

Efficacy and Drift: Recognizing the Conflicts on the Label

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Droplet size

- Droplet diameters measured in microns (μm)
- 1 micron = 1/25,000 of an inch
- All nozzles produce a range of droplet sizes, know as the droplet size spectrum

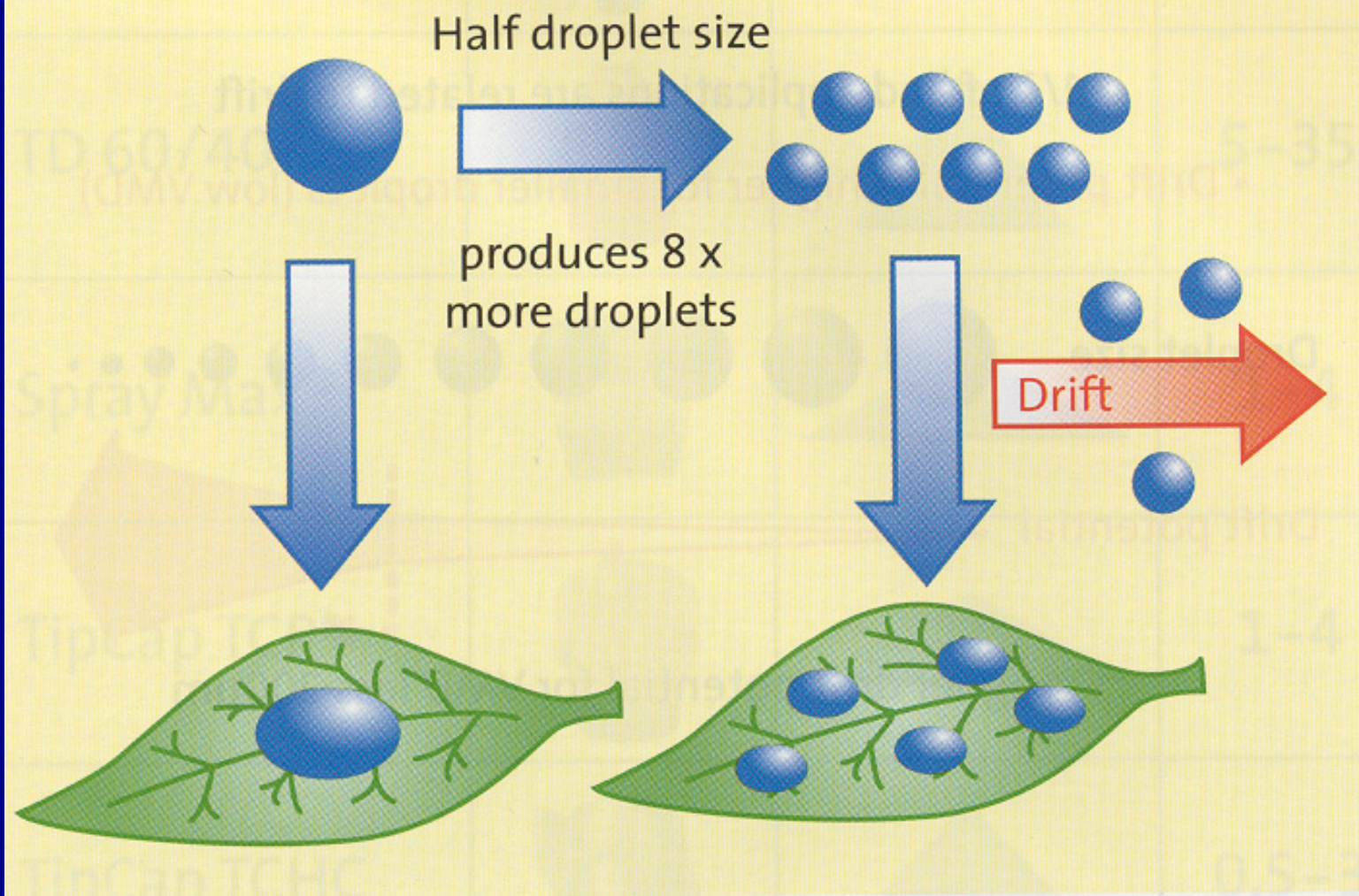
Droplet size: influences coverage and spray drift

Small droplets provide better coverage but are more likely to drift

Need to select droplet size based on application: balance need for coverage with drift reduction

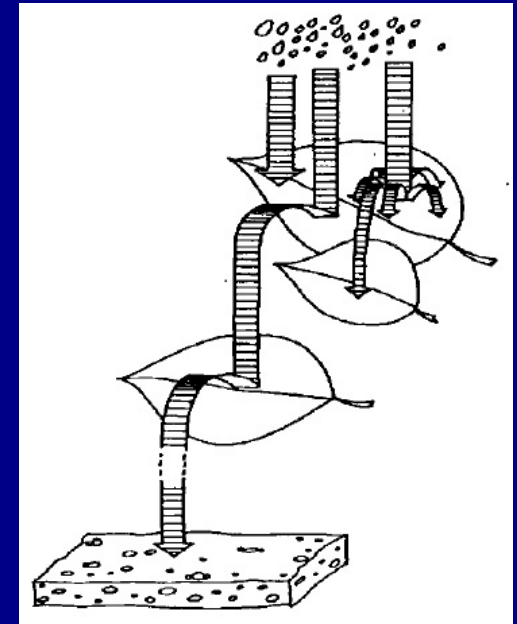
Droplet size and number

Effect of droplet size on coverage



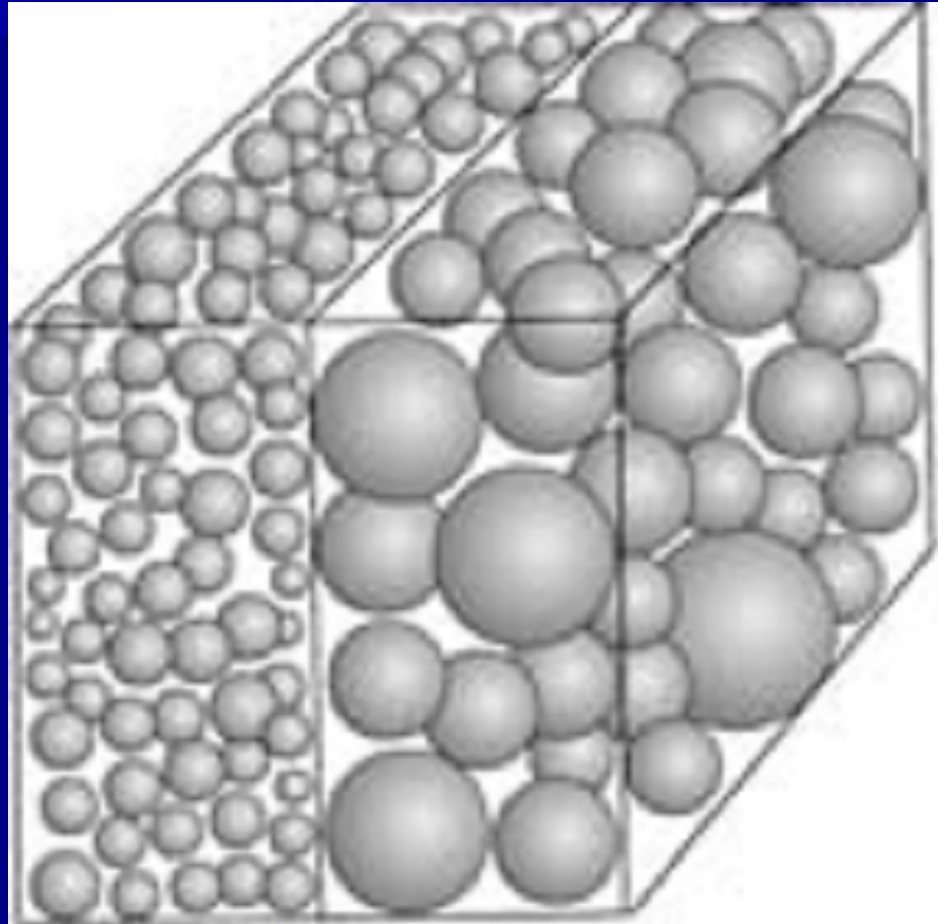
Droplet deposition

- Small droplets (fine) deposit more efficiently than larger (medium and coarse) droplets – need to get there
- Large droplets can rebound
- Large droplets can shatter into smaller droplets
- Target influences deposition
 - Plant part – leaf, stem, etc.
 - Orientation and interception angle
 - Wettability – cuticle surface



Volume Median Diameter

Half the
spray
volume
contained
in smaller
drops



Half the
spray
volume
contained
in larger
drops

VMD

ASABE Standard S-572

Nozzle Classification by Droplet Spectrum

Category	VMD (microns)
Very Fine (VF)	< 150
Fine (F)	150 – 250
Medium (M)	250 – 350
Coarse (C)	350 – 450
Very Coarse (VC)	450 – 550
Extremely Coarse (XC)	> 550

Very Fine

Fine

Medium

Coarse

**Very
Coarse**

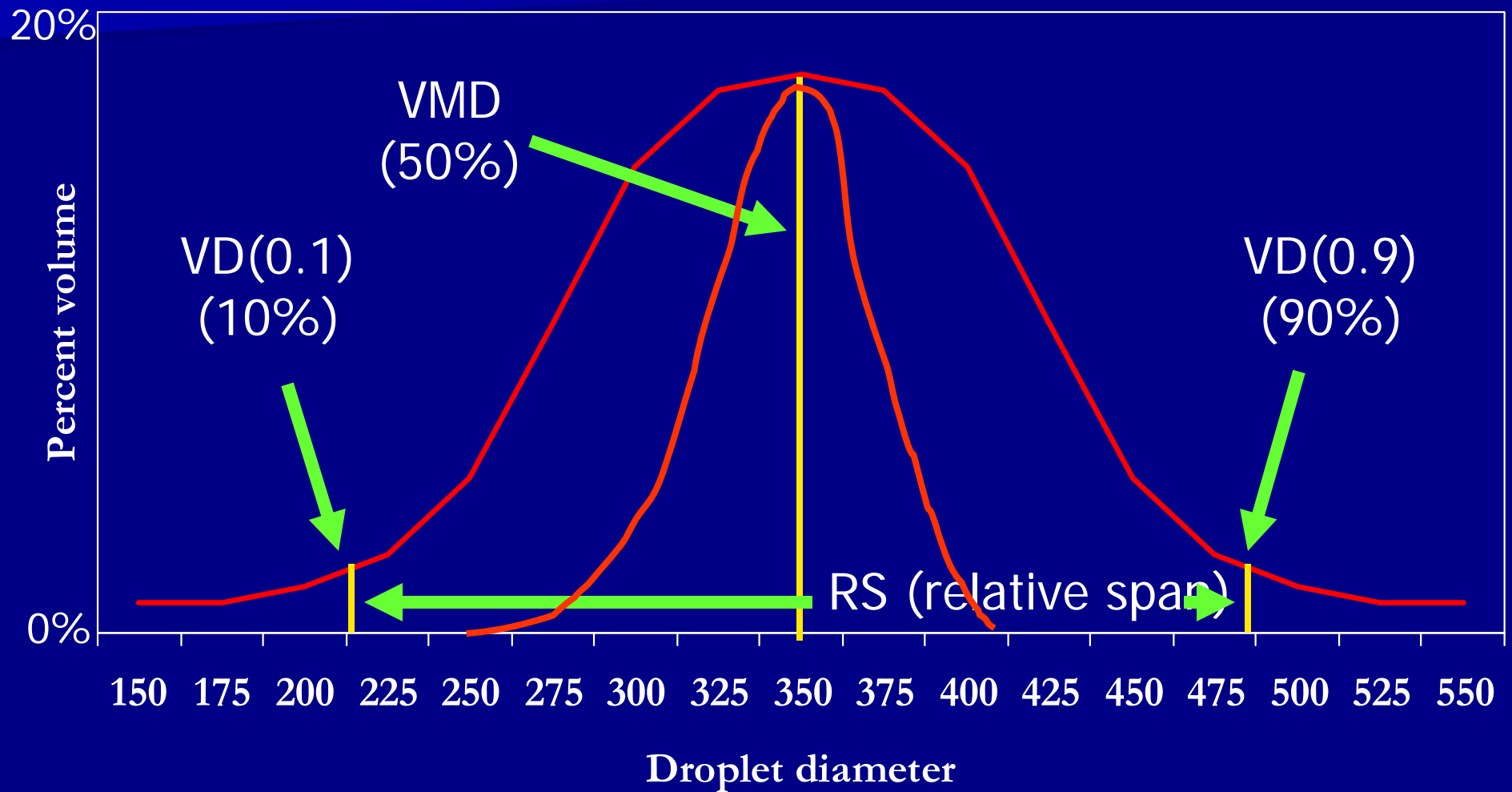
**Extremely
Coarse**

Choose nozzles that provide good coverage for product and minimize drift

Droplet size spectrums recommended for various pesticide uses

Droplet Spectrum (by ASABE S572)	Contact insecticide and fungicide	Systemic insecticide and fungicide	Contact foliar herbicide	Systemic foliar herbicide	Soil- applied herbicide	Incorporated soil-applied herbicide
Very fine VF						
Fine F	✓					
Medium M	✓	✓	✓	✓		
Coarse C		✓		✓	✓	✓
Very Coarse VC					✓	✓
Extremely Coarse XC						✓

Cumulative volume distribution



Increasing coverage

- Two ways to increase coverage:
 - Decrease droplet size
 - Increase spray application rate (GPA)

Example #1:

20 GPA

500 μm droplets

1.2 billion droplets/acre

Example #2:

5 GPA

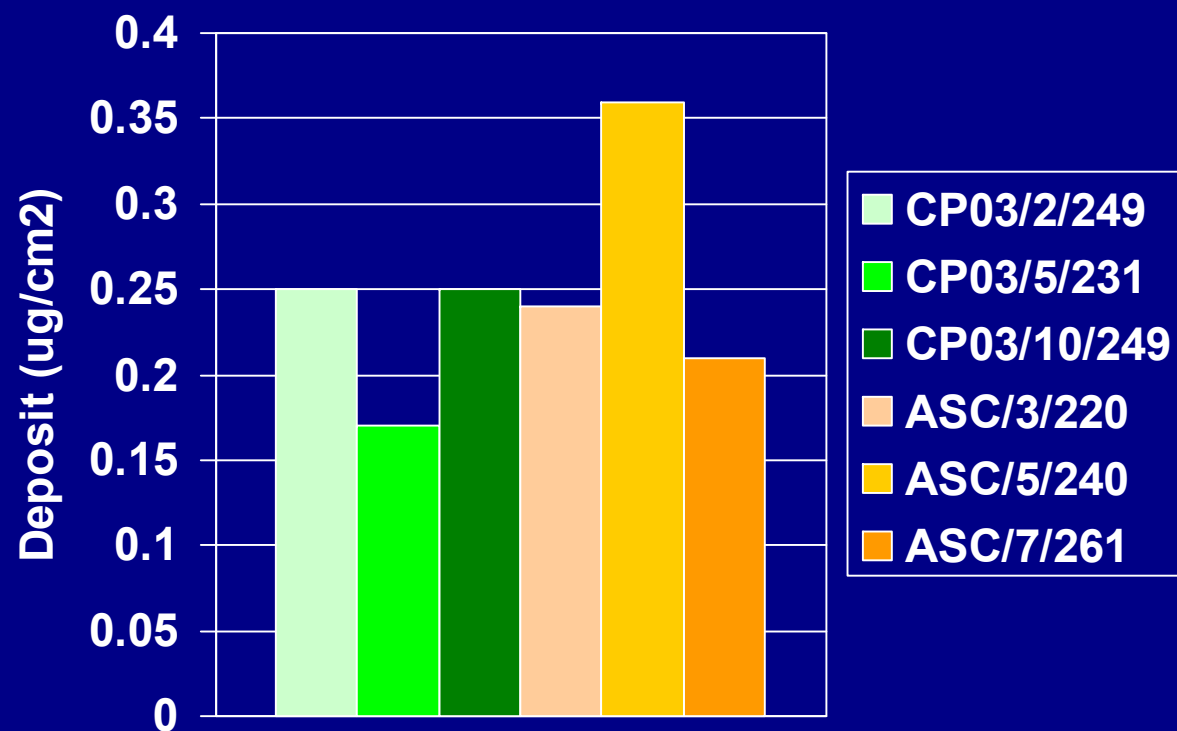
250 μm droplets

2.3 billion droplets/acre

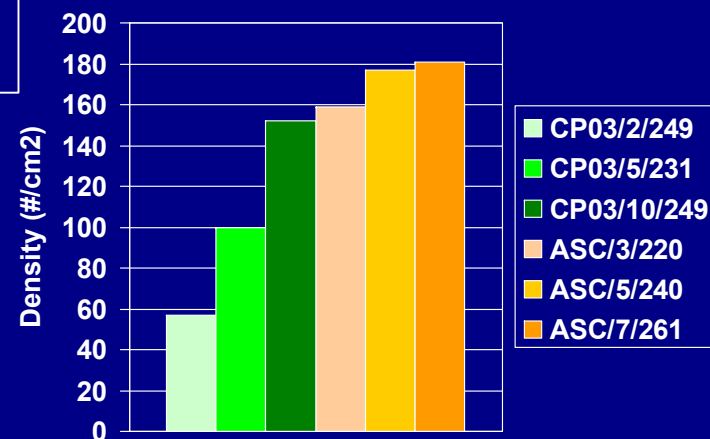
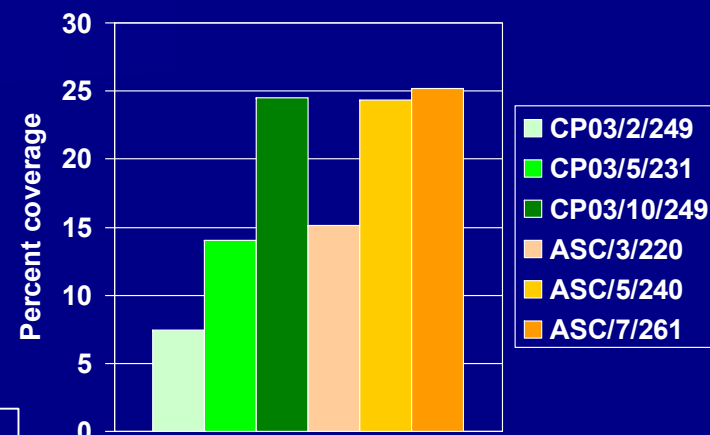
Tank mixing example

- Fungicide application rate: 6 fl oz per acre
- Field size: 50 acres
- Ground spray application rate: 20 GPA
 - Amount of product needed: 300 fl oz
 - Amount of spray solution needed: 1000 gallons
- Aerial spray application rate: 5 GPA
 - Amount of product needed: 300 fl oz
 - Amount of spray solution needed: 250 gallons
- 5 GPA tank mix is 4 times the concentration of the 20 GPA tank mix

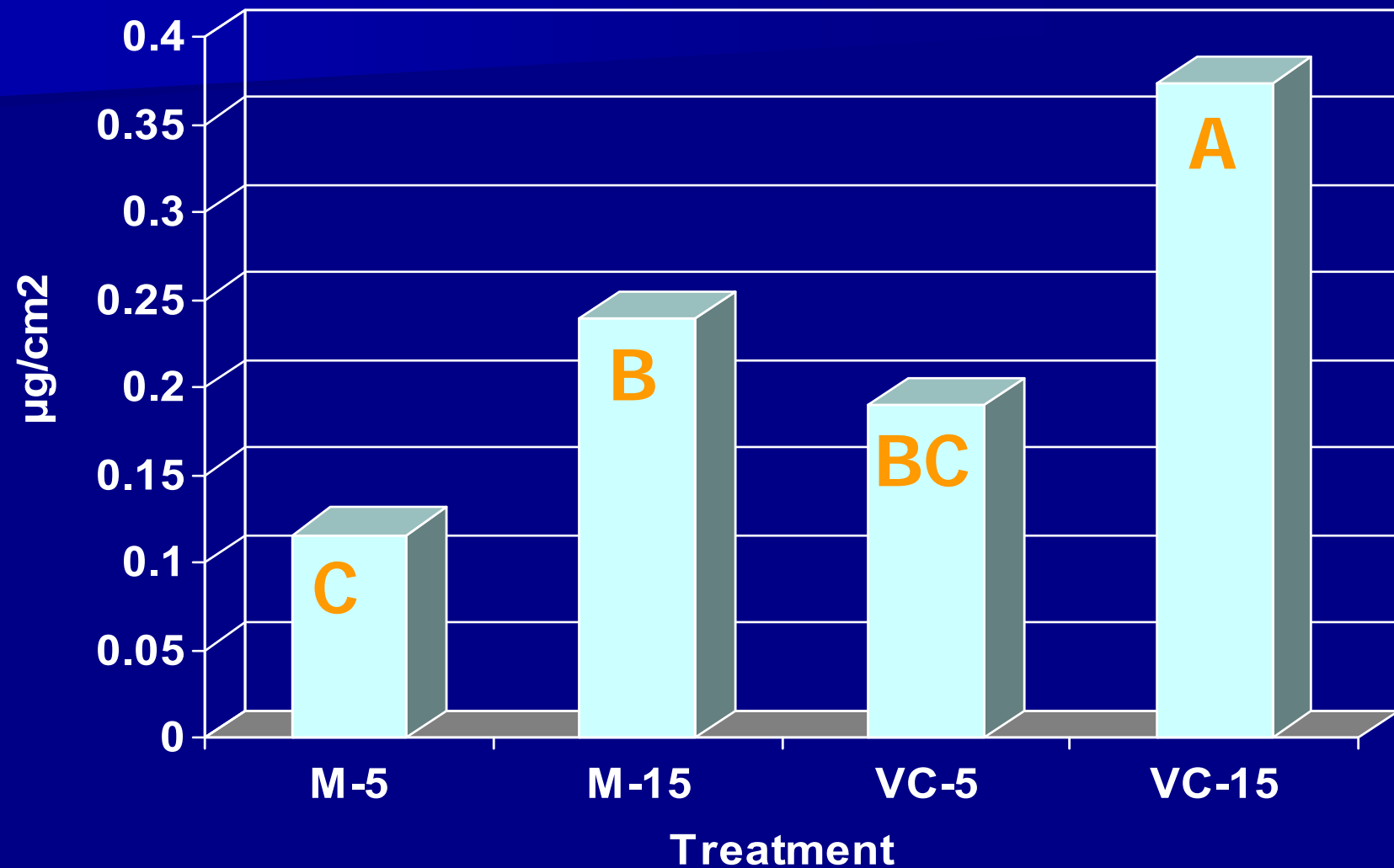
Spray deposition on wheat heads



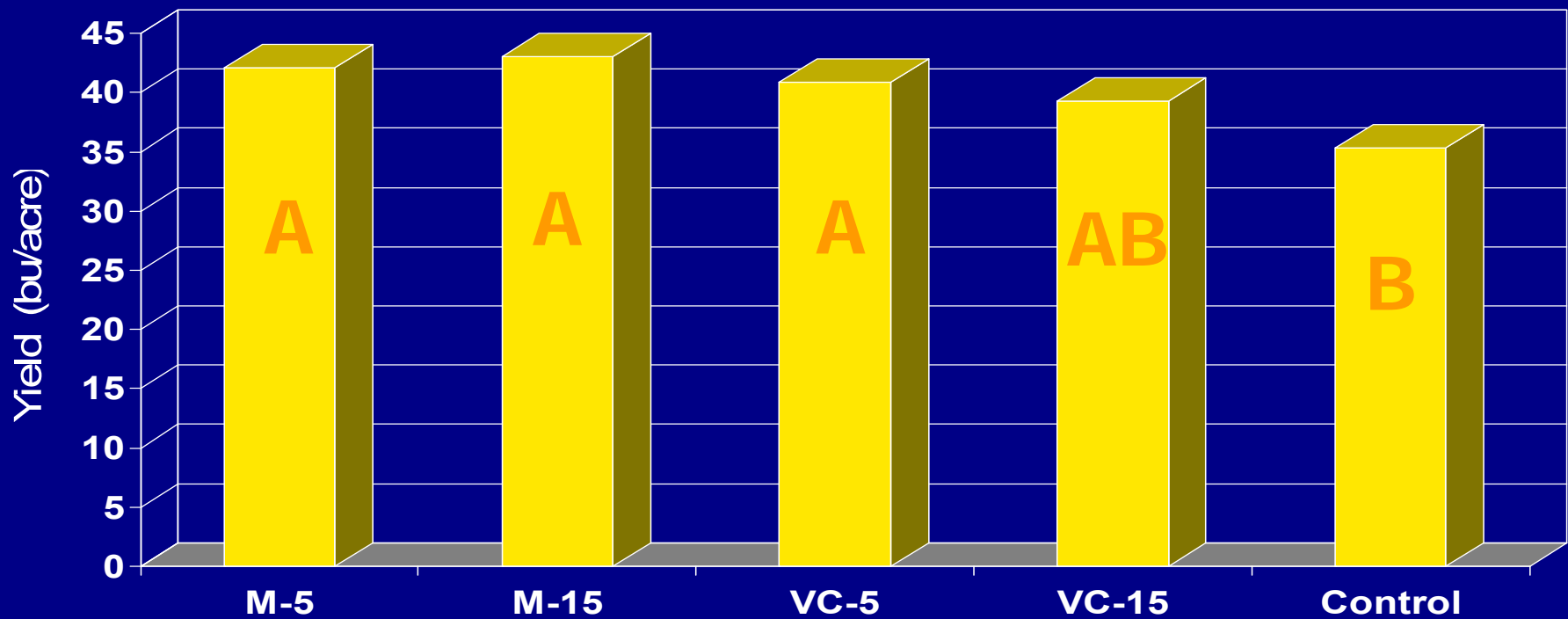
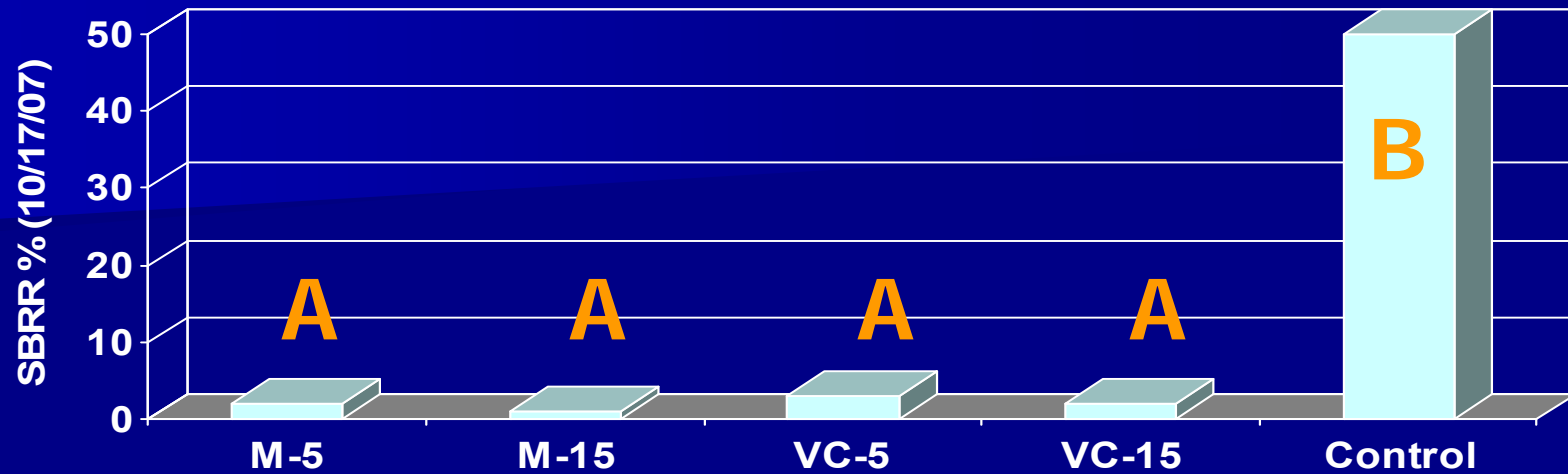
Source: USDA ARS



Deposition – lower canopy

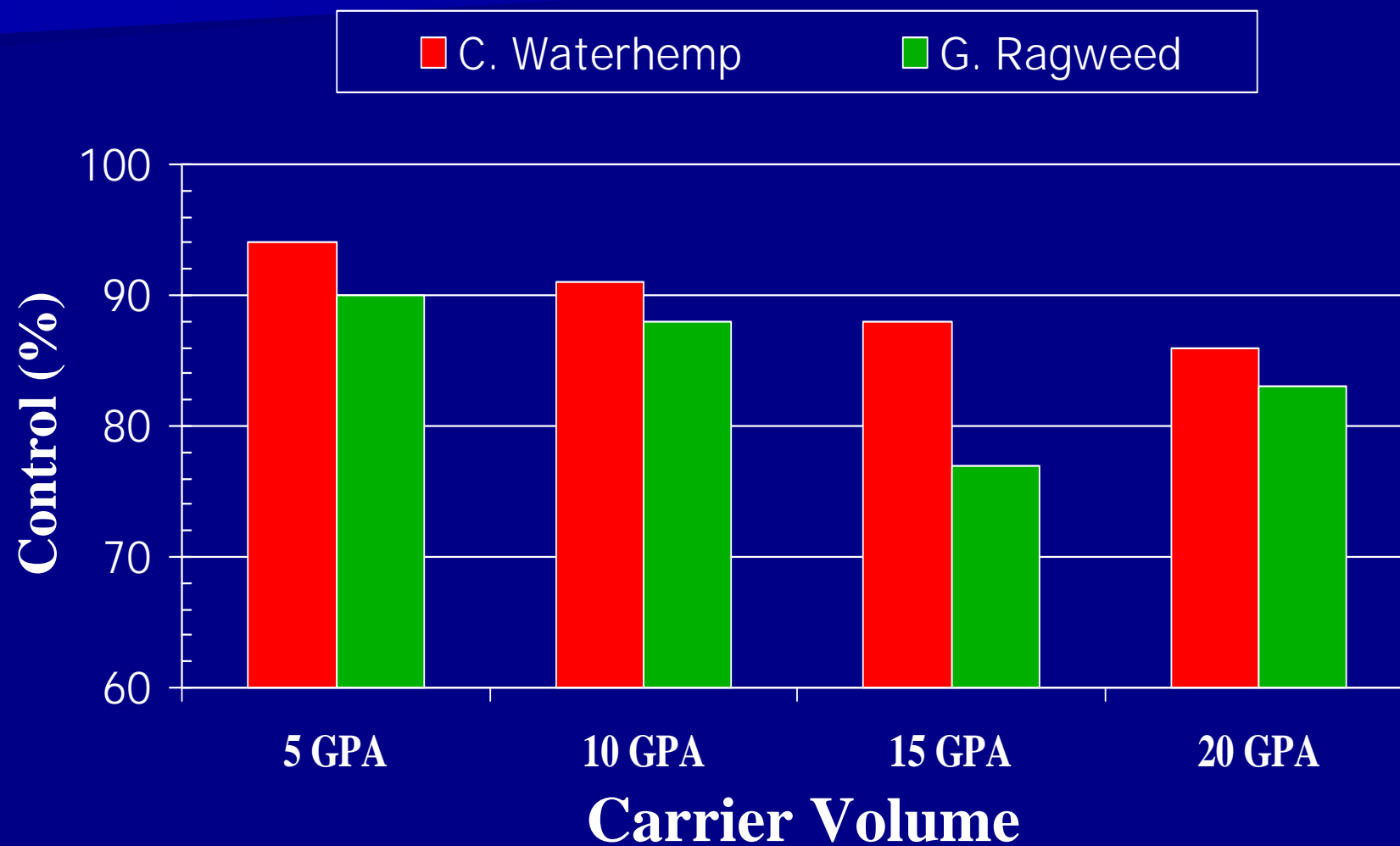


Disease and yield



Glyphosate and GPA

Weed Control 28 DAT



Ground: Nozzles and droplet size

- Nozzle design

- Orifice size

- Small orifices create finer droplets
- Larger orifices create coarser droplets

- Pressure

- Lower pressure creates coarser droplets
- Higher pressure creates finer droplets

- Nozzle fan angle

- Narrow angles create coarser droplets
- Wider angles create finer droplets

Ground Nozzle droplet classification

Turbo TeeJet® (TT)

	PSI										
	15	20	25	30	35	40	50	60	70	80	90
TT11001	C	M	M	M	M	M	F	F	F	F	F
TT110015	C	C	M	M	M	M	M	M	F	F	F
TT11002	C	C	C	M	M	M	M	M	M	M	F
TT11003	VC	VC	C	C	C	C	M	M	M	M	M
TT11004	XC	VC	VC	C	C	C	C	C	M	M	M
TT11005	XC	VC	VC	VC	VC	C	C	C	C	M	M
TT11006	XC	XC	VC	VC	VC	C	C	C	C	C	M
TT11008	XC	XC	VC	VC	VC	VC	C	C	C	C	M

Droplet Size Chart (ASAE/BCPC)

	PSI						
	15	30	45	60	75	90	105
Low Pressure AirMix®							
AM11001	24		42				
AM110015	29		48				
AM11002		32		55			
AM110025	20					81	
AM11003	19	32		52			
AM11004	19	33		55			
AM11005	20	35		57			

Extremely Coarse Very Coarse Coarse Medium Fine Very Fine

These are our spray tips that best match your input information

ER110-06 Part No. 40281-06 Part Colour Grey				ER110-08 Part No. 40281-08 Part Colour White				MR110-04 Part No. 40291-04 Part Colour Red			
	Speed MPH	Press. PSI	Drop VMD		Speed MPH	Press. PSI	Drop VMD		Speed MPH	Press. PSI	Drop VMD
Minimum	8.4	20	276	Minimum	11.2	20	328	Minimum	6.3	25	443
	9.4	25	267	Target	12.0	23	313		6.9	30	420
	10.3	30	261		12.5	25	304		7.4	35	401
	11.1	35	255		13.7	30	286		7.9	40	385
	11.9	40	251		14.8	35	272		8.4	45	371
Target	12.0	41	250		15.8	40	260		8.8	50	360
	12.6	45	247		16.8	45	249		9.3	55	350
	13.3	50	243		17.7	50	241		9.7	60	341
	13.9	55	240		18.6	55	233		10.1	65	333
	14.5	60	237		19.4	60	226		10.5	70	325
	15.1	65	235		20.2	65	220		10.8	75	318
Maximum	15.7	70	232	Maximum	20.9	70	215		11.2	80	312
									11.5	85	307
									11.9	90	301
								Target	12.0	92	299
									12.2	95	297
								Maximum	12.5	100	292
								Pre-orifice No. R04 Part No. 40285-04 Screen Mesh/Color: 50/Red Part No. 40250			

	15 PSI	20 PSI	30 PSI	40 PSI	50 PSI	60 PSI	70 PSI	80 PSI	90 PSI	100 PSI	115 PSI
GRD120-01	C	C	C	M	M	M	M	M	M	M	M
GRD120-015	C	C	C	M	M	M	M	M	M	M	M
GRD120-02	VC	C	C	C	C	M	M	M	M	M	M
GRD120-025	VC	C	C	C	C	M	M	M	M	M	M
GRD120-03	VC	C	C	C	C	C	M	M	M	M	M
GRD120-04	VC	C	C	C	C	C	M	M	M	M	M
GRD120-05	VC	C	C	C	C	C	M	M	M	M	M
GRD120-06	XC	VC	C	C	C	C	M	M	M	M	M
GRD120-08	XC	XC	VC	C	C	C	M	M	M	M	M

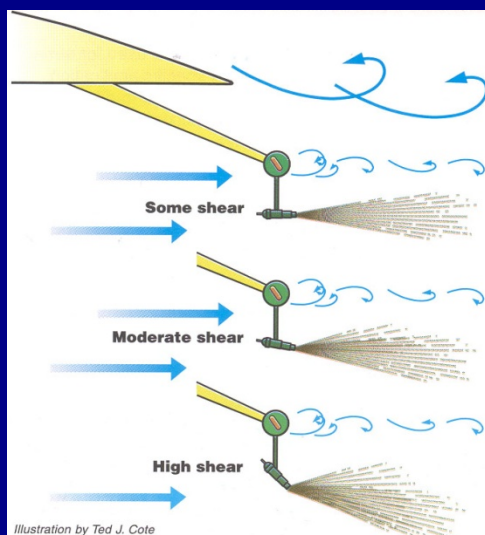
Aerial: Speed and pressure

- Speed - determines the force of the high speed air flow into which spray is forced
 - Influences shearing effect
- Pressure - forcing spray out at speeds similar to air flow reduces shearing effect
 - High pressure tends to increase droplet size
 - Low pressure tends to decrease droplet size



Aerial: Deflection angle

- Alter the angle at which spray enters high speed air flow - key tool in managing droplet size
- Change degree of air shear
 - Increase shear creates smaller droplets
 - Decrease shear creates larger droplets



Large droplets

Medium droplets

Fine droplets



USDA ARS aerial nozzle models

- Based on extensive wind tunnel research
- Applicator enters orifice size, deflector angle, pressure, and air speed
- Model calculates VMD and other droplet size statistics and graphs spectrum
- Valuable tool for setting up aircraft for correct droplet size
- Flat fan example

Label examples

- Aerial: Select spray nozzles, pumping pressure, and sprayer height to provide medium-to-fine spray droplets that penetrate throughout the crop canopy. Spray calibration must be conducted to confirm spray droplet sizes.
- Aerial: Nozzles must always point backward parallel with the airstream and never be pointed downward more than 45 degrees

Label examples

- Use nozzle types and arrangements that will provide optimum coverage while producing a minimal amount of fine droplets
- Do not exceed 30 psi spray pressure unless otherwise required by the manufacturer of drift reducing nozzles

Label examples

- Ground: Use standard low-pressure herbicide sprayers equipped with boom and flat-fan nozzles. Use nozzle sizes that deliver a medium-fine droplet in 15 to gallons total spray per acre at 40 to 50 psi and at ground speeds not in excess of 3 to 4 mph

Label examples

- Aerial: Nozzles must always point backward parallel with the airstream and never be pointed downwards more than 45 degrees
- Aerial: Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flow produce larger droplets
- Aerial: Use the lower spray pressures recommended for the nozzle. Higher pressure reduces droplet size and does not improve canopy penetration

Label examples

- Ground: Product should be applied in a minimum of 10 gallons of water per broadcast acre. Flat-fan nozzles are recommended. Do not use air-inducting or flood type nozzles. Use a minimum pressure of 30 psi. Under dense weed/crop canopies, higher spray pressure and increased gallonage are important in obtaining thorough spray coverage.

Label examples

- Complete coverage and uniform application are essential for the most effective results
- Use the largest droplet size consistent with pest control. Formulation of very small droplets may be minimized by appropriate nozzle selection, by orienting nozzles away from the airstream as much as possible and by avoiding excessive spray boom pressure.

Label examples

- Volume: Use high flow rate nozzles to apply the highest spray volume. Nozzles with higher rated flows produce larger droplets.
- Pressure: Use the lower spray pressures recommended for the nozzle. Higher pressure reduce droplet size.

Label examples

- Thorough spray coverage of the plant foliage is essential for optimum control. Apply in sufficient water to ensure good coverage. Finished spray volumes should be increased under extreme pest populations or dense plant foliage.

Label examples

- Aerial: Droplet size for air applications should be in the medium size category as defined in the August 1999 ASAE S572 publication
- Aerial: Use nozzle types and arrangements which will provide maximum coverage and minimize the potential for off target movement of spray particles

Label examples

- Product may be applied with all types of spray equipment commonly used for making ground and aerial applications
- Equip sprayers with nozzles that provide accurate and uniform application
- Nozzles should be the same size and uniformly spaced across the boom

Questions?

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