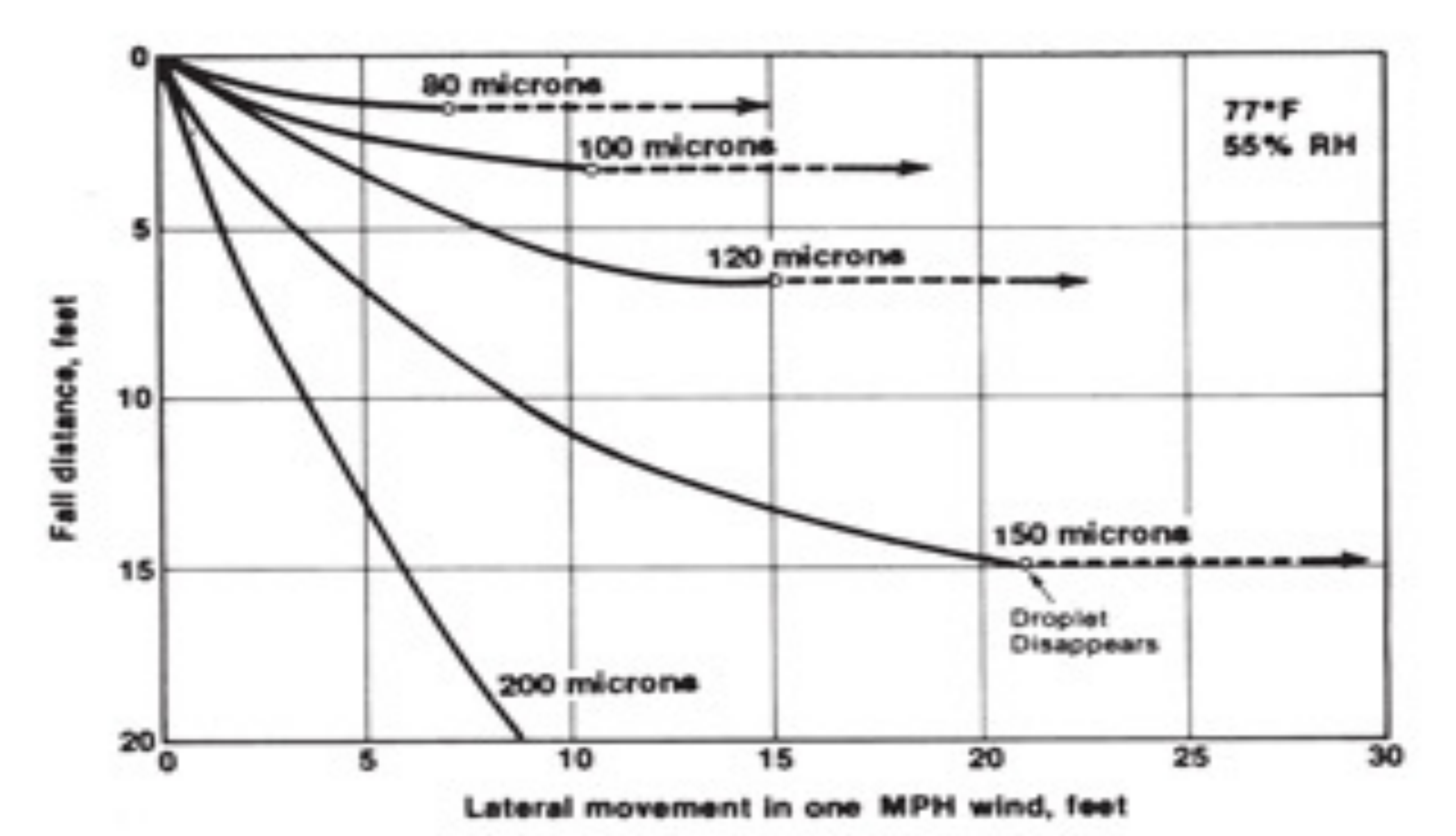
Mark Ledebuhr, Application Insight LLC, Presenter

Using AccuPatt to Analyse Swathgobbler Datasets

How will you know where spray lands?



Qualitative Sampling

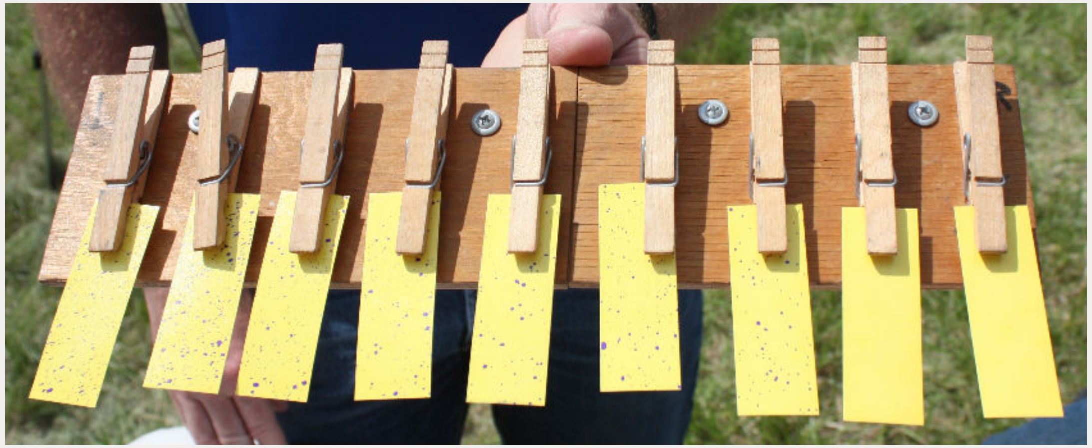
Showing the **quality** of the coverage, not the quantity. Generally expressed two ways:

hits per area

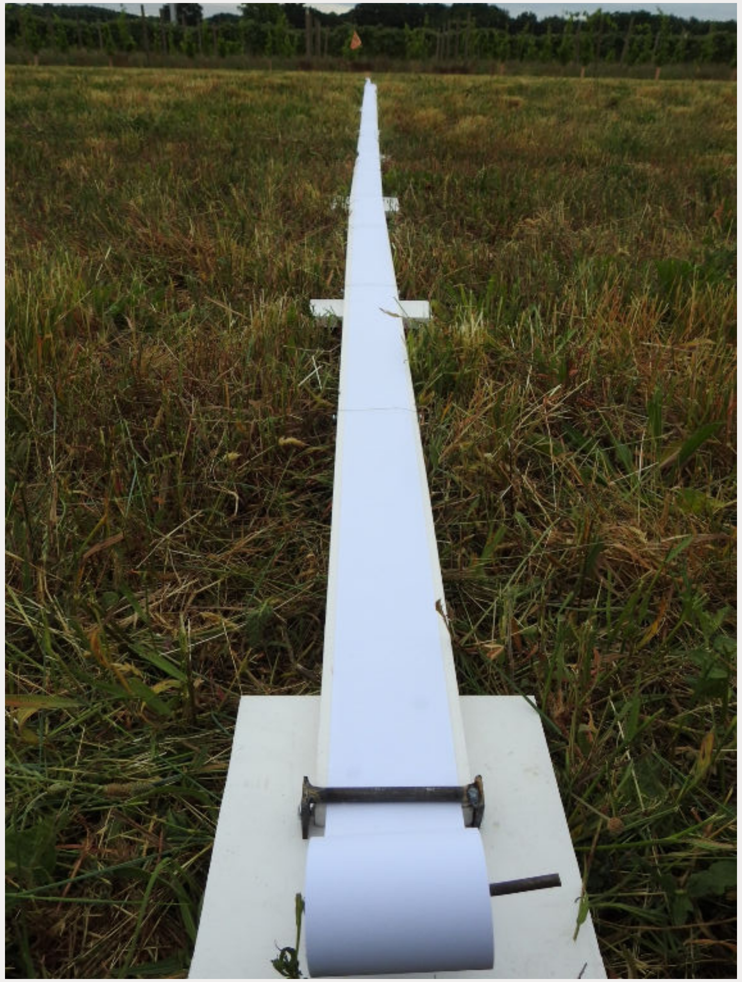
Percent coverage

Qualitative sampling, Water sensitive paper (WSP)

Pros	Cons
High precision	Slow to collect and scan
Can be used with any spray.	Highly sensitive to humidity, easily ruined
Lots of software options designed to evaluate it.	Expensive consumable, up to $1 per sample
	May not capture very fine droplets (<30 micron)
	Requires some pre-planning to get



Qualitative Measurement, Bond paper calculator rolls.

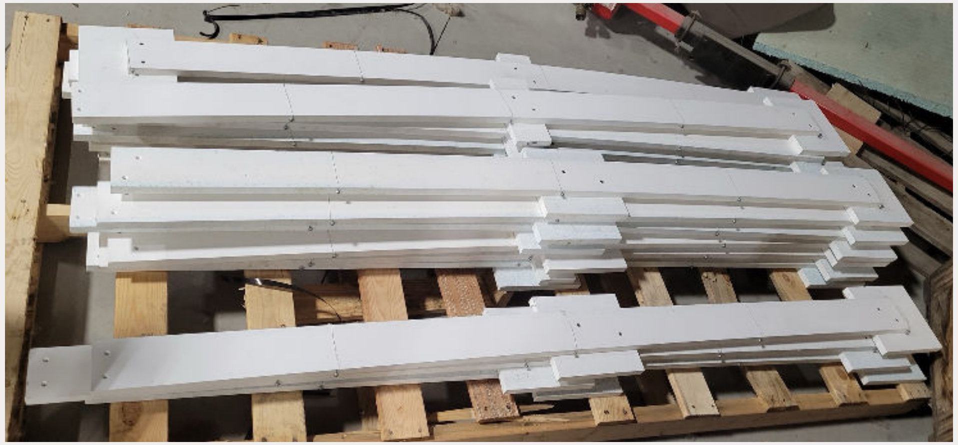


Why use bond paper rolls?

PROS	CONS
Lowest cost consumable	Bond paper less precise collector, allows more bleed than Kromekote or WSP
Correlated data set (impossible to mix up cards)	Requires a visible dye
Fast to deploy and collect	Requires a fairly large, bulky swath board to hold the collector.
Highest data resolution of any method (most images and data contributing to swath)	Holding the paper securely can be difficult for large drones/aircraft
Easily visually interpreted result, actionable data **without software analysis**	
Durable- not damaged by humidity or sunlight.	

Low barrier to entry for intermittent users:

- Swathboards are easy to fabricate



- PVC cove molding works and is very portable (recent luggage to France)

Swathgobbler Speed Track™

High-speed, high-quality data collection

Speedtrack makes it easy and fast to gather formerly impossible-to-collect data

Other ways continuous swath makes easier data collection

Digital analysis with Swath Gobbler™

Complete data capture for each swath, percent coverage and hits/area reported.

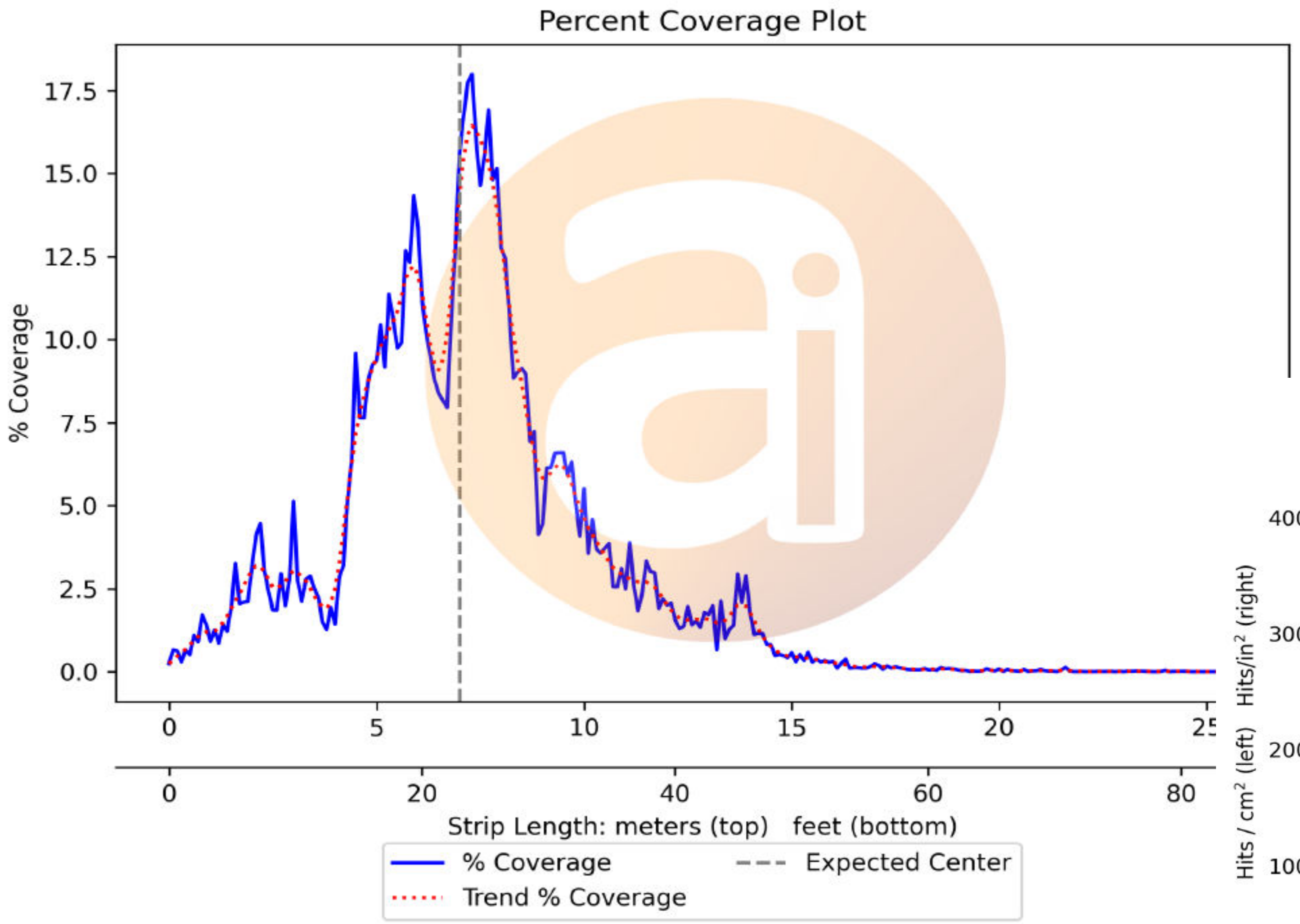
1200 DPI resolution, infinite swath width.

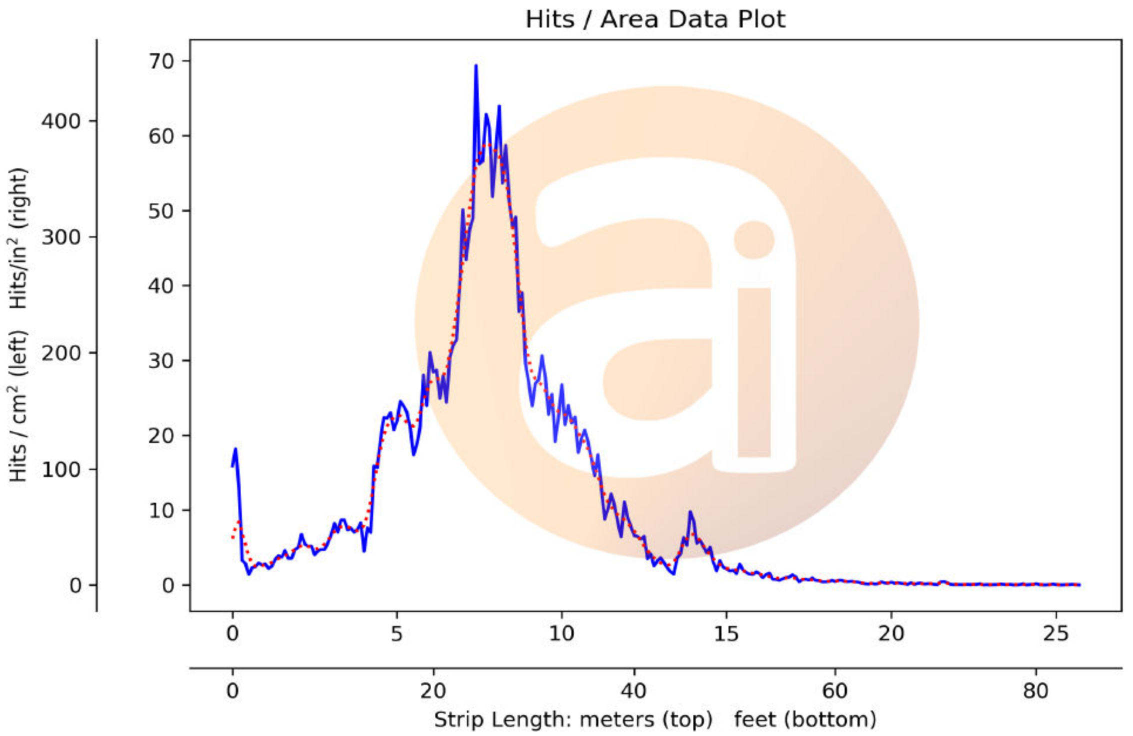
Scalable: multiple Swath Gobblers run in parallel for fast processing

Permanent, traceable proof of quality.

Useful for GLP and other research quality verification

Swath Gobbler Report: SG-4-2023-10-05T1127





Data outputs

Swath Gobbler Report: SG-4-2023-10-05T1127

Scanning Parameter	Value
Date YMD	2023-10-05 11:27
Report Date	2024-02-22 22:04
Trial Number	4
Swath Number	4
Aircraft Type	P100Pro
Nozzle Type	Rotary
Nozzle Size	TBD
Image Spacing	100.0 mm (3.94 in)
Lighting	Red:0 Green:0 Blue:0 White:10
HSV Intervals	Hue: [30, 89], Saturation: [0, 115], Value: [0, 162]

Scan Notes
None

Analysis Notes
Single Pass from RPAAS 2023, P100

Expected Center
7 m

Min %	Left	Right	Swath	Center	Shift	CV	T. Left	T. Right	T. Swath
0.5%	-22.64 ft	27.56 ft	50.20 ft	25.43 ft	2.46 ft	91.12%	-21.98 ft	25.59 ft	47.57 ft
1.0%	-21.00 ft	23.95 ft	44.95 ft	24.44 ft	1.48 ft	82.29%	-20.67 ft	23.95 ft	44.62 ft
1.5%	-20.34 ft	22.97 ft	43.31 ft	24.28 ft	1.31 ft	80.01%	-18.37 ft	23.29 ft	41.67 ft
2.0%	-17.72 ft	22.64 ft	40.35 ft	25.43 ft	2.46 ft	76.13%	-17.72 ft	22.31 ft	40.03 ft
2.5%	-17.72 ft	22.64 ft	40.35 ft	25.43 ft	2.46 ft	76.13%	-17.06 ft	15.42 ft	32.48 ft
3.0%	-17.72 ft	15.09 ft	32.81 ft	21.65 ft	-1.31 ft	65.16%	-16.40 ft	12.47 ft	28.87 ft
4.0%	-16.08 ft	10.50 ft	26.57 ft	20.18 ft	-2.79 ft	57.59%	-9.19 ft	10.50 ft	19.69 ft
5.0%	-13.12 ft	9.84 ft	22.97 ft	21.33 ft	-1.64 ft	51.20%	-8.86 ft	9.19 ft	18.04 ft
6.0%	-8.53 ft	8.86 ft	17.39 ft	23.13 ft	0.16 ft	33.59%	-8.53 ft	8.20 ft	16.73 ft
7.0%	-8.20 ft	5.91 ft	14.11 ft	21.82 ft	-1.15 ft	26.61%	-8.20 ft	5.58 ft	13.78 ft
8.0%	-8.20 ft	5.25 ft	13.45 ft	21.49 ft	-1.48 ft	25.88%	-7.55 ft	4.92 ft	12.47 ft
9.0%	-8.20 ft	4.92 ft	13.12 ft	21.33 ft	-1.64 ft	25.84%	-6.89 ft	4.59 ft	11.48 ft
10.0%	-6.23 ft	3.94 ft	10.17 ft	21.82 ft	-1.15 ft	23.70%	-5.91 ft	4.27 ft	10.17 ft
15.0%	0.00 ft	2.95 ft	2.95 ft	24.44 ft	1.48 ft	6.99%	0.33 ft	2.30 ft	1.97 ft
20.0%	--	--	--	--	--	--	--	--	--
25.0%	--	--	--	--	--	--	--	--	--
30.0%	--	--	--	--	--	--	--	--	--

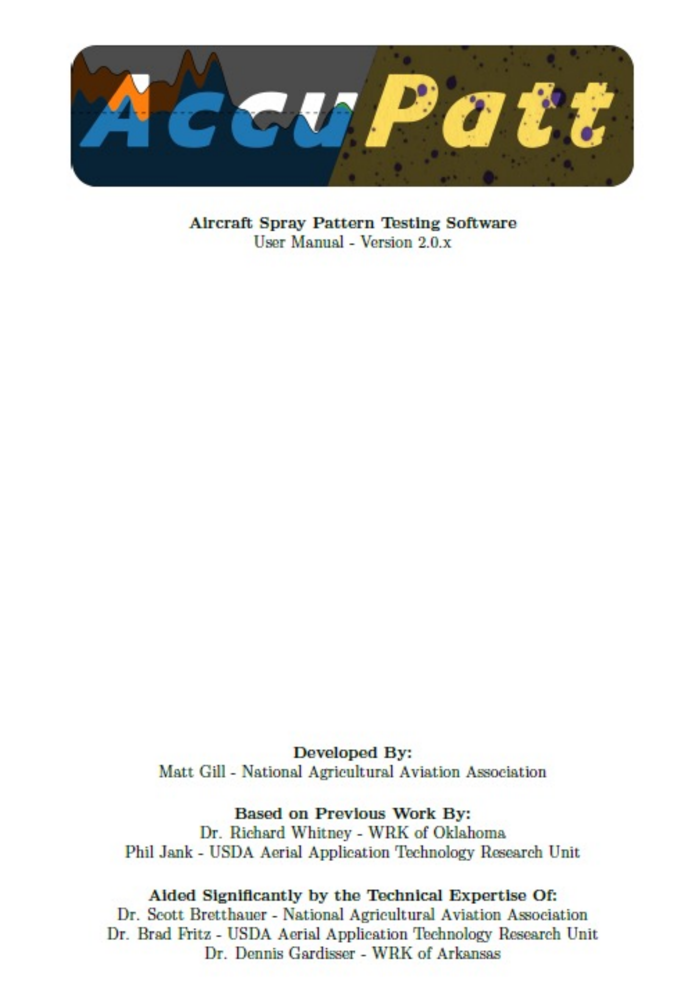
Limitations of calculating droplet size from spray cards. You can calculate it, **but should you?**

Assumption	True/False
Spreadfactor can be predicted	**False.** Spray rheology, droplet size, weather conditions, type of collector used, and velocity of droplet all affect spread factor. There are no easy ways to measure spread factor in field
Evaporation does not occur (drop size shift)	**False.** Evaporation DOES occur and can be substantial, especially at height. The spectra measured is not the spectra sprayed.
All spray emitted is captured on the card equally.	**False.** As droplet size decreases, transfer efficiency decreases rapidly. Small, driftable droplets do not transfer well to smooth flat cards.

AccuPatt

Quantitative string analysis designed for manned aerial work using strings and WRK system

Qualitative swath analysis using WSP/other cards



AccuPatt

Aircraft Spray Pattern Testing Software
User Manual - Version 2.0.x

Developed By:
Matt Gill - National Agricultural Aviation Association

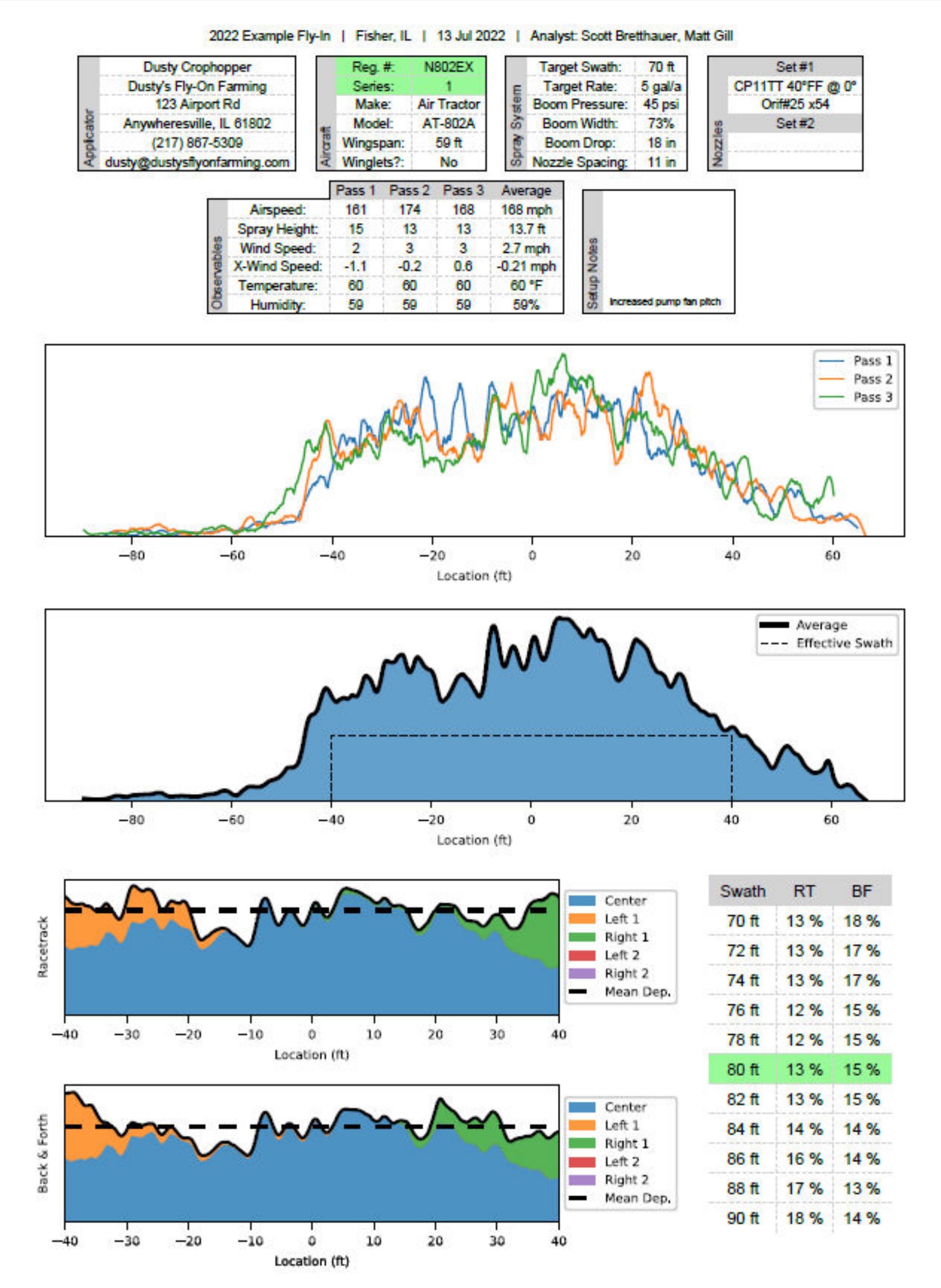
Based on Previous Work By:
Dr. Richard Whitney - WRK of Oklahoma
Phil Jank - USDA Aerial Application Technology Research Unit

Aided Significantly by the Technical Expertise Of:
Dr. Scott Bretthauer - National Agricultural Aviation Association
Dr. Brad Fritz - USDA Aerial Application Technology Research Unit
Dr. Dennis Gardisser - WRK of Arkansas

AccuPat WRK String Analysis Report

Provided by NAAA as Freeware:

https://github.com/gill14/AccuPatt



AccuPat Swathing with cards

2022 Example Fly-In | Fisher, IL | 13 Jul 2022 | Analyst: Scott Bretthauer, Matt Gill

Applicator
Dusty Crophopper
Dusty's Fly-On Farming
123 Airport Rd
Anywheresville, IL 61802
(217) 867-5309
dusty@dustysflyonfarming.com

Aircraft	
Reg. #:	N802EX
Series:	1
Make:	Air Tractor
Model:	AT-802A
Wingspan:	59 ft
Winglets?:	No

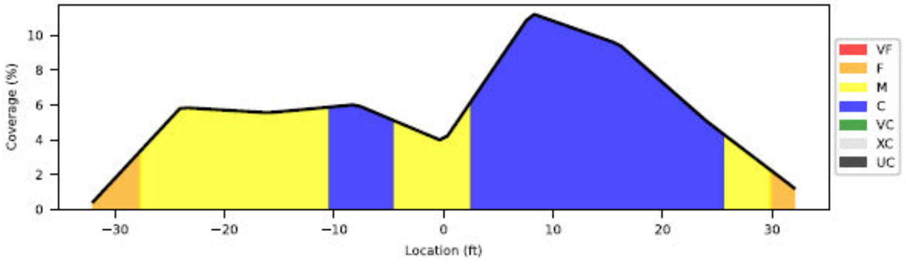
Spray System	
Target Swath:	70 ft
Target Rate:	5 gal/a
Boom Pressure:	45 psi
Boom Width:	73%
Boom Drop:	18 in
Nozzle Spacing:	11 in

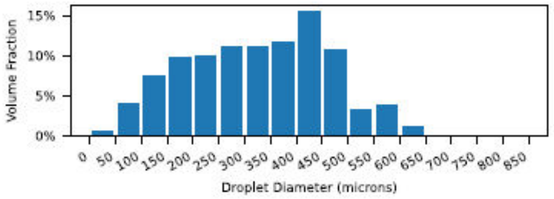
Nozzles
Set #1
CP11TT 40°FF @ 0°
Orif#25 x54
Set #2

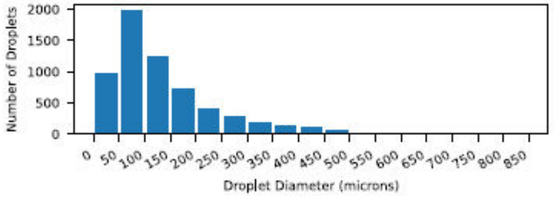
Observables	Pass 1	Pass 2	Pass 3	Average
Airspeed:	161	174	168	168 mph
Spray Height:	15	13	13	13.7 ft
Wind Speed:	2	3	3	2.7 mph
X-Wind Speed:	-1.1	-0.2	0.6	-0.21 mph
Temperature:	60	60	60	60 °F
Humidity:	59	59	59	59%

Setup Notes

Increased pump fan pitch

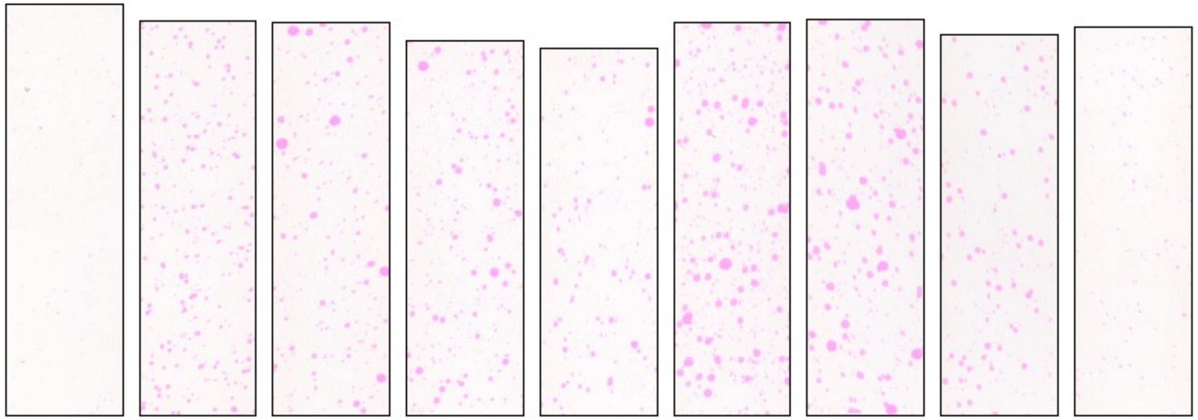






Composite - Pass 1	Measured [1,2]	USDA Model [3]
Category	M	M
Dv0.1	170 µm	116 µm
Dv0.5	351 µm	285 µm
Dv0.9	481 µm	568 µm
RS	0.89	1.59
Cov.	5.31%	
Area	20.74 in²	
Stains	6036	
D / in2	291	

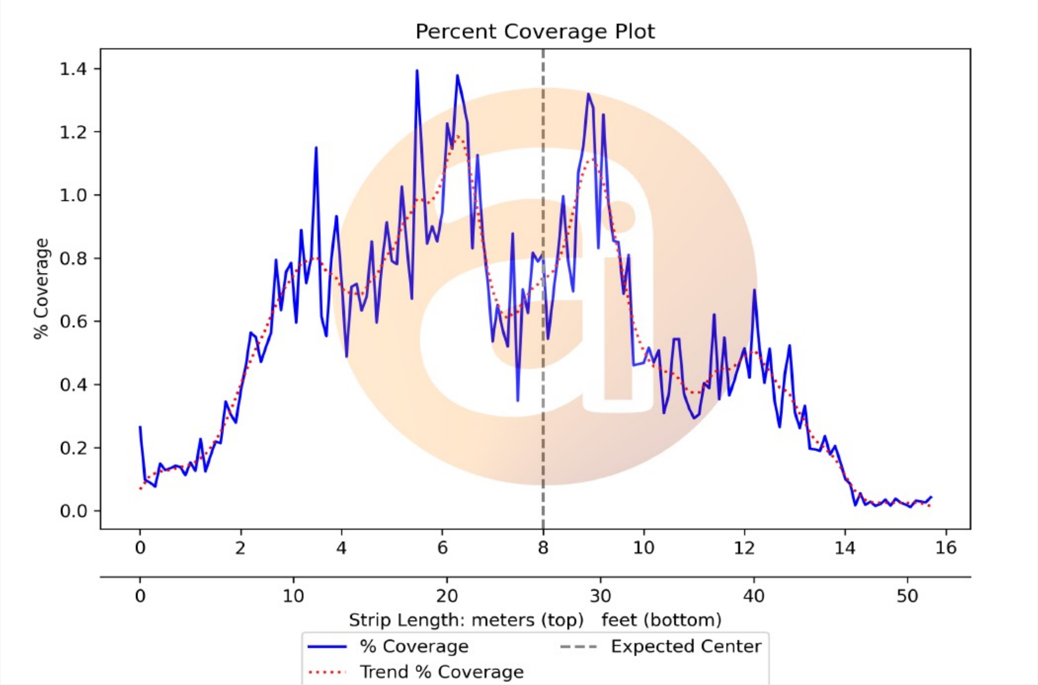
[1] Based on inputs, minimum detectable droplet diameter is 28 µm.
[2] Measured Droplet Spectrum Category is calculated with reference nozzle data, and should not be considered absolute.
[3] USDA Model flow-weighted and interpolated composite calculation based on stated nozzle configuration and quantities.

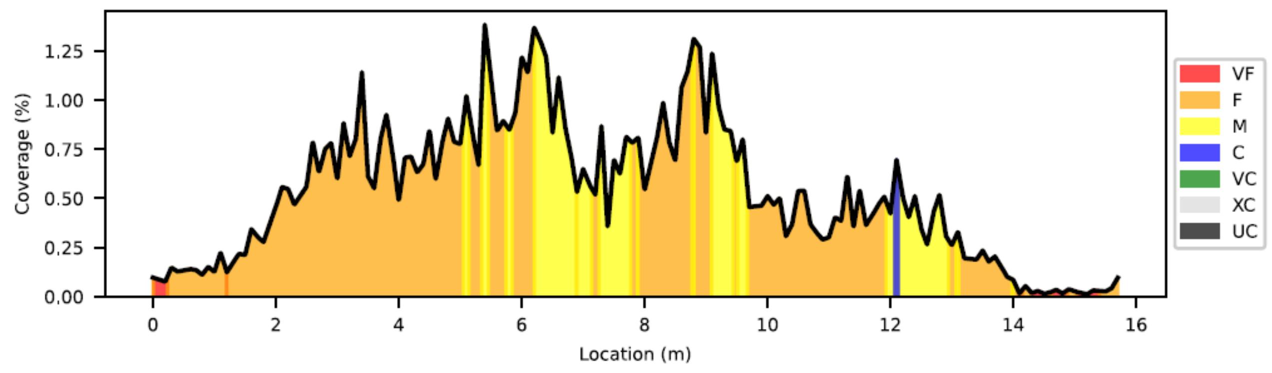


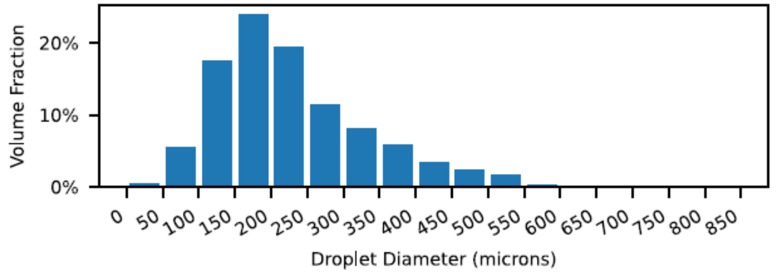
	L-32	L-24	L-16	L-8	Center	R-8	R-16	R-24	R-32
DSC	F	M	M	C	M	C	C	C	F
Dv0.1	88 µm	189 µm	157 µm	169 µm	155 µm	174 µm	187 µm	195 µm	130 µm
VMD	147 µm	317 µm	325 µm	372 µm	339 µm	406 µm	385 µm	404 µm	206 µm
Dv0.9	228 µm	368 µm	560 µm	480 µm	452 µm	494 µm	548 µm	449 µm	266 µm
RS	0.95	0.56	1.24	0.84	0.88	0.79	0.94	0.63	0.66
Cov.	0.44%	5.85%	5.54%	6.01%	3.89%	11.25%	9.48%	5.06%	1.23%
Area	2.24 in²	2.31 in²	2.33 in²	2.45 in²	2.51 in²	2.30 in²	1.83 in²	2.41 in²	2.36 in²
St.	223	610	758	889	752	1269	726	521	288
St./in²	99	264	326	363	299	553	397	217	122

N802EX 01 - Individual Card Data for Pass 1 - Page 1/1

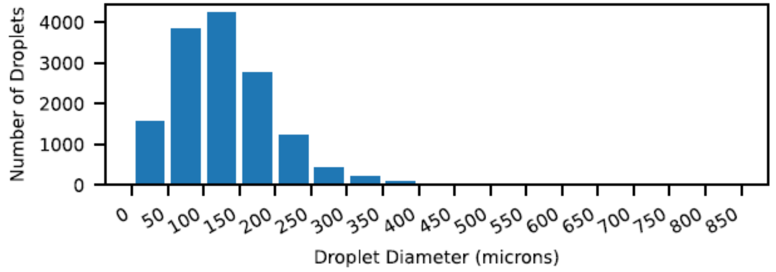
Very low volume







Composite - Pass 1		Measured [1,2]	USDA Model [3]
	Category	F	-
	Dv0.1	132 µm	-
	Dv0.5	224 µm	-
	Dv0.9	391 µm	-
	RS	1.16	-
	Cov.	0.53%	
	Area	308.57 in²	
	Stains	14405	
	D / in2	47	



[1] Based on inputs, minimum detectable droplet diameter is 28 µm.

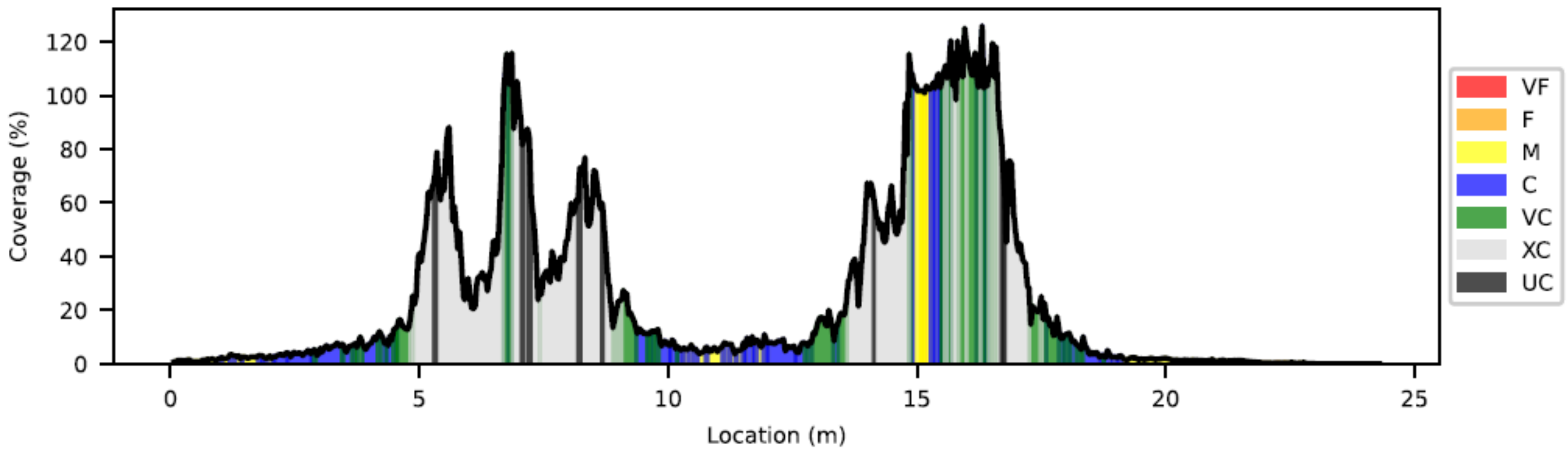
[2] Measured Droplet Spectrum Category is calculated with reference nozzle data, and should not be considered absolute.

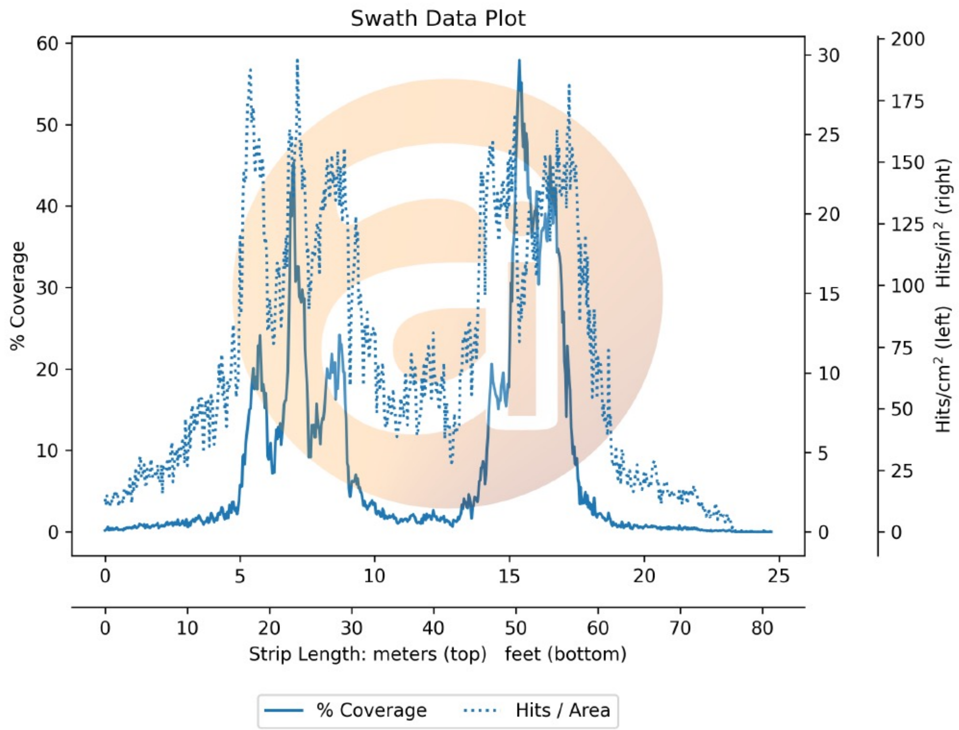
[3] USDA Model flow-weighted and interpolated composite calculation based on stated nozzle configuration and quantities.

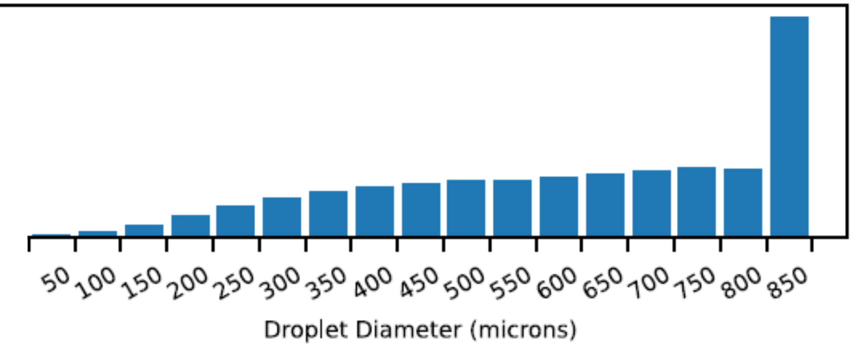
High Volume Sprays: 15 GPA

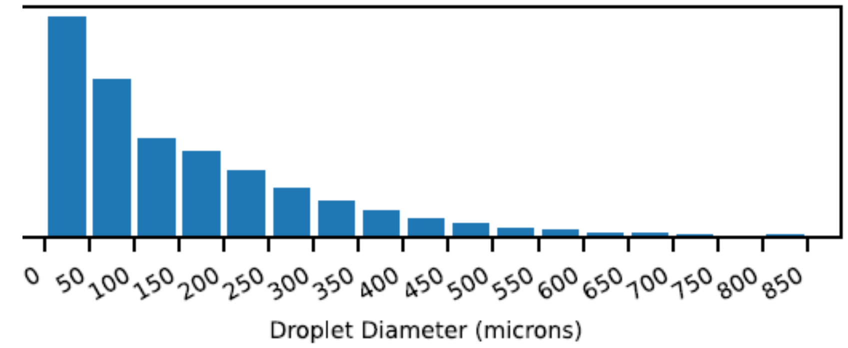
It's possible to have too many pictures:

Full scan, ~700 images. 100 minutes to analyse.









Composite - Pass 1		Measured [1,2]	USDA Model [3]
	Category	XC	-
	Dv0.1	259 µm	-
	Dv0.5	506 µm	-
	Dv0.9	782 µm	-
	RS	1.03	-
	Cov.	25.06%	
	Area	1349.53 in²	
	Stains	268031	
	D / in2	199	

[1] Based on inputs, minimum detectable droplet diameter is 28 µm.

[2] Measured Droplet Spectrum Category is calculated with reference nozzle data, and should not be considered absolute.

[3] USDA Model flow-weighted and interpolated composite calculation based on stated nozzle configuration and quantities.

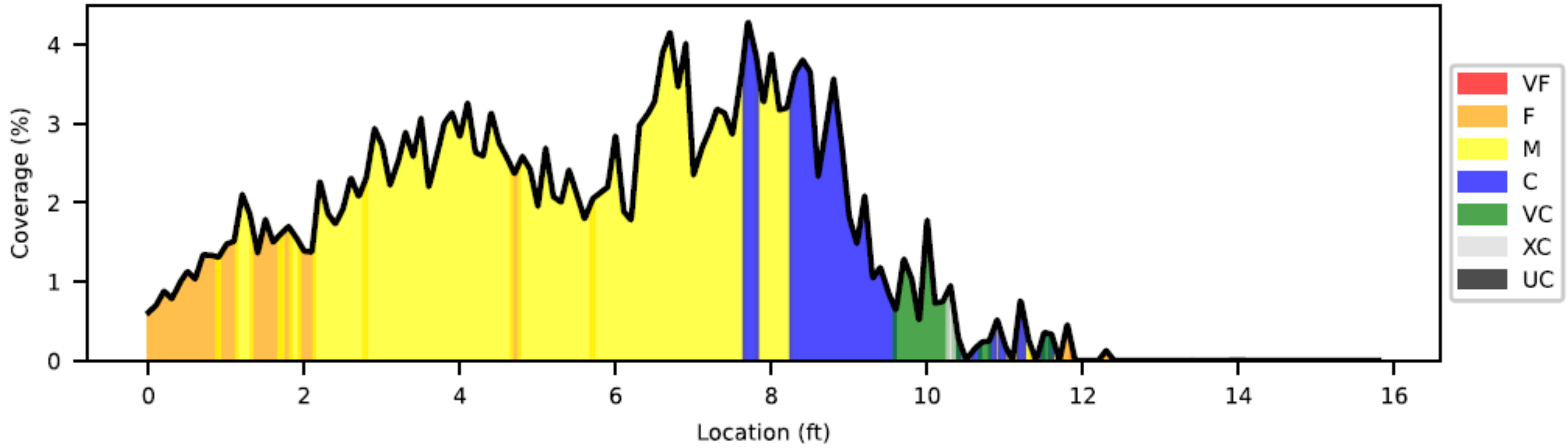
2 GPA application with rotary atomizer drone

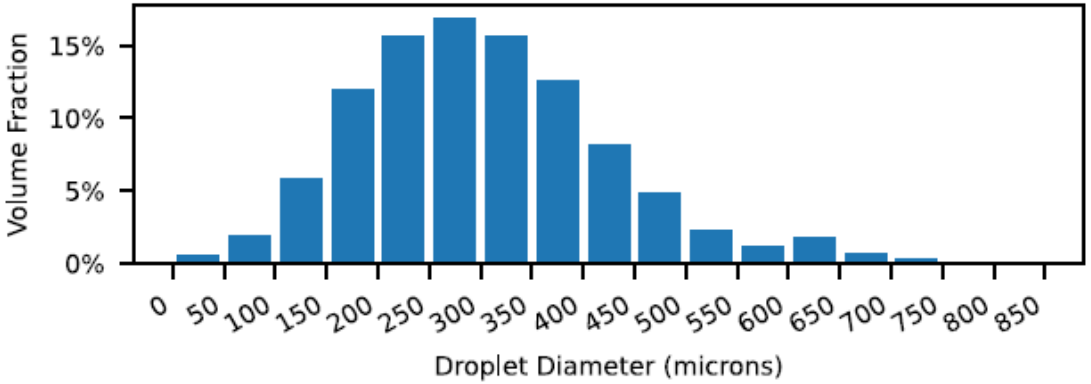
Downwind fractionation obvious (right to left)

Swathgobbler read the paper Every 200 mm (5x/meter). 6-7 min.

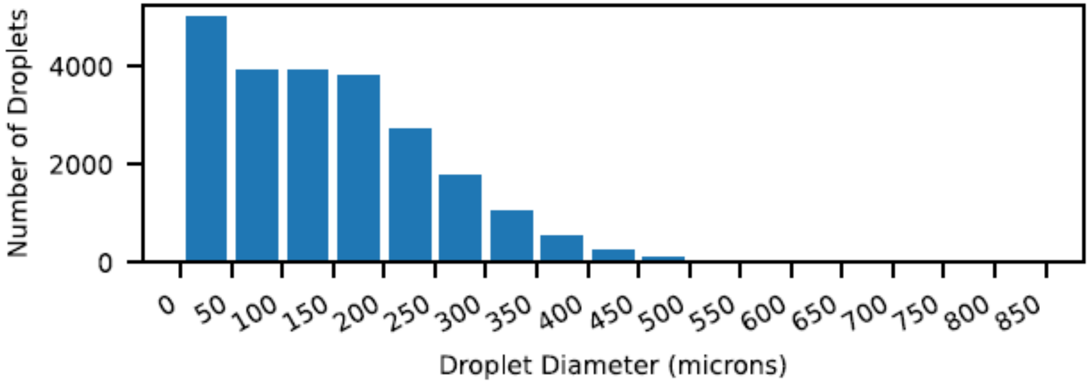
80 samples over 16 meters

Faster to capture data and analyse, 20-30 min total time.





Composite - Pass 1	Measured [1,2]	USDA Model [3]
Category	M	-
Dv0.1	179 µm	-
Dv0.5	303 µm	-
Dv0.9	453 µm	-
RS	0.90	-
Cov.	1.50%	
Area	310.53 in²	
Stains	23137	
D / in2	75	



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[3] USDA Model flow-weighted and interpolated composite calculation based on stated nozzle configuration and quantities.

Conclusions:

- AccuPatt provides comparable outcomes to SwathGobbler Pro software in percent cover and hits. More work needed in some drop sizing scenarios.
- AccuPatt offers additional robustness of the final report with ability to repeat and average passes.
- AccuPatt offers additional, highly valuable insight into the spray deposition across and outside the swath.
- AccuPatt card analysis with very large batches is slow to run. The software requires more technical training.

Thank You!

Questions?