Deposition Testing and Pattern Refinement for Spray Swath Analysis and Drift Management

Project No.: **12-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. Coverage on the berm was light indicating excellent interception of spray within the canopy. The in berm and orchard floor readings indicated a high degree of capture by the canopy. The readings at the berm 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. 29 aircraft were assessed for the quality of their swaths and droplet size patterns.

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 volumes 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 in the orchard middle and along the berm. The cards were approximately 18 inches above the soil surface. Those on the berm were placed equidistant between the trees. The cards on the orchard floor were place opposite those on the berm.

Treatment parameters. The almond orchard is a mature 8 year old orchard. The density is 145 trees per acre based on twenty foot row spacing and fifteen foot tree spacing. The orchard consists of two varieties: Nonpareil, and Monterey. The application was made by an Air Tractor 802 fixed winged aircraft. The swath width was 80 feet. The rate was 15 gallons per acre. The temperature was 71.4 F, with 40% relative humidity. The wind was out of the Northwest at 2.1 miles per hour. Treatment was made as a bloom spray on February 22, 2013.
The products applied were Pristine Fungicide and Integrity Fertilizer.

The aircraft used in the study of canopy penetration had a droplet spectrum as follows: Dv 0.5 – 375 microns; Dv 0.1 – 229; Dv 0.9 – 552; %< 200 microns – 5.0; percent coverage – 11. The swath of this aircraft had a coefficient of variation of 16 percent. This aircraft was individually characterized before the study was conducted.

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: Twenty nine aircraft were tested for those droplet parameters that would indicate a drift potential. Four 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 ten percent of spray volume below 200 microns 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
1	370	217	569	6
2	341	188	520	7.5
3	461	227	722	5
4*	514	265	725	4.5
5	449	238	622	6
6	552	251	345	5
7	509	254	728	6
8	513	231	755	5.5
9	425	205	635	8
10	466	240	697	6
11	439	223	647	6.2
12	501	231	881	7
13	569	251	858	5
14	455	218	674	7.5
15	571	260	816	5
16	494	254	696	5.8
17	362	187	545	11
18	402	208	644	10
19	326	201	464	8.8
20	294	171	434	17
21	376	197	551	8
22	535	334	769	1
23	355	188	503	10.5
24	517	273	758	3
25	393	219	556	7.5
26	420	216	618	6.3
27	492	284	764	3.5
28	517	245	831	4
29	364	186	527	10.5
MEAN	448	230	645	6.8
Optimum	400	200-250	600	10

- Rotary winged aircraft

Canopy Penetration: Berm coverage was 5 percent and middle coverage was 11 percent (**Table 2**). This indicates that the canopy of the trees was denser over the berm. This is to be expected as the trees are 15 feet apart. The canopy is less dense between rows as the rows are 20 feet apart. However, the amount of spray that reached the orchard floor is consistent with past studies when done by either fixed or rotary winged aircraft. These past studies had been performed at full leaf. In either spray timing the bulk of the spray stays within the crop canopy and not on the orchard floor. This helps to minimize off target movement by drift, runoff or leaching.

Table 2. Canopy Penetration

	Percent Coverage
Berm	5
Middle	11

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
2012. Aerial Deposition Alliance Program. Report to Rice Research Board of California. December. 2011
2013. Almond Research Data presented in the annual “On the Deck” Publication of the California Agricultural Aircraft Association

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Noyes, R.T., D.R. Gardisser, and D.K. Kuhlman. Aerial Pesticide Drift Management, MP 392, UACES, 1997.

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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.