

Spraying Orchards in 2013



Dr. Jason S.T. Deveau
Application Technology Specialist
OMAFRA, Simcoe Station



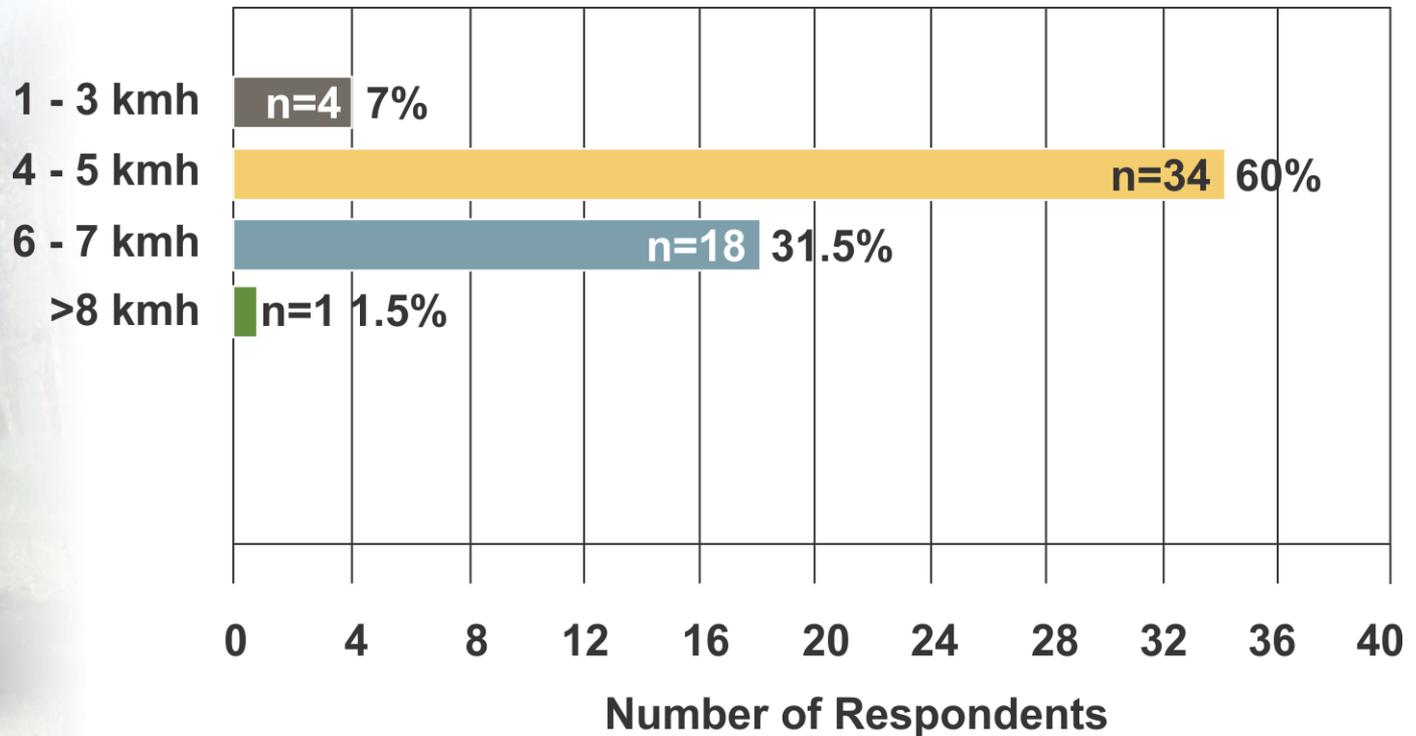
Automated, flying field sprayer from the movie “Looper” (2012)

2009 – The year of the scab

- Back in 2009 scab was a significant problem
- Resistance was the primary concern, but was it the only concern? A survey was circulated among Ontario's apple growers to poll their spray practices
- 57 Ontario spray applicators responded. With the unknowns we're facing in 2013, their responses are perhaps more relevant now...

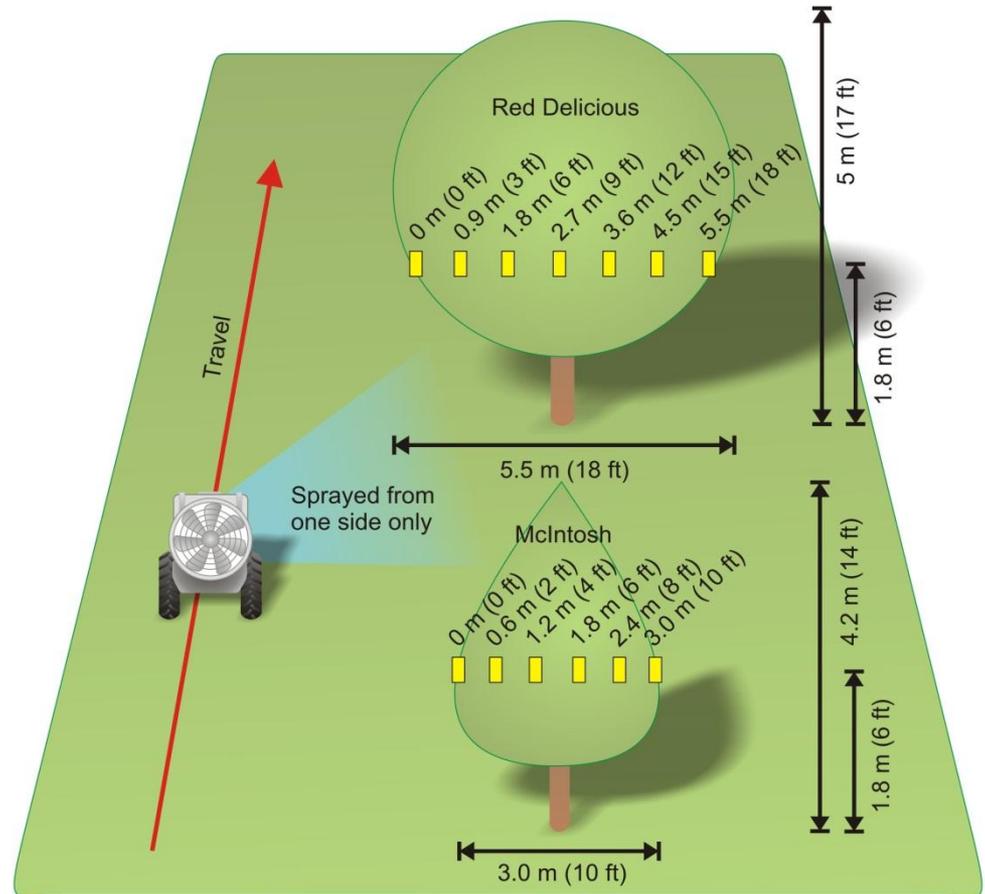
Average sprayer ground speed

- How fast do you drive?



Slow and steady

- **Slower travel speeds will counteract higher winds, to a certain degree, and increase the number of small droplets that penetrate the canopy**



2011 trial near Hamilton.

Three speeds (2, 5 and 8 km/h) and 600 L/ha.

Slowest speed = best penetration and more drops deposited.

Confirm ground speed

- Flag a 50 metre course through a block. Drive three times with the tank half-full
- It's pretty typical to be off by +/- 5% or more



$$\text{Travel Speed (km/h)} = \frac{50 \text{ metres} \times 3.6}{\text{Average drive time in seconds}}$$

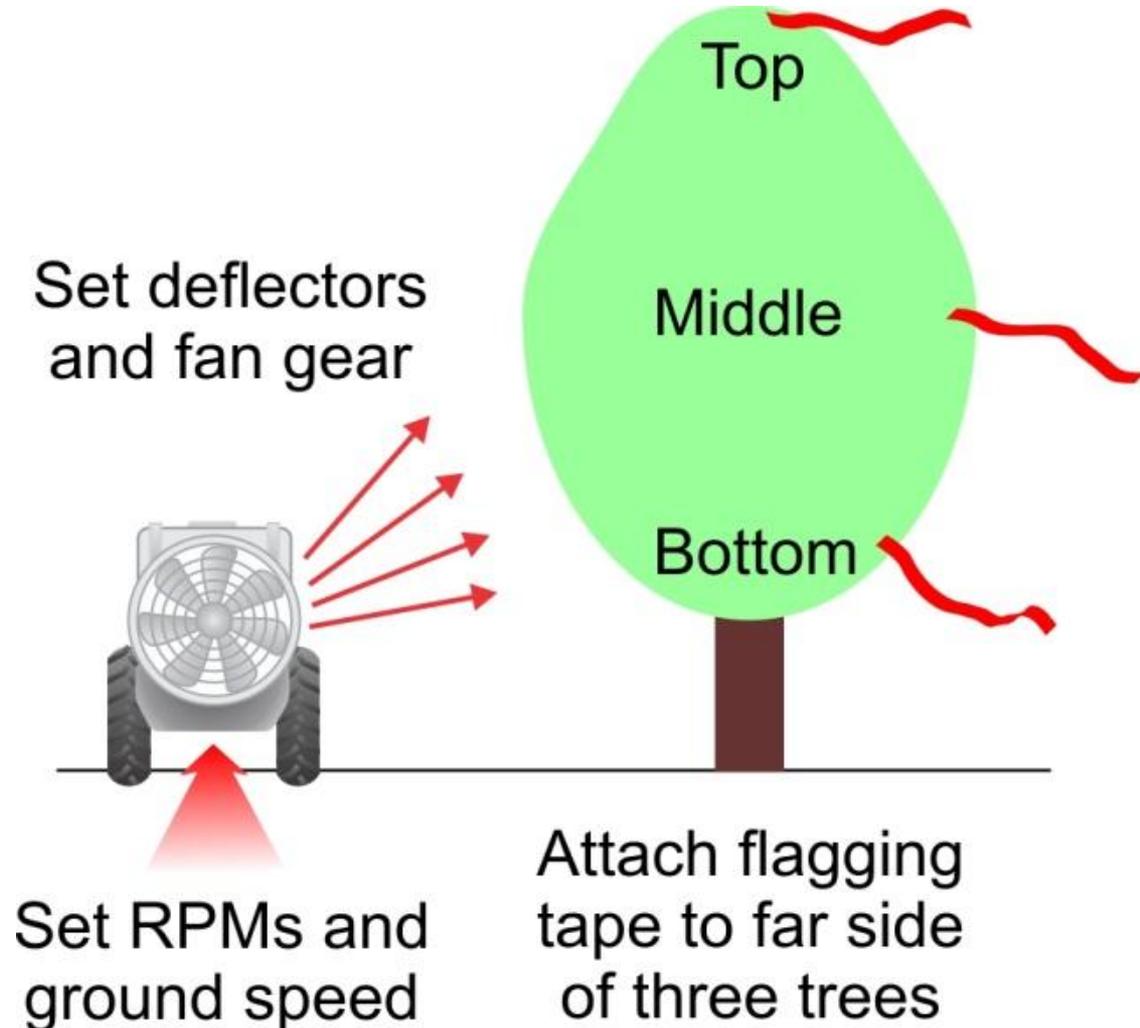
$$\text{Travel Speed (mph)} = \frac{50 \text{ metres} \times 2.2}{\text{Average drive time in seconds}}$$

The “right” air speed

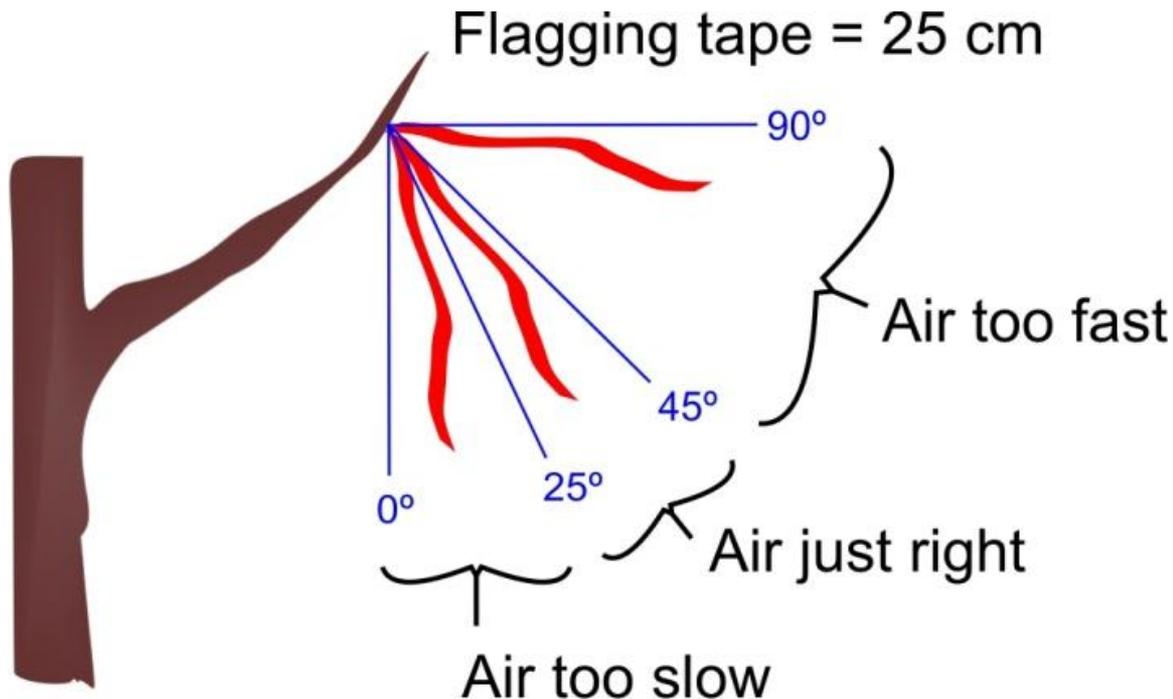


- **Using LiDAR in apples, Bernard found more surface area was exposed using only enough air to rustle leaves vs. no air at all**
- **He also found too much air (or more specifically, too fast) reduced surface area vs. no air at all**
- **Is slip-streaming why scab is often found beside the sprayer?**

Ground and air speed together



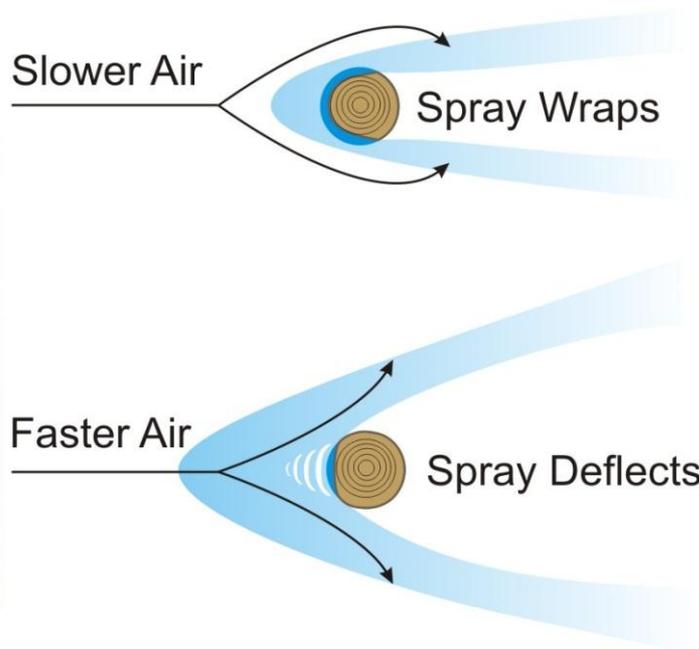
Ground and air speed together



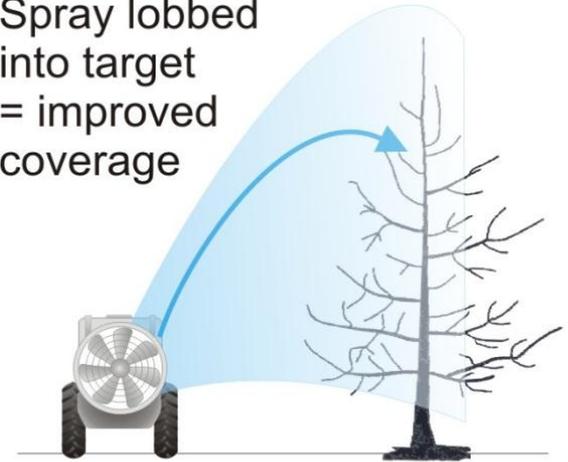
- If air is too fast: speed up tractor, raise RPM's, or lower fan gear
- If air is too slow: slow down tractor, drop RPM's or raise fan gear

Gear up, throttle down early season

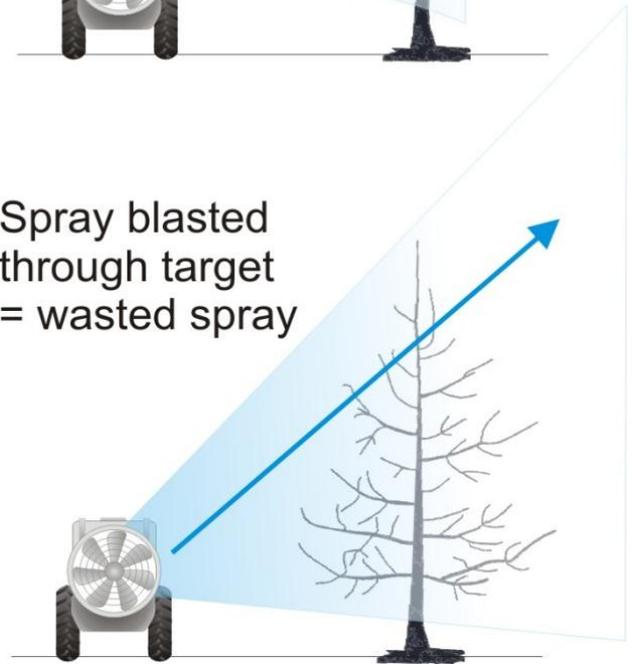
- **Who says 540 rpm's is the only way to go? As long as your tractor doesn't lug, and you're using a positive-displacement pump, you can try this**



Spray lobbed into target = improved coverage

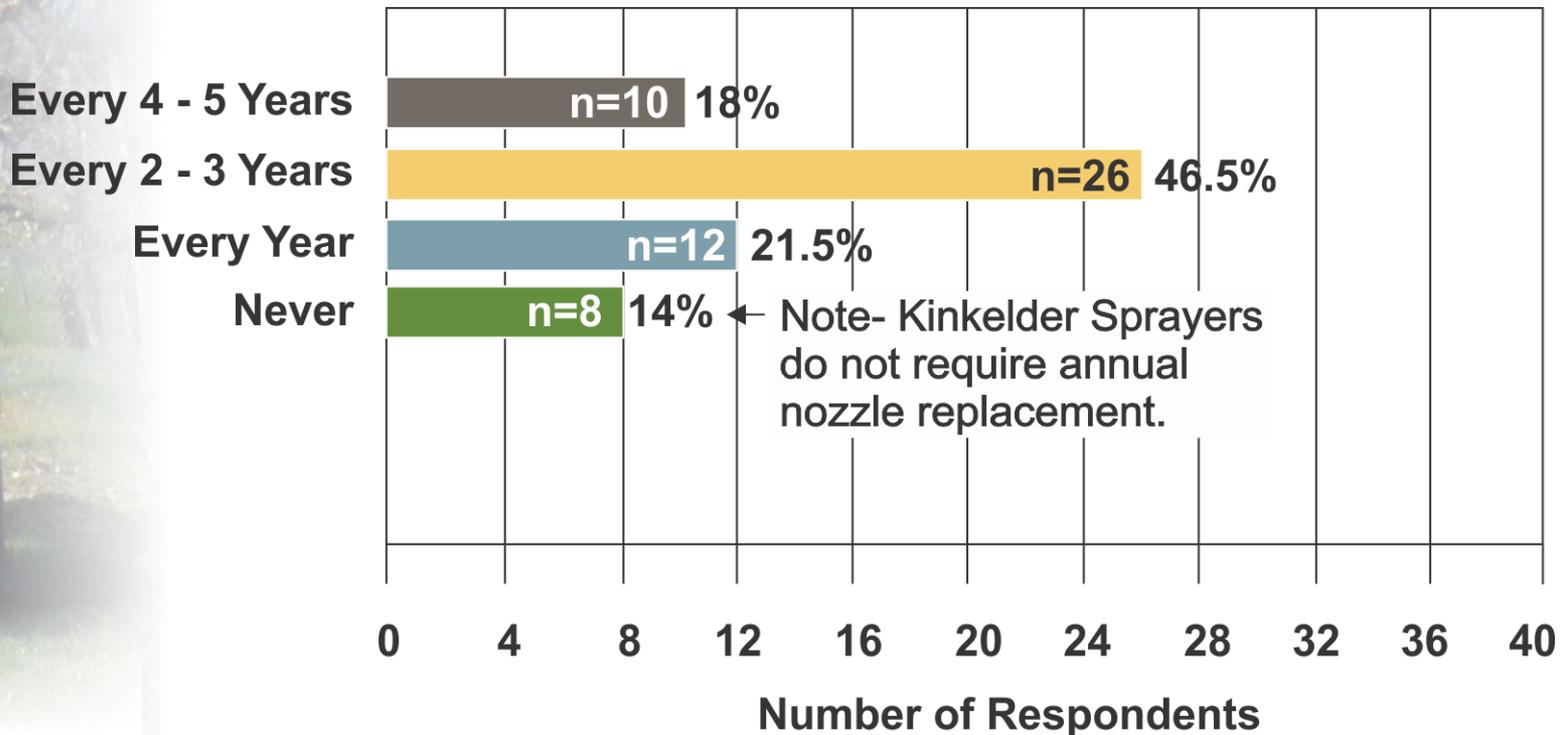


Spray blasted through target = wasted spray



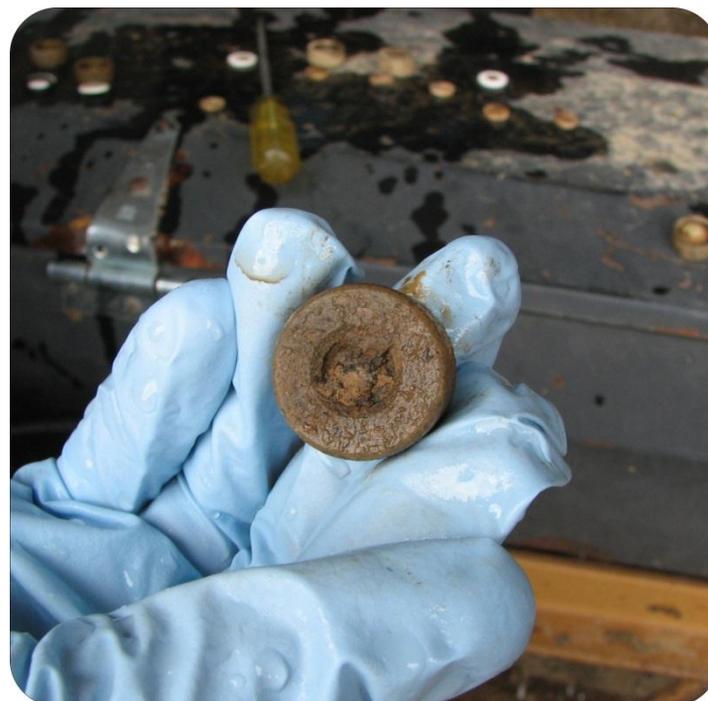
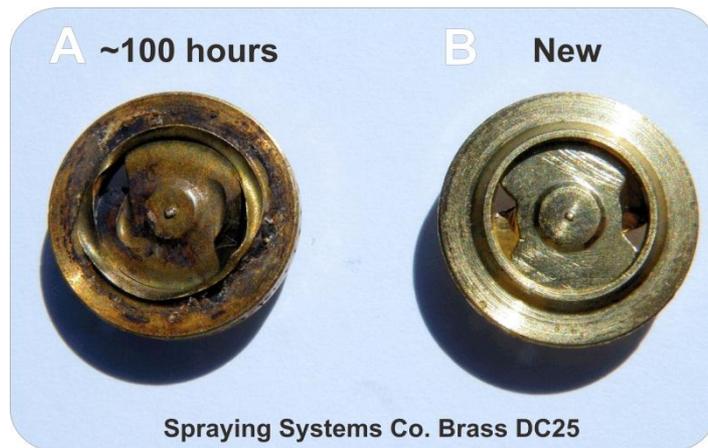
Nozzle Replacement Schedule

- Check your nozzles at the beginning and middle of the season. Brass lasts for half a season, ceramic can last a few



Confirming nozzle & sprayer output

- **Collect spray from each nozzle for one minute and compare the output to the manufacturer's charts**
- **Replace any nozzles that are out by 10%, and if two or more are out, replace them all!**



*One nasty SS whirl Plate
– H. Zhu, Ohio State*

How droplets behave

- Imagine this golf ball and this ping pong ball are spray droplets
- The golf ball is a coarse droplet, produced by a venturi (air induction) nozzle
- The ping pong ball is a fine droplet, produced by conventional disc-core tips
- Now, imagine throwing them. Which will go further?



How droplets behave



The clear winner



In live demos, I've seen
this ball blow back
behind the thrower!

- **Now, imagine throwing them twice as hard (i.e. increasing the pressure) what will happen?**

How droplets behave



- The golf ball goes much further. The ping pong ball goes a little further

- This is why increasing pressure does not improve penetration or distance for small droplets. In fact, higher pressure makes droplets smaller! So...

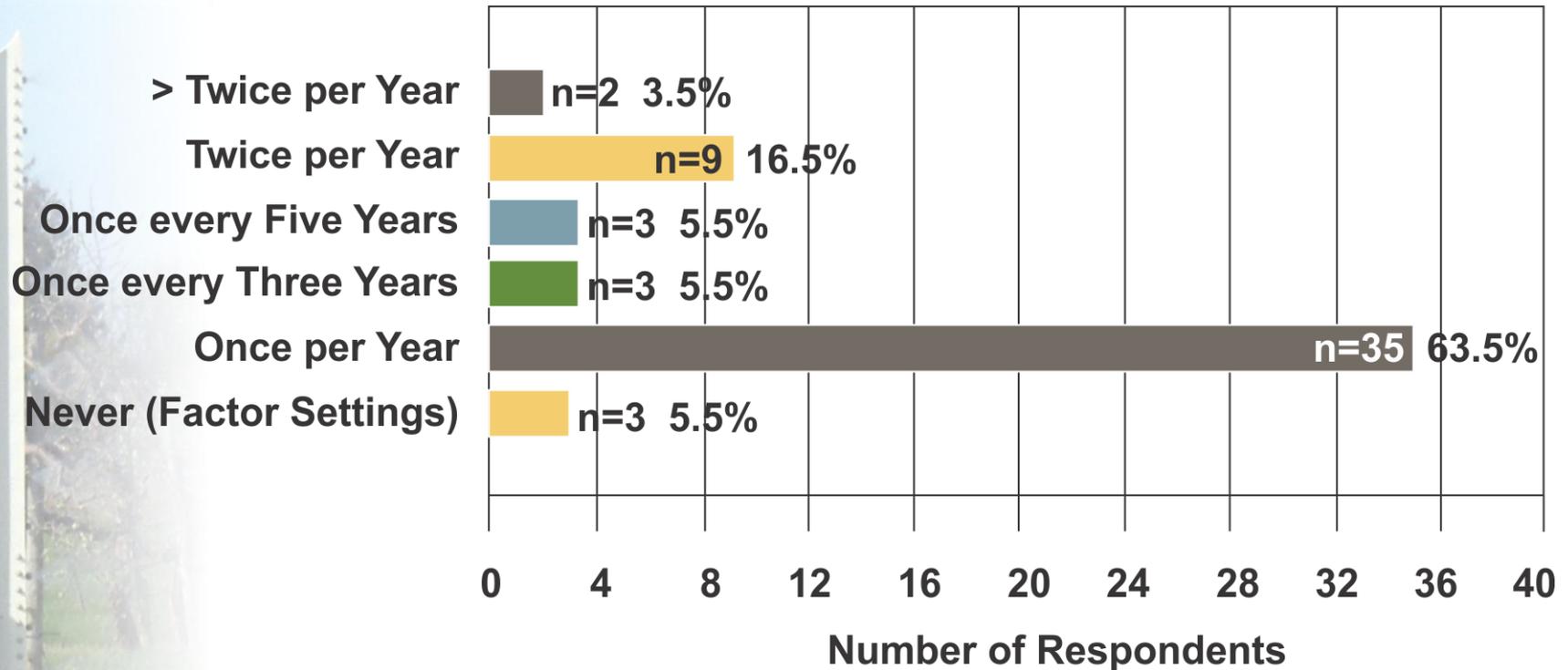


Venturi's on top

- The nozzles that most often create drift problems are those in the top positions
- One of the hardest parts of a tree canopy to spray is the top of the tree
- By switching to venturi tips in the top two positions, two problems are solved – coverage is improved, and the large droplets are not prone to drift



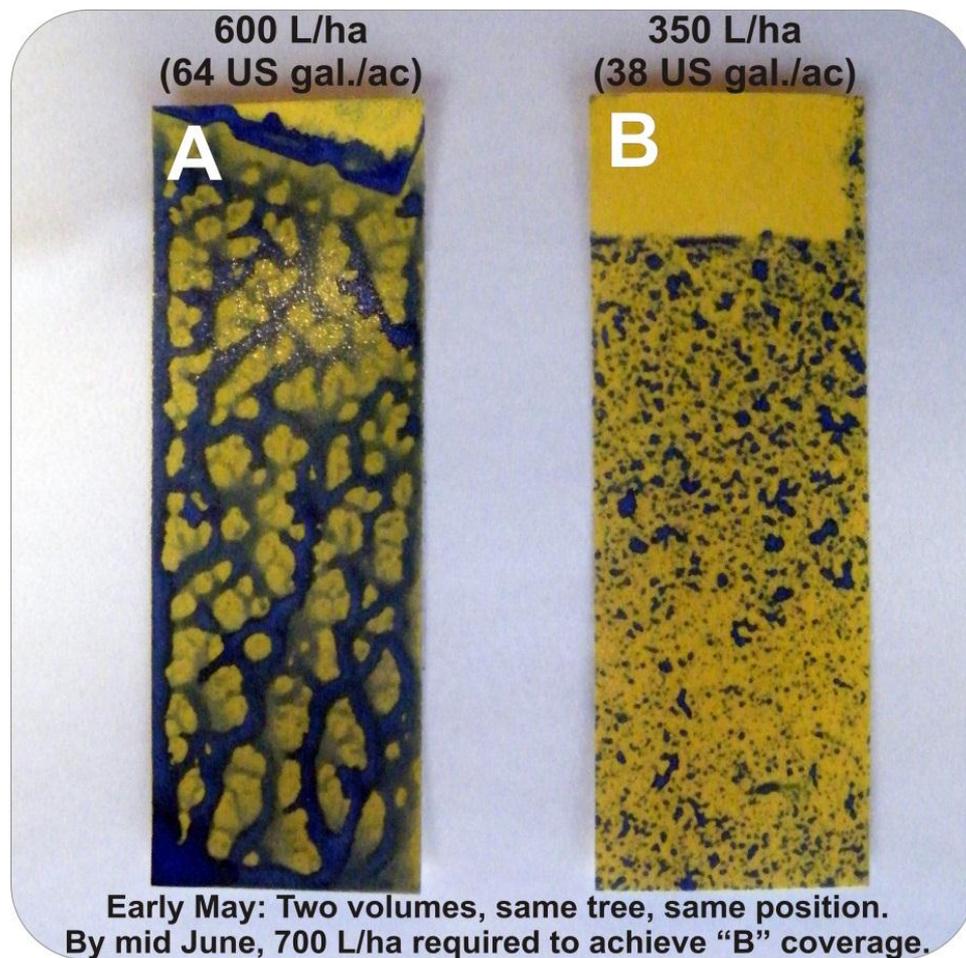
Sprayer calibration schedule



- **Sprayers should be calibrated twice per year. Once at season start, once around late May (it really depends how fast the canopy fills)**
- **Don't rely on just one sprayer setting for all trees, or for all season**

Why two volumes / distributions?

- **Mid way through the season (late May?), consider switching to a second set of nozzles, calibrated to match the 'new' target**



Alternate row middle spraying

100% of Applications

n=2 3.5%

75% of Applications

n=3 5.5%

50% of Applications

n=9 16%

25% of Applications

n=13 23%

Never

n=29 52%

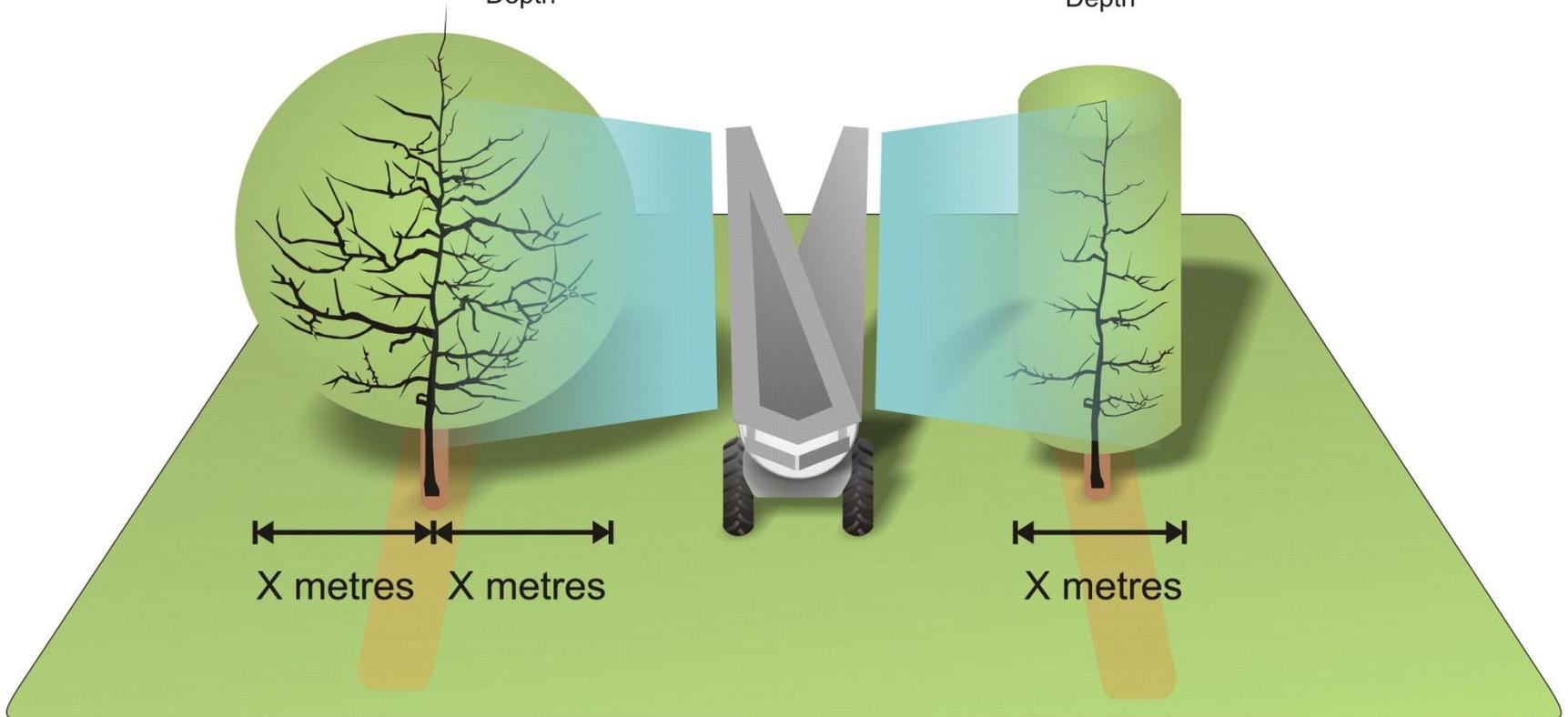
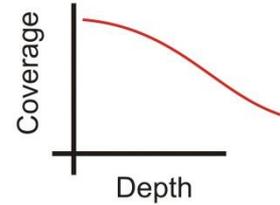
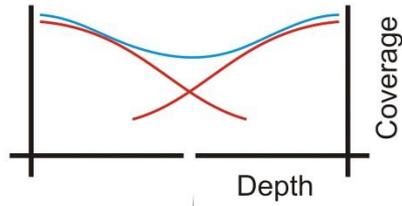
0 4 8 12 16 20 24 28 32 36 40

Number of Respondents



- I've seen alternate row middle spraying work, but only under very specific circumstances, and even then *it always compromises coverage*

Canopy penetration depth



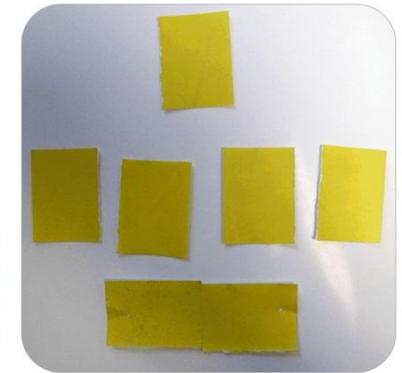
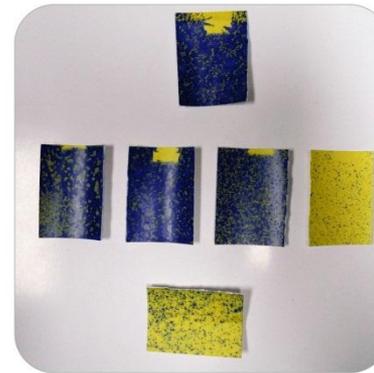
ARM and product choice

- **Product formulation often includes adjuvants (e.g. sticker spreaders)**
- **This affects how droplets behave in the canopy**

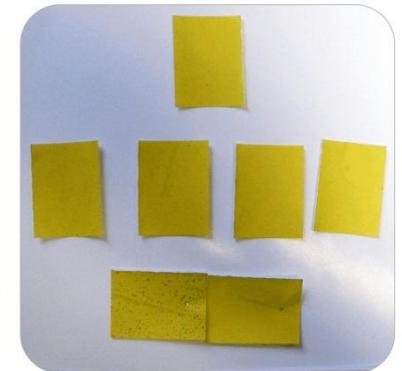
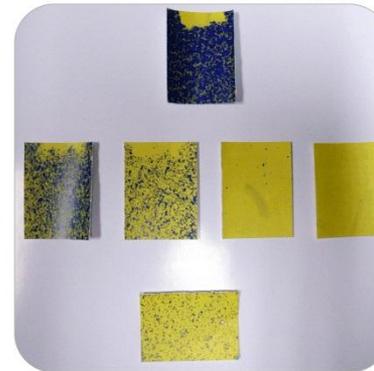
Tree Adjacent to Sprayer

Tree in Next Alley

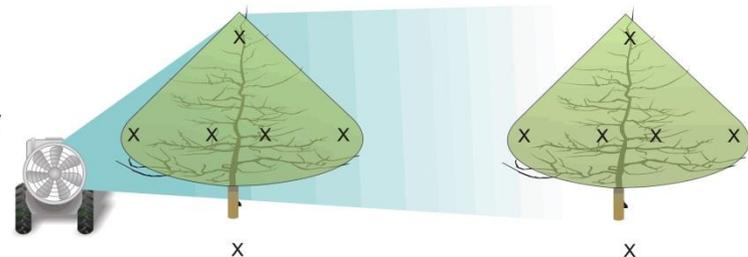
Control (600 L / ha)



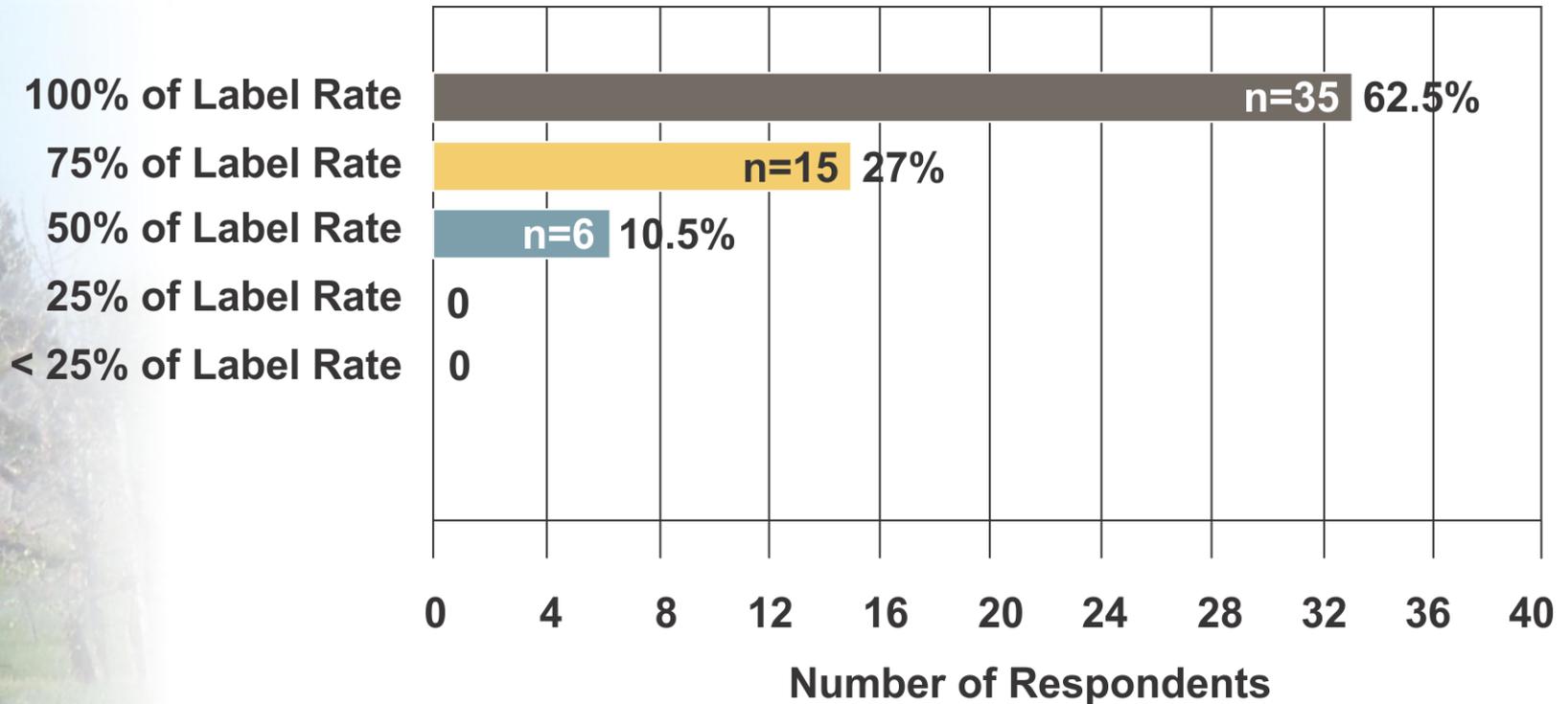
Deposition Utility Modifier (500 ml in 600 L / ha)



Key



Label rates



- **Certain product rates per area can be reduced where smaller, sparser canopies warrant it. This is at your own risk and it requires skilful application. Try a test plot first, scout intensively and be prepared to abandon reduced rates**

Label rates

- All photographs taken on the same day in Simcoe, Ontario



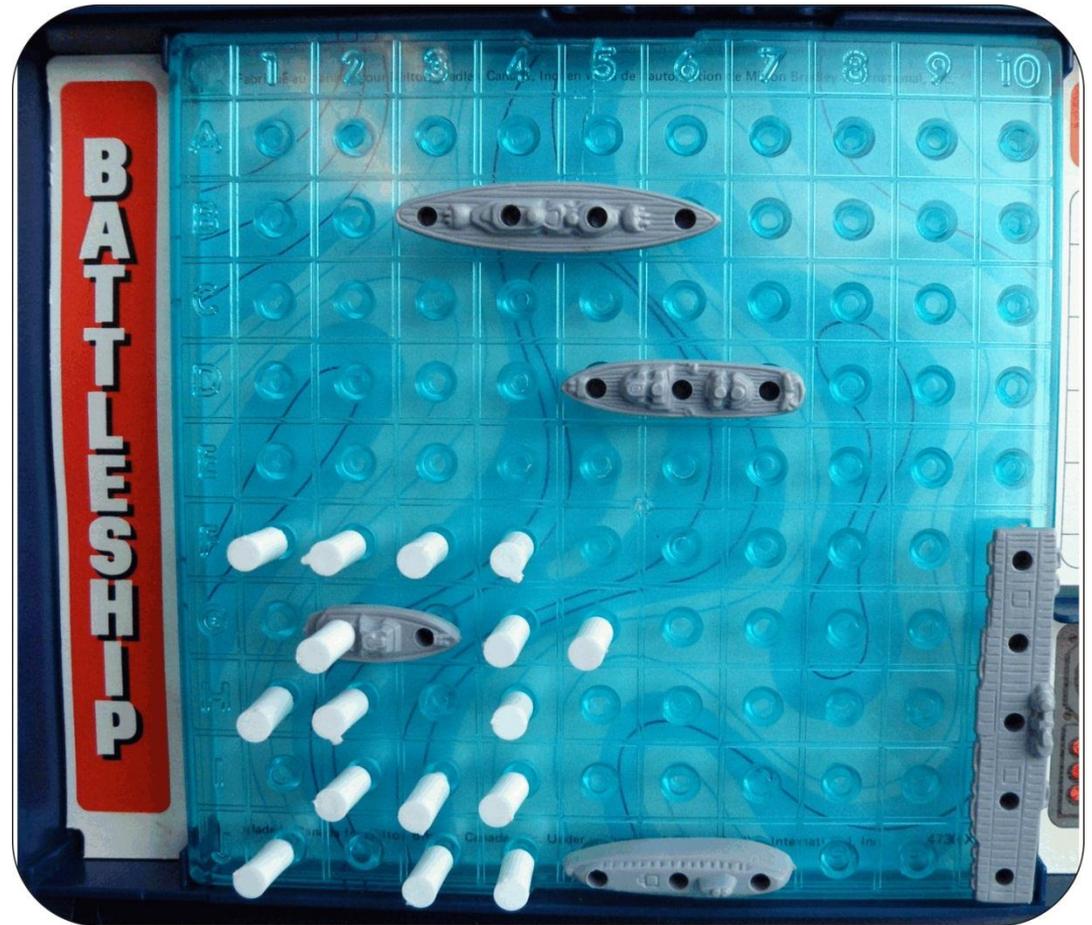
Coverage is **EVERYTHING!**

- The white pegs are spray droplets
- The boats are target pests (e.g. fungal spores)
- While effective, would you say this is efficient coverage? Is it even possible?



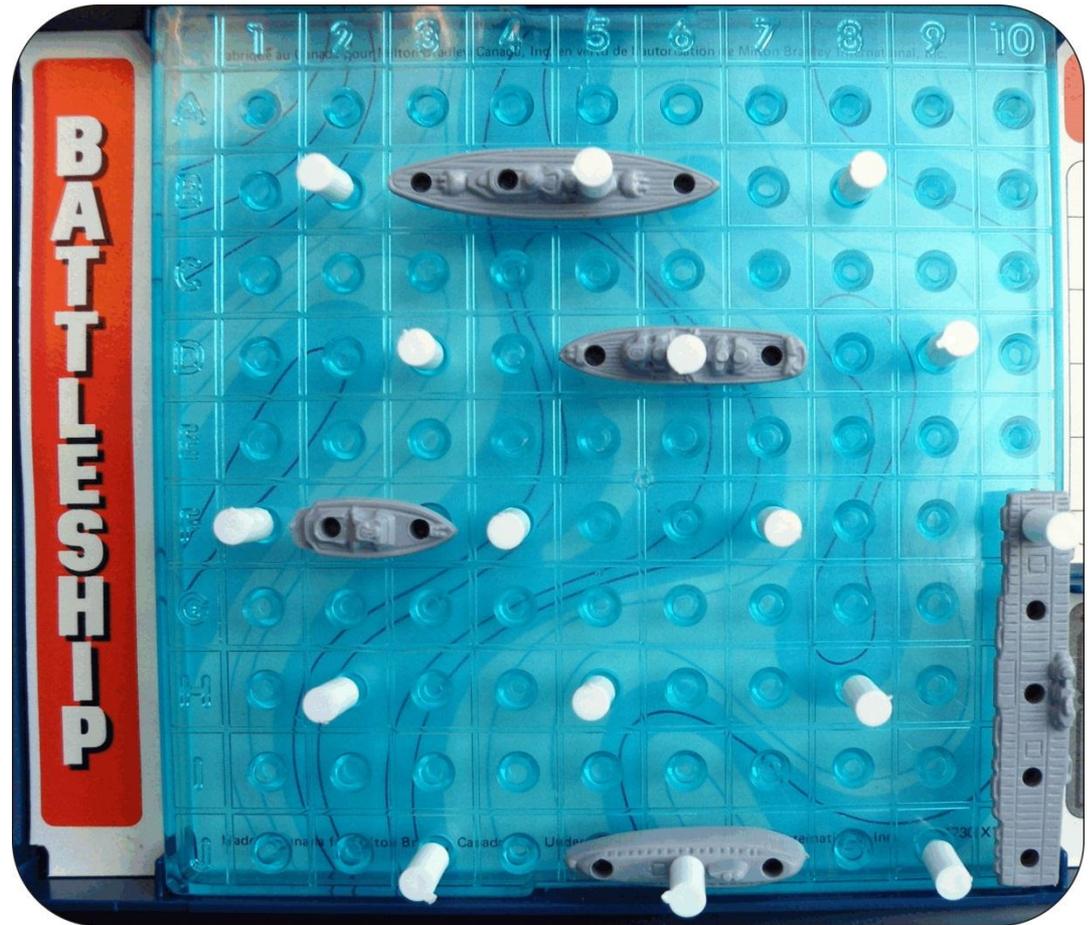
Coverage is EVERYTHING!

- Here's a more realistic volume of spray on our "leaf"
- But, poor distribution due to run-off or leaf shadowing has missed most of the targets.



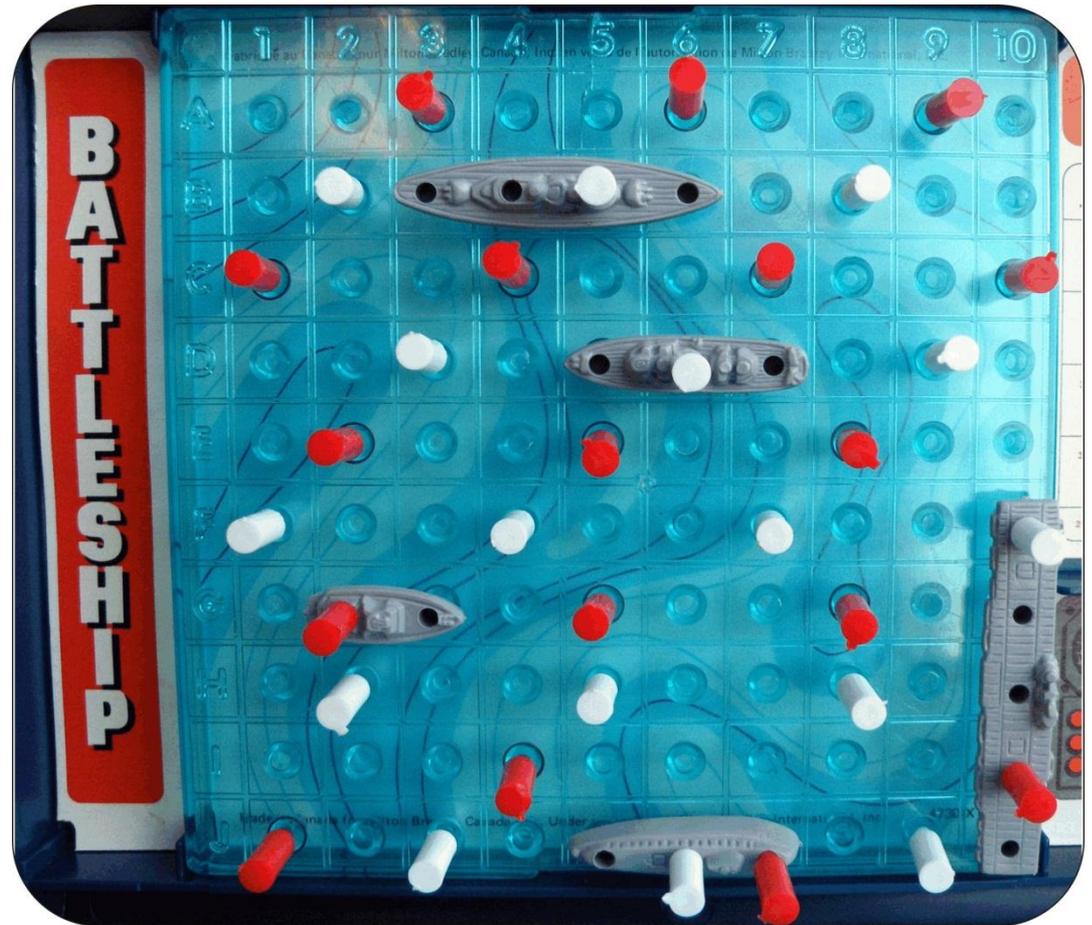
Coverage is EVERYTHING!

- Here are the same number of “droplets”
- Nice, even distribution hits almost every target. It’s a matter of odds
- What about the one you missed?



Coverage and **TIMING** are **EVERYTHING!**

- The red pegs are from a former application, which is still active because it was applied 4-7 days ago with no precipitation
- They landed in different spots but **we sunk their Battleship!**



Coverage and TIMING are EVERYTHING!

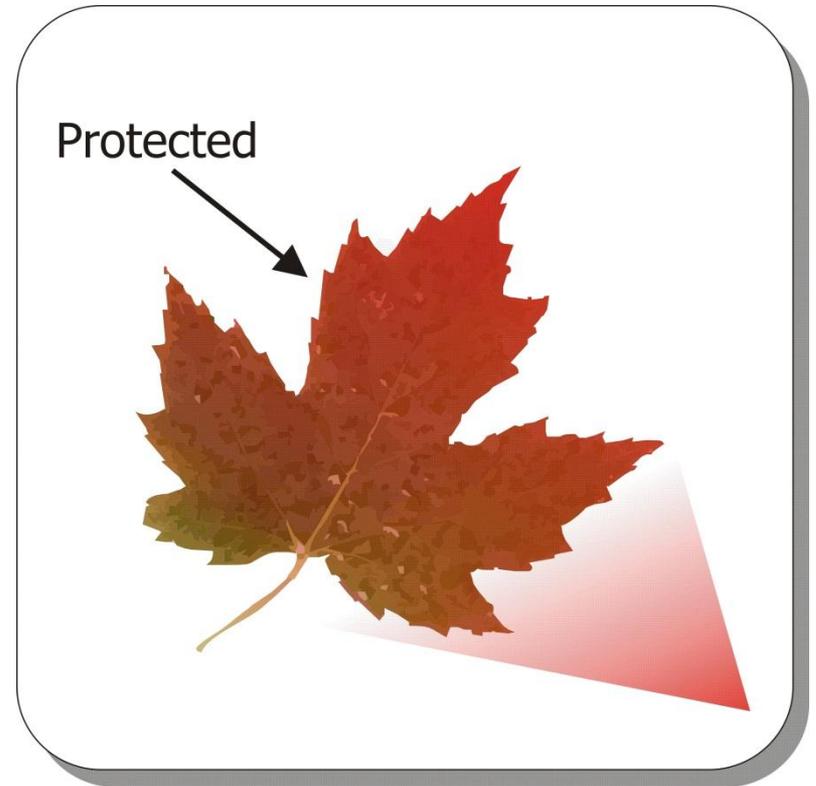
- As leaves grow, the product doesn't move with them
- Imagine painting a piece of rubber, then stretching it
- The paint would crack and separate, exposing bare areas, or the leaf would spread and the paint would not



A young leaf with no fungicide.

Coverage and TIMING are EVERYTHING!

- As leaves grow, the product doesn't move with them
- Imagine painting a piece of rubber, then stretching it
- The paint would crack and separate, exposing bare areas, or the leaf would spread and the paint would not



A young leaf with good coverage.

Coverage and TIMING are EVERYTHING!

- As leaves grow, the product doesn't move with them
- Imagine painting a piece of rubber, then stretching it
- The paint would crack and separate, exposing bare areas, or the leaf would spread and the paint would not



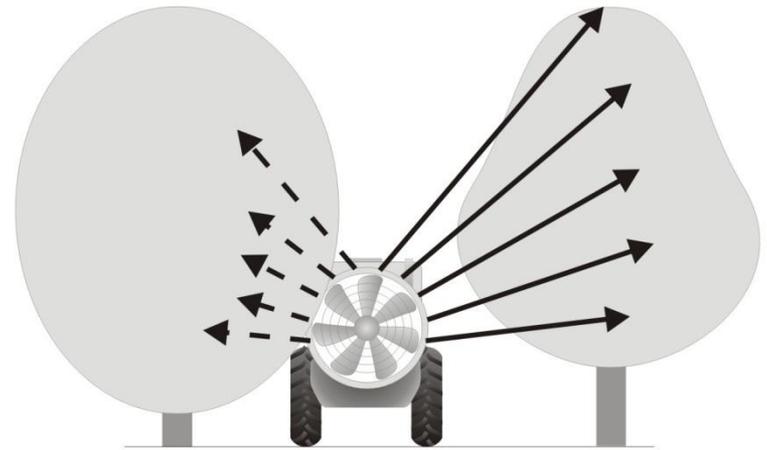
*The leaf grows, and the pesticide isn't there.
You need to put more on.*

Canopy Management



Closed canopy, top of tree blocked
by lower limbs, crowded alley
-BAD COVERAGE-

Open canopy, top of tree not blocked
by lower limbs, good alley clearance
-GOOD COVERAGE-



- **If you can't see it, you can't spray it... I know because we tried.**

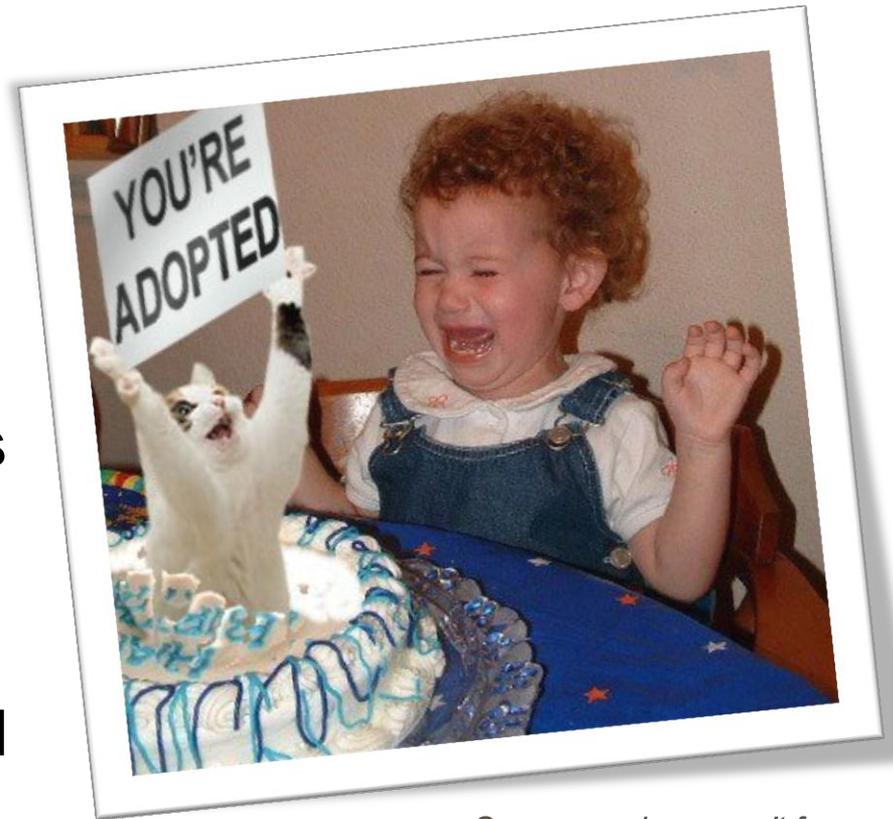
Canopy Management

- This is a large tree – 20 feet in diameter
- However, it is an easy spray target because it is not the size of the box, it's what's in the box that matters
- A good trick is to look at the tree's shadow. Then you'll know if it's open to spray



Recommendations

- **More frequent calibration and nozzle changes will improve spray efficiency**
- **Reasonable ground speeds, the omission of ARM applications and opening canopies will improve deposition uniformity**
- **Confirm coverage and check your air!**



*Some surprises aren't fun.
Spray failure is one of those surprises.*

THANK YOU



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