2002 NAAA/ASAE TECHNICAL SESSION

Operational Factors Influence Spray Drift and Deposition from Helicopters

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Introduction

- Helicopters are used primarily for specialty applications and there is not as much spray performance data available as for fixed-wing aircraft.
- What about boom length and droplet size vs. spray drift for helicopters?
- What about boom length and swath width?
- For drift control, EPA says 90% boom length on helicopters, compared to 75% on fixed-wing.
- Droplet size is the most important variable affecting spray drift.

Introduction

- Bob Ewing, North Star Helicopters, volunteered to provide equipment and manpower to help answer some of these questions for rotary-wing operators.
- Linda Bergey, Bishop Equipment and Carolyn Baecker, CP Products provided nozzles for two droplet sizes.
- Jess McCrory, Buffalo Ranch, Burleson County, TX, provided the worksite.

Introduction

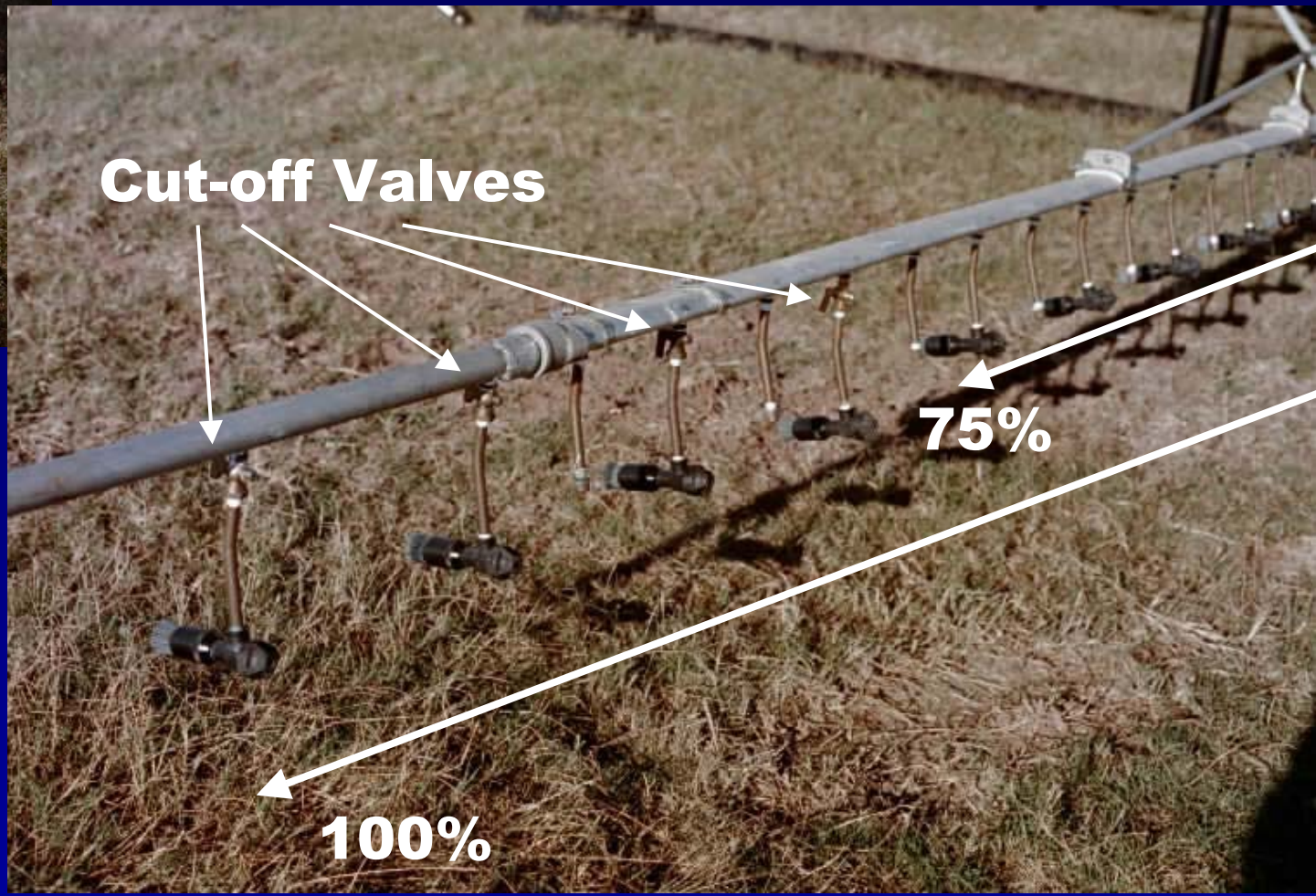
- This is a report of our study of the effects of boom length and spray droplet size on spray drift and swath width for helicopter operations.
- The study plan:
  - 2 helicopters – Bell turbine and Hiller piston
  - 2 droplet sizes – 400 µm and 1000 µm
  - 2 boom lengths – 75% and 100%

Materials and Methods: Aircraft

Bell OH-58 (North Star Helicopters)

Hiller UH-12E (USDA ARS)

Materials and Methods: Boom Length



Materials and Methods: Spray Droplet Size

$D_{V0.5}$ = 400 µm

$D_{V0.5}$ = 1000 µm

CP-03 NOZZLE

FOR USE ON ROTARY-WING AIRCRAFT

AERIAL APPLICATORS SPRAY NOZZLE HANDBOOK
USDA ARS AGRICULTURAL HANDBOOK NO. XXX

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Directions: Enter CP 03 nozzle settings, pressure, and airspeed in the cells highlighted below.
(Atomization parameters are valid only with nozzle and operational settings specified in the Acceptab

	Orifice Size, inches	Deflector Angle, degrees	Pressure, psi	Airspeed, mph
Acceptable Range:	.061 to .171	30 to 90	20 to 60	30 to 100
	0.078	55	50	60

Application parameters are displayed in the box below.

CAUTION: Do not enter or clear data in the cells in this box!

$D_{V0.5}$ =	425 µm	= Volume median diameter
RS =	1.26	= Relative Span
%V<100µm =	2.47 %	= Percentage of spray volume in droplets smaller than 100 µm dia
%V<200µm =	7.36 %	= Percentage of spray volume in droplets smaller than 200 µm dia
DSC =	MEDIUM	= ASAE S572 AUG99 Droplet Spectra Classification

Values and classifications reported here are least-squares best-estimate predictions from experimental data collected in
Values reported from other laboratories may not yield the exact same values, but similar trends would be expe
The ASAE droplet spectra classification category is based on droplet sizes in the mid-80% of the spectrum and not a si

ROTARY-WING

ACCU-FLO DOUBLE ROW NOZZLE

FOR USE ON ROTARY-WING AIRCRAFT

AERIAL APPLICATORS SPRAY NOZZLE HANDBOOK
USDA ARS AGRICULTURAL HANDBOOK NO. XXX

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Directions: Enter ACCU-FLO DOUBLE ROW nozzle settings, pressure, and airspeed in the cells hig
(Atomization parameters are valid only with nozzle and operational settings specified in the Accepta

	Tube Size,	Restrictor Size	Pressure, psi	Airspeed, mph
Acceptable Range:	0.016 to 0.028	4 to 12	20 to 60	30 to 100
	0.028	6	50	60

Application parameters are displayed in the box below.

CAUTION: Do not enter or clear data in the cells in this box!

$D_{V0.5}$ =	991 µm	= Volume median diameter
RS =	0.94	= Relative Span
%V<100µm =	0.47 %	= Percentage of spray volume in droplets smaller than 100 µm di
%V<200µm =	1.42 %	= Percentage of spray volume in droplets smaller than 200 µm di
DSC =	EXT. COARSE	= ASAE S572 AUG99 Droplet Spectra Classification

Values and classifications reported here are least-squares best-estimate predictions from experimental data collected
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The ASAE droplet spectra classification category is based on droplet sizes in the mid-80% of the spectrum and not a s

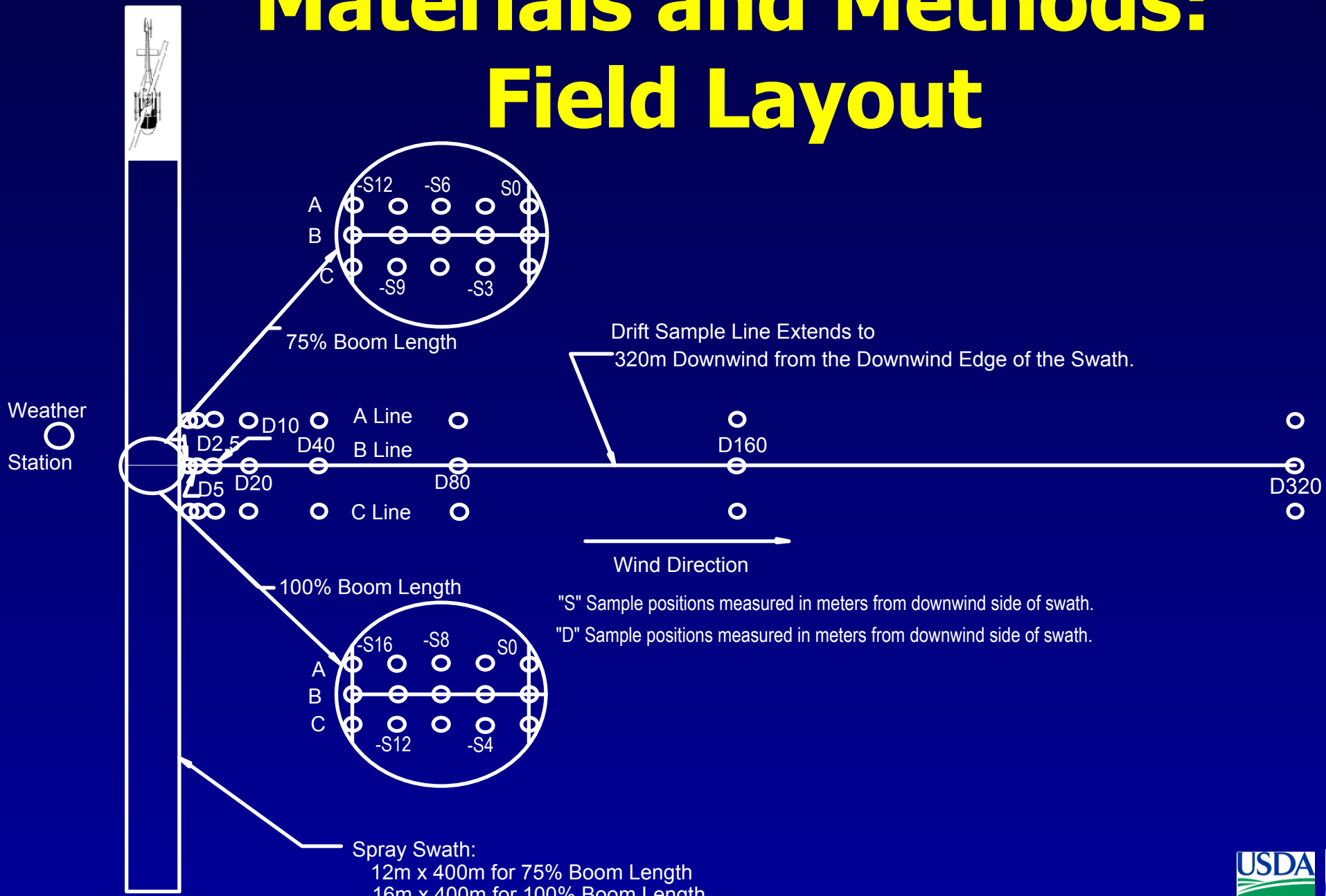
Both selections for 50 psi, 60 mph and 6 gpa on swath width of 1.5X boom length

Materials and Methods: Treatment Setup

Helicopter	Boom/Rotor %	Droplet Size, µm ($D_{V0.5}$)	Nozzles No. and ID
Hiller	100	1000	33 Accu-Flo 64-0.028, 6
Bell	100	1000	33 Accu-Flo 64-0.028, 6
Hiller	75	1000	25 Accu-Flo 64-0.028, 6
Bell	75	1000	25 Accu-Flo 64-0.028, 6
Hiller	100	400	33 CP-03, 0.078, 55°
Bell	100	400	33 CP-03, 0.078, 55°
Hiller	75	400	25 CP-03, 0.078, 55°
Bell	75	400	25 CP-03. 0.078, 55°

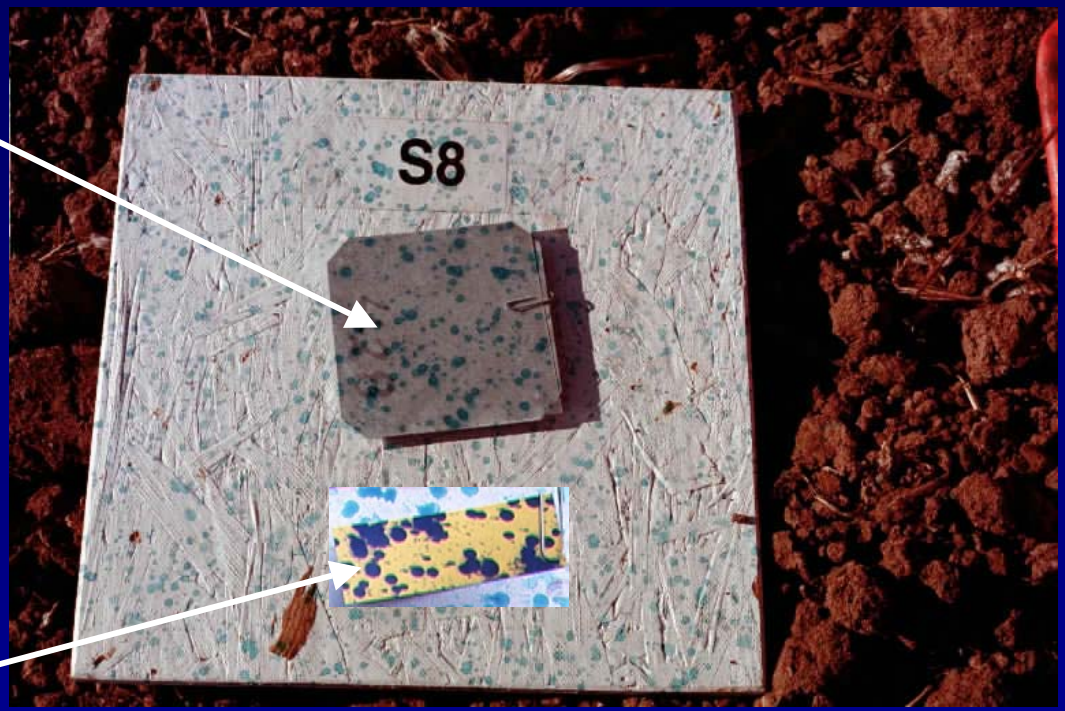
Treatments were applied and sampled in four replications.

Materials and Methods: Field Layout



Materials and Methods: Sampling Protocol

A Mylar card for deposits by spectrofluorometry



A water-sensitive card for deposits by image analysis

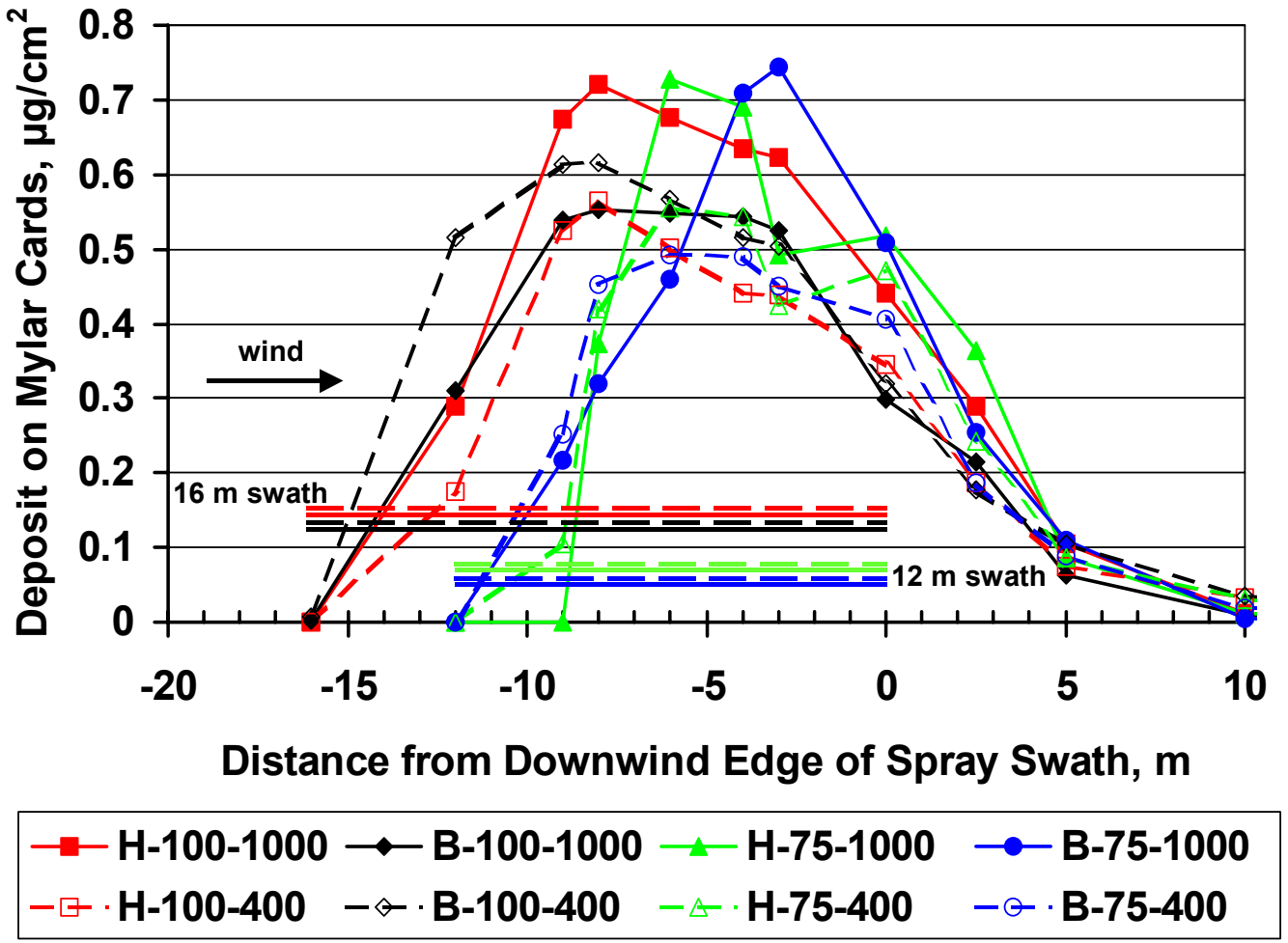
Materials and Methods: Deposition and Drift Sampling

Materials and Methods: Swath Width Sampling

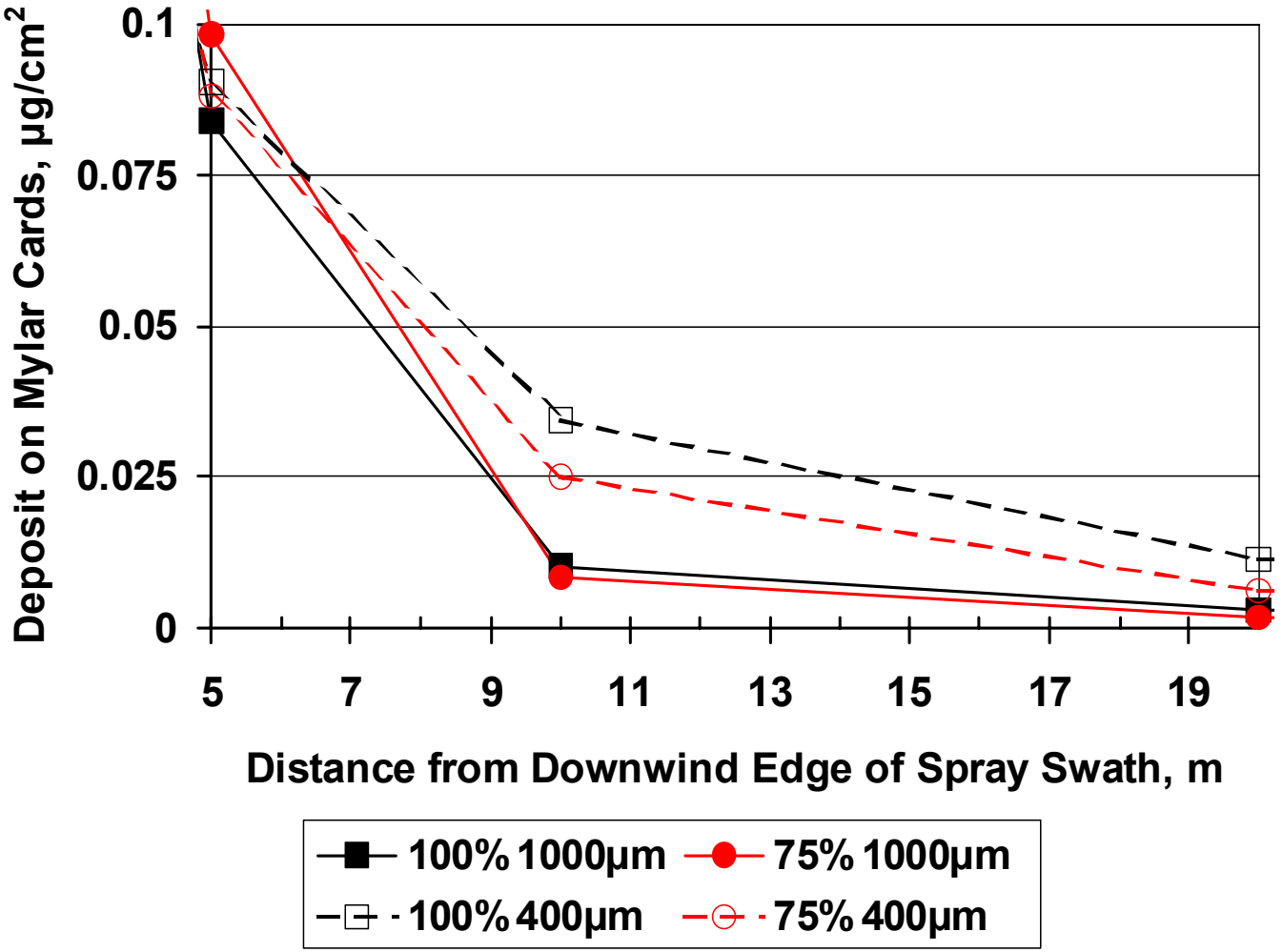
Results:
Weather Conditions for the Study

- Temperature – relatively stable at 78°F
- Relative Humidity – 29% to 62%
- Wind Velocity – 4-10 mph
  - Covariate in drift analysis
- Wind Direction – -22° to +27°
  - 0° velocity vector used in drift analysis

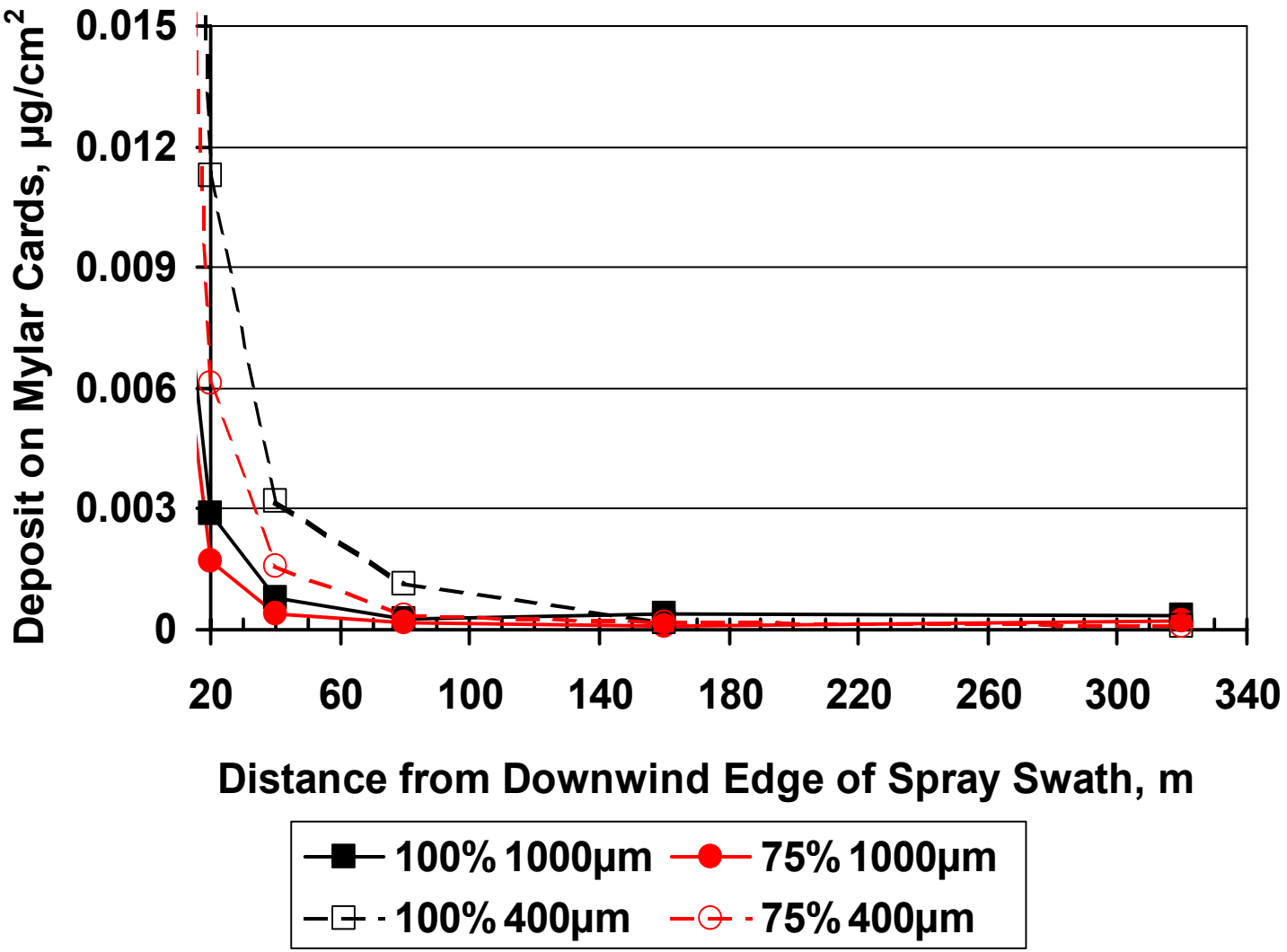
Results from Mylar Cards:
Displaced Swath Deposition



Results from Mylar Cards:
Near-Field Deposition/Drift



Results from Mylar Cards:
Far-Field Deposition/Drift

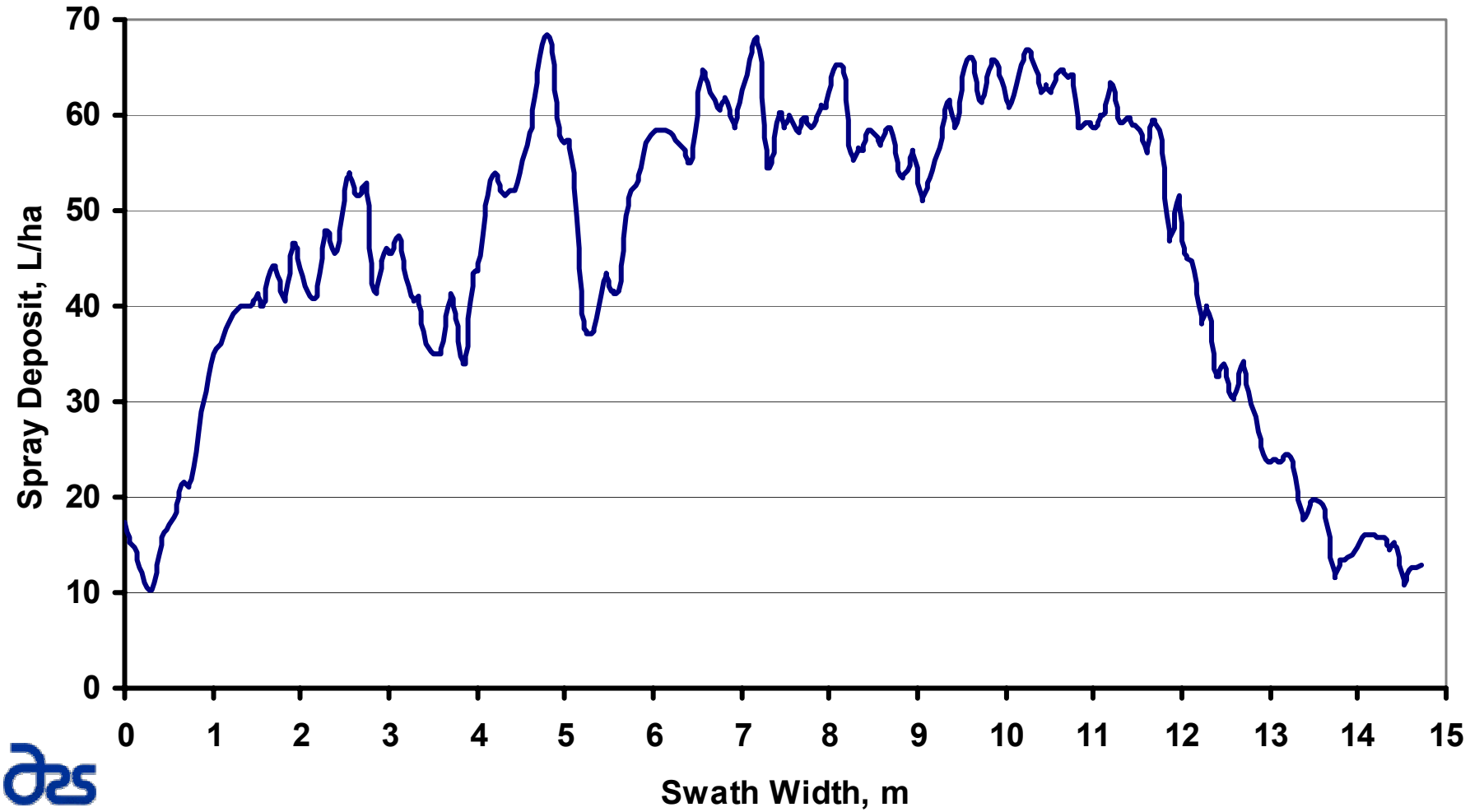


Results from Water Sensitive Cards:

- **No difference between helicopters equipped and operated the same.**
  - **Percent Coverage: 100% boom length and 400 µm spray droplet spectrum had higher drift deposits.**
  - **Droplet Density: More droplets drift and deposit downwind with the 400 µm droplet spectrum.**
  - **Droplet Size: Deposited droplet size was smaller than wind-tunnel estimates. Larger droplets drift and deposit downwind with the 100% boom length.**

USDA ARS

Results from Swath Width Analyses



Results from Swath Width Analyses:

- Droplet size was not a significant factor in determining swath width for 400-1000µm droplet size spectra
- Effective swath width is reduced with 75% boom length compared to 100% boom length for 400-1000µm droplet size spectra
- Optimum swath widths, based on low overall CV were on target with the guideline *effective swath width = 1.5X boom length* for 400-1000µm droplet size spectra

Drift and Swath Width for Helicopters

Summary

- No difference between helicopters in drift or swath width when setup and operated similarly
- 1000µm droplet spectrum results in less downwind than 400µm droplet spectrum
- 75% boom length reduces effrective swath width compared to 100% boom length
- 100% boom length results in increased spray drift with 400µm droplet spectrum
- With 1000µm droplet spectrum, 100% boom length does not have higher drift than 75% boom length


-- Time for Questions --