Spray Swath Analysis/Drift Management

Project No.: **09-WATER1-Stoltz**

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Objectives:

To minimize off target movement and to improve infield efficiency and distribution of almond crop production products. Too explore the possibility of reduction in spray fines by a novel spray boom

Interpretive Summary:

Agricultural aircraft were tested to monitor spray pattern variability and drift potential. 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.

This information will help improve efficacy, reduce off site movement by drift, and off site movement by runoff due to material being on the ground rather than the tree. Also, spray fines were reduced by a novel spray boom design (Reverse Venturi Application)

Materials and Methods:

<u>Swath analysis</u> 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 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.

Spray Fines Reduction Arena Pest Control is working on technology to reduce the number of fines in spray applications. They have invented a Reverse Venturi Application (RVA) system. The results of some preliminary droplet spectra analysis show that they are on the right track. Some of this data is presented in **Table 2**.

This study looked at three issues. Swath variability, droplet analysis and spray fines reduction.

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

Forty three 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. It was reconfigured and retested to bring it into compliance with industry standards. There were some others that were very close to the upper limit. They too were retested and this figure was reduced. The others all met or greatly exceeded 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 0.1 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 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 B	446	250	646	5.7
2 B	328	194	507	9.5
3 B	592	277	840	4
4 B	428	206	650	8
5 H	561	291	805	2
6 B	499	255	781	4.5
7 B	402	227	595	6.2
8B	327	188	490	10.8
9 H	626	318	887	3
10 M	379	206	591	7.5
11 M	460	241	685	5.5
12 M	402	200	627	9
13 M	465	221	737	6
14 M	459	228	696	6.2
15 B	494	245	721	4.5
16 B	416	205	651	8
17 M	501	253	712	5.8
18 M	383	205	555	7.5
19 H	450	253	627	5
20 B	514	282	716	3
21 M	388	213	581	6.2
22 M	381	199	596	9
23 H	594	317	851	3
24 B	531	265	789	4.5
25 B	485	238	720	5
26 M	348	234	485	6
27 H	690	305	965	5.5
28 H	527	251	794	4.5
29 M	532	268	736	5
30 H	593	313	859	3
31 M	371	202	543	8
32 B	438	235	680	6
33 B	514	254	750	5.7
34 B	483	248	728	4.5
35 B	497	255	741	4.5
36 B	623	292	838	3.5
37 B	455	239	724	4.5
38 B	502	290	739	3
39 H	447	245	667	5.5
40 B	340	206	494	7.5
41 B	347	200	533	8
42 M	478	252	714	5.5
43 B	444	237	662	6
Mean	468	244	657	5.7
Optimum	400	200-250	600	<10

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

SPRAY FINES REDUCTION

TABLE 2

COMPARISON OF RVA AND CONVENTIONAL SYSTEMS

SYSTEM	VMD	DV 0.1	DV 0.9	%<200m	#DROPS<200m
Conventional	406	238	553	5.0	330
RVA	456	287	647	3.7	232

These data indicated that the RVA system does reduce the number of driftable fines. Further work is continuing to improve on the reduction of driftable fines and work is continuing to optimize spray patterns.

Research Effort Recent Publications:

Hoffman, Clint. 2008. Comparisons of Aerial and Ground Applications and Drift. Unpublished data. Texas A&M University. College Station, Texas.

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

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

2009. 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.

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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 Affect of Flat-fan Nozzle Angle on Aerial Spray Droplet Spectra. ASAE Paper No. AA05-003. NAAA/ASAE Technical Session. Reno, NV. 2005.