Update to the USDA ARS Rotary Wing Nozzle Models

NAAA Annual Convention – Technical Session

December 7, 2015

USDA ARS

Aerial Application Technology Research Unit

College Station, TX 77845

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New Models

- CP11TT with 20, 40, 80 degree flat fans
  - 0 to 45° Deflection
- CP11TT with straight stream
  - 0 and 15° Deflection
- Standard 40 & 80 degree flat fans
  - 0 to 45° Deflection
- Steel & ceramic disc core #45
  - 0 to 45° Deflection
- Steel & ceramic disc core straight stream
  - 0 and 15° Deflection
- CP03 (All settings)

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Major Changes

- CP09 and TriSet
  - Now broken up into Deflection only and Straight stream only models
    - CP09 Deflection 5 and 30°
    - TriSet Deflection 22.5 and 45°
  - Lower end airspeed limits
    - Straight Stream nozzles: 70 mph
    - All other nozzles: 50 mph

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Lower End Airspeed Limits

- Measurement system showed droplet size increasing from 30 to 50 (70) mph.
  - Instrument bias
- Account for this in models
  - For airspeeds below the 50 or 70 mph limit, use the droplet size calculated at that lower limit
    - Example: FF Nozzle A shows $D_{V0.5}$ = 300 µm at 50 mph. At 30 mph, $D_{V0.5}$ = 300 µm…..or 35, 40, 45 mph.

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WHERE DO THE NOZZLES “LIKE” TO OPERATE?

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CP11TT 80 Degree Flat Fan

80 mph and lower

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CP03
80 mph and lower

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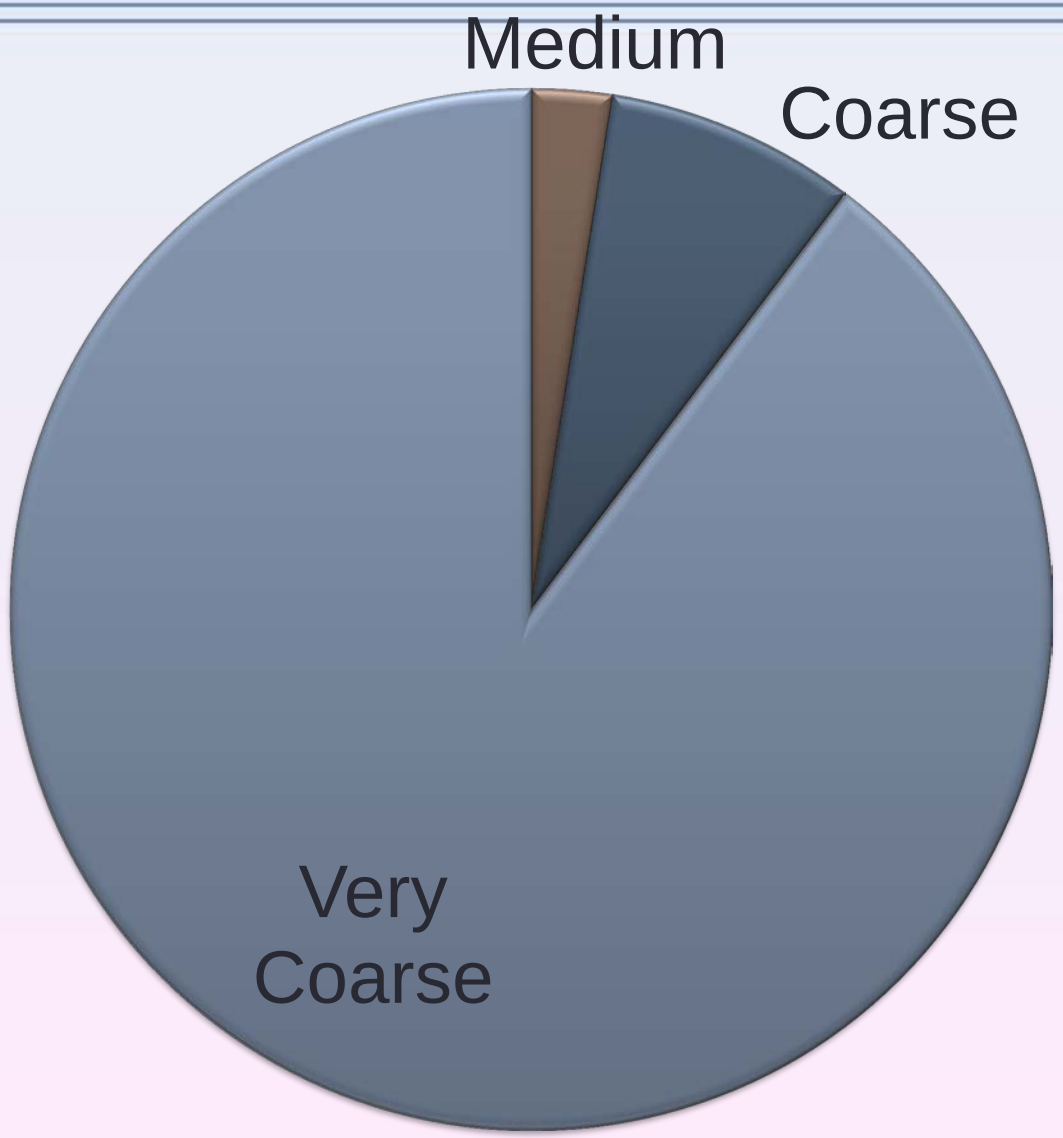
CP11TT 20 Degree Flat Fans
80 mph and lower



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Any Straight Stream
80 mph and lower

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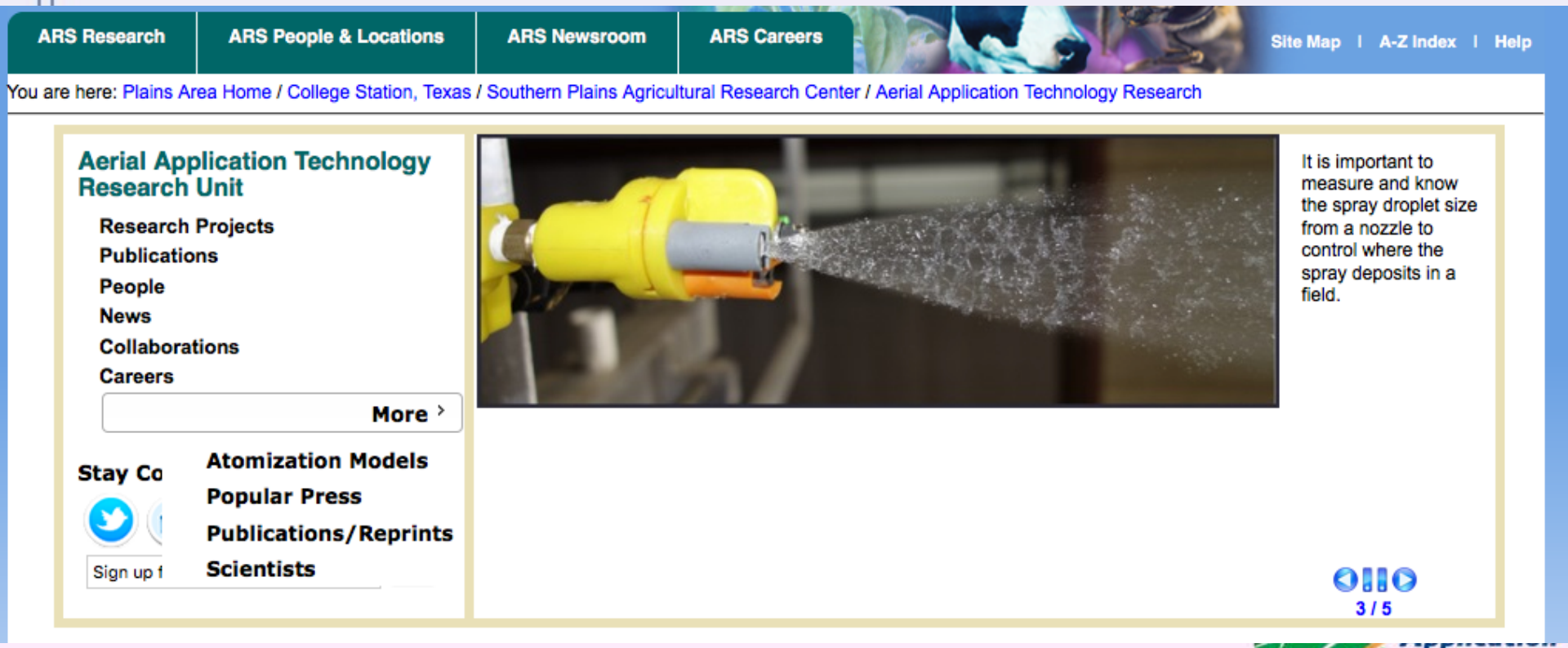
Models

- Same Excel format as current models
- Available online and in App NLT Jan 1, 2016
  - Google Search “USDA ARS Aerial Application”



Using High Pressure Sprays at High Airspeeds

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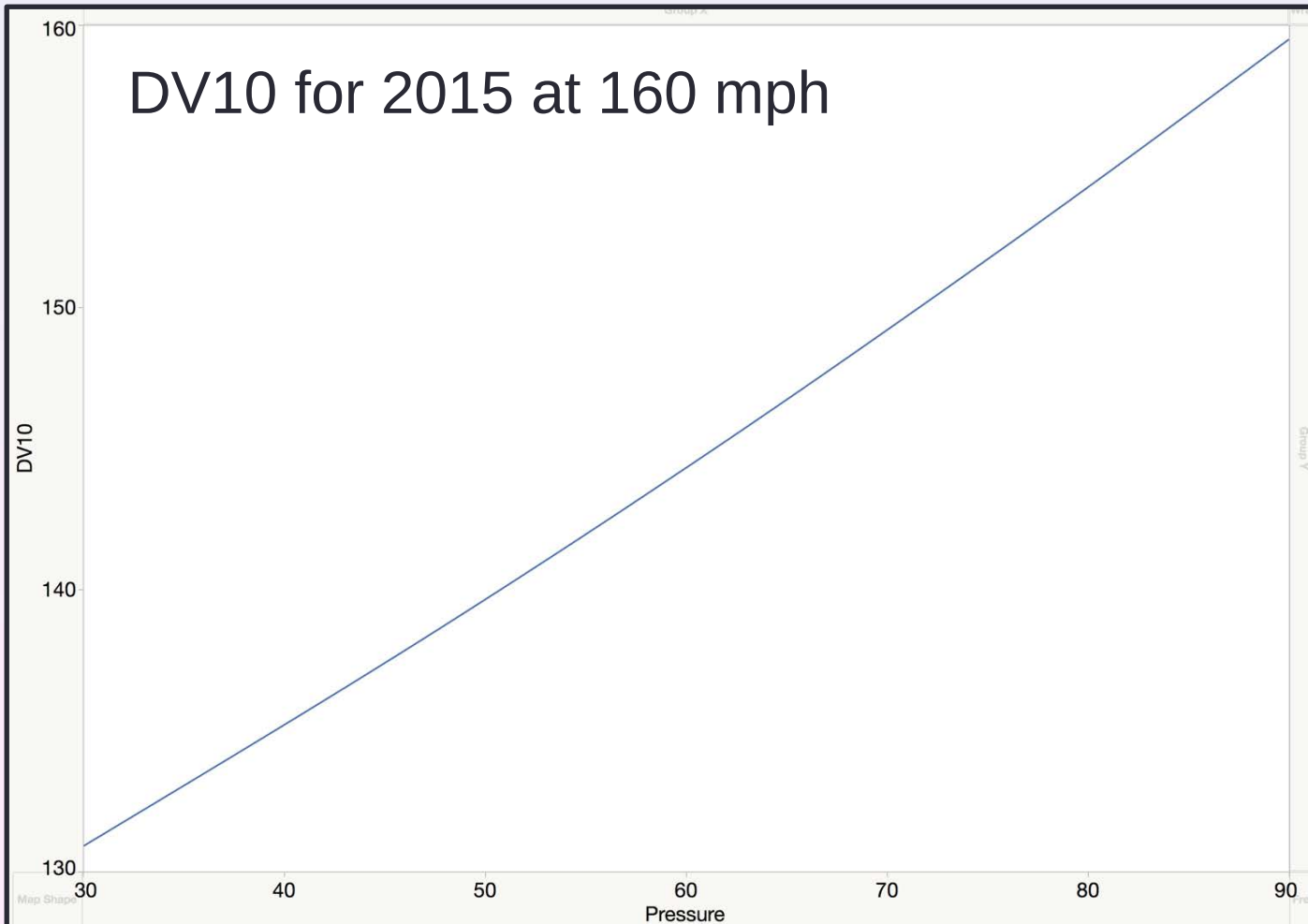
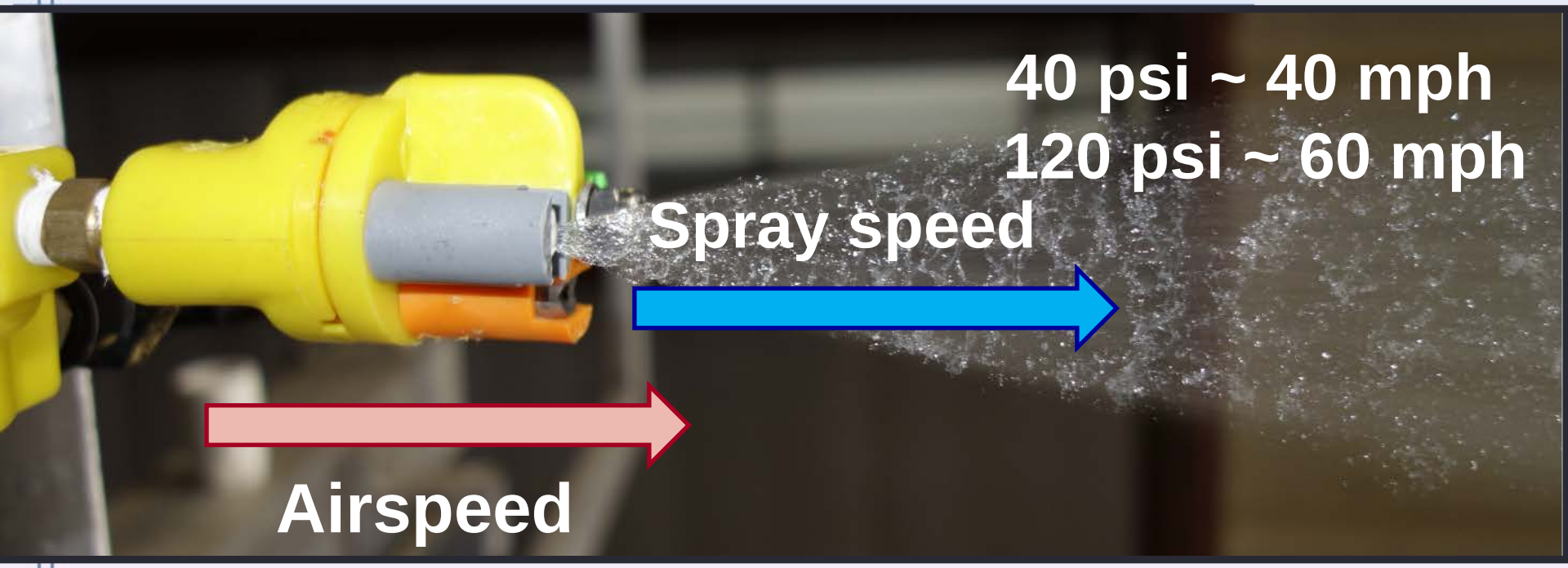
Why the Interest in High Pressures?

- New atomization models: Increased size up to 90 psi.



Why?



40 to 120 psi spray speed increases 20 mph

Similar to 160 mph down to 140 mph

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Higher Pressure Sprays

- **Can we further increase droplet size at higher airspeeds with higher than normal pressures?**
- **The short answer is "YES!"**
  - ~ 2% increase in $D_{V0.1}$ per 5 psi
  - ~ 2% decrease in %Vol<100µm per 5 psi

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Classification

Solution	Airspeed (mph)	2015 - DSC		4015 - DSC	
		40 psi	120 psi	40 psi	120 psi
PM	140	M	C	F	M
	160	F	M	F	F
	180	F	F	F	F
PM + MSO	140	M	C	M	C
	160	F	M	F	M
	180	F	F	F	F
PM + COC	140	M	C	M	C
	160	F	C	F	M
	180	F	M	F	F
PM + Silicone	140	F	C	F	M
	160	F	F	F	F
	180	F	F	F	F
PM + Polymer	140	M	C	F	M
	160	F	M	F	F
	180	F	F	F	F

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Considerations for High Pressures

- Plumbing
  - Most standard spray component will handle the higher pressure with no issue.
  - Potentially long term wear issues.
- Pump capacity
  - Looking like it will take hydraulic pump system to get flow and pressure.
  - Working with several entities to determine potential options
  - Ultimately hope to do field testing of prototype either on our or another aircraft.

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Considerations for High Pressures

- Flowrate and Boom Setup
  - 40 ➔ 120 psi - per nozzle flowrate ↑70%
  - For 65’ swath, 140 mph at 3 gpa with 2015s
    - 40 psi = 39 nozzles
    - 120 psi = 23 nozzles
    - Major change in boom layout and resulting pattern.
    - Orifice size reduction possible
      - Likely going down to an 08 would provide same application rate with 39 nozzles at the 120 psi
        - » Will need to confirm flowrate and DS
  - New, higher pressure boom layouts would require evaluation at a S.A.F.E. Clinic.

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