Advances in Aerial Herbicide Application for Drift Mitigation

2011 SE Herbicide Applicator Conference

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Topics for Discussion

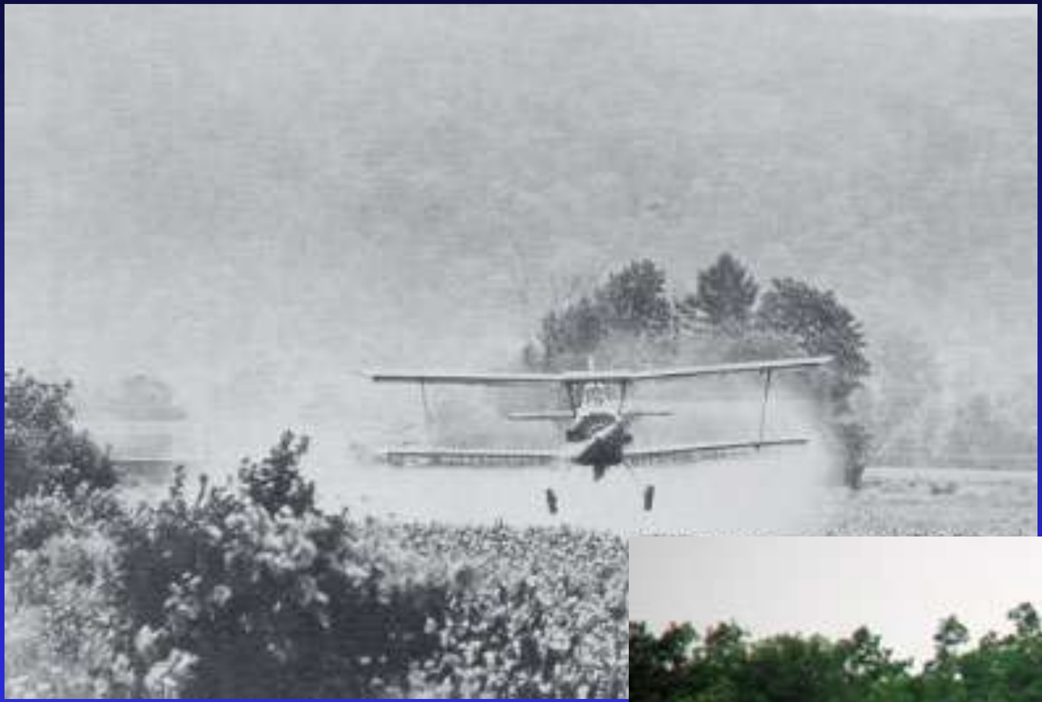
- Factors affecting drift potential
- Application of solids
- Aerial spraying, deposition efficiency
- Aircraft and equipment selection
- Effect of spray additives
- Environmental factors affecting drift potential and herbicide performance

Factors Affecting Drift Potential

- **Application parameters**, especially droplet size and spraying technique (nozzle selection, booms, aircraft, etc.)
- **Weather effects**, especially wind speed and direction, height of inversion layer
- **Tank mix effects**, product formulations, surfactants, emulsifiers, drift control agents

- Research by the Spray Drift Task Force and others provides some useful information for minimizing drift

Fixed-Wing Application



Helicopter Spraying

Rotor Vs. Fixed Wing

- **HELICOPTER**
- Remote Landing
- Maneuverable
- Slow Air Speed
- Used in Sensitive areas

- **FIXED WING**
- Greater Payload
- Lower Costs
- More Potential for Off-Site Movement
- Not Permitted with Some Herbicides

Solids: Iso-Lair Bucket

Aerial Application of Solids

- Modified seeders and fertilizer spreaders are used to broadcast herbicide granules
- More difficult to control rate per acre and uniformity across the swath than sprays
- Carrier evaporation is not a concern
- Fines or dust in product formulations increase potential for off-site movement
- To avoid streaks or drift, do not apply when winds are gusty or exceed 5 mph

Small Droplets Give Good Coverage on the Leaf Surface

Droplet Diameter (Microns)	Droplets on Leaf (Per Sq. Inch)
50	92,250
100	11,750
200	1,425
400	180
800	22

Akesson and Yates, 1987, WSSA

Small Droplets Drift!!!!

Droplet Diameter (Microns)	Wind 1 mph	5 mph	10 mph
10	1.5 miles	7.5 miles	14.5 miles
100	75 feet	375 feet	750 feet
300	8 feet	42 feet	83 feet
600	2 feet	11 feet	21 feet
800	1 foot	6 feet	12 feet

Hansen, 1965; see Akesson and Yates, 1987, WSSA

Evaporation Rate & Droplet Size

20 ft, 1 mph Wind, 25C, 55%RH

Droplet Diameter (Microns)	Droplet Disappears (Fall Distance)
200	--
150	15 ft
120	7 ft
100	3.5 ft
80	2 ft

Akesson and Yates, 1987, WSSA

Application Parameters Affecting Droplet Size Spectrum

- Orifice size and type of nozzle
- Nozzle discharge angle
- Pressure at the nozzle
- Application height
- Droplet shear, turbulence, airspeed
- Evaporative losses while airborne

Nozzle Selection

- Flat fans, disc-cores, cone nozzles can produce fairly coarse sprays by VMD if operated at low pressures and low nozzle angles
- Solid stream nozzles can produce even coarser sprays by VMD if operated at medium pressures
- *All of these also tend to produce some "fines"*

- Multiple-orifice solid stream nozzles such as TVB and Accu-Flo tend to produce very coarse sprays and almost no "fines" if operated optimally

Aerial Spray Equipment

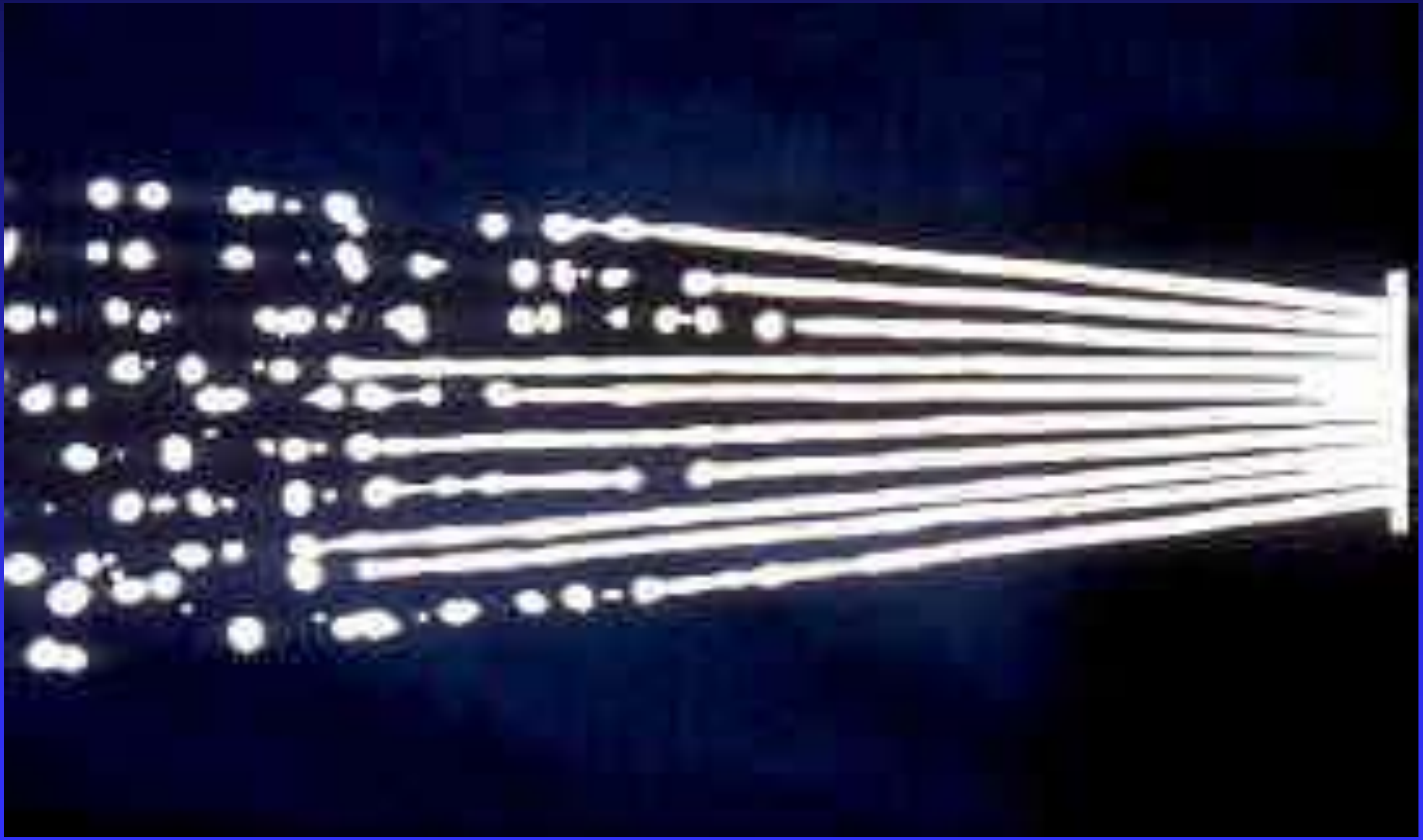
- <u>**CONVENTIONAL**</u>
- Simplex(R) Boom
- Warnell(R) Boom
- Teejet(R) Disc-Core Nozzles
- Raindrop(R) Nozzles

- <u>**CONTROLLED DROPLET BOOMS**</u>
- Microfoil(R) Boom
- Thru-Valve(R) Boom
- Microfoil(R) Nozzles
- TVB(R) Nozzles
- Accu-Flo(R) Nozzles

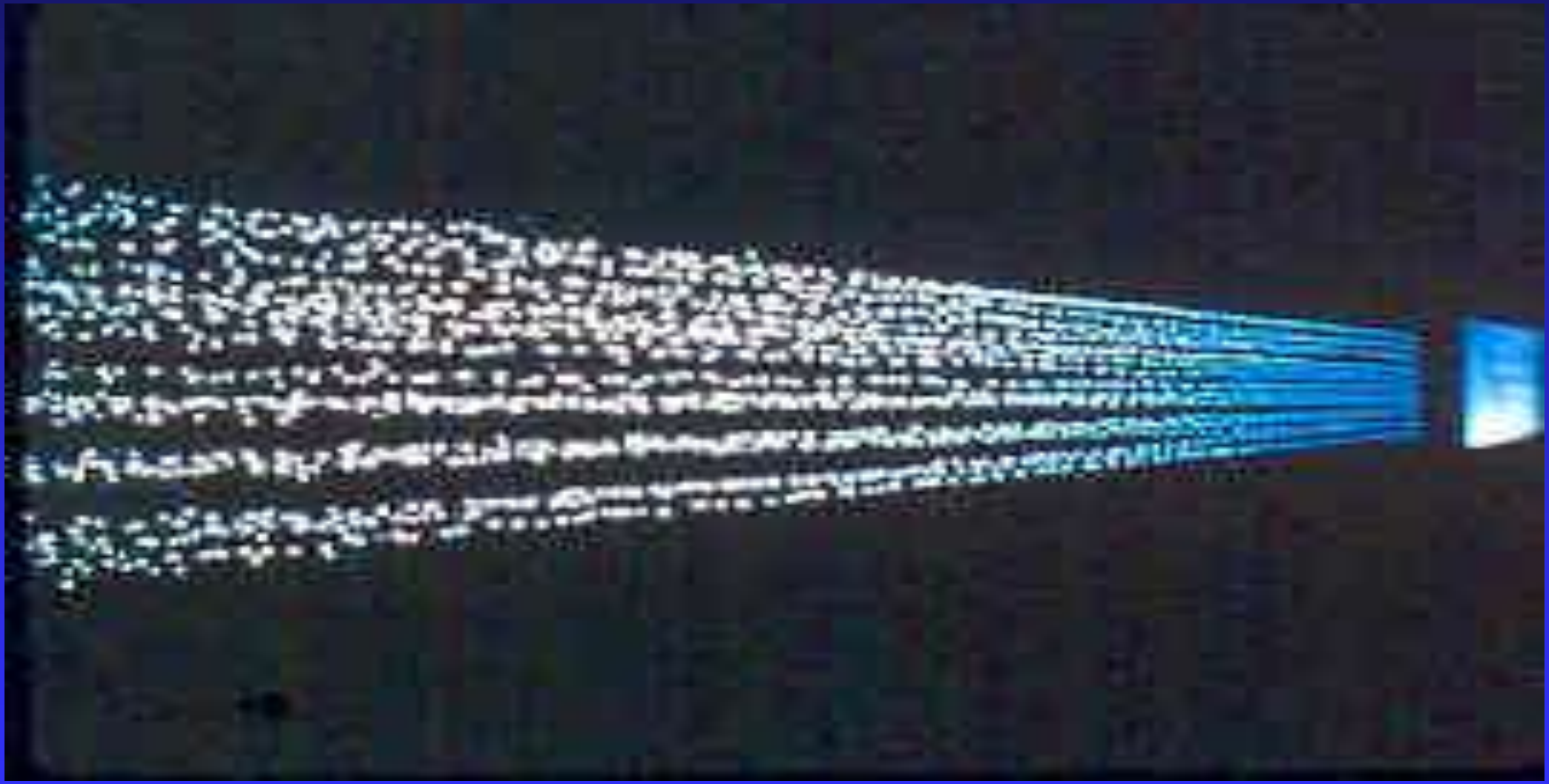
Microfoil® Boom

Thru-Valve Boom & Nozzle (TVB)

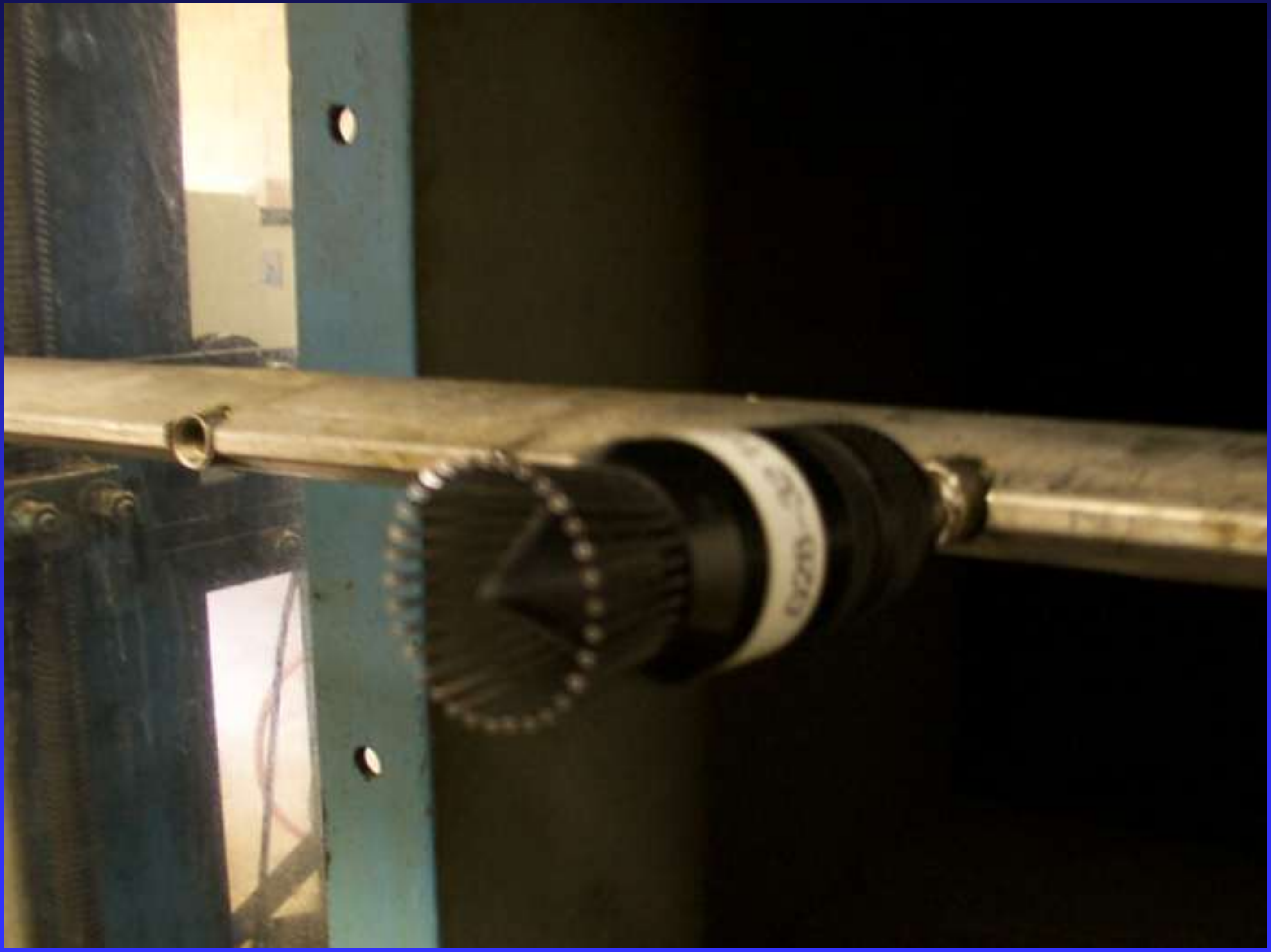
TVB 0.045 Pattern



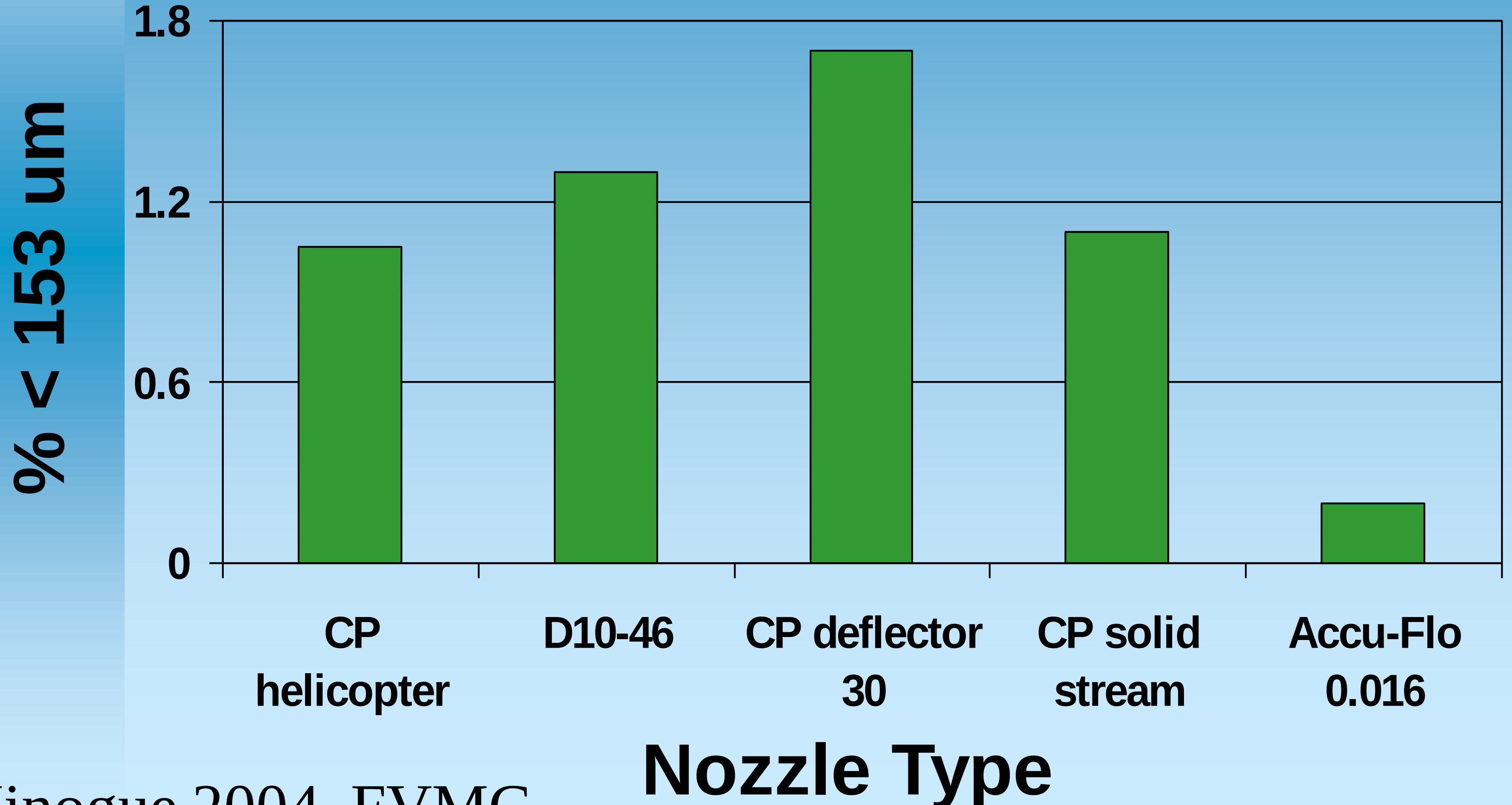
TVB 0.028 Pattern



Accu-Flo Nozzle



Comparison of the percentage of fines with various nozzles spraying water



Minogue 2004, FVMC

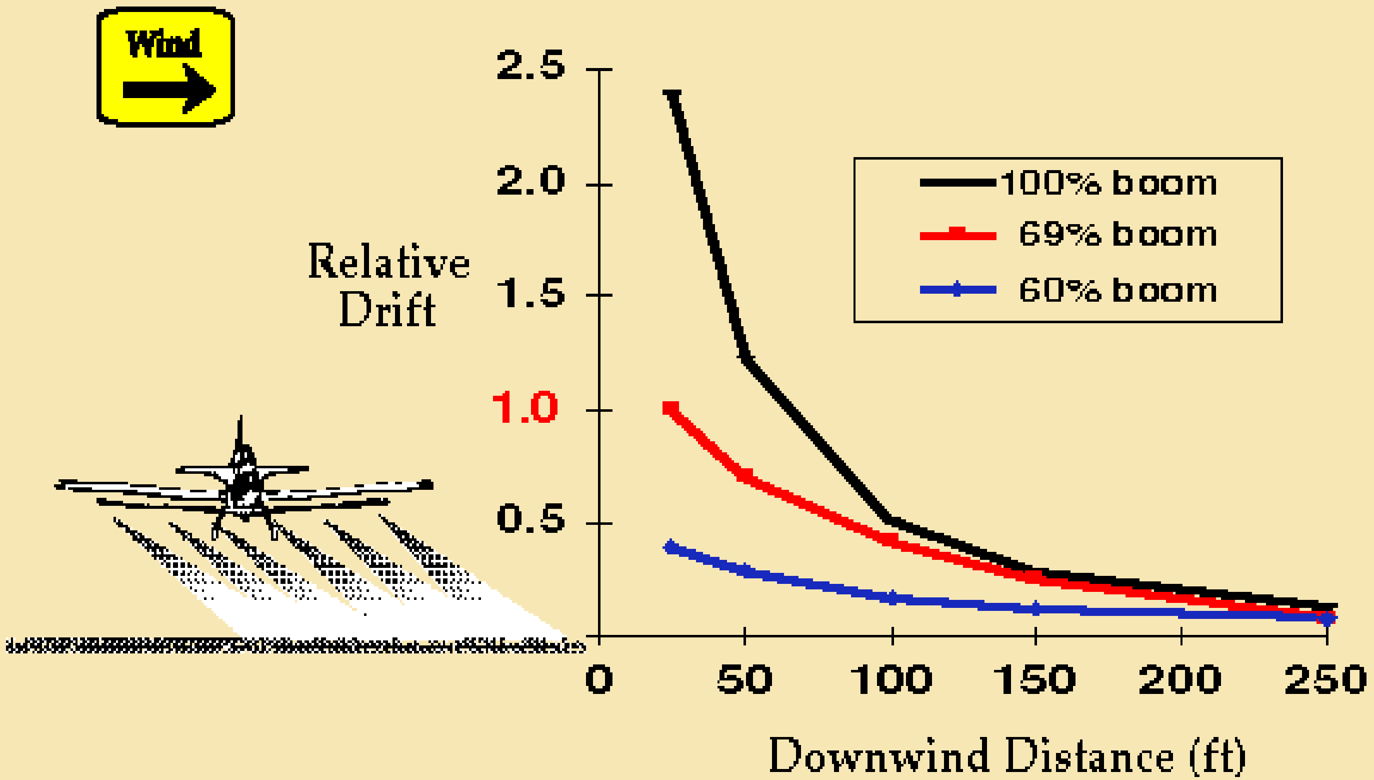
Boom Length

- Shorter boom lengths can greatly reduce drift, for rotary and fixed wing aircraft
- For fixed-wing aircraft, the greatest benefit is obtained when booms are <65% of wing length
- Will not necessarily decrease swath width sufficiently to require significantly more flight passes

Shorter boom

How boom length affects drift

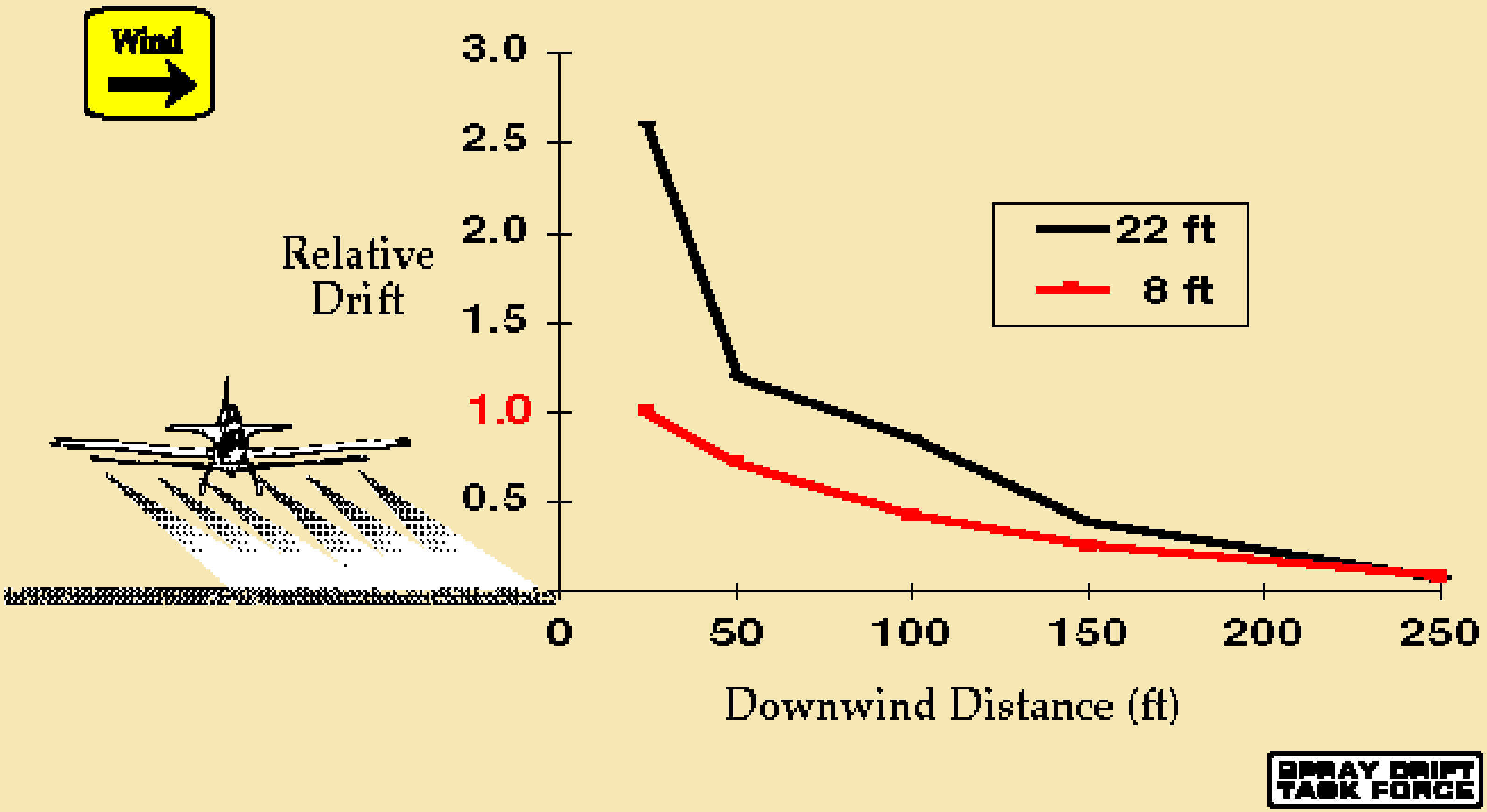
Model-generated data for Control Application



SPRAY DRIFT TASK FORCE

How nozzle height affects drift

Control Application



GPS: Global Positioning Systems

- Documents path of the aircraft
- Delineates treatment area
- Very useful to determine airspeed to ensure correct calibration of spray volume and herbicide rates per acre.
- Can be integrated with injection systems to control delivery rate.

AG-NAV GPS

- Direction to Swath
- Cross-Track
- Direction to Intercept

Large Nav-Bar - External

Medium Nav-Bar - Internal

AG-Flow Flow-Control

Controls output volume based on ground speed

Application Practices: Swath Adjustment

- Most applicators already practice swath adjustment, a practice which can have a very large effect on reducing drift
- Offset varies by wind speed and droplet size

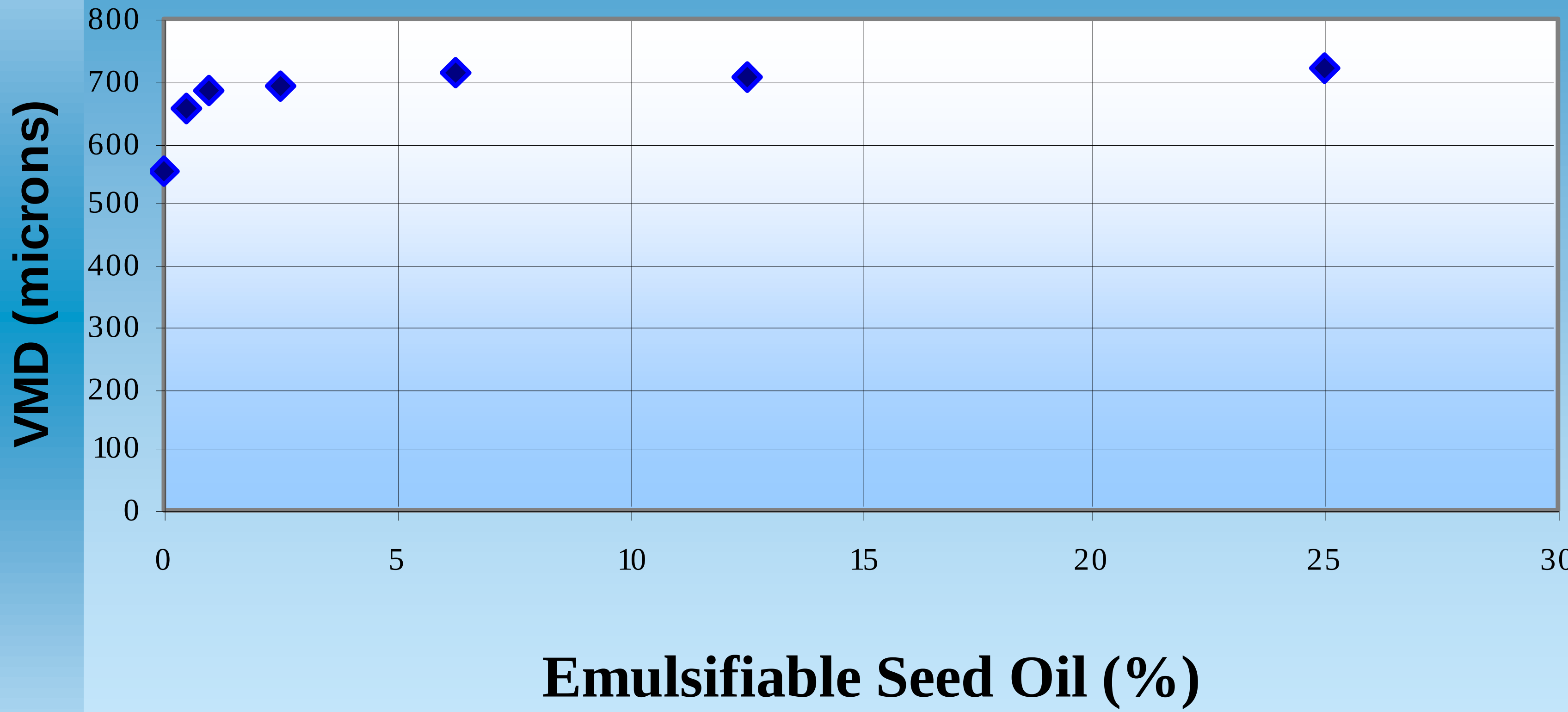
- Fly the pattern

Tank Mix Effects

- Tank mix selection can have a large effect on droplet size from some nozzle types
- Avoid the use of excessive non-ionic surfactant where possible (especially polyethoxylates)
- Emulsion adjuvants such as emulsified seed oils and organosilicones can reduce “fines”,

  but oils increase drift hazard!
- “**Drift Control**” Polymers tend to increase VMD, but often also increase % “fines”, and may be affected by pumping and tank mix partners; not suitable with some nozzle types

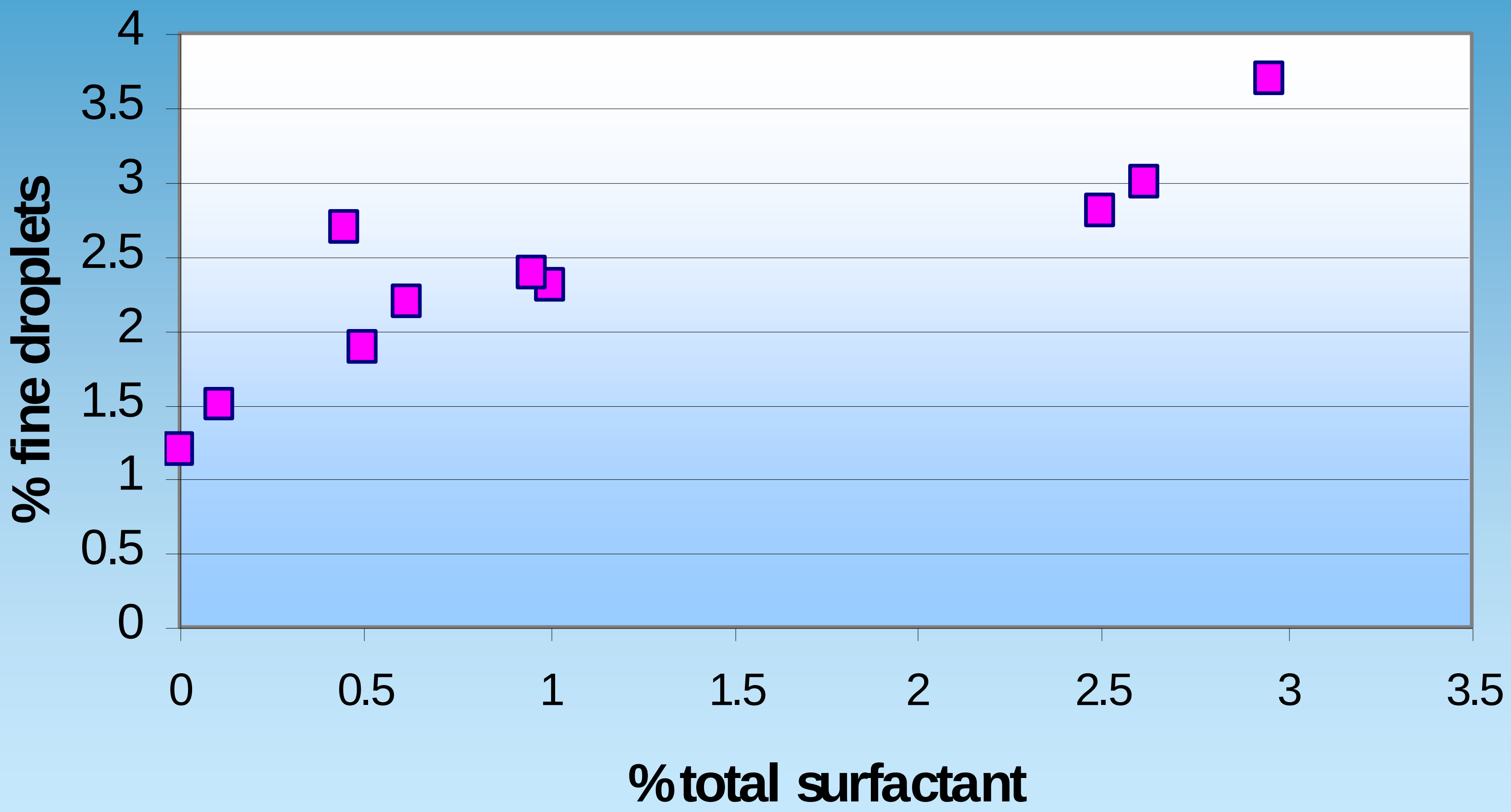
Herbicide/ Modified Seed Oil Tank Mixes



Minogue and Dexter, 2002, BASF Research Rpt. 2002-02

Polyethoxylate surfactants increase fines.

Percentage of Droplets < 153 microns



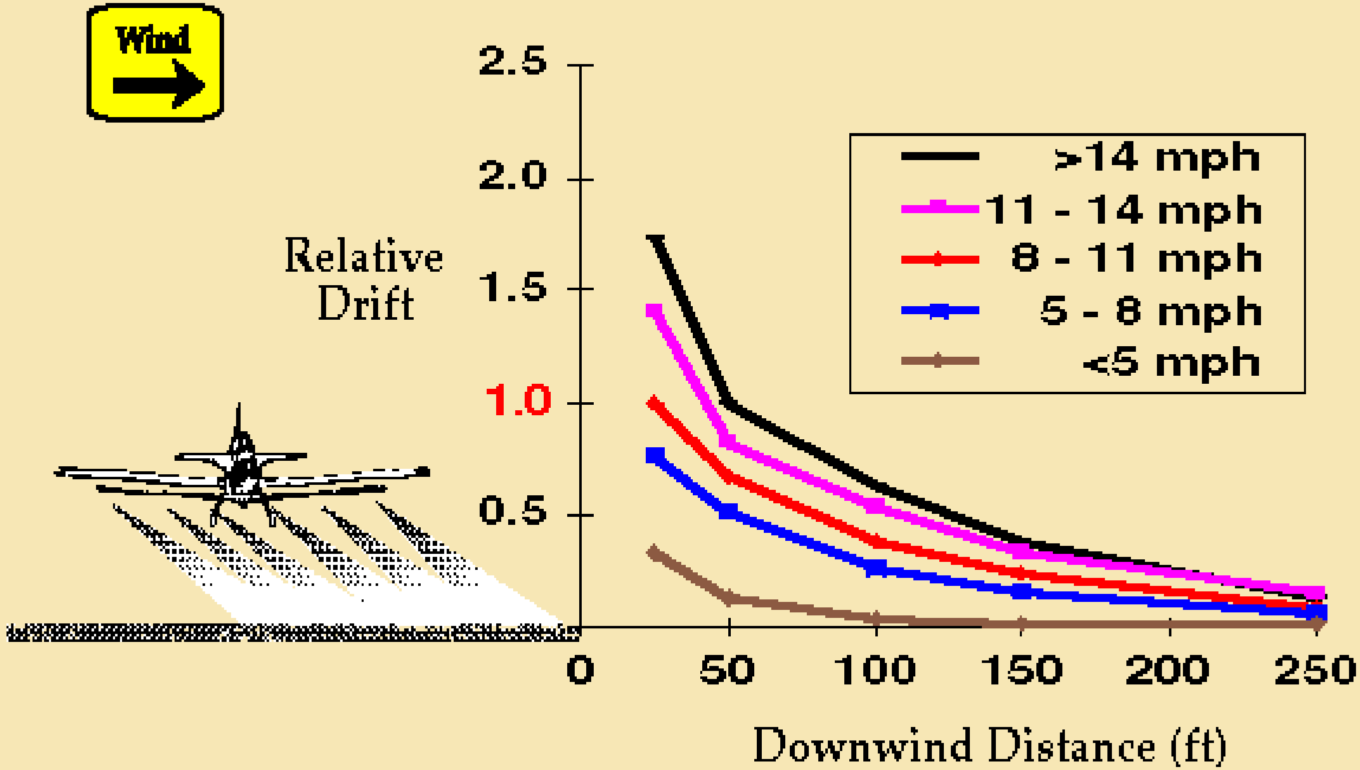
Minogue and Dexter, 2002, BASF Research Rpt. 2002-02

Meteorological Effects

- Wind speed and direction are key parameters affecting drift
- Temperature and relative humidity can affect evaporation rates, so may also be important
- Air stability important- most labels recommend not spraying under local surface temperature inversion condition

How wind speed affects drift

Control Application



SPRAY DRIFT TASK FORCE

Conclusions

- **Select nozzle type to avoid fine droplets**
- **Carefully consider application methods and conditions**
- **Avoid great release heights**
- **Avoid high wind speeds**
- **Use short boom lengths and good application practices**
- **Avoid excessive (NIS) surfactant**

Sources of Additional Information

- **Up to Date Extension Publications "edis" http://edis.ifas.ufl.edu**

  Forestry Program Website: http://nfrec.ifas.ufl.edu/contact/PatMinogue.shtml

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