Airblast Sprayers

Review of the Basics and a Look to the Future

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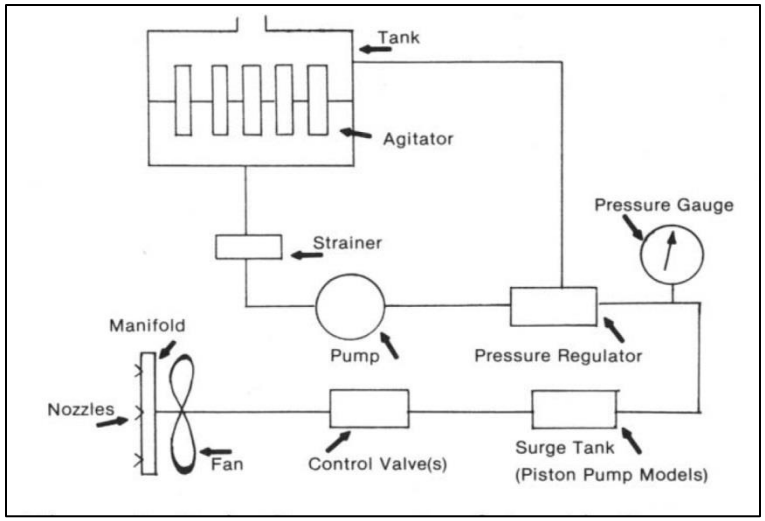
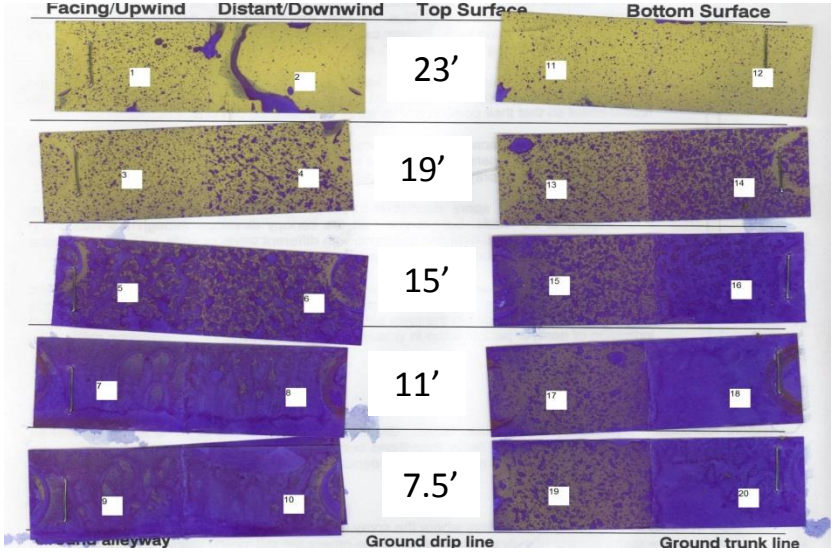
Effective, efficient and safe orchard spraying requires matching air and spray delivery to the canopy.

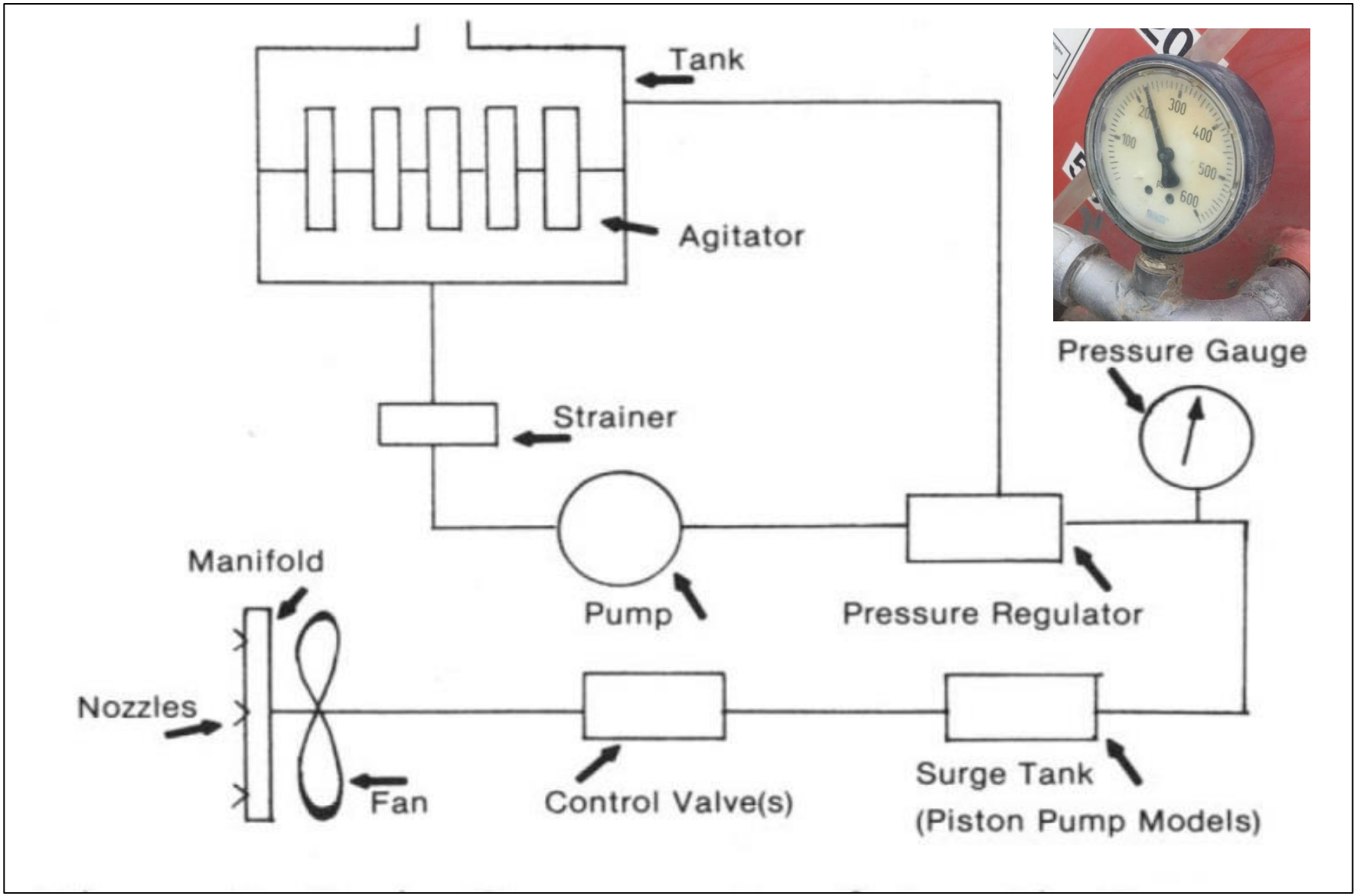


Extension.uga.edu



Walnuts.org.nz

- **Sprayer review**
- **Droplets and air flow**
- **Deposition**
- **Research**
- **Future**



Extension.uga.edu

There are two different designs of airblast sprayers in most US orchards.

Nozzles meter flow and generate droplets.

		GPM																		
		30 PSI	40 PSI	50 PSI	60 PSI	70 PSI	80 PSI	90 PSI	100 PSI	120 PSI	140 PSI	160 PSI	180 PSI	200 PSI	220 PSI	240 PSI	260 PSI	280 PSI	300 PSI	320 PSI	340 PSI	360 PSI
TXR800053VK	100	0.046	0.053	0.059	0.064	0.069	0.073	0.077	0.081	0.089				0.113	0.118	0.123	0.127	0.132	0.136	0.140	0.144	0.148
		VF	VF	VF	VF	VF	VF	VF	VF	VF				VF						VF	VF	VF
TXR800071VK	50	0.062	0.071	0.079	0.086	0.093	0.099	0.105	0.110	0.120				0.153						0.192	0.197	0.203
		F	VF	VF	VF	VF	VF	VF	VF	VF				VF						VF	VF	VF
TXR8001VK	50	0.087	0.100	0.111	0.121	0.131	0.139	0.147	0.155	0.169	0.182	0.194	0.205	0.216						0.270	0.278	0.286
		F	F	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF						VF	VF	VF
TXR80013VK	50	0.116	0.133	0.148	0.162	0.174	0.186	0.196	0.207	0.225	0.243	0.259	0.274	0.288						0.360	0.371	0.381
		F	F	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF						VF	VF	VF
TXR80015VK	50	0.131	0.150	0.167	0.182	0.196	0.209	0.221	0.232	0.254	0.273	0.291	0.308	0.324						0.405	0.417	0.429
		F	F	F	F	F	VF	VF	VF	VF	VF	VF	VF	VF						VF	VF	VF
TXR80017VK	50	0.145	0.167	0.185	0.202	0.218	0.232	0.246	0.258	0.282	0.303	0.323	0.342	0.360						0.450	0.464	0.476
		F	F	F	F	VF	VF	VF	VF	VF	VF	VF	VF	VF						VF	VF	VF
TXR8002VK	50	0.174	0.200	0.223	0.243	0.261	0.279	0.295	0.310	0.338	0.364	0.388	0.410	0.432	0.452	0.471	0.489	0.507	0.524	0.540	0.556	0.572
		F	F	F	F	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF
TXR80028VK	50	0.240	0.275	0.306	0.334	0.359	0.383	0.405	0.426													6
		F	F	F	F	F	VF	VF	VF													
TXR8003VK	50	0.260	0.300	0.335	0.367	0.396	0.423	0.449	0.473													2
		F	F	F	F	F	F	VF	VF													
TXR80036VK	50	0.309	0.356	0.398	0.435	0.470	0.502	0.532	0.561													
		F	F	F	F	F	F	VF	VF													
TXR8004VK	50	0.347	0.400	0.447	0.489	0.528	0.564	0.598	0.630	0.690	0.745	0.796	0.843	0.889	0.932	0.973	1.01	1.05	1.09	1.12	1.16	1.19
		F	F	F	F	F	F	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF
TXR80049VK	50	0.423	0.488	0.545	0.597	0.644	0.688	0.730	0.769	0.842	0.909	0.971	1.03	1.09	1.14	1.19	1.24	1.28	1.33	1.37	1.41	1.45
		F	F	F	F	F	F	F	F	F	F	F	VF	VF	VF	VF	VF	VF	VF	VF	VF	VF

2-3X GPM

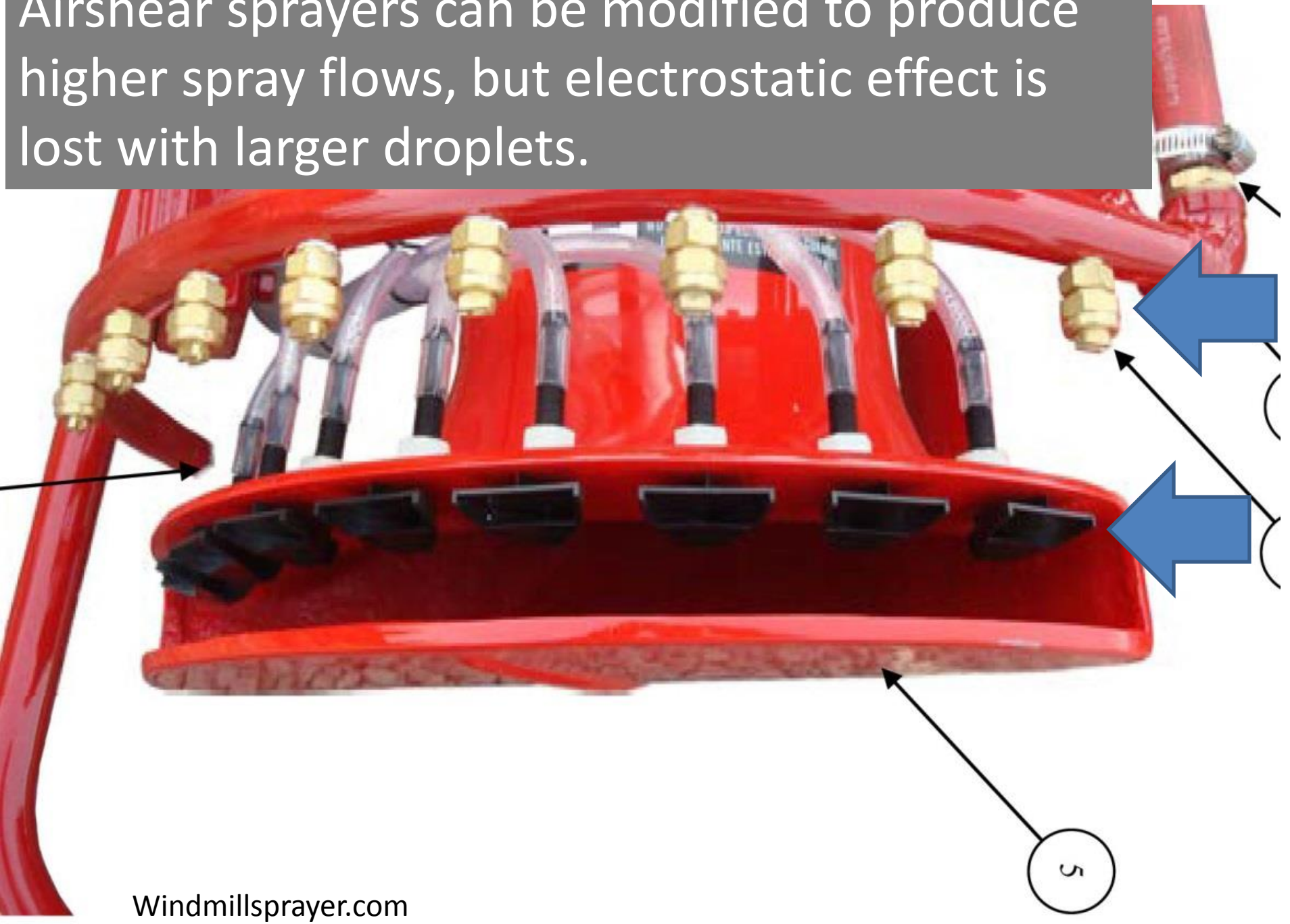
TeeJet TXR hollow cone nozzles produce Very Fine to Fine droplets across 30-360 psi.

Spraysystems.com

Air flow and droplet generation are not connected in hydraulic sprayers.

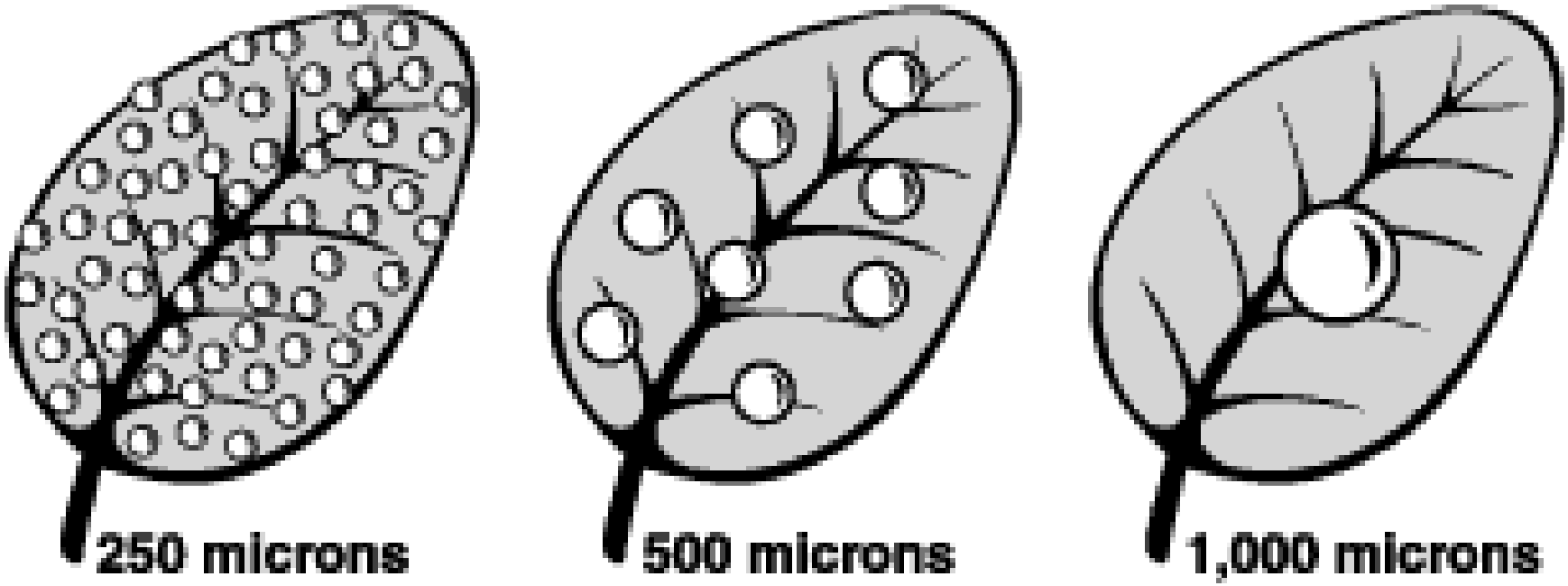

Air flow generates droplets in air shear sprayers.

Airshear sprayers can be modified to produce higher spray flows, but electrostatic effect is lost with larger droplets.



Windmillsprayer.com

Droplet Size and Surface Coverage



NDSU Agriculture Communication

1 ml fluid

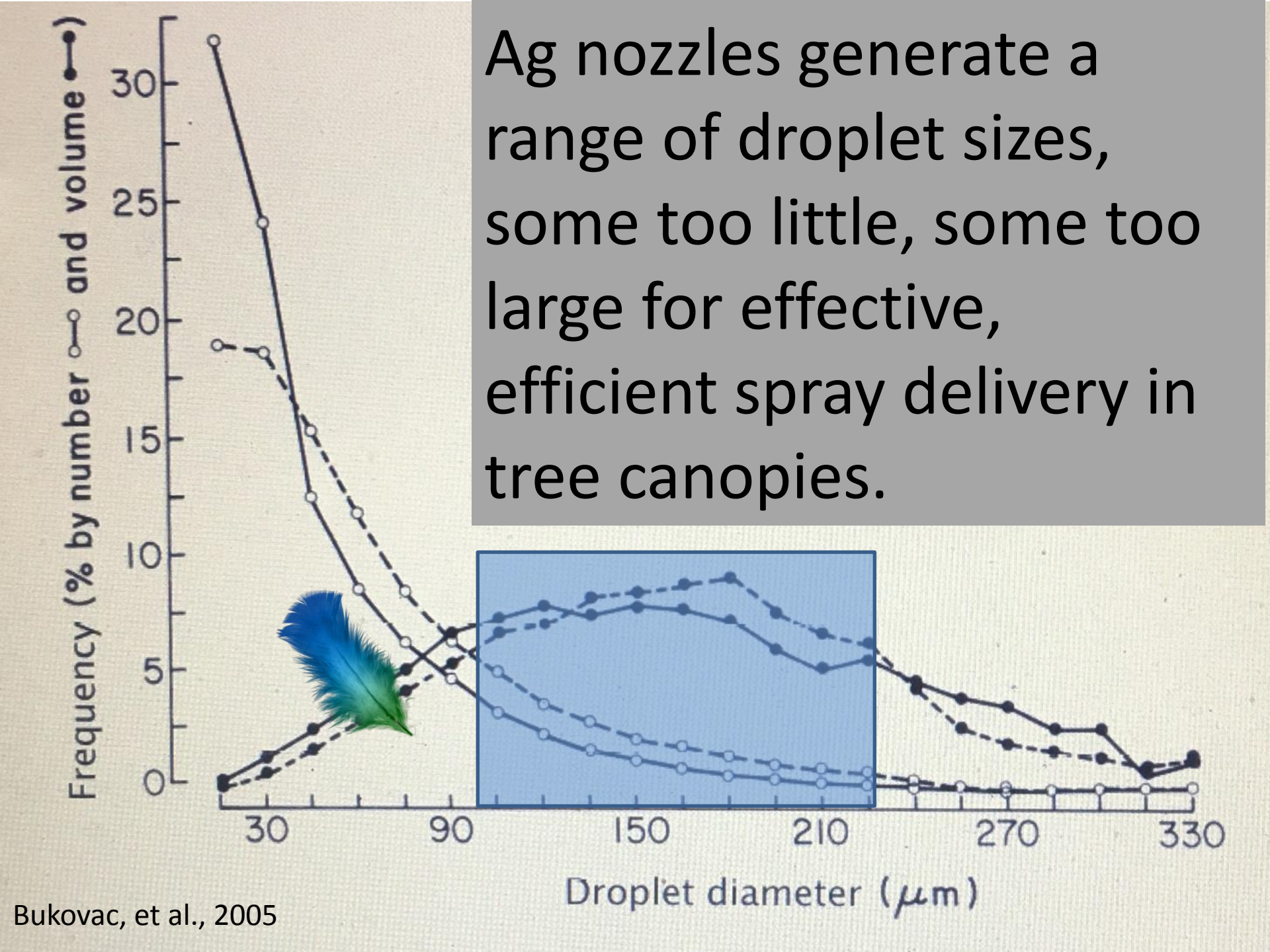
1 droplet ~ 12.4 mm dia.

10^6 droplets ~ 124 µm dia.

10^9 droplets ~ 12.4 µm dia.

Volume: $4/3\pi r^3$

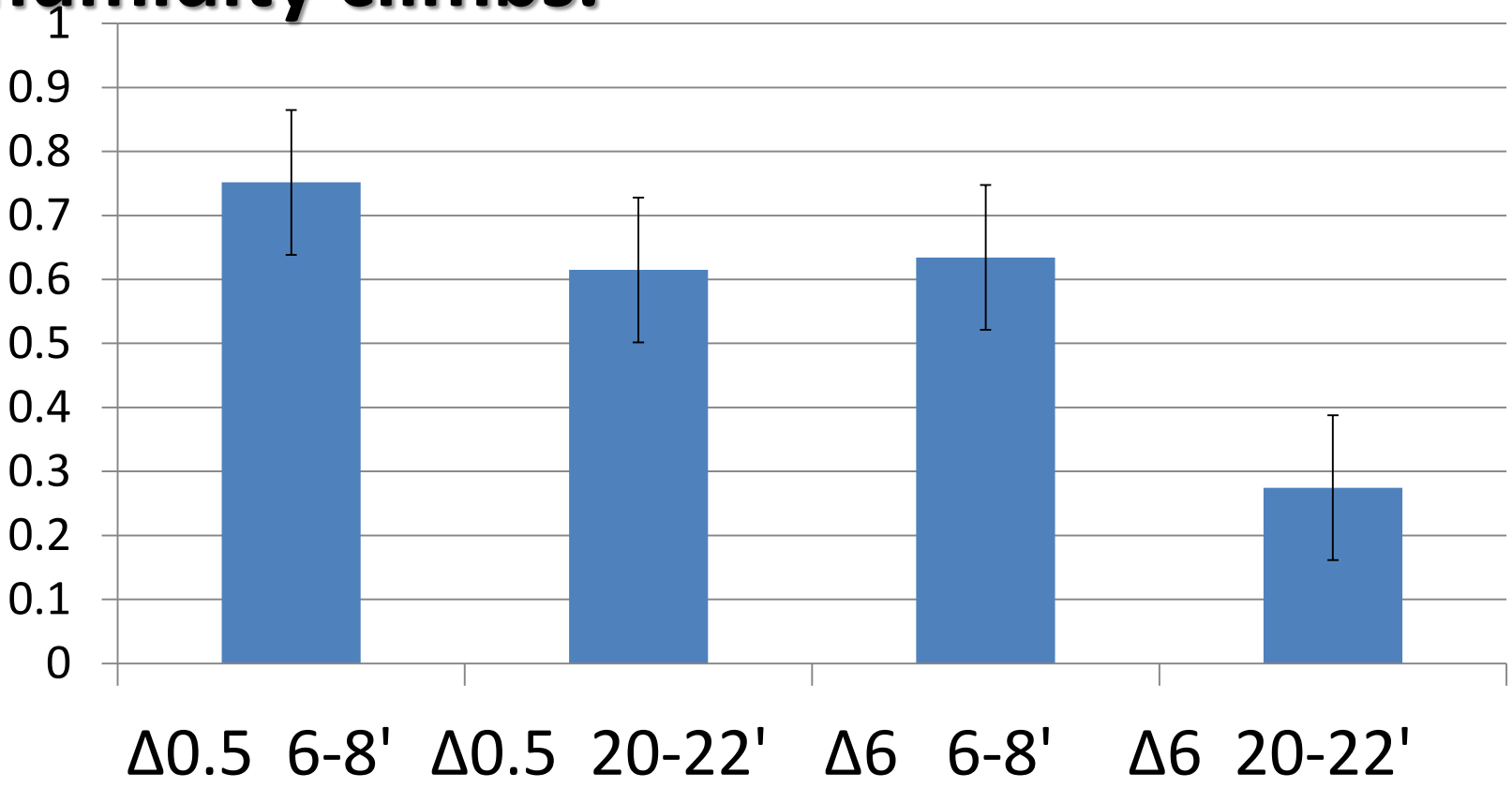
Ag nozzles generate a range of droplet sizes, some too little, some too large for effective, efficient spray delivery in tree canopies.



Bukovac, et al., 2005

The smallest droplets tend to keep moving and not land (unless they are charged, move slow & get close to target).

Smaller drops also evaporate quickly, so for best coverage, spray when temps drop and humidity climbs.



6:30-7 AM; 63ºF

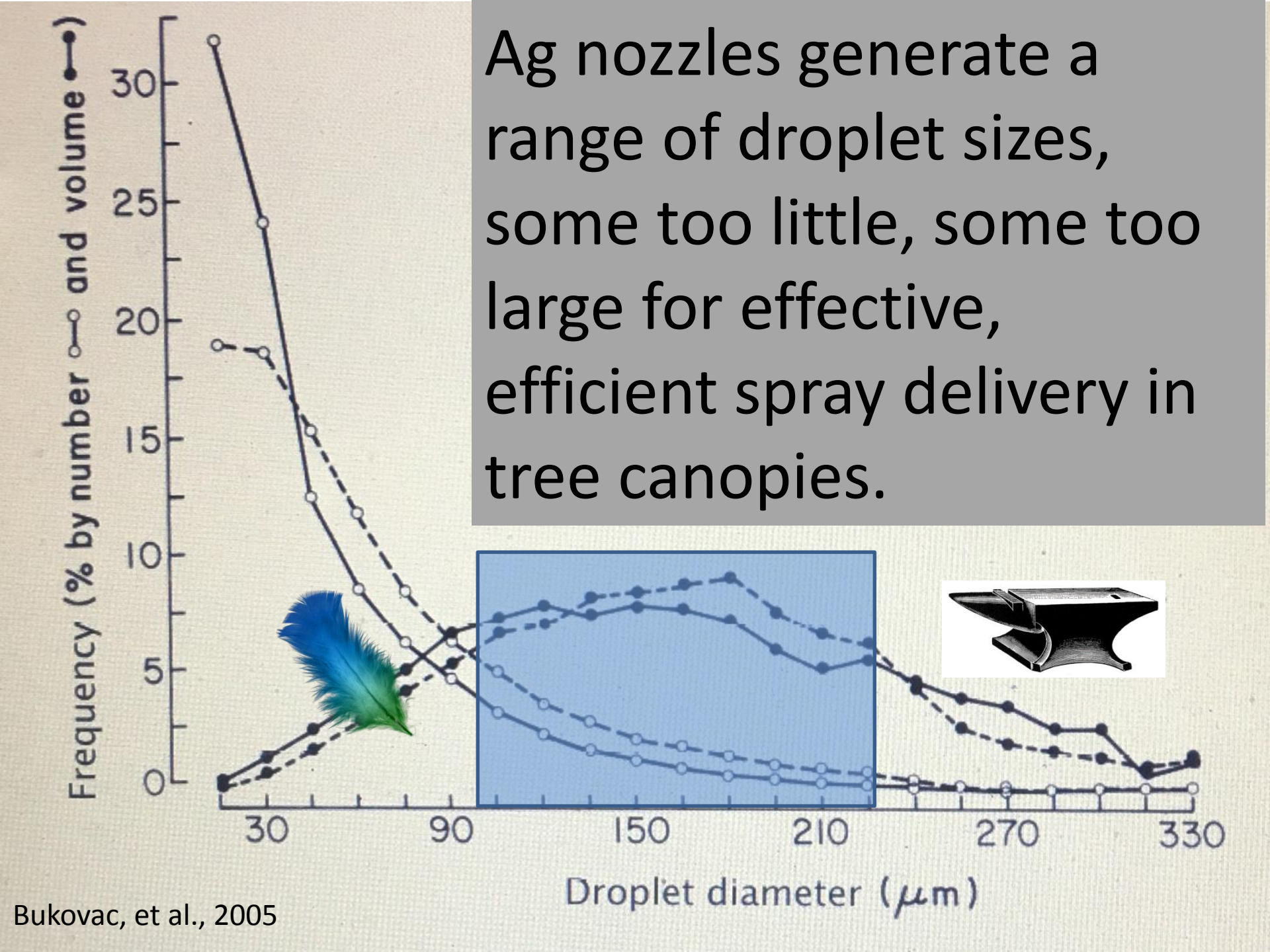
11:30-12; 83ºF

Droplet Diameter (microns)	Type of Droplet	- - - 1 gal/A Application - - - Droplets Per In² (No.)	Coverage Relative to 1000 Micron Drops	Drift Distance in 10 ft. Fall With 3 mph Wind (ft)
5	Dry Fog	9,220,000	200	15,800
10		1,150,000	100	4.500
20	Wet Fog	144,000	50	1,109
50		9,220	20	178
100	Misty Rain	1,150	10	48
150		342	7	25
200	Light Rain	144	5	15
500		9	2	7
1000	Heavy Rain	1	1	5

*Air temperature of 86° F and 50% relative humidity

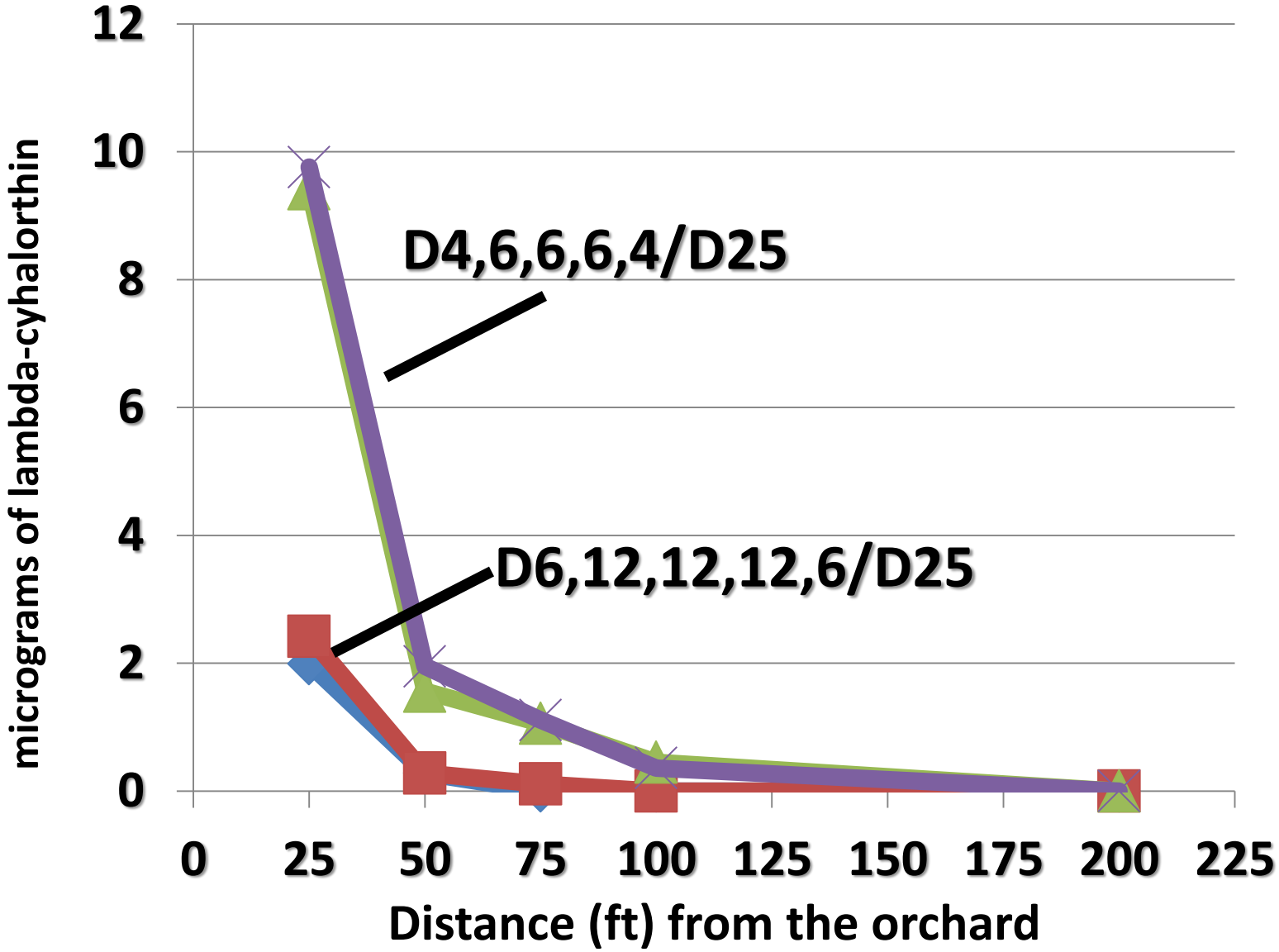
North Dakota State

Ag nozzles generate a range of droplet sizes, some too little, some too large for effective, efficient spray delivery in tree canopies.



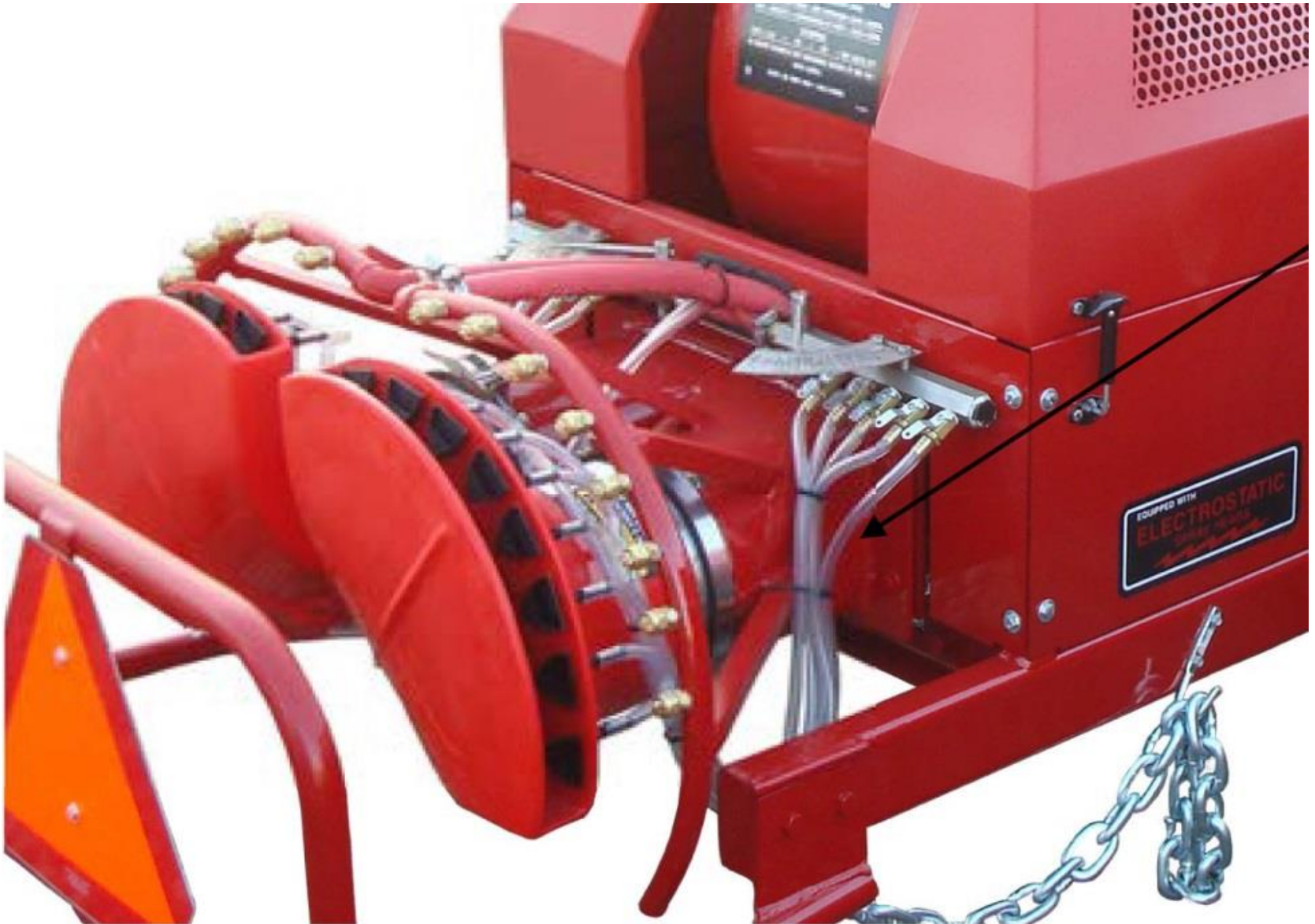
Bukovac, et al., 2005

However, big drops keep most of the spray material closer to the orchard.

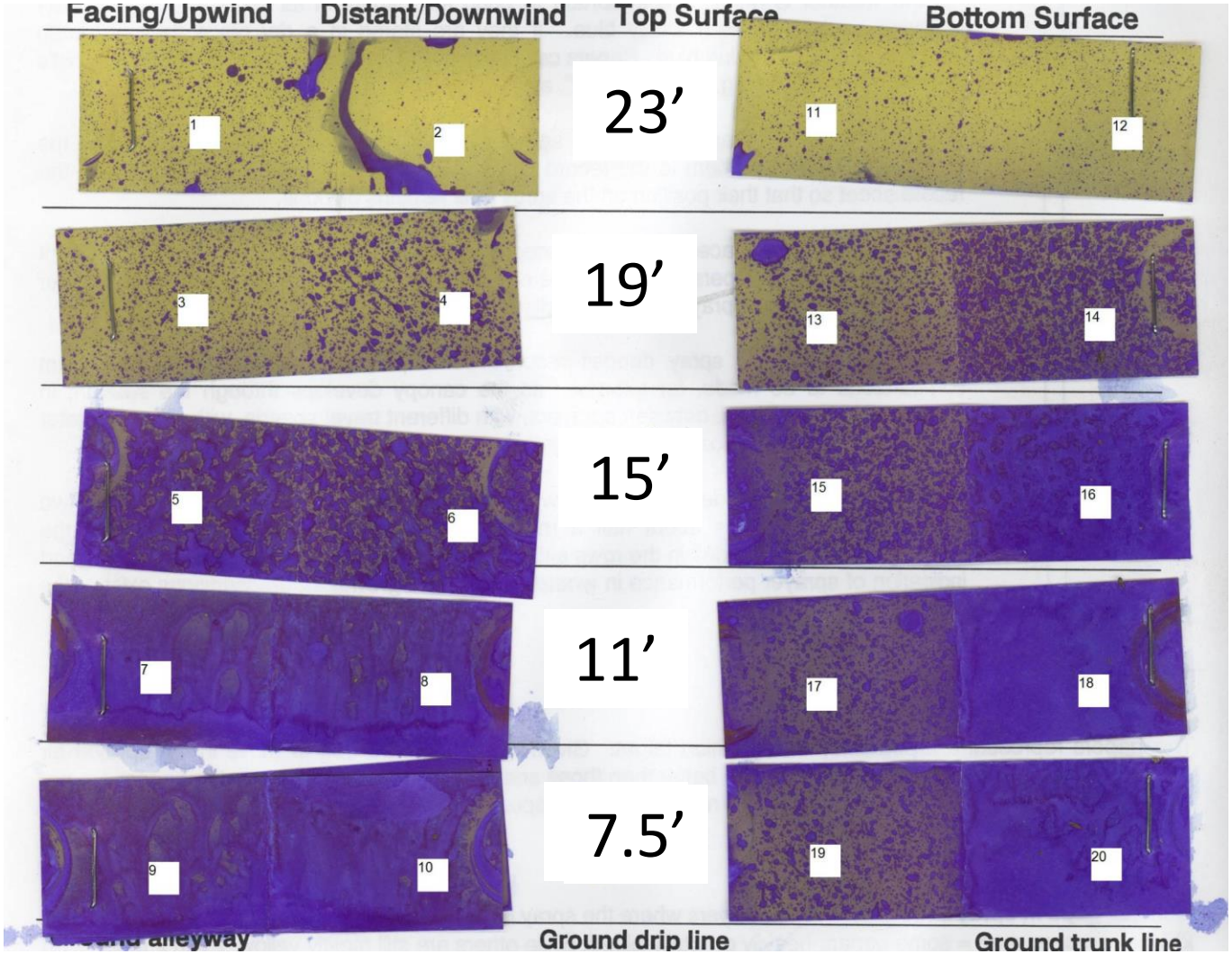


Direct the spray volume to target the tree and fight gravity.

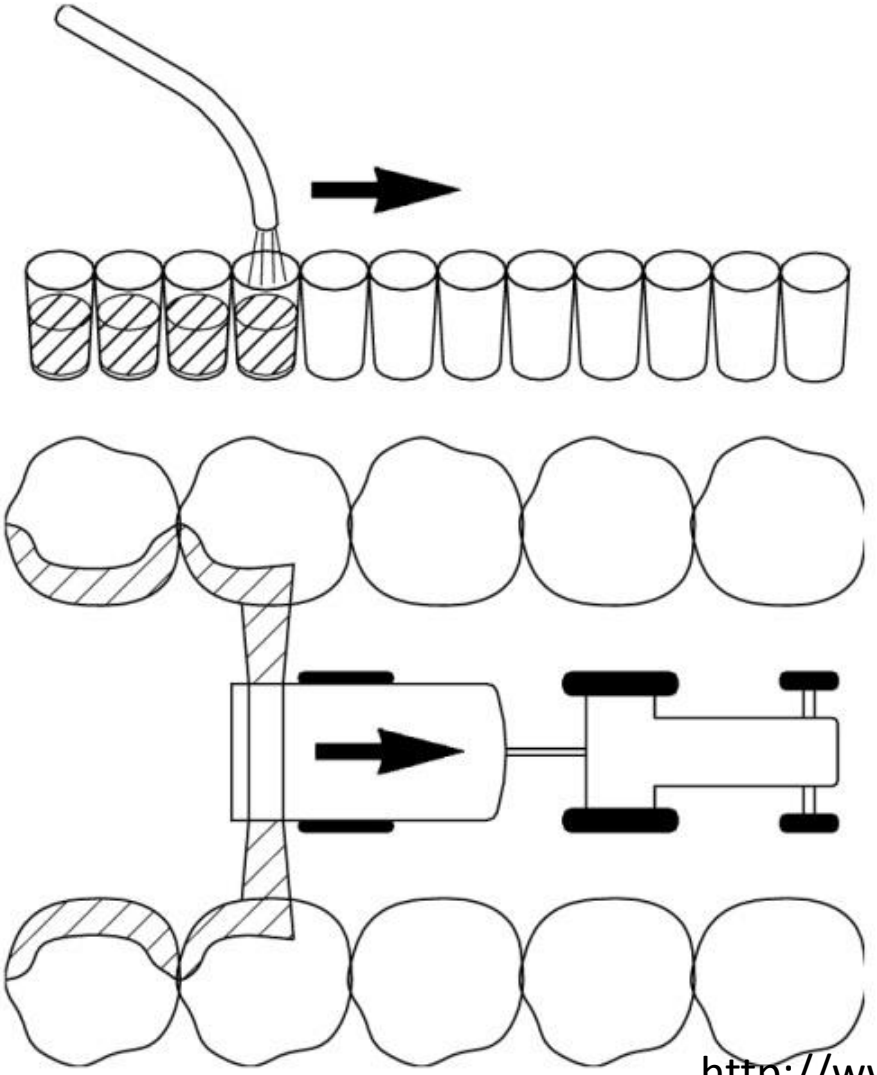
Air shear sprayers do not alter spray flow from top to bottom of spray jet.



Adjust and add nozzles (GPM) near the top of the sprayer.

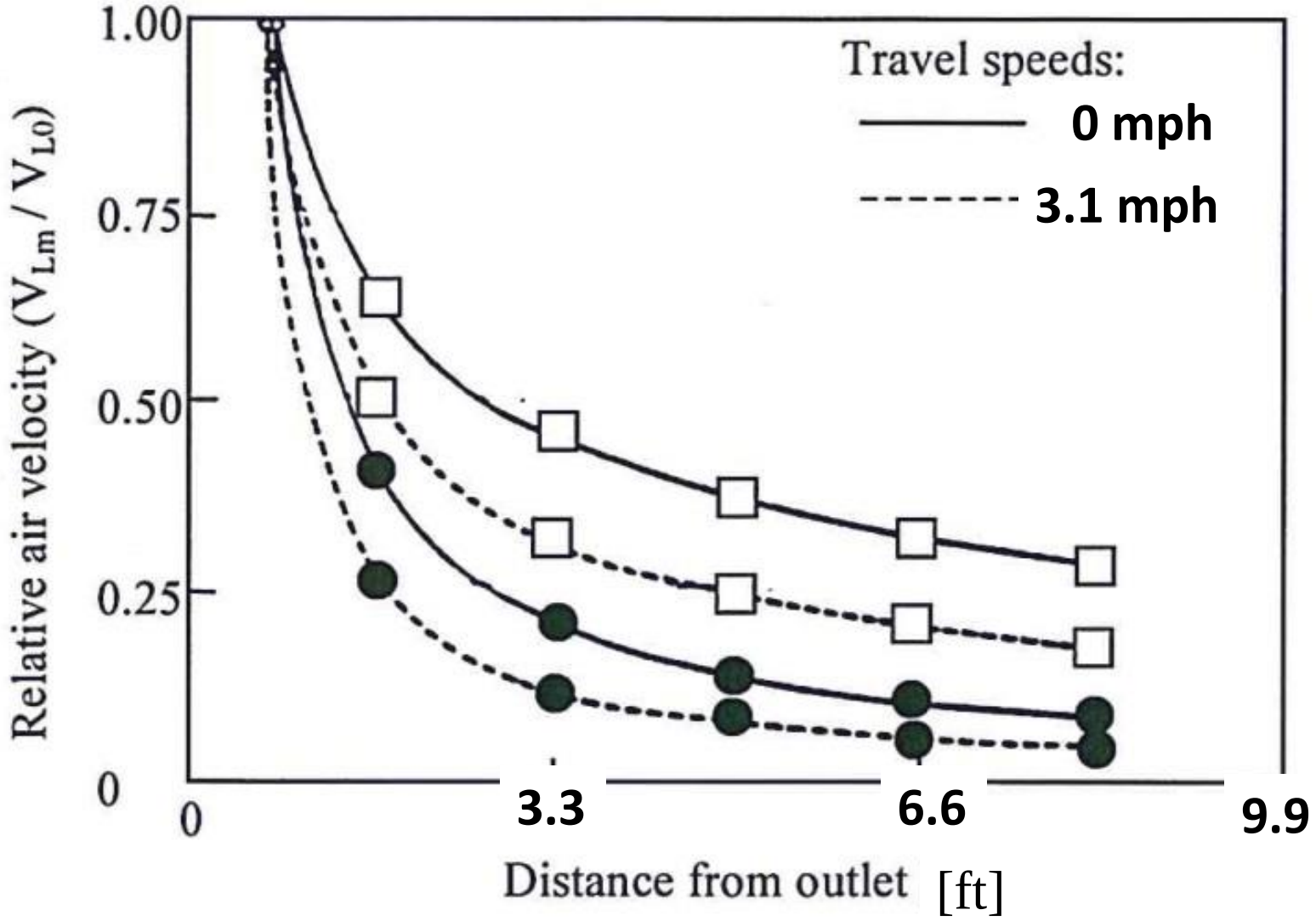


Because it affects air movement, ground speed is the most important variable affecting air (spray) movement in the tree.



http://www.hardi-international.com/

Air velocity decreases rapidly the further away from the outlet.

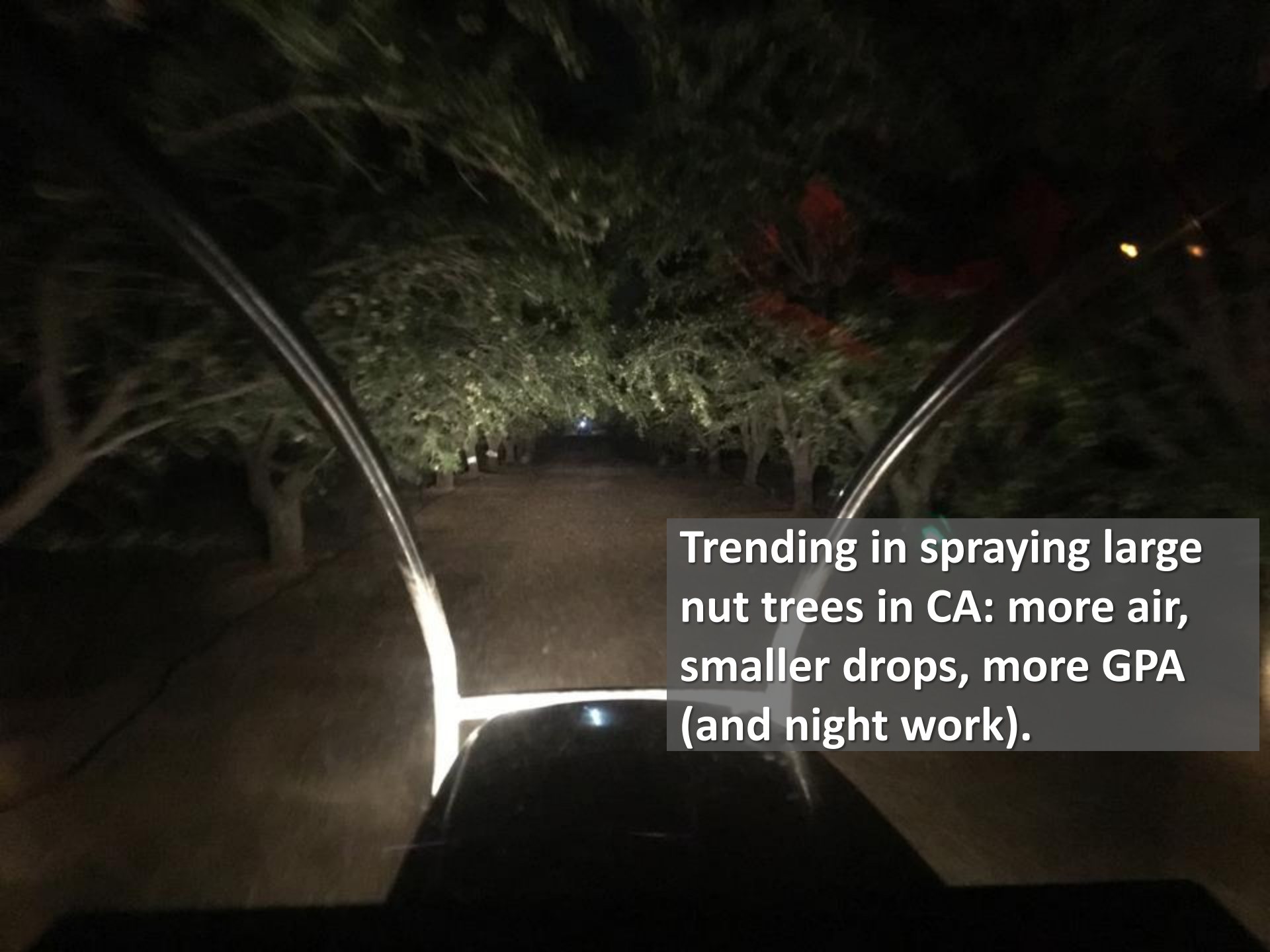


http://pub.epsilon.slu.se/9399/

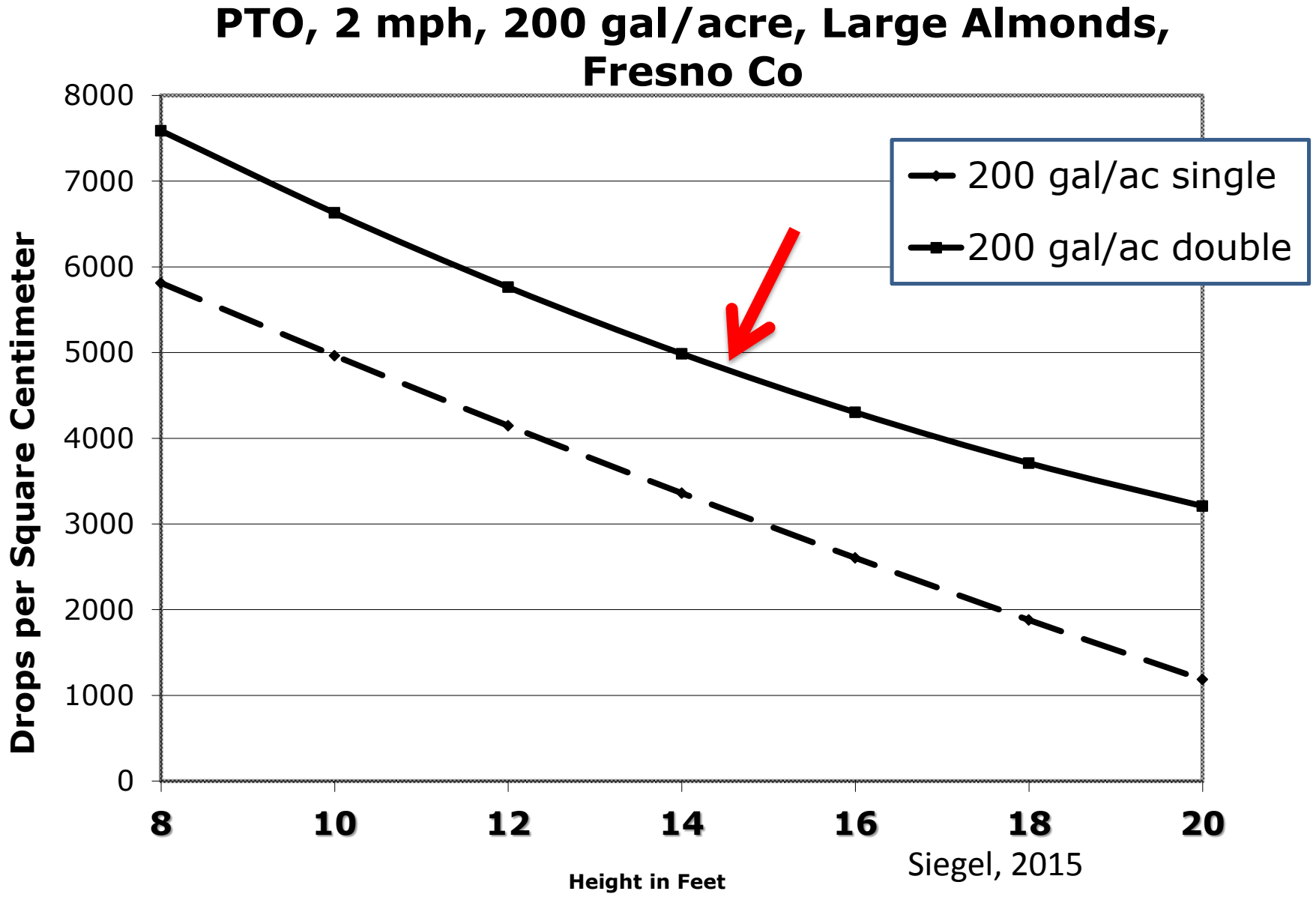
Set ground speed based on upper canopy coverage.

Air movement = coverage potential.

Photo: Brad Higbee, Trece’ Inc.


Trending in spraying large nut trees in CA: more air, smaller drops, more GPA (and night work).

Double the nozzles at high volume = more coverage higher in the tree



Spray treatments	%NOW Survival Lower	%NOW Survival Upper
Airblast (140 gpa; 1.75 MPH)	**0.2** a	**1.6** a
Electrostatic (off) 50 gpa; 3.3 MPH	**1.4** b	**3.5** b
Electrostatic (on) 50 gpa; 3.3 MPH	**0.7** b	**2.9** b

No difference in tracer leaf deposits in upper canopy.

More tracer leaf deposits in lower canopy airshear (w/ or w/o electrostatic

Giles, Siegel, and Niederholzer, 2013

Electrostatic Spray: Altacor 4.5 oz/ac + Bifenture at 12.5 oz/ac, 30 gpa, 4 mph, Aug 5

Dead Egg	Dead Blackhead	Dead Larva outside Egg	Total Dead	Total Eggs
379	774	476	1,629	2,100
23.3%	47.5%	29.2%	77.57%	

Of the 471 survivors, only 4 made it to the fifth instar;

Total mortality of 99.81%

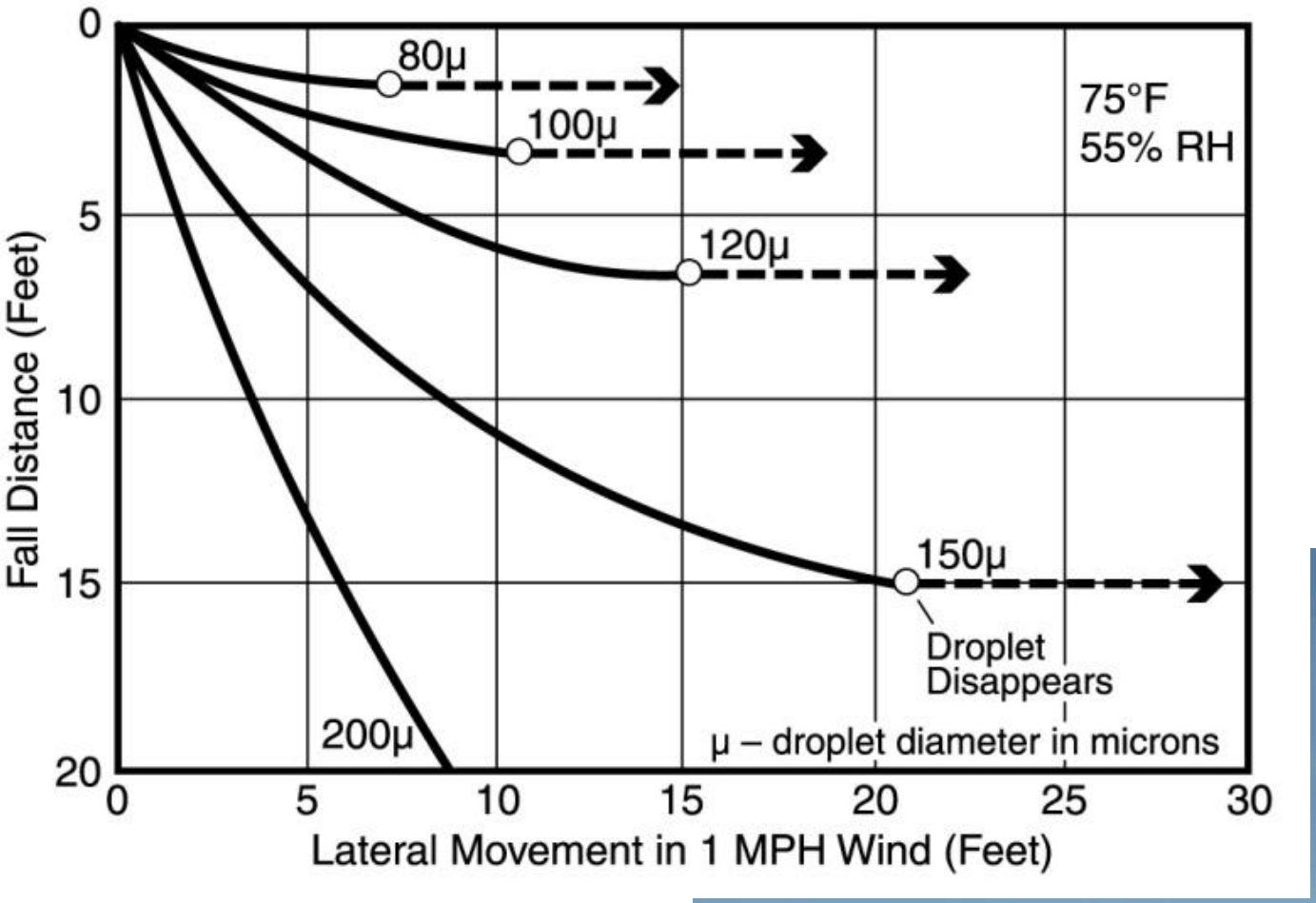
In contrast, in a Contact Assay from this same spray, Mortality was as follows:

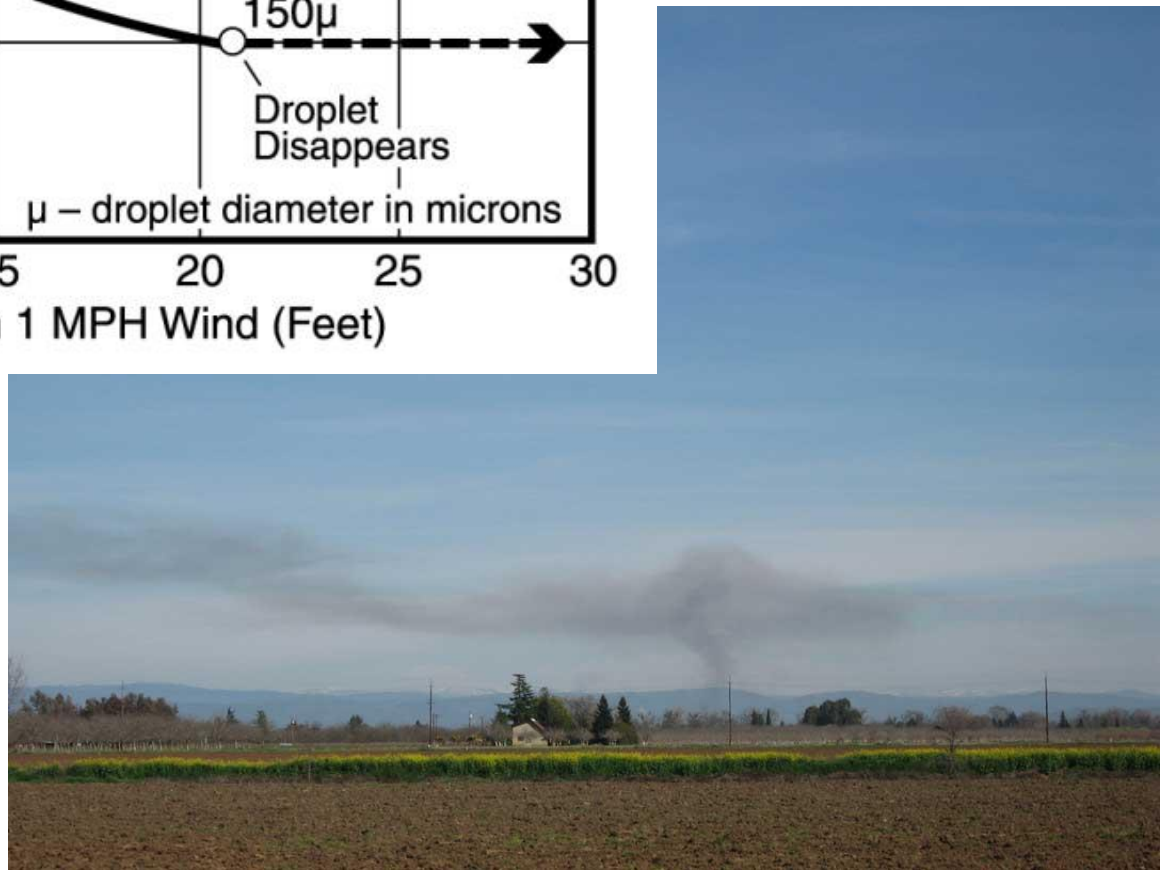
Dead	Live	Total Eggs
932	68	1,000

Total mortality was 93.20%

Siegel, 2015


To find the right sprayer for your farm, test it against your toughest spray job


0
5
10
15
20
Fall Distance (Feet)
80μ
100μ
120μ
150μ
200μ
75°F
55% RH
Droplet
Disappears
μ – droplet diameter in microns
0
5
10
15
20
25
30
Lateral Movement in 1 MPH Wind (Feet)



Buying a sprayer: will it work for me?

- Enough air?
- Enough volume?
- Agitation?
- Durable

Robotic Airblast sprayer (Global Unmanned Spray System) from Crinklaw Farm Services, Kingsburg, CA

Photo: pecanreport.com

Prototype (USDA)sprayer matches air flow, spray volume and pesticide dose to canopy, automatically.

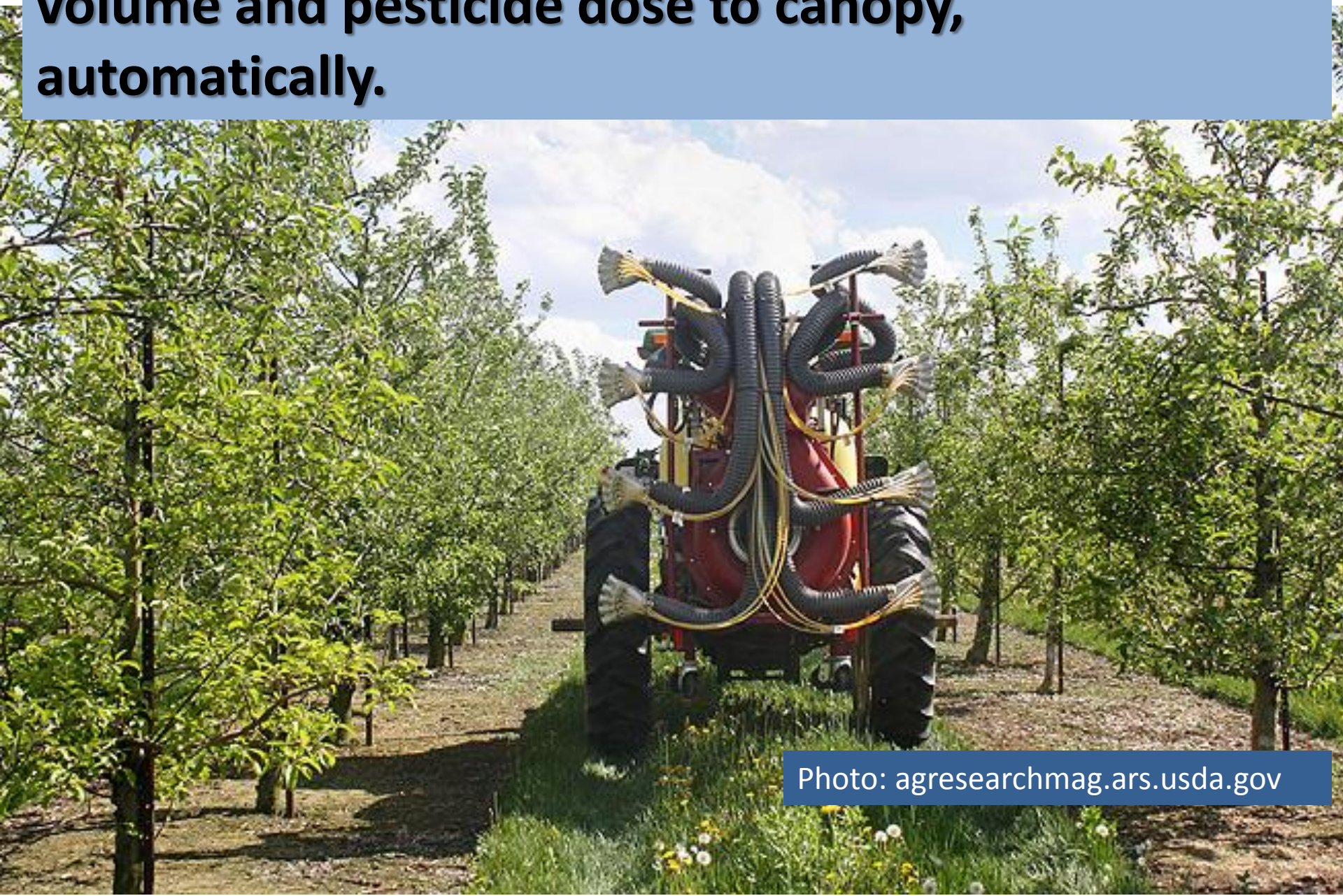


Photo: agresearchmag.ars.usda.gov

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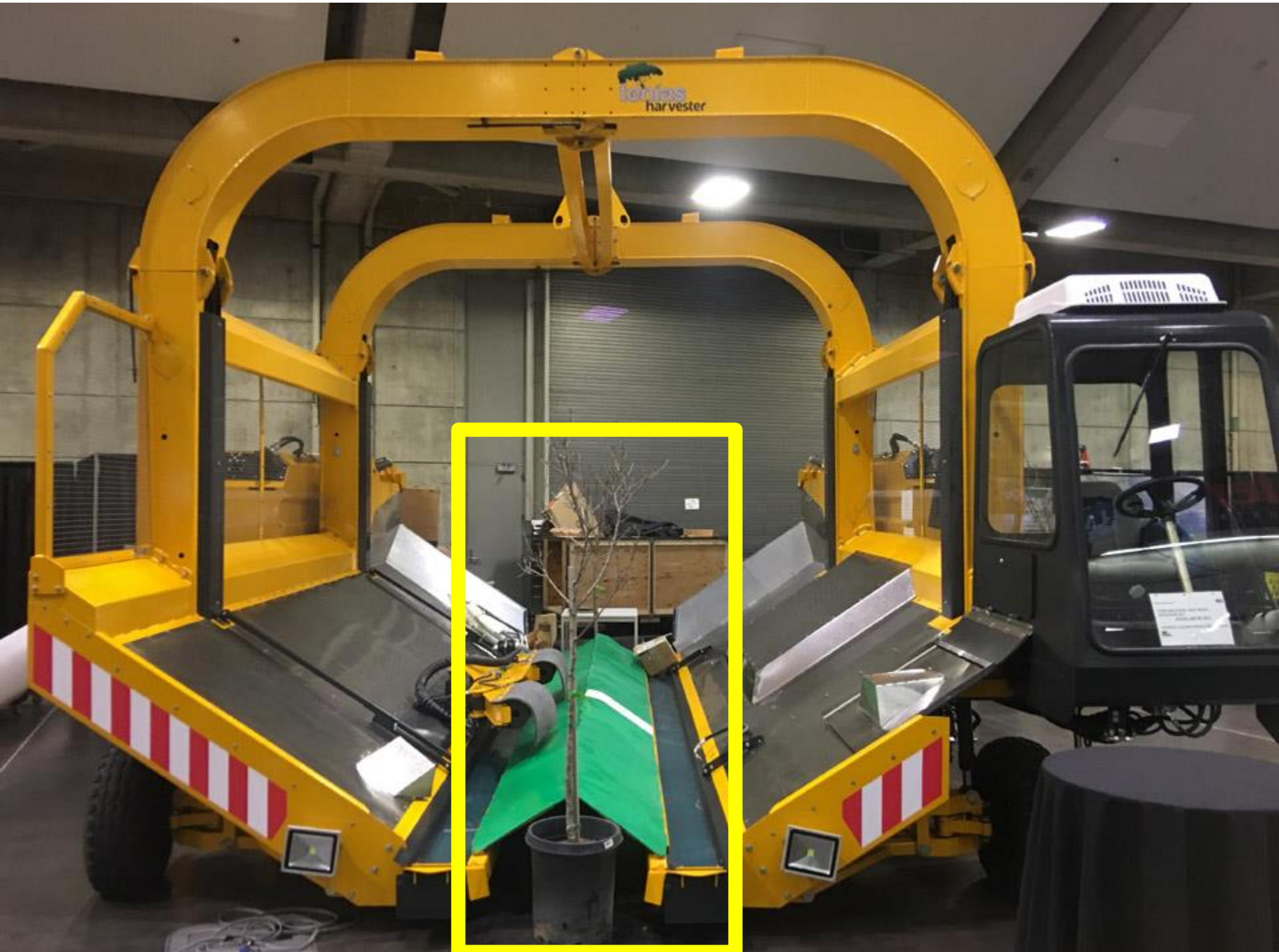
harvester

Thank you