does not appear that full crop canopy had much effect.

Vertical drift was quite low. Table 3 contains vertical drift data.

TABLE 3
2004 vs. 2005
Vertical Drift

Height ft	0	5	10	15	20	25	30
% coverage 2004	.05	.03	.03	.18	.06	.08	.10
% coverage 2005	.02	.02	.03	.15	.13	.18	.28

As was the case of horizontal drift, full crop canopy versus a young canopy did not appear to have much effect on vertical drift.

Table 4 presents the results of the open ground drift study. As one would expect, the further away from the swath center, the lower the percent coverage. The results are not atypical when compared to other drift trials. When compared to the trials conducted in the almond orchard, the results indicate that crop canopy may reduce off target drift.

TABLE 4
Horizontal Drift % Coverage
Three Tank Mixes

Distance from Swath Center	50ft	100ft	150ft	200ft	250ft	300ft
OS 1	19.30	11.19	4.58	1.80	1.01	.46
OS 1 + UAN	14.95	15.12	6.67	2.87	1.44	.64
OS 2 + UAN	18.14	14.54	6.80	1.78	.54	.34

In table 5, vertical drift measurements are variable at the different heights. This may be due to microclimatic effects and height of spray release. However, as in the case of horizontal drift, the coverage’s are greater when compared to the crop canopy study.

TABLE 5
Vertical Drift % Coverage
Three Tank Mixes

Height ft	0	5	10	15	20	25	30
Organosilicon 1	.45	.59	1.29	1.45	1.65	1.08	1.10
Organosilicon1 + UAN	.61	1.06	1.40	.81	1.23	.99	.99
Organosilicon2 + UAN	.34	.62	.40	.23	.43	.60	.47

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 studies, 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. It also appears that crop canopy may effect off target drift by reducing drift during application.

Also, as the crop canopy increases, from early spring to early summer, more spray is intercepted by the crop. This means that more material is kept where it is needed; less material reaches the soil surface, thus reducing soil contamination and runoff potential.

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