Aerial Spray Swath Analysis and Drift Management

Project No.: **11-WATER1-Stoltz**

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Objectives:

To minimize off target movement and to improve infield efficiency and distribution of almond crop production products.

Interpretive Summary:

Agricultural aircraft were tested to monitor spray pattern variability, canopy penetration and drift potential. None of the aircraft tested were out of compliance for pattern variability. None of the aircraft tested showed a high propensity to drift. Some showed little potential for drift but may have droplets too large to give adequate coverage. The overall spray droplet distribution was near perfect with a span of 1.02. Coverage on the floor was light indicating excellent interception of spray within the canopy. The in canopy readings indicated a high degree of capture by the canopy. The readings at the 18 inch level are similar to berm readings reported in previous studies. Therefore, product reaching the ground is minimal and thus runoff and infiltration potential is minimal. This information will help improve efficacy, reduce off site movement by drift, and off site movement by runoff due to the material being on the tree rather than the soil. Results indicate that most aerial applicators are set up to apply almond production products in a safe and efficient manner.

Materials and Methods:

Swath analysis is accomplished by a process using the California Agricultural Aircraft Association (CAAA) Fluorometer. The aircraft is loaded with water and Rhodamine Dye. The aircraft flies over and sprays a specially treated string. The string is then analyzed by the Fluorometer. A pattern is displayed and swath variability is determined. If variability is too high (greater than 20 percent) then adjustments are made to the spray boom and the aircraft is retested. Also, certain pattern characteristics may indicate a potential to drift. If these are noticed, the usual correction is to shorten the boom length.

Drift potential is measured by flying over a set of Syngenta water sensitive cards. These cards are then scanned and analyzed utilizing the WRK DropletScan System. Data derived provide droplet spectra analysis for Volume Medium Diameter (Dv 0.5), (Dv 0.1), and (Dv 0.9). Dv 0.5 means that half of the spray volume is made up of droplets that size or larger and one half the volume is made up of droplets that size or smaller**.** Dv 0.1 means that ten percent of the spray volume is made up of droplets that size or smaller and Dv 0.9 means that ten percent of the spray volume is made up of spray droplets that size or larger. Droplets are measured in microns. The other key data relating to drift potential, and possibly the more important one, is the percent of spray volume below 200 microns. This latter information is related to the driftibility to droplets. The lower the percent of volume below 200 microns, the less potential there is for drift.

Canopy penetration. Droplet cards were placed on stakes at heights of 10 feet, 8 feet, 6 feet, and at 18 inches above ground level. The canopies were open at the top so that the 10 foot cards were unobstructed by the tree canopy.

Treatment parameters. The almond orchard is a mature 8 year old orchard. The density is 132 trees per acre based on a twenty two foot row spacing and a fifteen foot tree spacing. The orchard consists of three varieties: fifty percent Nonpareil, twenty five percent Monterey, and twenty five percent Fritz. The application was made by a Huey rotary winged aircraft. The swath width was 70 feet. The rate was 20 gallons per acre. The temperature was 98 F, with 25% relative humidity. The wind was out of the Northwest at 3 miles per hour.

Results and Discussion:

Swath analysis: All aircraft tested at or below the minimum industry accepted swath variability of 20 percent. Thus, all aircraft would give a uniform distribution of the spray. Therefore, this data is not reported.

Droplet analysis: Thirty nine aircraft were tested for those droplet parameters that would indicate a drift potential. Two exceeded the ten percent of spray volume below 200 microns. The remainder met or greatly exceeded this industry standard (**Table 1**). Those that exceeded the standard were adjusted and retested until the standard was met.

The Dv 0.1 is also an indication of drift potential. The nominal number is 200 microns. If smaller, the potential for drift increases. Generally, those aircraft that had Dv 0.1 below 200 microns tended to have a larger percent of the spray volume below 200 microns. Conversely, those aircraft that tested for larger Dv 0.1 tended to have smaller percentages of the spray volume below 200 microns. This means less drift potential but when droplets become too large, the potential to decrease coverage, and thus efficacy, increases.

While the overall averages are above the optimum droplets sizes and thus the potential for drift is reduced the droplet spectra are not overly large so that efficacy may not become an issue.

The percent average for spray volume below 200 microns indicates a strong possibility to minimize drift. It should be noted, however, that other factors such as wind speed, humidity,

temperature, and spray tank additives can also affect drift potential. Therefore, all of these factors must be taken into account when applying almond production products by air.

Table 1. Droplet Spectra Analysis

Aircraft *	Dv 0.5	Dv 0.1	Dv 0.9	% < 200 micron
1S	471	238	697	5
2 H	443	281	606	2
3H	481	308	699	2
4H	485	287	686	2
5H	513	286	703	3
6S	360	200	537	8
7B	385	183	607	12
8S	390	194	583	11
9S	517	263	763	4
10S	544	278	793	4
11S	429	238	651	6
12S	410	227	591	6
13B	493	258	744	5
14B	505	268	724	5
15B	569	278	801	4
16B	493	309	734	2
17H	639	290	858	3
18H	465	270	641	3
19H	567	293	800	3
20S	477	259	726	4
21B	480	268	678	5
22H	523	324	731	3
23B	548	268	803	4
24B	546	278	760	4
25B	526	248	804	5
26H	580	310	836	3
27B	511	278	758	4
28B	491	238	720	5
29B	408	240	584	6
30B	420	246	598	6
31S	515	233	828	6
32B	533	254	889	5
33S	397	214	609	8
34B	467	214	676	6
35H	522	262	798	5
36H	580	282	892	4
37H	649	414	807	2
38B	422	222	663	6
39B	469	210	718	7
MEAN	453	262	719	4.4
Optimum	400	200-250	600	10

***B = biwing, S = single wing, H = rotary wing (helicopter)**

Canopy Penetration: At 10 feet the coverage was quite good as would be expected with no canopy penetration (**Table 2**). At the 8 foot height approximately 75 percent of the spray had been intercepted. At the 6 foot height, only a small percentage of the spray was collected and at 18 inches above the berm, at the base of the tree, only a small percentage of the spray was captures. Thus, the bulk of the application is remaining where it is intended within the tree canopy.

TABLE 2. Canopy Penetration

	Percent Coverage		
10 ft.	8 ft.	6 ft.	18 in.
24.9	6.5	3.7	2.6

Research Effort Recent Publications:

2009. Deposition Testing and Pattern Refinement for Spray Swath Analysis and Drift Minimization including Variable Rate Application. Annual Summary. Cotton, Inc. Tulare, CA.

2009. Research presentation at the CAAA District 2 meeting. October, 2009. Stockton, CA

2010. Aerial Deposition Alliance Program. Report to Rice Research Board of California. December. 2009.

2010. Deposition Testing and Pattern Refinement for Spray Swath Analysis and Drift Minimization. Annual Summary. Cotton, Inc. Tulare, CA

2010. Almond Research data presented in the annual “On the Deck” Publication of the California Agricultural Aircraft Association. Lincoln, CA.

2010. Crop Canopy penetration in cotton. Report to Cotton, Inc. Cary, NC.

2011. Aerial Deposition Alliance Program. Report to Rice Research Board of California. December. 2011

2011. Research presentation at the CAAA District 2 meeting. October, 2011. Stockton, CA

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Bouse, L.F. “Effect of Nozzle Type and Operation on Spray Droplet Size”, Transactions of the ASAE, Vol. 37, no.5, 1994, pp. 1389-1400.

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Wolfe, R.E., Bretthauer, S. and D.R. Gardisser. Determining the Effect of Flat-fan Nozzle Angle on Aerial Spray Droplet Spectra. ASAE Paper No. AA05-003. NAAA/ASAE Technical Session. Reno, NV. 2005.