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IMPORTANCE OF DROPLET SPECTRUM

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Why do we calibrate and measure droplets?



- Historically, certain compounds during aerial applications caused paint spotting on automobiles
- Early research also discovered certain droplet sizes are more efficacious
- Heavy deposition resulted in non-target mortality
- Smaller droplets are virtually ineffective or wasted

History



- Jim Robinson of Pasco County discovered through high-speed photography in a wind tunnel, the presence of extremely large droplets produced by flat-fan nozzles.



History



- Study in 1970 by G. Mount concluded:
 - In a 1970 paper, Mount et al looked at the “Relationship of Minimum Lethal Dose To The Optimum Size of Droplets of Insecticides for Mosquito Control”.
 - They found the “lethal dose” size to be 25 microns for malathion, 17.5 and 20 microns for Naled and Fenthion.
 - They concluded that, for the above mentioned insecticides, they should be atomized to droplets of 25 microns or less for maximum efficiency.

History



- A lethal dose of an active ingredient is contained in an 18 micron diameter droplet.
- A 54 micron drop would contain 27x the lethal dose (wasting 26x the dose even if it does contact a mosquito!)
- Droplet Density – Number of droplets per unit volume changes as the “inverse cube” of the change in droplet size. (Halve the diameter, increase the number by 8x)

History



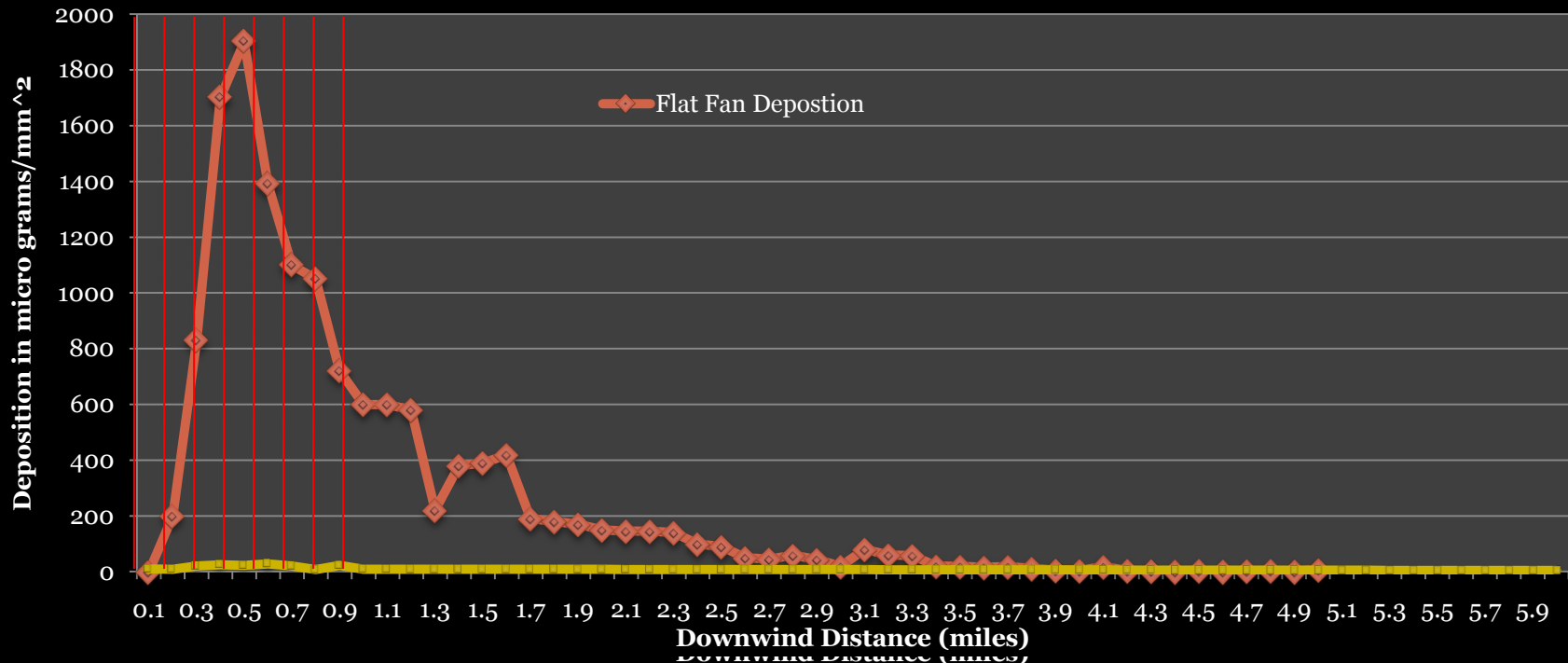
- How many droplets would be produced from a BB?
 - ✦ 20 micron droplet would produce 9,761,000
 - ✦ 17 micron droplet would produce 15,079,991
 - ✦ 10 micron droplet would produce 74,088,000

History



- Dr. Jim Dukes, PHEREC Lab Panama City Beach, FL. performed non-target effect and drift study in cooperation with Collier Mosquito Control

Inefficient Droplet Spectrum vs. Efficient Droplet Spectrum



History



- Malvern laser wind-tunnel



History



- Measuring meteorology at aircraft release height
- Advent of advanced GPS system which provided real-time optimization offsets
- Introduction, training and use of AGDISP

What benefits did these advances yield if adopted?



- Approximately 75% more of an adulticide ounce, gallon, etc... is within a droplet size to result in a LD90
- Greatly reduced the concentration of deposition
- Efficient droplet spectrum provided users the economic opulence of reducing application rates while increasing mortality
- Demonstrated to regulators that as an industry we guided standards vs. being told what to do (especially during the FQPA re-registration)

Enough History, What are the driving forces now?

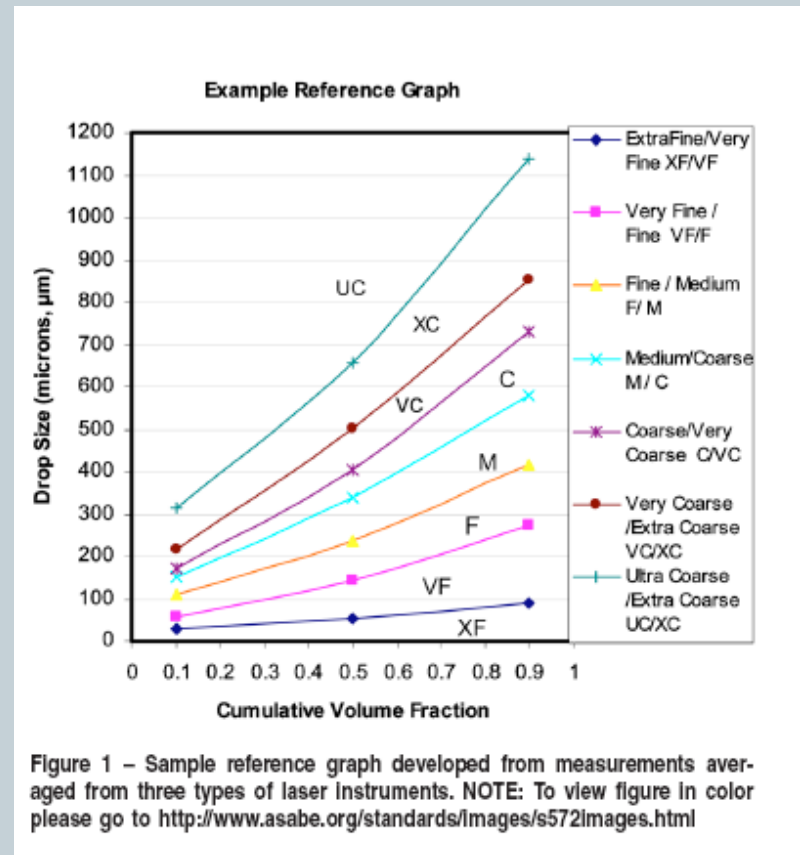


- The $Dv_{0.1}$, $Dv_{0.5}$ and $Dv_{0.9}$ are Standard Terminologies (used by the ASABE ASTM and world wide) now adopted by the EPA
- These are simple standard methods for describing a spray distribution
- VMD alone describes only a median, no information on the rest of the spray
- The most popular method of describing the spread or distribution of a droplet spectrum spray cloud is called the Relative Span (RS)

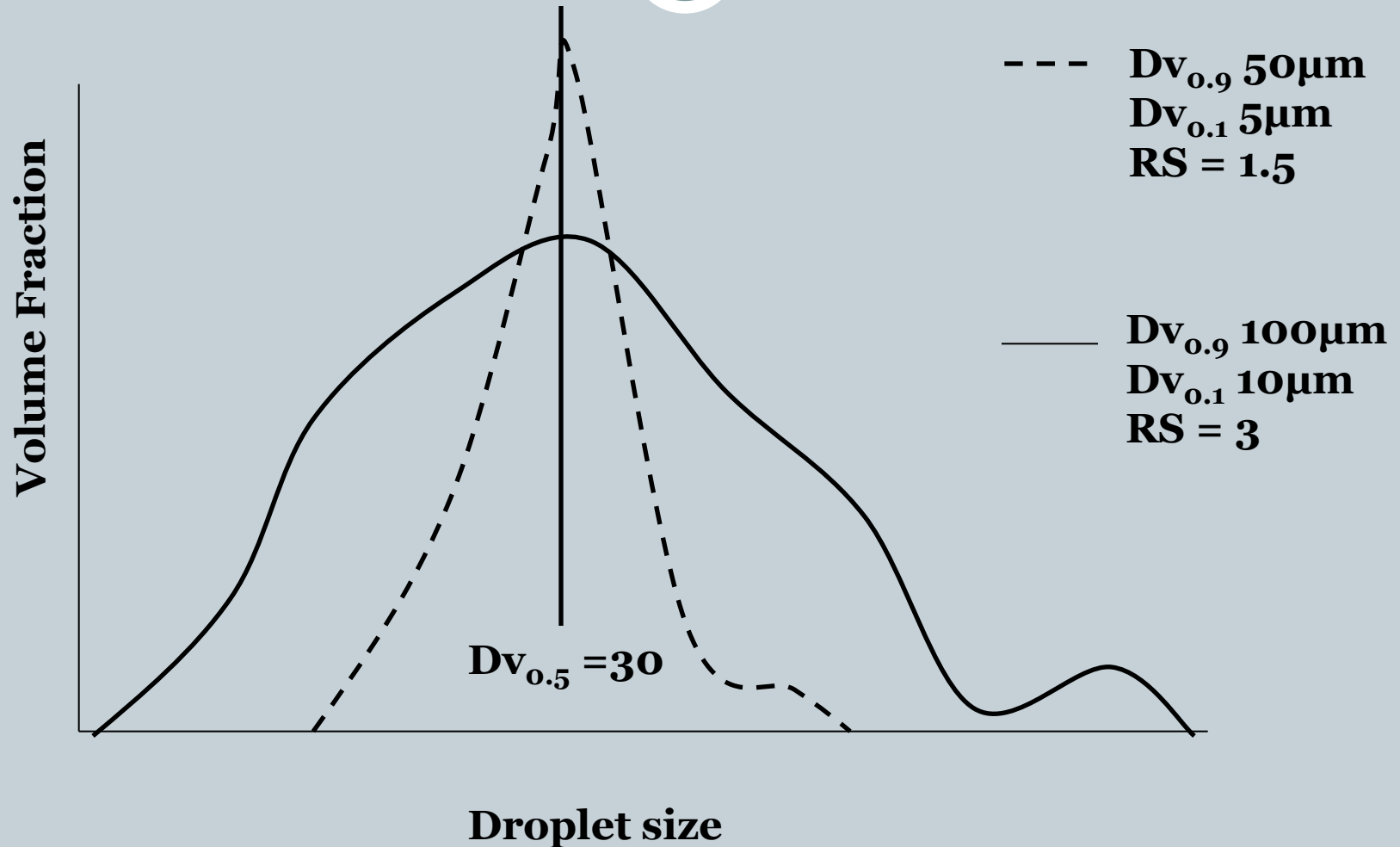
$$RS = \frac{(Dv_{0.9} - Dv_{0.1})}{Dv_{0.5}}$$

Importance of Droplet Spectrum

- As per the ASABE and ASTM the standard terminologies for droplet distributions are;
 - ✦ The $Dv_{0.5}$ is the diameter of the drop where 50% of the volume is in drops of a smaller diameter
 - ✦ The $Dv_{0.1}$ and $Dv_{0.9}$ are the diameters where 10% and 90% respectively are in drops of a smaller diameter
- Vector/Mosquito Control have a category now called Extra Fine (XF)



Importance of Droplet Spectrum

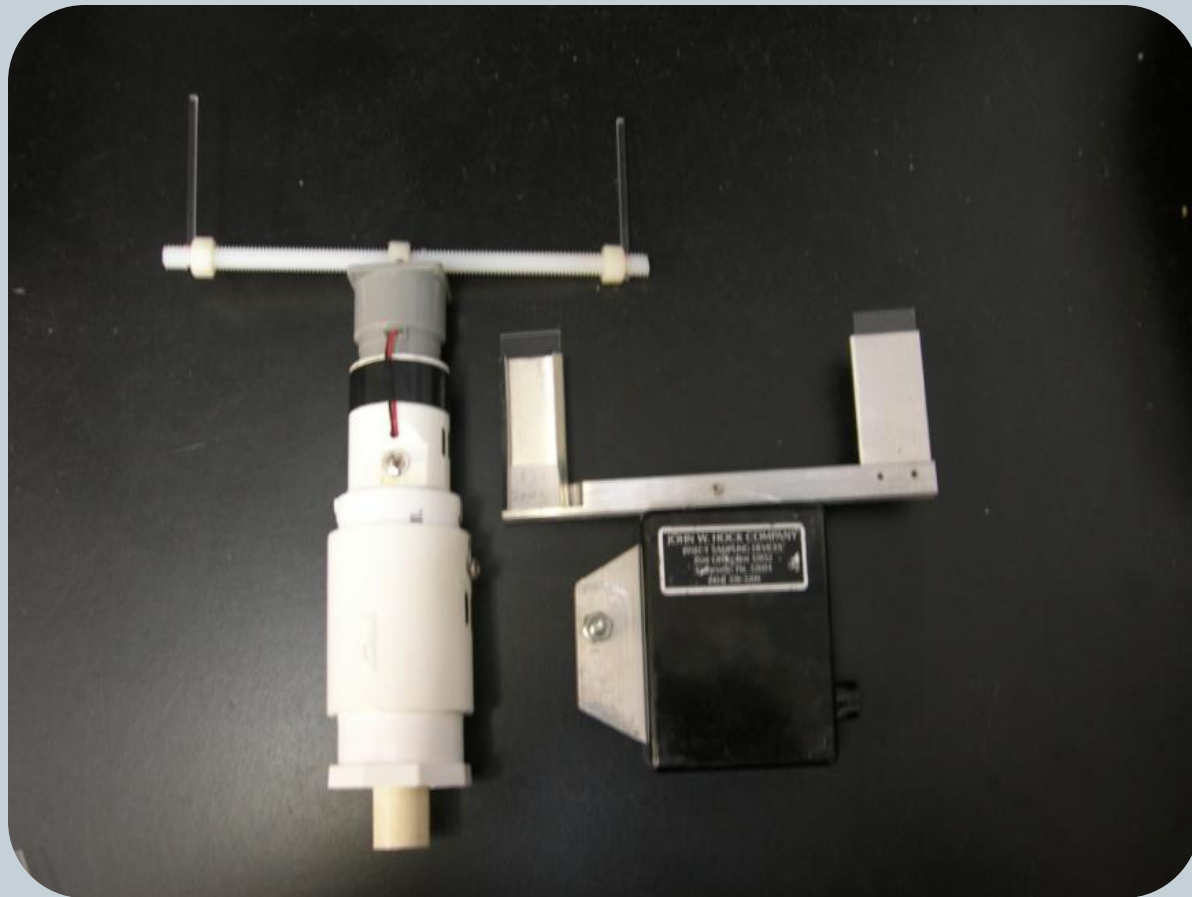


Droplet Collection Methods



- Spinning Impingers
 - 1" slides
 - ✦ Good for ground and aerial adulticide characterization
 - ✦ Not efficient at collecting far field or downrange smaller droplets
 - ✦ Biased collection method
 - ✦ Slightly more expensive
 - 3mm slides
 - ✦ Good for ground and aerial adulticide characterization
 - ✦ Efficient at collecting far field or downrange smaller droplets
 - ✦ Biased collection method
 - ✦ Economical
 - ✦ Last a long time
 - Magnesium oxide slides
- Cascade Impacter
- Silicon

Droplet Collection Methods



Methods for Measuring Droplet Spectrum



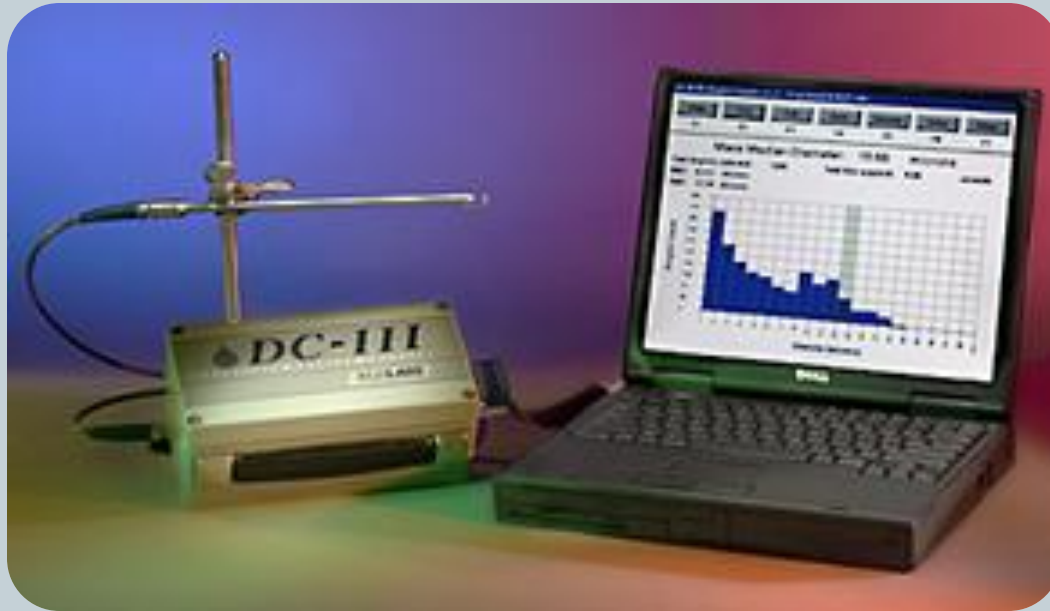
- Read teflon, magnesium oxide slides by human eye with microscope



Methods for Measuring Droplet Spectrum



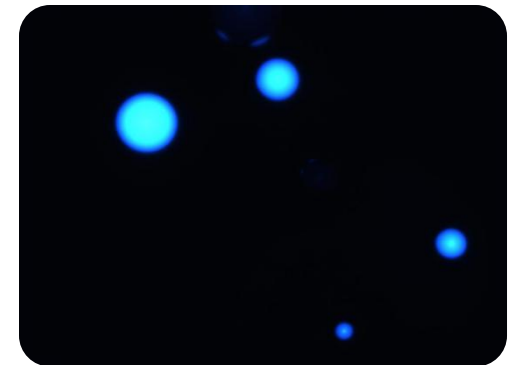
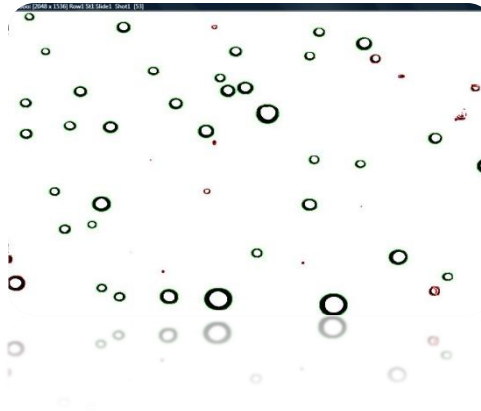
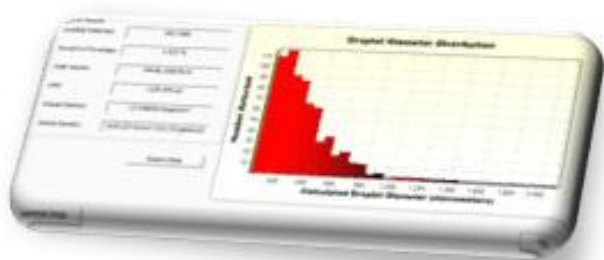
- DC-III hotwire



Methods for Measuring Droplet Spectrum



- DropVision™
- DropVision™ Fluorescence
- DropVision AG™ – Larvacide



Questions?

