

# Fundamentals: Improving Spray Coverage

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- A close-up photograph of a green leaf, showing a network of veins. The veins are dark green and form a complex, branching pattern across the leaf's surface. The leaf cells are a lighter, vibrant green. The background is slightly blurred, emphasizing the texture and structure of the leaf.
- **Assuming timing and product choice requirements are satisfied, improved spray coverage typically results in improved crop protection.**
  - **For contact products like fungicides (which don't tend to translocate or redistribute) the region of influence is small, making coverage especially important.**



- **Dr. Tom Wolf performed spray coverage work on chickpeas that is relevant to cucumber.**
- **One variety (adzuki) is similarly dense and leafy.**



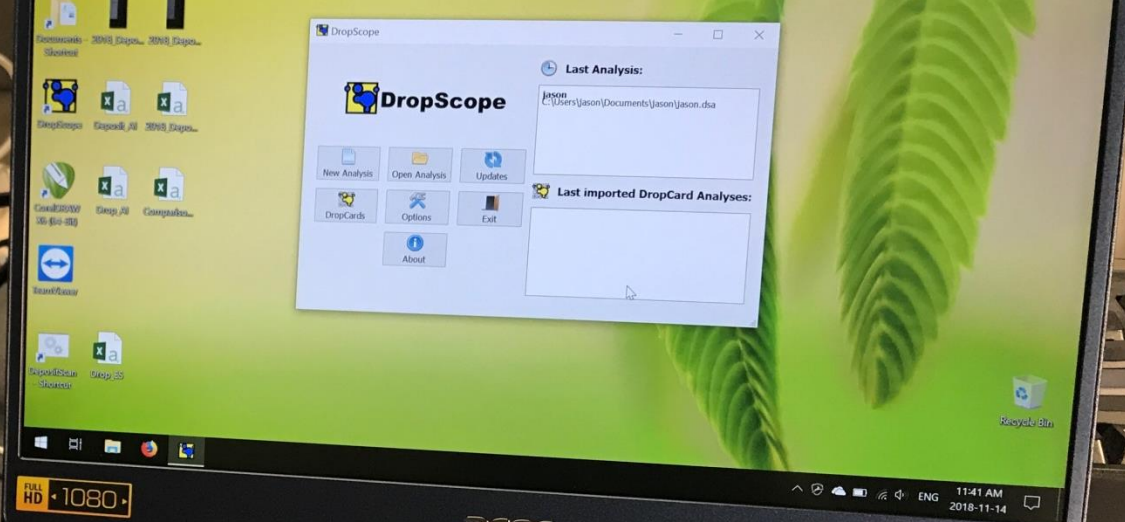


- **Water sensitive paper was placed at three canopy depths to assess the effect of spray volume (Medium spray quality, 10-12 mph).**





# DropScope



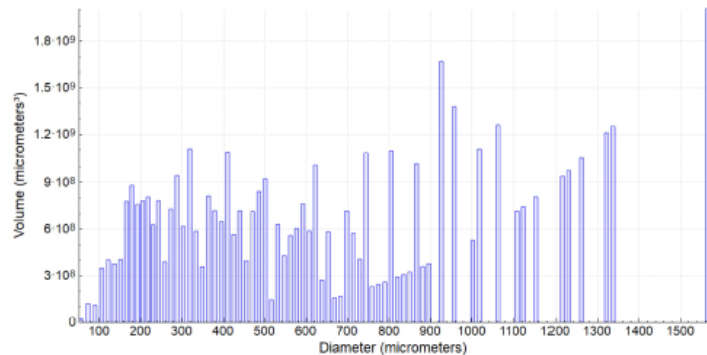
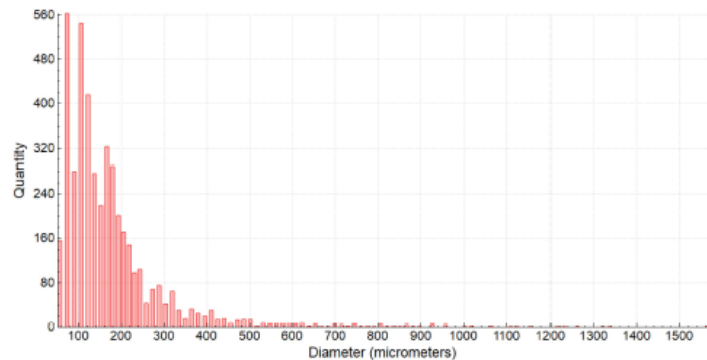
FULL HD 1080p

acer

Intel  
CORE i5  
7th Gen

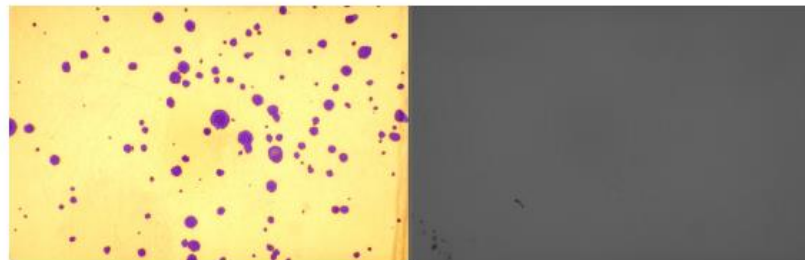
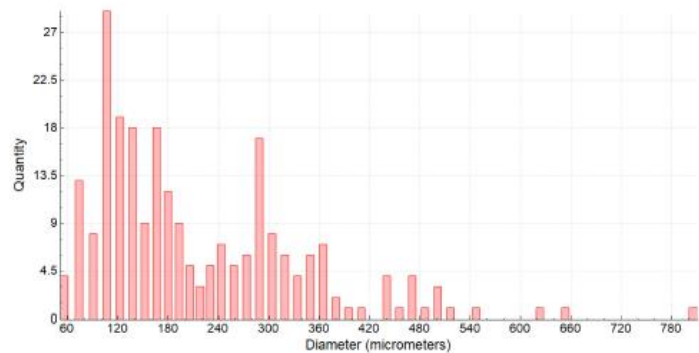
### ConvTop

Analysed Area	16.08 cm <sup>2</sup>	Covered Area	30.49
Estimated applied volume	2.99 $\mu\text{L}/\text{cm}^2$	Density	274.69
Number of Drops	4,418.00	Relative Amplitude	1.65
Variation coefficient	72.34	Drift Potential	0.50
VMD	638.19	D0.1	205.89
D0.9	1,261.19	NMD	137.60
Largest Drop	1,565.09 $\mu\text{m}$	Smallest Drop	56.31
Average Diameter	174.84 $\mu\text{m}$		

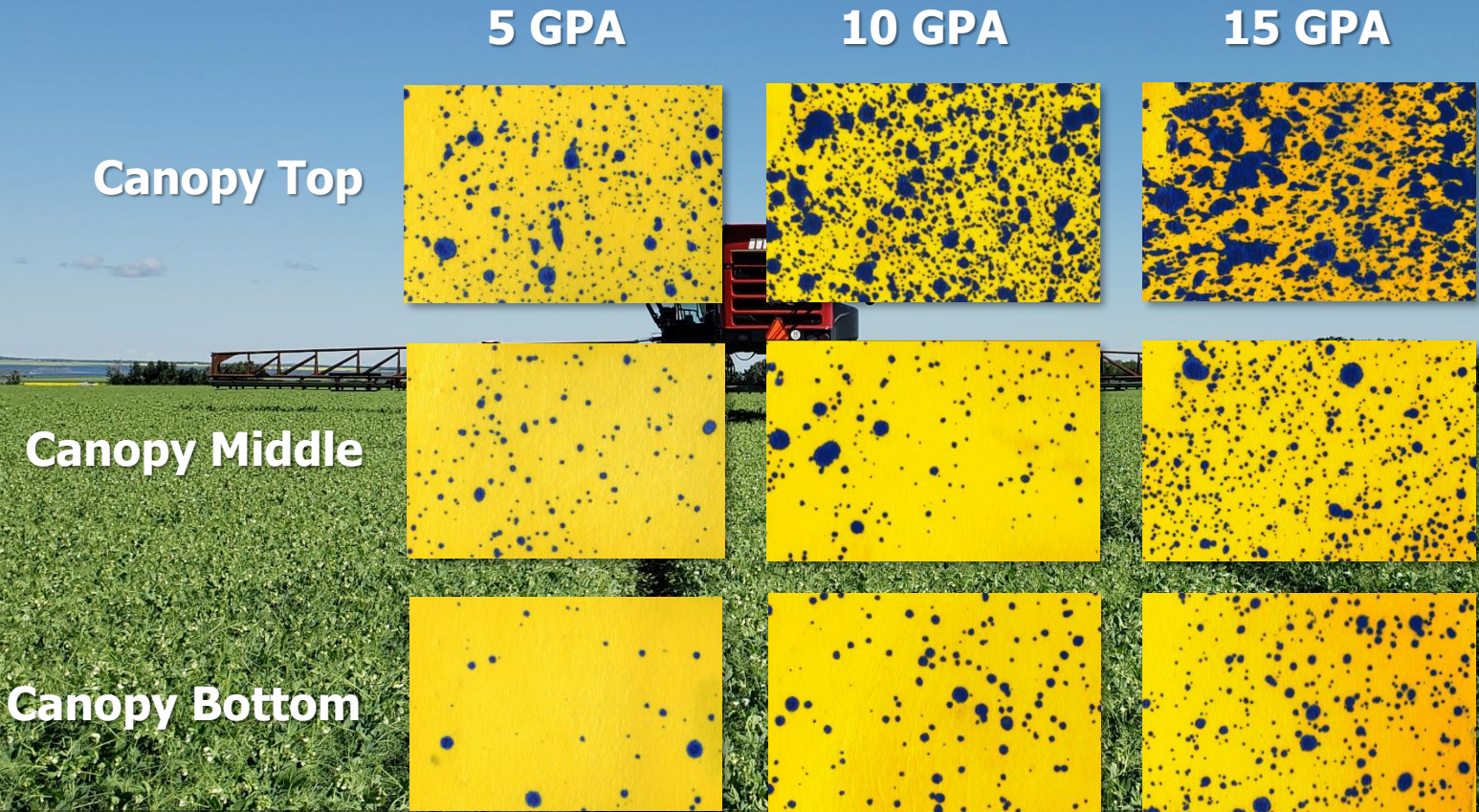


### Conv 10gpa Bot R2 - Results

Analysed Area	7.99 cm <sup>2</sup>	Covered Area	5.66%
Estimated applied volume	0.35 $\mu\text{L}/\text{cm}^2$	Density	30.03 N/cm <sup>2</sup>
Number of Drops	240.00	Relative Amplitude	0.93
Variation coefficient	57.35	Drift Potential	0.22%
VMD	440.66	D0.1	243.12
D0.9	653.39	NMD	179.91
Largest Drop	805.34 $\mu\text{m}$	Smallest Drop	56.31 $\mu\text{m}$
Average Diameter	214.95 $\mu\text{m}$		








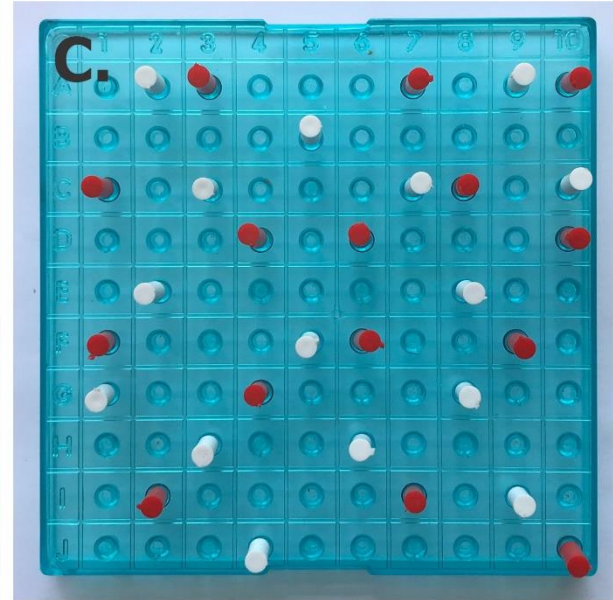
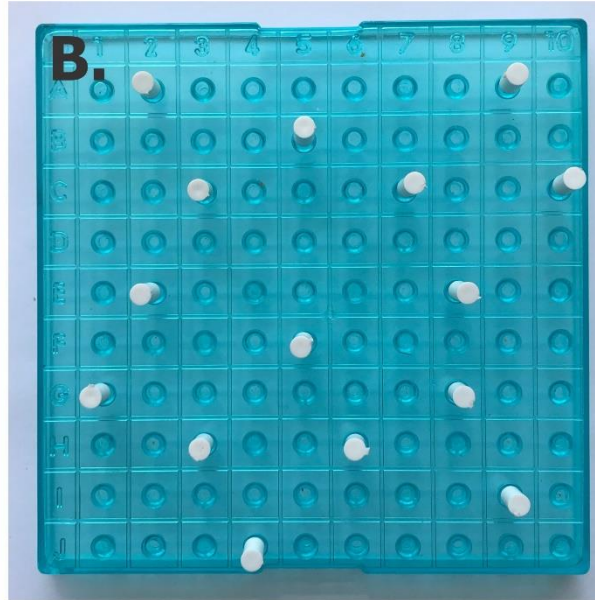
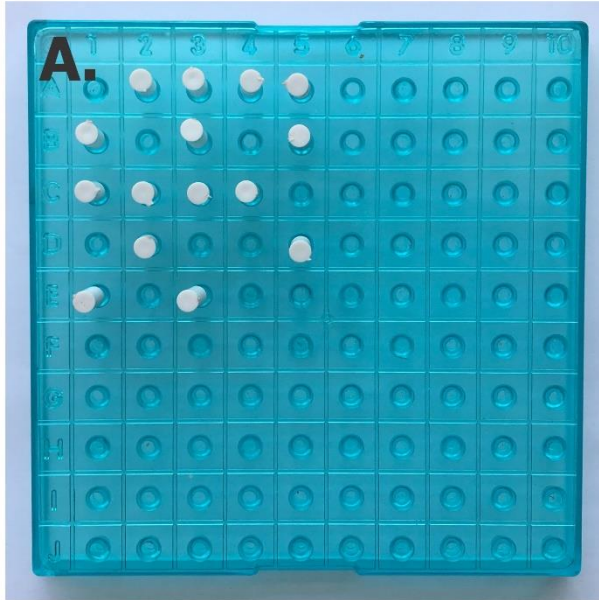
- Higher volumes mean more plant area covered, even deep in the canopy, but with diminishing return



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- **In the case of contact products we can also improve efficacy without using more volume or covering more of the target surface area.**

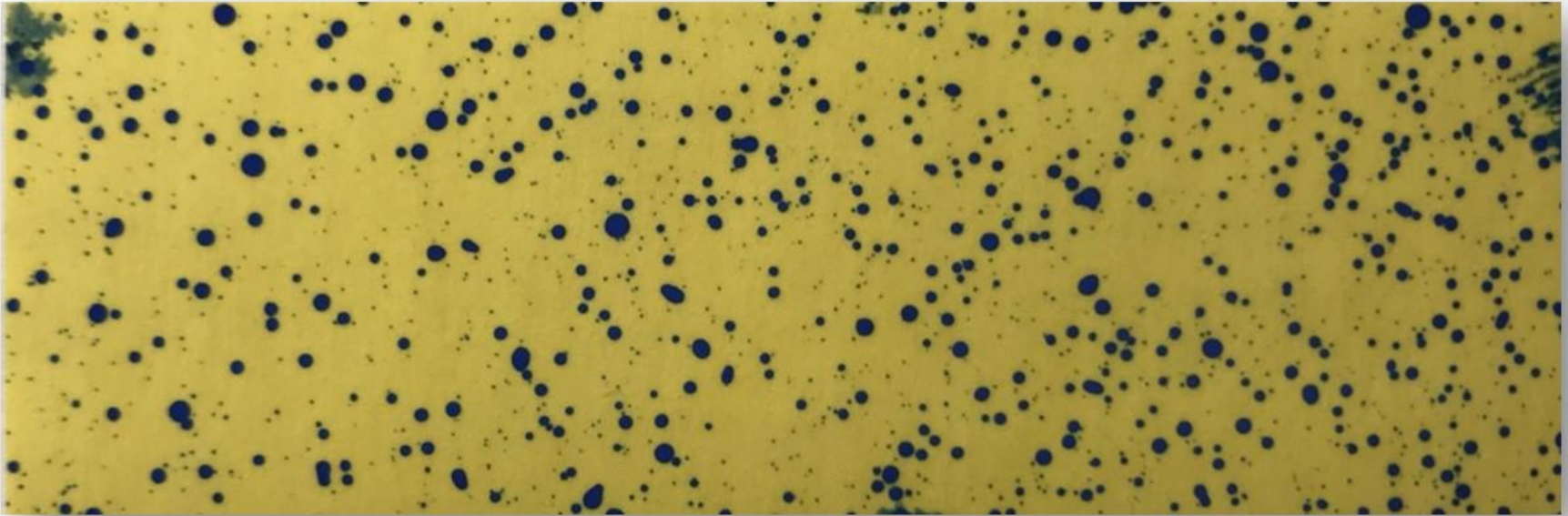


- **Deposit density describes the distribution of deposition and it is an important consideration.**



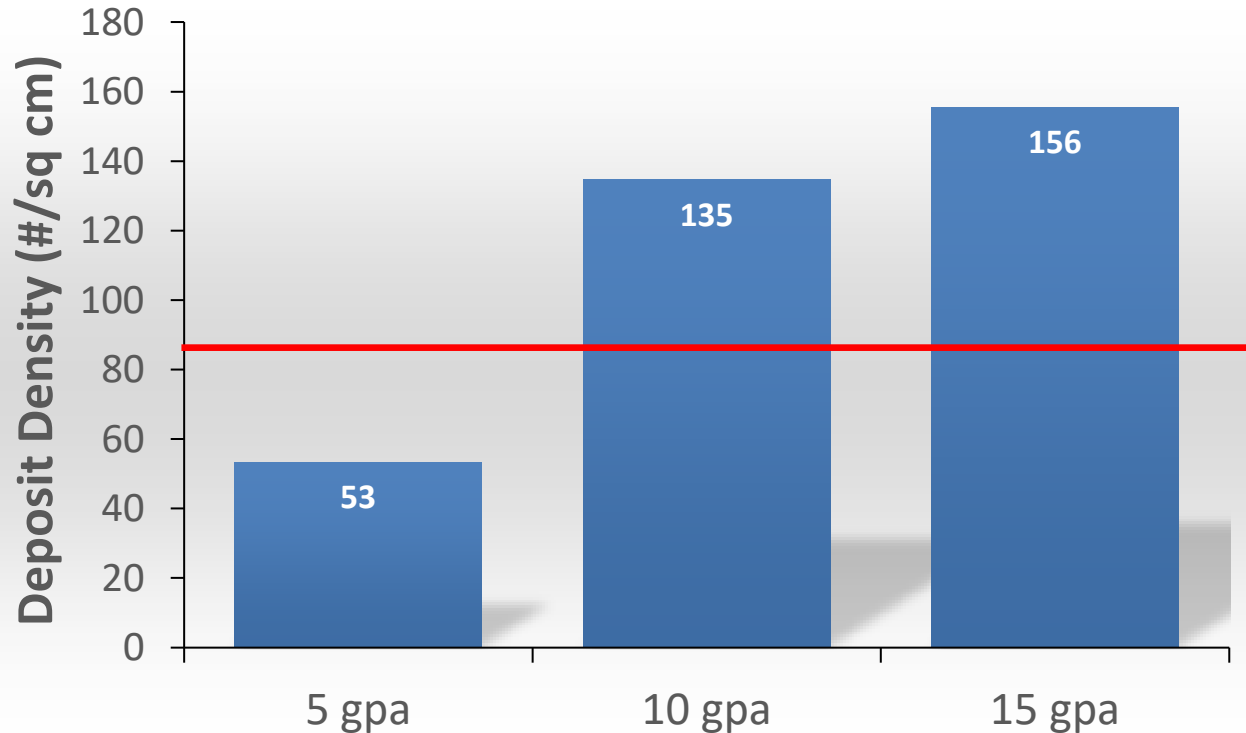


- **Research and experience suggest that a droplet density of 85 droplets per cm<sup>2</sup> and 15% overall coverage should be adequate for most foliar fungicides.**





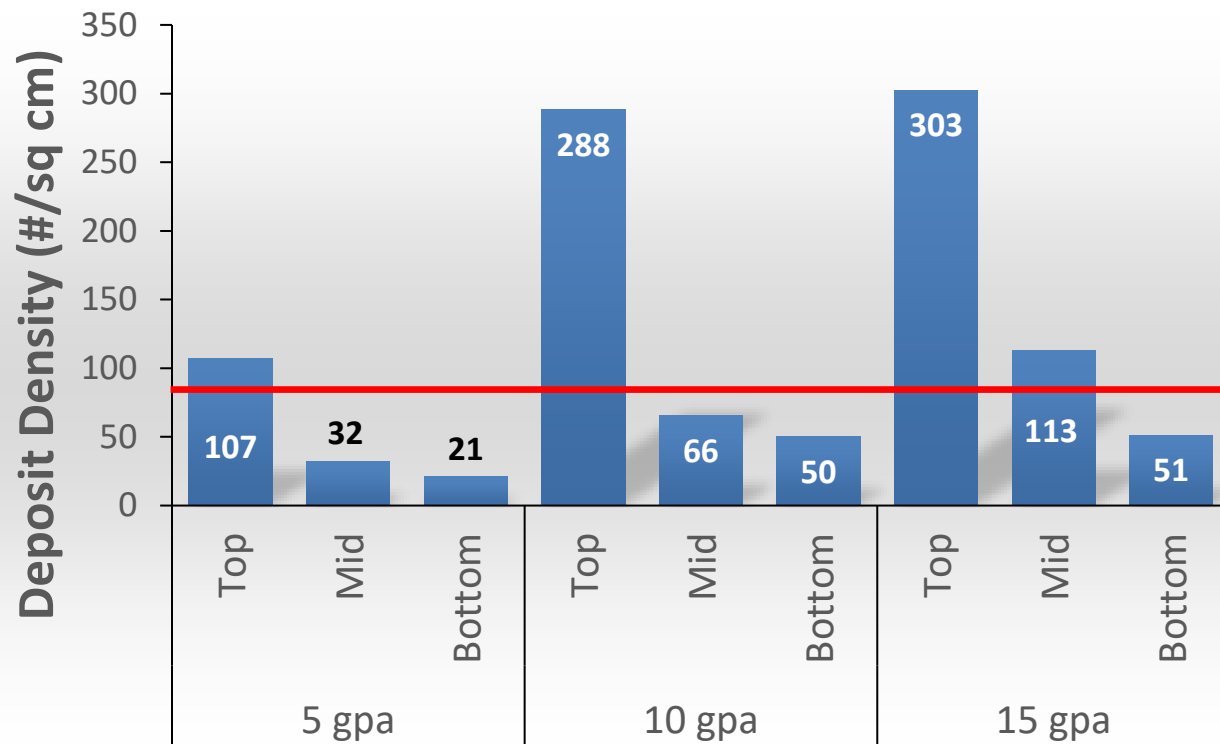
# Average Deposit Density by Volume



- **Area covered maxed out at 25-30 GPA in closed, dense canopies.**
- **Higher volumes = higher deposit densities.**



# Stratified Deposit Density by Volume



- Area covered maxed out at 25-30 GPA in closed, dense canopies.
- Higher volumes = higher deposit densities.



- **Look into the crop from the nozzle's point of view. If you can't see the target, how will a droplet get there?**

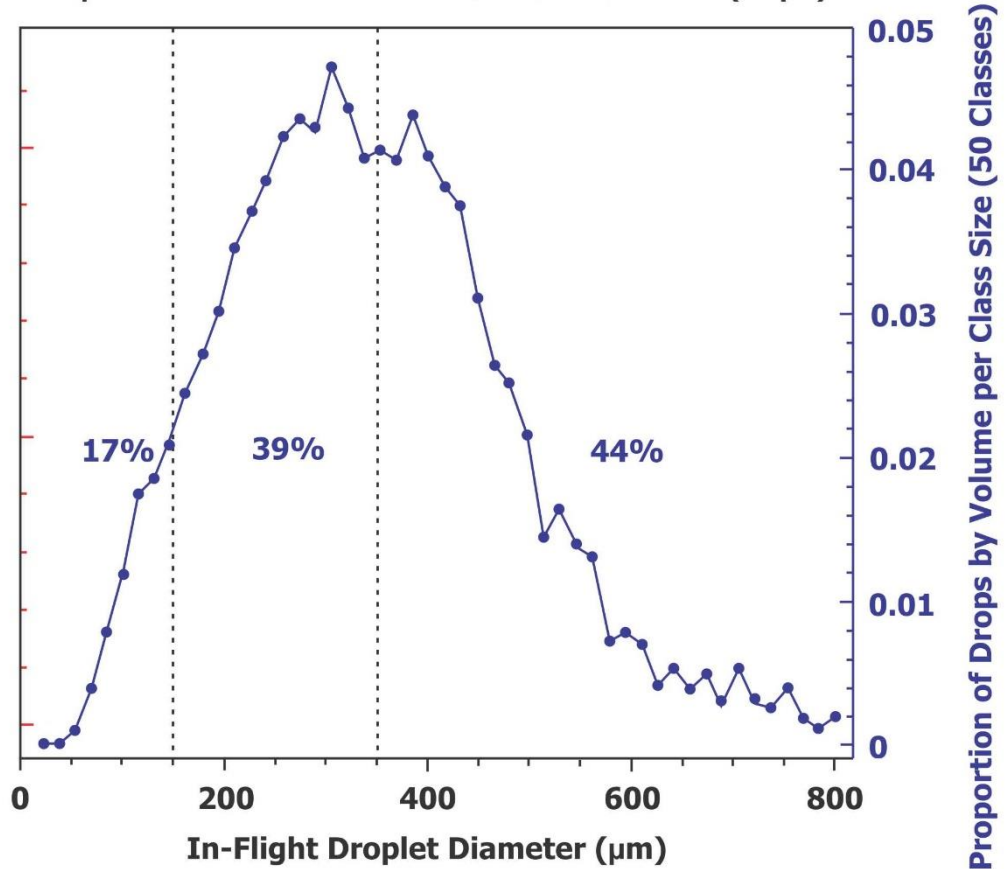
Three blue umbrellas are positioned in a field of green plants, likely soybeans. The umbrellas are arranged in a line, with the largest one in the center and two smaller ones on either side. The background shows a clear blue sky with some light clouds. The text 'DOWNY MILDEW & SPIDER MITES' is overlaid on the bottom of the image.

**DOWNY MILDEW  
& SPIDER MITES**



- **All nozzles produce a range of droplet sizes, and they behave very differently.**

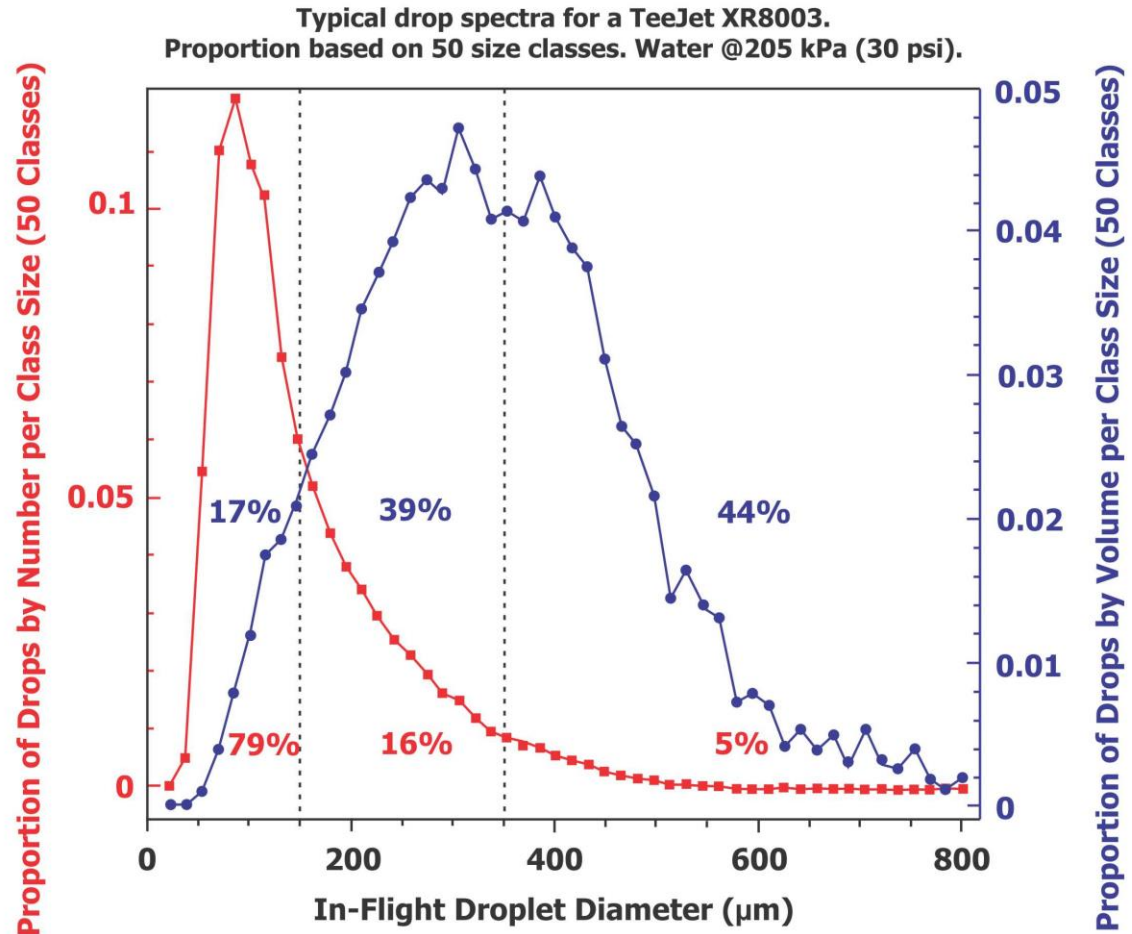
Typical drop spectra for a TeeJet XR8003.  
Proportion based on 50 size classes. Water @205 kPa (30 psi).



"Use of nozzle-induced air-entrainment to reduce active ingredient requirements for pest control" A.C. Chapelle et al. Crop Protection. 1997. Volume 16. Number 4. 323-330



- **All nozzles produce a range of droplet sizes, and they behave very differently.**
- **The finer droplets are more numerous and move unpredictably.**



"Use of nozzle-induced air-entrainment to reduce active ingredient requirements for pest control" A.C. Chapelle et al. Crop Protection. 1997. Volume 16. Number 4. 323-330



VMD=VC



syngenta

VMD=M

syngenta



**600  $\mu\text{m}$**

- Very high spread factor

**350  $\mu\text{m}$**

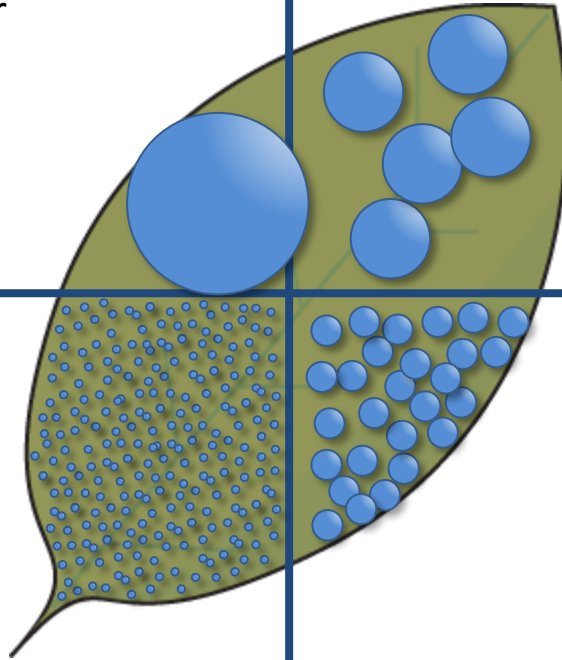
- High spread factor

**100  $\mu\text{m}$**

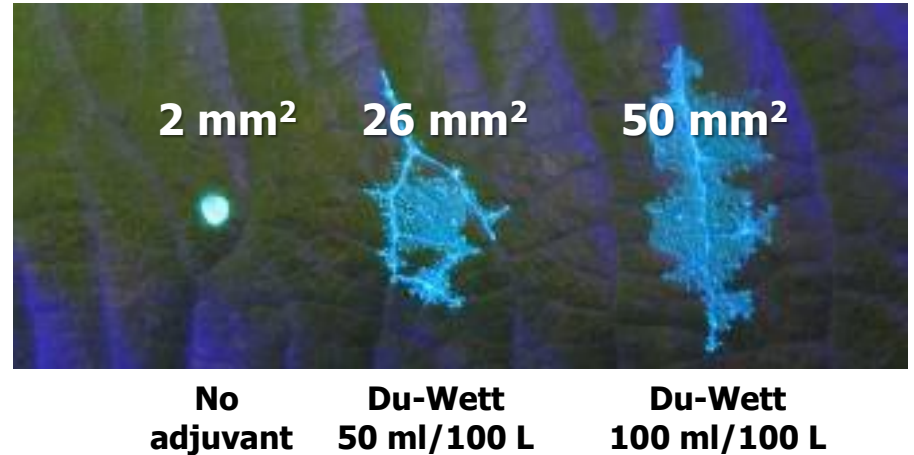
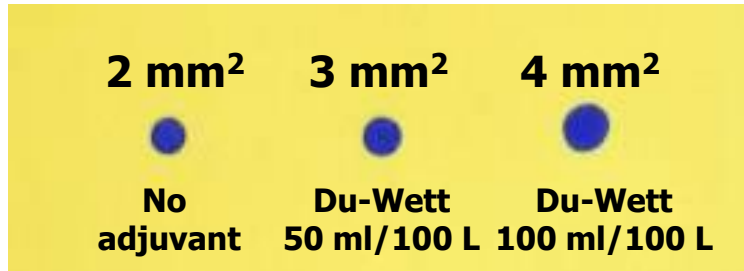
- Low spread factor

**200  $\mu\text{m}$**

- Moderate spread factor



# Water sensitive paper under-estimates spread







**Survivability and retention matter.**

## 600 $\mu\text{m}$

- No drift
- High rebound
- Low Evaporation

## 350 $\mu\text{m}$

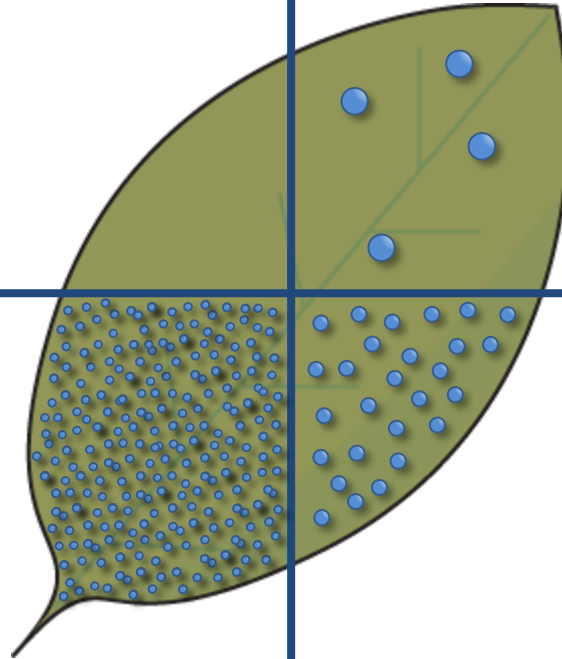
- Low drift
- Some rebound
- Moderate evaporation

## 100 $\mu\text{m}$

- Very high drift
- no rebound
- Very high evaporation

## 200 $\mu\text{m}$

- Some drift
- Low rebound
- High evaporation







**THE**

# **TAKE-HOME MESSAGE**

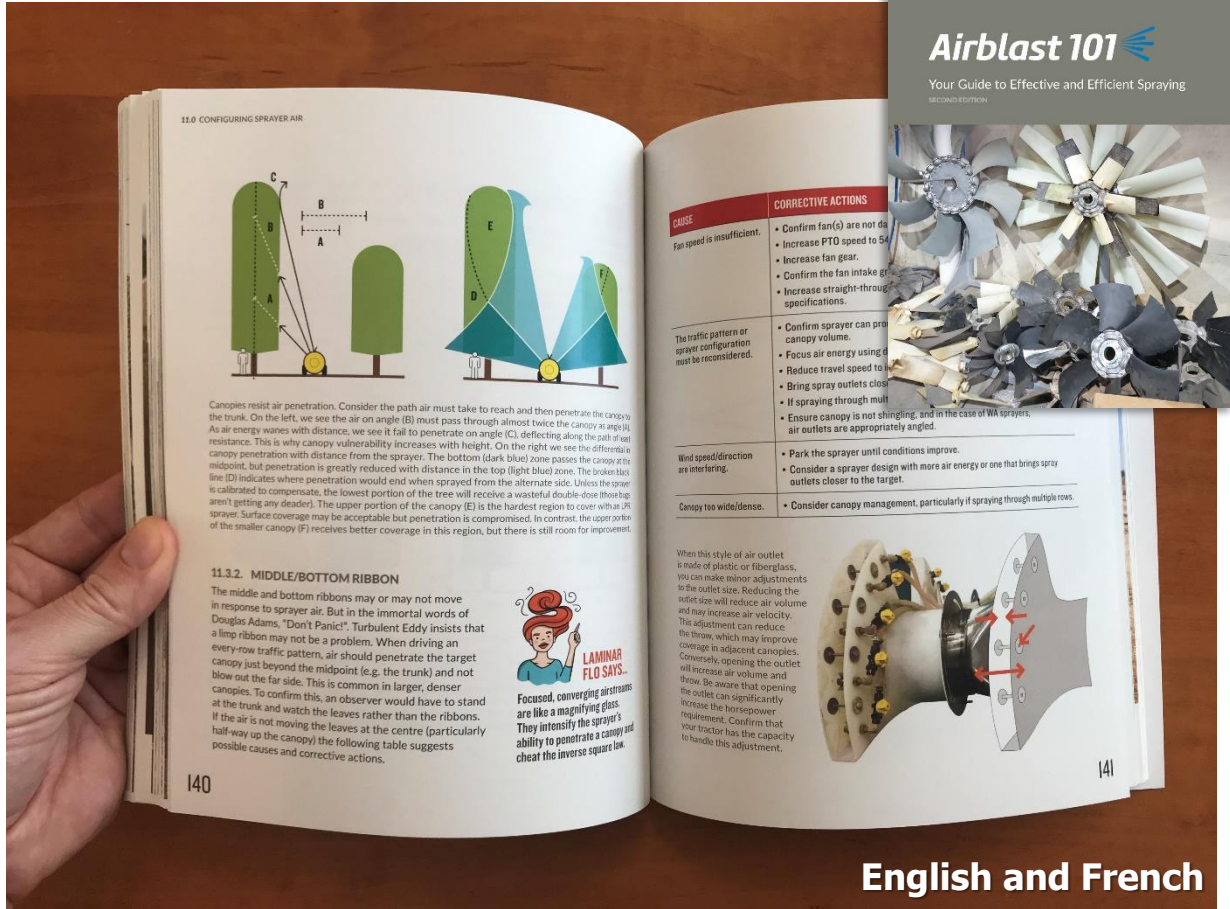
- **For a given volume, coarser spray deposits more volume, but retention, canopy penetration and deposit density is reduced and vice versa.**
- **Higher volumes improve area covered, droplet density, and canopy penetration.**
- **Droplets that are on the high end of Medium would be a good compromise between coverage and drift.**



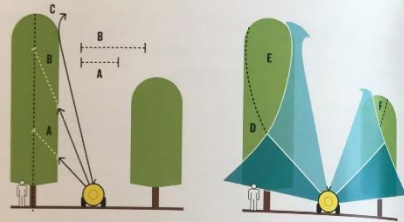
# Interested in Future Experiments?

- Trials at Ontario Crops Research Centre – Simcoe:
  - Spray Quality (Fine, Medium, Coarse) @ 40gpa
  - Carrier Volume (20, 30, 40, 50 gpa) @ Medium
  - 30 gpa & Medium applied weekly for 6 weeks to show effect of growth on coverage.
- Demo at grower's field:
  - Twilight coverage meeting using fluorescent dye





11.0 CONFIGURING SPRAYER AIR



Canopies resist air penetration. Consider the path air must take to reach and then penetrate the canopy to the trunk. On the left, we see the air on angle (B) must pass through almost twice the canopy angle (A). As air energy wanes with distance, we see it fail to penetrate on angle (C), deflecting along the path of least resistance. This is why canopy vulnerability increases with height. On the right we see the differential in canopy penetration with distance from the sprayer. The bottom (dark blue) zone passes the canopy in the midpoint, but penetration is greatly reduced with distance in the top (light blue) zone. The broken black line (D) indicates where penetration would end when sprayed from the alternate side. Unless the sprayer is calibrated to compensate, the lowest portion of the canopy (E) is the hardest region to cover when it isn't getting any deader. The upper portion of the tree will receive a wasteful double-dose (those that aren't getting any deader). Surface coverage may be acceptable but penetration is compromised. In contrast, the upper portion of the smaller canopy (F) receives better coverage in this region, but there is still room for improvement.

11.3.2. MIDDLE/BOTTOM RIBBON

The middle and bottom ribbons may or may not move in response to sprayer air. But in the immortal words of Douglas Adams, "Don't Panic!". Turbulent Eddy insists that a limp ribbon may not be a problem. When driving an every-row traffic pattern, air should penetrate the target canopy just beyond the midpoint (e.g. the trunk) and not blow out the far side. This is common in larger, denser canopies. To confirm this, an observer would have to stand at the trunk and watch the leaves rather than the ribbons. If the air is not moving the leaves at the centre (particularly half-way up the canopy) the following table suggests possible causes and corrective actions.

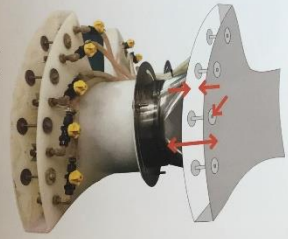


LAMINAR FLO SAYS...

Focused, converging airstreams are like a magnifying glass. They intensify the sprayer's ability to penetrate a canopy and cheat the inverse square law.

CAUSE	CORRECTIVE ACTIONS
Fan speed is insufficient.	<ul style="list-style-type: none"> <li>• Confirm fan(s) are not damaged.</li> <li>• Increase PTO speed to 540 RPM.</li> <li>• Increase fan gear.</li> <li>• Confirm the fan intake gear is correct.</li> <li>• Increase straight-through flow.</li> </ul>
The traffic pattern or sprayer configuration must be reconsidered.	<ul style="list-style-type: none"> <li>• Confirm sprayer can penetrate canopy volume.</li> <li>• Focus air energy using deflector.</li> <li>• Reduce travel speed to 1000 ft/min.</li> <li>• Bring spray outlets closer to canopy.</li> <li>• If spraying through multiple canopies, ensure canopy is not shingling, and in the case of WA sprayers, air outlets are appropriately angled.</li> </ul>
Wind speed/direction are interfering.	<ul style="list-style-type: none"> <li>• Park the sprayer until conditions improve.</li> <li>• Consider a sprayer design with more air energy or one that brings spray outlets closer to the target.</li> </ul>
Canopy too wide/dense.	<ul style="list-style-type: none"> <li>• Consider canopy management, particularly if spraying through multiple rows.</li> </ul>

When this style of air outlet is made of plastic or fiberglass, you can make minor adjustments to the outlet size. Reducing the outlet size will reduce air volume and may increase air velocity. The adjustment can reduce the throw, which may improve coverage in adjacent canopies. Conversely, opening the outlet will increase air volume and the throw, which may increase the horsepower requirement. Confirm that your tractor has the capacity to handle this adjustment.



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Turbulent Eddy and Laminar Flo

English and French

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