Aerial Spray Swath Analysis/Drift Management

Project No.: **13-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.

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. There were two orchards involved - one was in Kern County. It had a tree spacing of twenty two feet and a row spacing of twenty six feet. The orchard density was 76 trees per acre. The treatment was made on March 29, 2014. Foliar nutrients were applied at the rate of 20 gallons per acre with a Bell 47 helicopter. The temperature was 60 degrees F. Application swath width was 45 feet.

A study was conducted on May 16 to an orchard in Fresno County. It consisted of Butte and Padre varieties planted alternately in row rather than in alternating rows. The spacing was twenty two feet between rows and fifteen feet within the row. This gave a density of 132 trees per acre. The trees were 7 years old. Treatment was made with a Robinson helicopter. Application rate was twenty five gallons per acre and consisted of water and Sunshield. The temperature was 78.2 degrees F, humidity was 22.4% and the wind was 4.7 miles per hour. The tree lines were used for the application and thus the swath width was twenty two feet.

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: 38 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. Those that exceeded the standard were adjusted and retested until the standard was met. The composite results for all aircraft after adjustments were made are presented in **Table 1**.

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
MEAN	422	226	594	7.0
Optimum	400	200-250	600	10

Canopy Penetration: In study one the berm coverage was 2.8 percent and middle coverage was 7.6 percent (**Table 2**). This indicates that the canopy of the trees was denser over the berm. This is to be expected as the trees provide denser canopy coverage over the berms and are closer together than the row spacing. The canopy is less dense between rows as the rows are 26 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 while this study was done late petal fall. The trees were also quite large indicating a more mature orchard. 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. Droplet spectra indicate that drift would be minimized.

TABLE 2. Canopy Penetration

Percent Coverage

LOCATION	VMD	VD(0.1)	VD(0.9)	% COVERAGE
BERM	376	181	690	2.8
MIDDLE	526	265	739	7.6

In the second study, (**Table 3**) we were able to monitor not only the berms, middles, but also the outside middles and get more detailed data on the berms because all passes were directly over the tree line. The middle south of row three only received one application as it was the outside row. The coverage was less than any of the other middles because of this. The coverage on the rows was fairly consistent and equal in all cases (Rows 3 and 4). Where the middles received applications from both adjacent rows the coverage was higher than the one outside row. (Middle ¾ and 4/5). This indicates good spray coverage in row and on the overlapping canopies in adjacent rows. The less coverage on the outside row indicates that there would be less potential for drift on the outside edges of the orchard and also less chance for runoff and leaching from the edges of the orchard.

The droplet spectra were also quite good. All ranges were within industry standards and indicated that the smaller droplets were captured by the orchard canopy and thus drift from the smaller droplets is minimized.

TABLE 3. CANOPY PENETRATION

Percent Coverage

LOCATION	VMD	VD(0.1)	VD (0.9)	% COVERAGE
Middle south of row 3	367	236	644	7.4
Row 3	345	226	514	7.8
Middle 3/4	429	238	661	17.9
Row 4	417	249	589	7.7
Middle 4/5	448	256	649	12.7
Row 5	427	246	604	10.5
Middle composite	421	235	638	12.1
Row composite	401	233	592	8.4

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.
2013 Research presentation at the CAAA District 2 meeting. October, 2013 Stockton, CA
2013. Aerial Deposition Alliance Program. Report to Rice Research Board of California. December. 2013
2014. Almond Research Data presented in the annual "On the Deck" Publication of the California Agricultural Aircraft Association. Lincoln, CA

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