Spray Swath Analysis/Drift Management

Project No.: 06-ENVIR9-Stoltz

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Interpretive Summary:

Agricultural aircraft were tested to monitor spray pattern variability and drift potential. Also, an in orchard study was conducted to compare berm and floor coverage from two types of aircraft and to measure down wind movement of the spray particles.

None of the aircraft tested were out of compliance for pattern variability. Only one 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.

Horizontal drift from two types of aircraft was minimal. Neither one displayed a potential to be problematic for off site movement. Berm coverage was not significantly different but floor coverage was greater from the plane as compared to the helicopter. Continued testing of agricultural aircraft will help reduce drift problems. Also, in orchard studies with young trees, mature trees, and dormant trees will give a better understanding of spray movement in and outside of the orchard environment. This information will help improve efficacy, off site movement by drift, and off site movement by runoff due to material being on the ground rather than the tree.

Objectives:

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

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 (grater than 25 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 volume below 200 microns, the less potential there is for drift.

This study looked at three issues. Swath variability, droplet analysis, and the distribution of droplets in an orchard and the off target movement from the orchard treatment. This latter portion was done with a fixed wing and rotary winged aircraft. Results were measured by analyzing for percent coverage.

For the orchard study, droplet cards were placed on the orchard floor and on the berms. Droplet cards were also place down wind from the applications at fifty foot intervals to a distance of 300 feet. The fixed wing aircraft flew the length of the orchard. The cards were then retrieved. New cards were put in place and then the treatment was repeated with the rotary winged aircraft.

The trees in the orchard study were third leaf almonds. The treatment rate was 15 gallons per acre. Temperature was 86.6 degrees Fahrenheit, humidity was 30.3 percent, and wind speed was 4.3 miles per hour. Both aircraft had previously been subjected to pattern refinement and droplet analysis. Both far exceeded the minimum standards. The studies were conducted in the spring of 2007.

Results and Discussion:

SWATH ANALYSIS

All aircraft tested at or below the minimum industry accepted swath variability of 25 percent. Thus, all aircraft would give a uniform distribution of the spray. Therefore, this data is not reported.

DROPLET ANALYSIS

Thirty aircraft were tested for those droplet parameters that would indicate a drift potential. Only one exceeded the ten percent of spray volume below 200 microns. The others all met or greatly exceed this industry standard (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 0.9 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.

Two aircraft had no measurable droplets in the percentage less than two hundred microns. In both cases, the Dv 0.1 was quite high.

Table 1
Droplet Spectra Analysis

Aircraft	Dv 0.5	Dv 0.1	Dv 0.9	% < 200 micron
1	366	173	565	6.5
2	418	228	596	5
3	553	301	787	2.5
4	511	253	811	3.5
5	470	256	668	4
6	520	243	717	4
7	458	238	739	3.5
8	604	255	859	4
9	472	203	741	5
10	420	246	582	4.5
11	323	179	479	8.5
12	514	344	663	0
13	564	233	839	3.5
14	436	245	642	2
15	455	223	686	4
16	526	337	699	0
17	489	201	739	4.5
18	373	192	582	6
19	528	268	713	2.5
20	387	210	585	4.5
21	289	158	428	13
22	285	181	444	9
23	340	194	492	7
24	523	256	762	3.5
25	469	220	710	4
26	501	262	716	2
27	425	216	649	5
28	458	241	727	3.5
29	441	220	681	4
30	362	192	534	6.5

The third part of the study deals with in orchard applications. The results in orchard can be seen in Table 2.

Table 2
In Orchard Coverage

Aircraft	Berm % coverage	Floor % coverage
Fixed Wing	3	14
Helicopter	5	7

The berm coverage's were less than the coverage's on the orchard floor. This is because the tree canopy intercepts the spray where there is very little canopy to intercept the spray. This is especially true in newer orchards.

The helicopter seemed to get a little more spray onto the berm when compared to the fixed wing aircraft. This may be due to the down draft caused by the rotors.

Horizontal drift is important when considering the move to reduce off target movement of products when applied. Table 3 gives the results.

Table 3
Horizontal Drift

Aircraft	50 ft.	100 ft	150 ft	200 ft	250 ft	300 ft
Fixed Wing	1.89 %	.56%	.14%	0 %	0 %	0 %
Helicopter	.37 %	.10 %	0 %	0 %	0 %	0 %

In both cases, there was very little off target movement of the spray. While the plane had considerably more drift and drift further down wind, neither one would be considered problematic.

Recent Publications:

Stoltz, R. 2003. Drift Trial for Pattern Variability and Droplet Characteristics with Four Different Tank Mixes. Valent USA Corp. Richvale, CA.

_____ 2004. Deposition Testing and Pattern Refinement for Spray Swath Analysis and Drift Minimization. Annual Summary. Cotton, Inc. Tulare, CA.

_____ 2005. Deposition Testing and Pattern Refinement for Spray Swath Analysis and Drift Minimization including Variable Rate Application. Annual Summary. Cotton, Inc. Tulare, CA.

_____ 2005. Down Wind Drift Comparing Four Tank Mixes. Valent USA Corp. Oakdale, CA