Sprayer Setup and Nozzle Selection

- ***Robert N. Klein***
  Western Nebraska Crops Specialist

Enhanced Stewardship Needed with Increased Use of Dicamba and 2, 4-D

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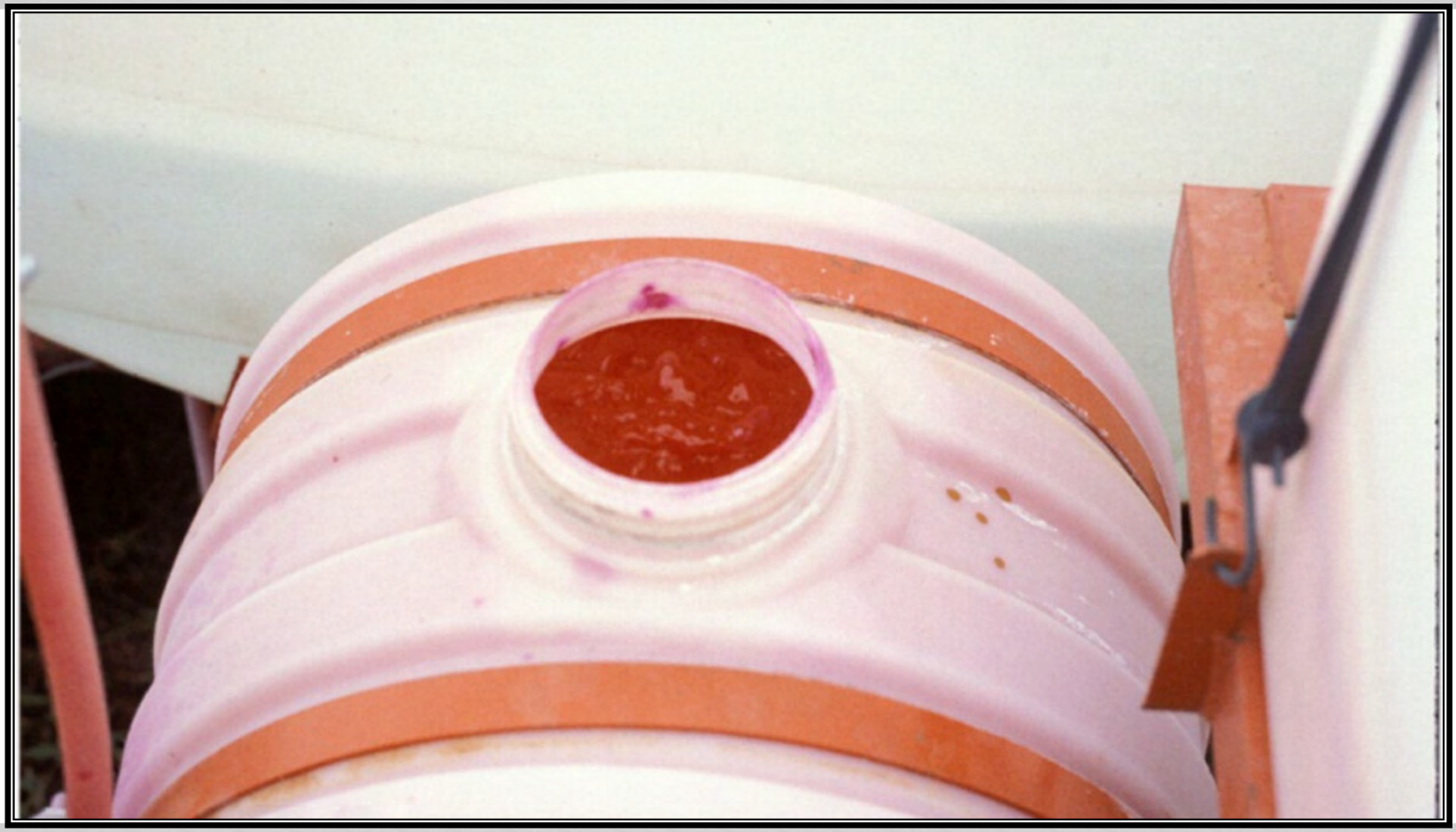

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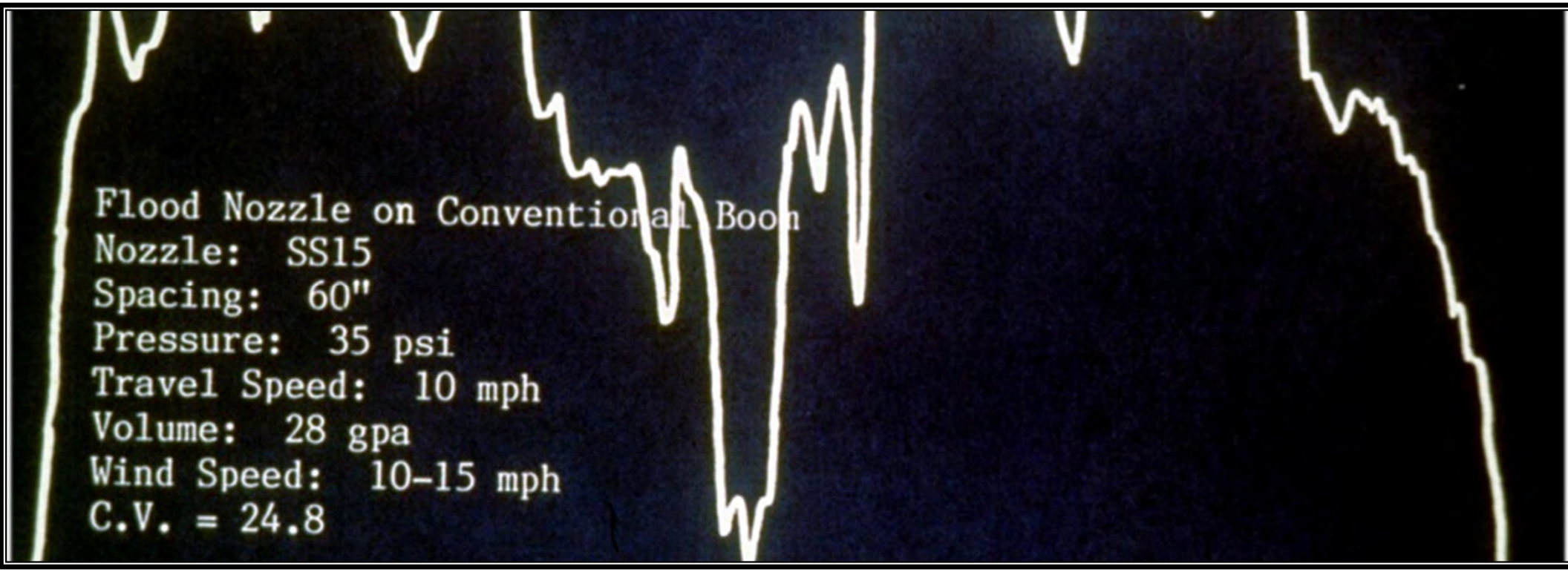

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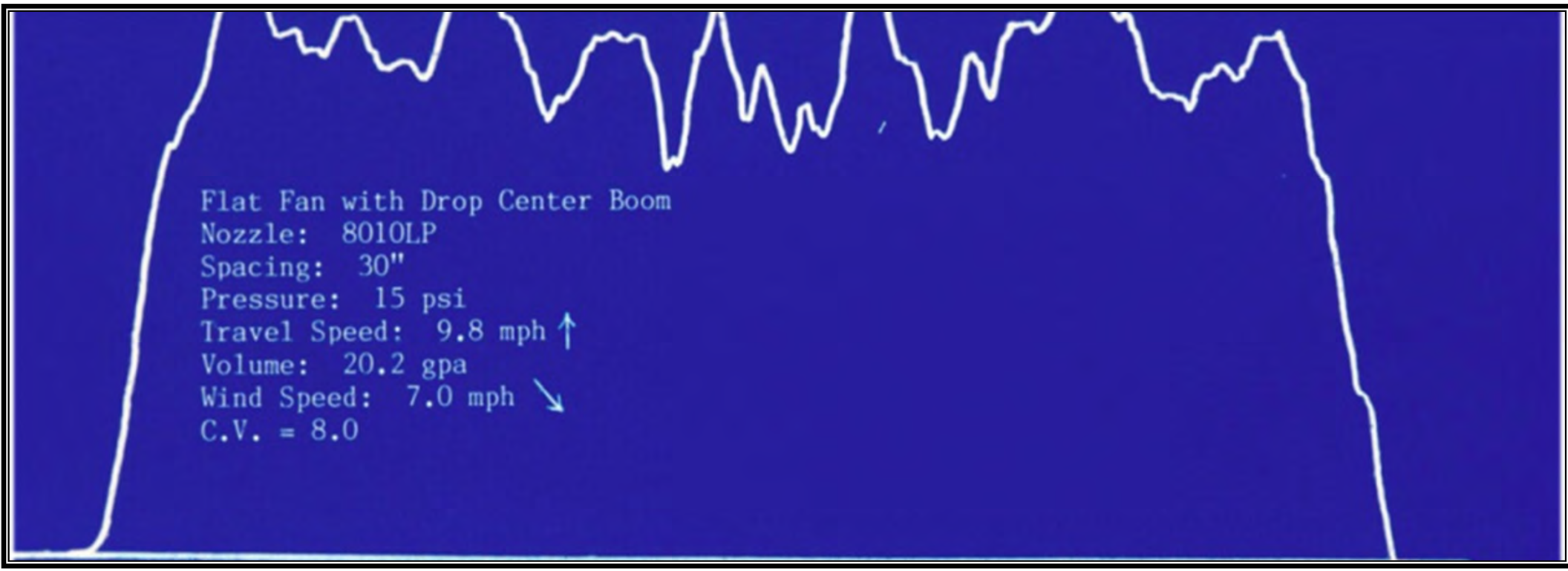
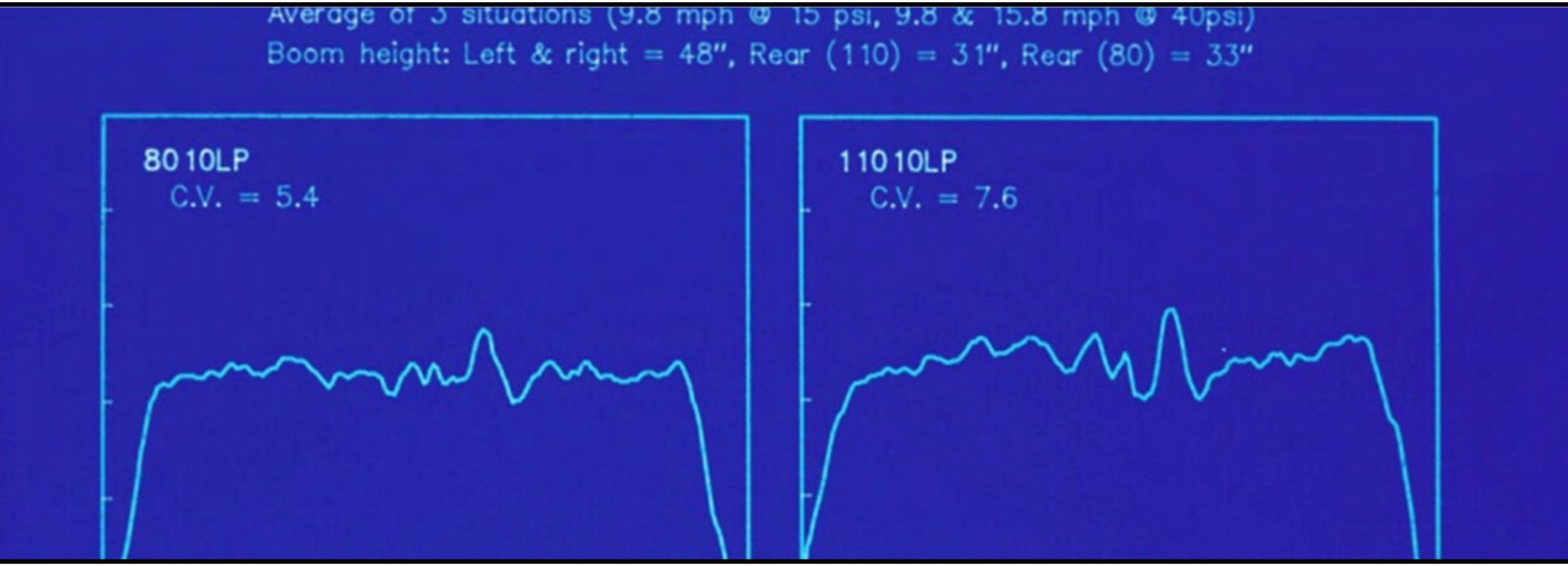
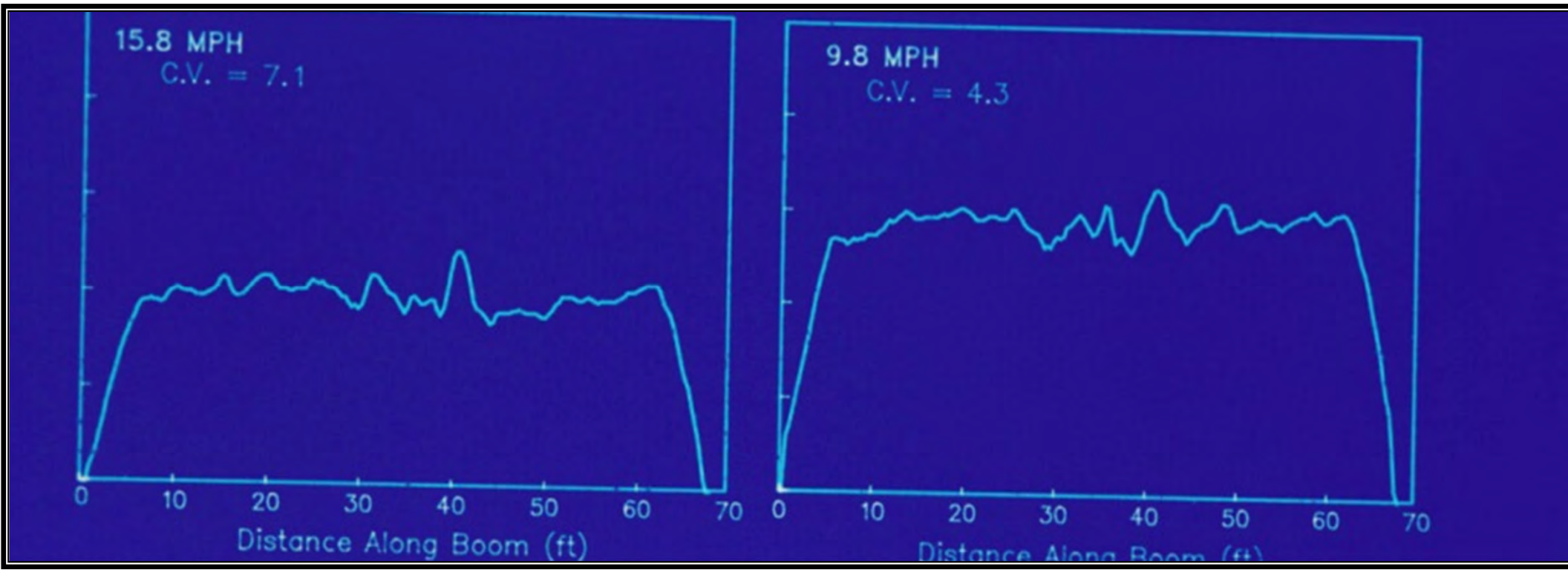

Flat Fan with Drop Center Boom
Nozzle: 8010LP
Spacing: 30"
Pressure: 15 psi
Travel Speed: 9.8 mph
Volume: 20.2 gpa
Wind Speed: 7.0 mph
C.V. = 8.0


Average of 3 situations (9.8 mph @ 15 psi, 9.8 & 15.8 mph @ 40psi)
Boom height: Left & right = 48", Rear (110) = 31", Rear (80) = 33"
80 10LP
C.V. = 5.4
110 10LP
C.V. = 7.6


15.8 MPH
C.V. = 7.1
0
10
20
30
40
50
60
70
Distance Along Boom (ft)
9.8 MPH
C.V. = 4.3
0
10
20
30
40
50
60
70

Willard – Solutions for Agriculture
Frederic, Maryland

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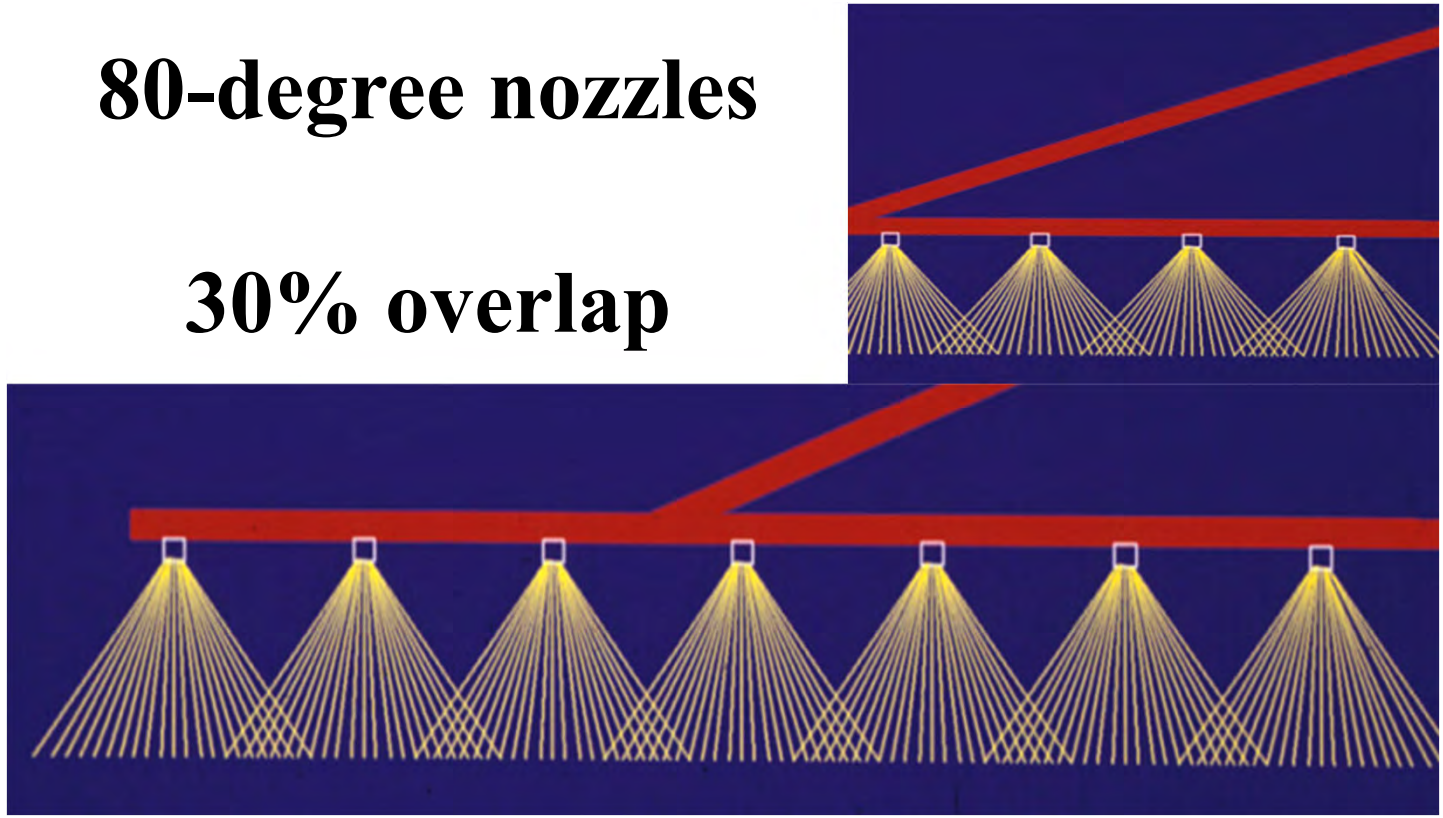
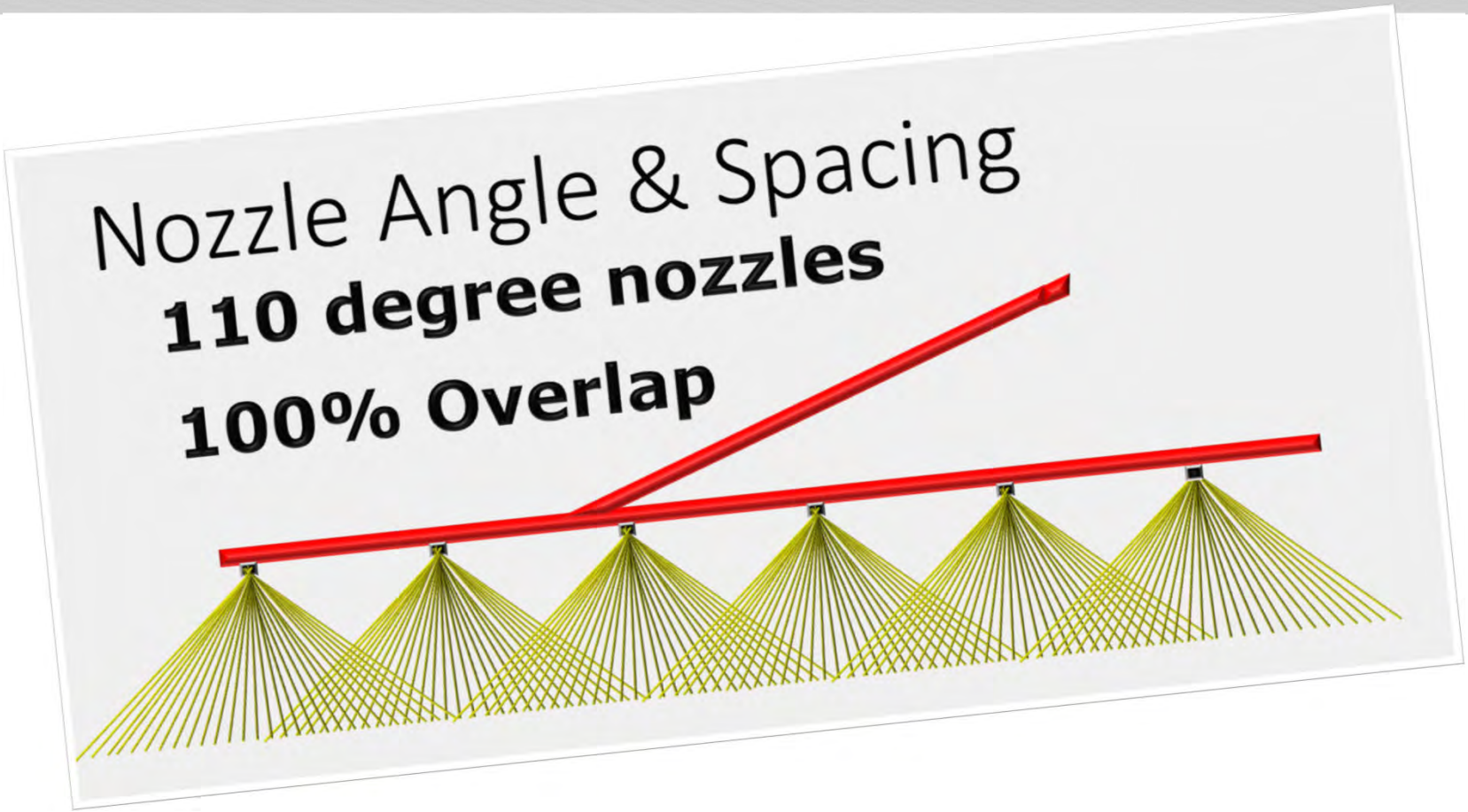
Left at 5:00 PM Back at 8:00 AM

80-degree nozzles

30% overlap




Nozzle Angle & Spacing
110 degree nozzles
100% Overlap

Theoretical Coverage at Various Spray Heights (Inches)

Spray Angle	18”	24”	30”	36”
80˚	30	40	50	60
110˚	51	69	86	103

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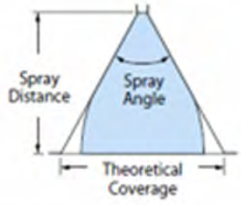
Spray Coverage Information

This table lists the theoretical coverage of spray patterns as calculated from the included spray angle of the spray and the distance from the nozzle orifice. These values are based on the assumption that the spray angle remains the same throughout the entire spray distance. In actual practice, the tabulated spray angle does not hold for long spray distances.

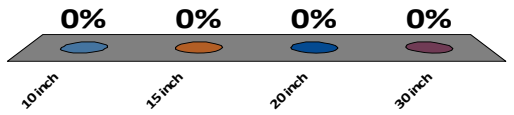


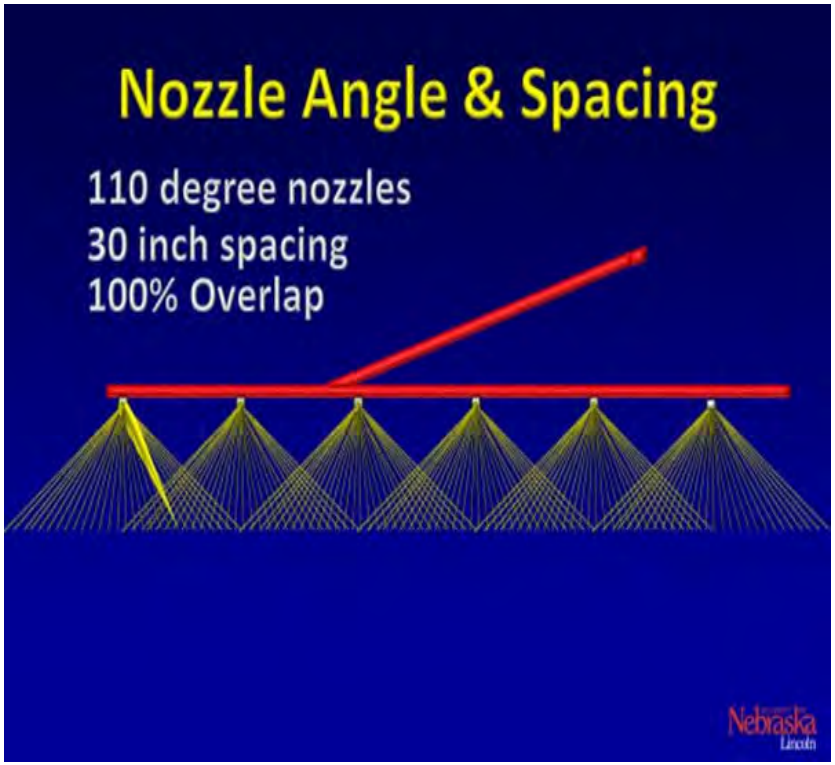
Included Spray Angle	Theoretical Coverage at Various Spray Heights (in Inches)							
	8”	10”	12”	15”	18”	24”	30”	36”
15˚	2.1	2.6	3.2	3.9	4.7	6.3	7.9	9.5
20˚	2.8	3.5	4.2	5.3	6.4	8.5	10.6	12.7
25˚	3.5	4.4	5.3	6.6	8.0	10.6	13.3	15.9
30˚	4.3	5.4	6.4	8.1	9.7	12.8	16.1	19.3
35˚	5.0	6.3	7.6	9.5	11.3	15.5	18.9	22.7
40˚	5.8	7.3	8.7	10.9	13.1	17.5	21.8	26.2
45˚	6.6	8.3	9.9	12.4	14.9	19.9	24.8	29.8
50˚	7.5	9.3	11.2	14.0	16.8	22.4	28.0	33.6
55˚	8.3	10.3	12.5	15.6	18.7	25.0	31.2	37.5
60˚	9.2	11.5	13.8	17.3	20.6	27.7	34.6	41.6
65˚	10.2	12.7	15.3	19.2	22.9	30.5	38.2	45.8
73˚	11.8	14.8	17.8	22.0	27.0	36.0	44.0	53.0
80˚	13.4	16.8	20.2	25.2	30.3	40.3	50.4	60.4
85˚	14.7	18.3	22.0	27.5	33.0	44.0	55.4	66.4
90˚	16.0	20.0	24.0	30.0	36.0	48.0	60.0	72.0
95˚	17.5	21.8	26.2	32.8	40.3	52.4	65.5	78.6
100˚	19.1	23.8	28.6	35.8	43.0	57.2	71.6	85.9
110˚	22.8	28.5	34.3	42.8	51.4	68.5	85.6	103
120˚	27.7	34.6	41.6	52.0	62.4	83.2	104	
130˚	34.3	42.9	51.5	64.4	77.3	103		
140˚	43.8	54.8	65.7	82.2	98.6			
150˚	59.6	74.5	89.5					

What is the best nozzle spacing for a sprayer if you do not have pulse width modulation?

a. 10-inch
b. 15-inch
c. 20-inch
d. 30-inch

Response Counter





I prefer 15-inch nozzle spacing for sprayers without Pulse Width Modulation. Also, 100% overlap where the pattern ends under the adjacent nozzles.

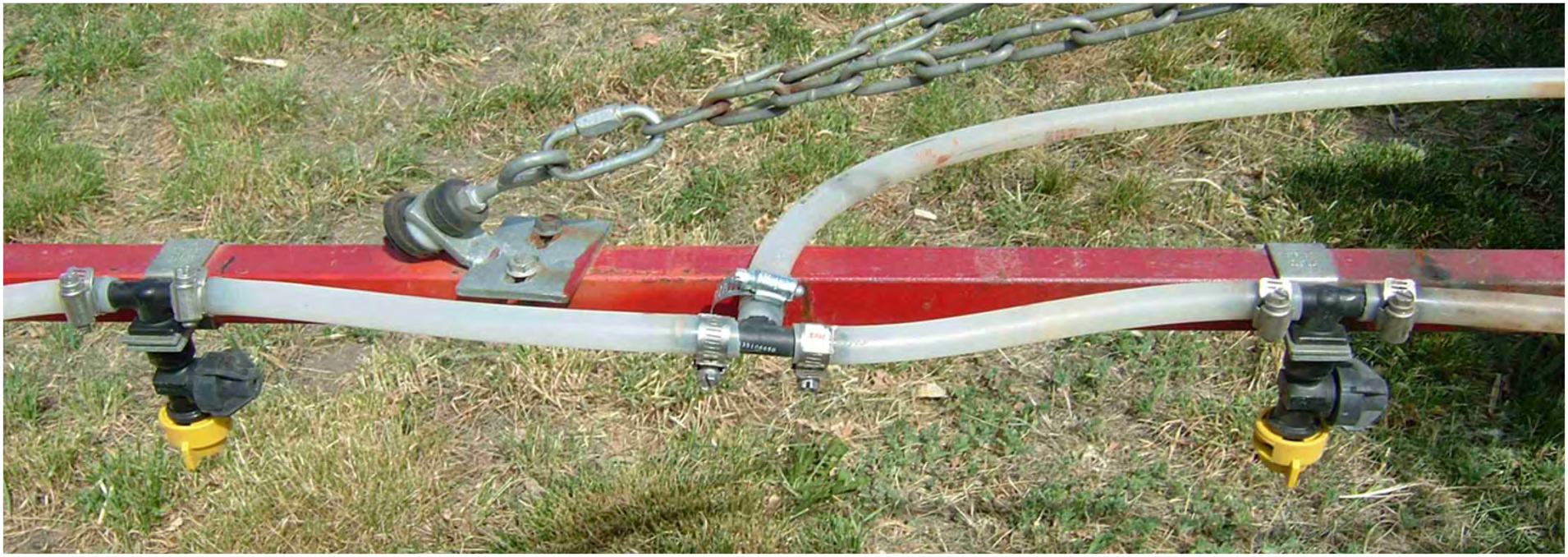
Advantages of 15-inch & 30-inch spacing:

- At low GPA, use 30-inch (close off the nozzles on 15 inches).
  -Larger nozzles are less prone to spray particle drift & plugging
- At high GPA, use 15-inch spacing
  - Do not need extremely large nozzles on 15-inch spacing

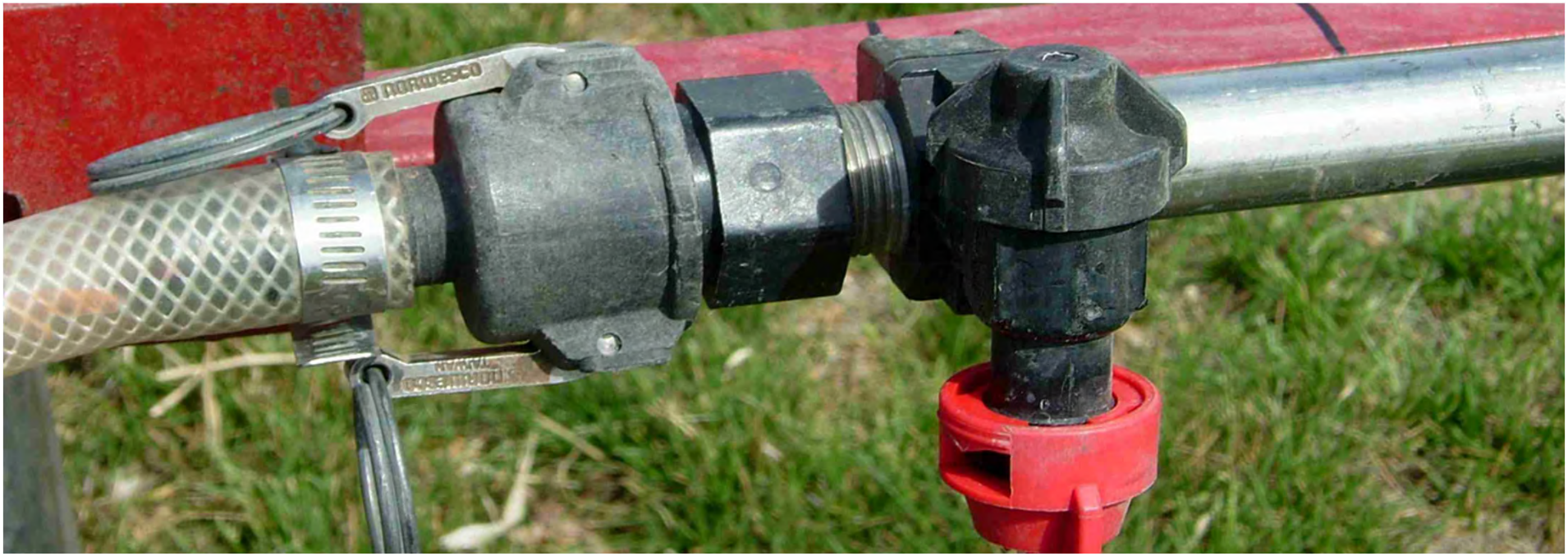
- Often can use the same nozzle at 15-inch & 30-inch.
  Example: 8 & 16 GPA, 10 & 20 GPA, and 12 & 24 GPA or application which are close to 2x.

Two booms – dry boom on top, wet boom on bottom.

How dry boom is fed – note restriction to flow.

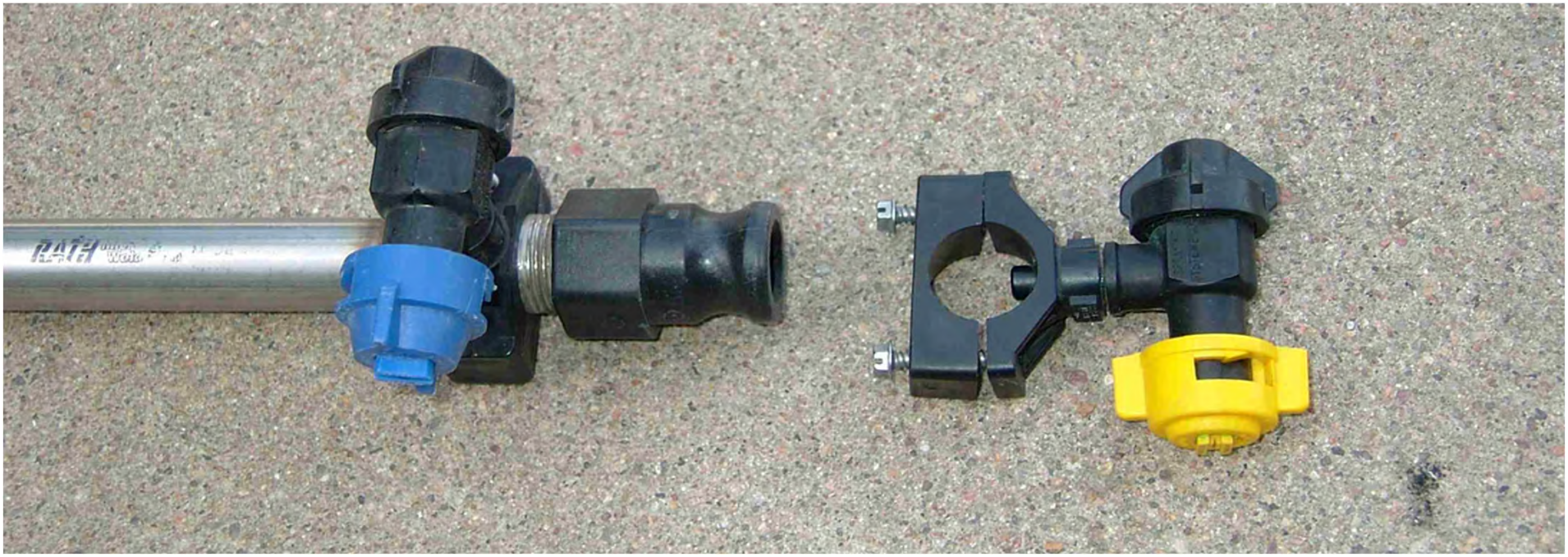


How wet boom is fed.

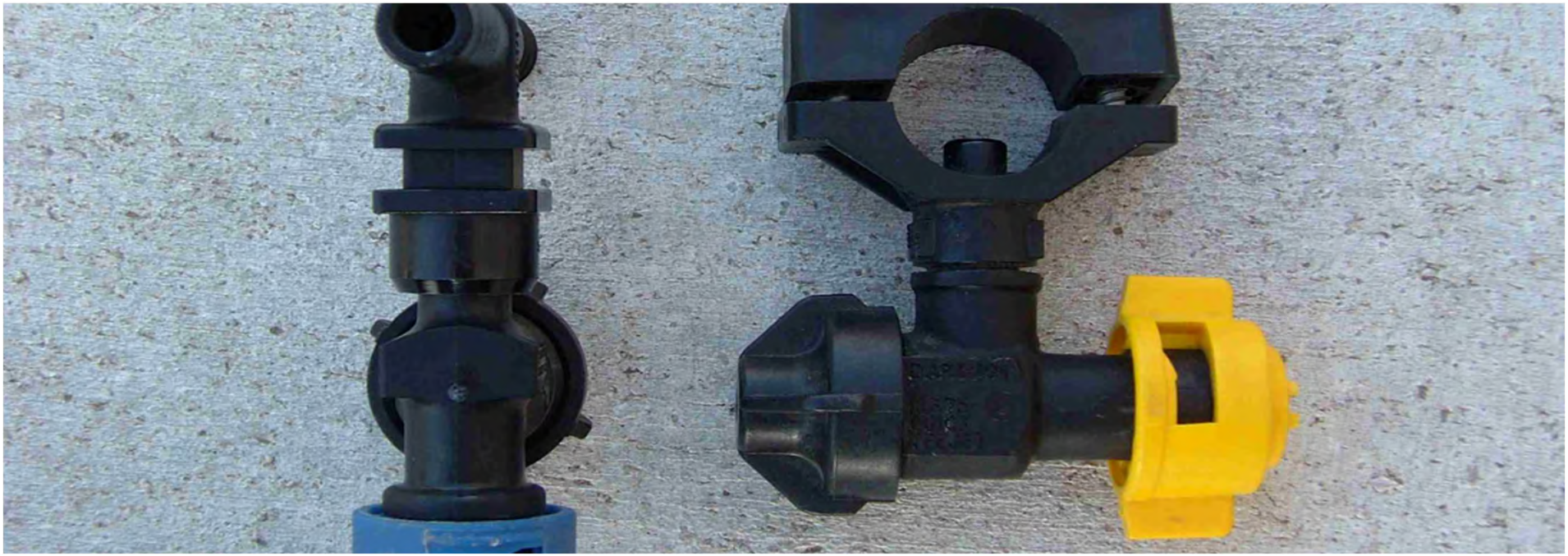


End cap on wet boom to drain and flush boom.

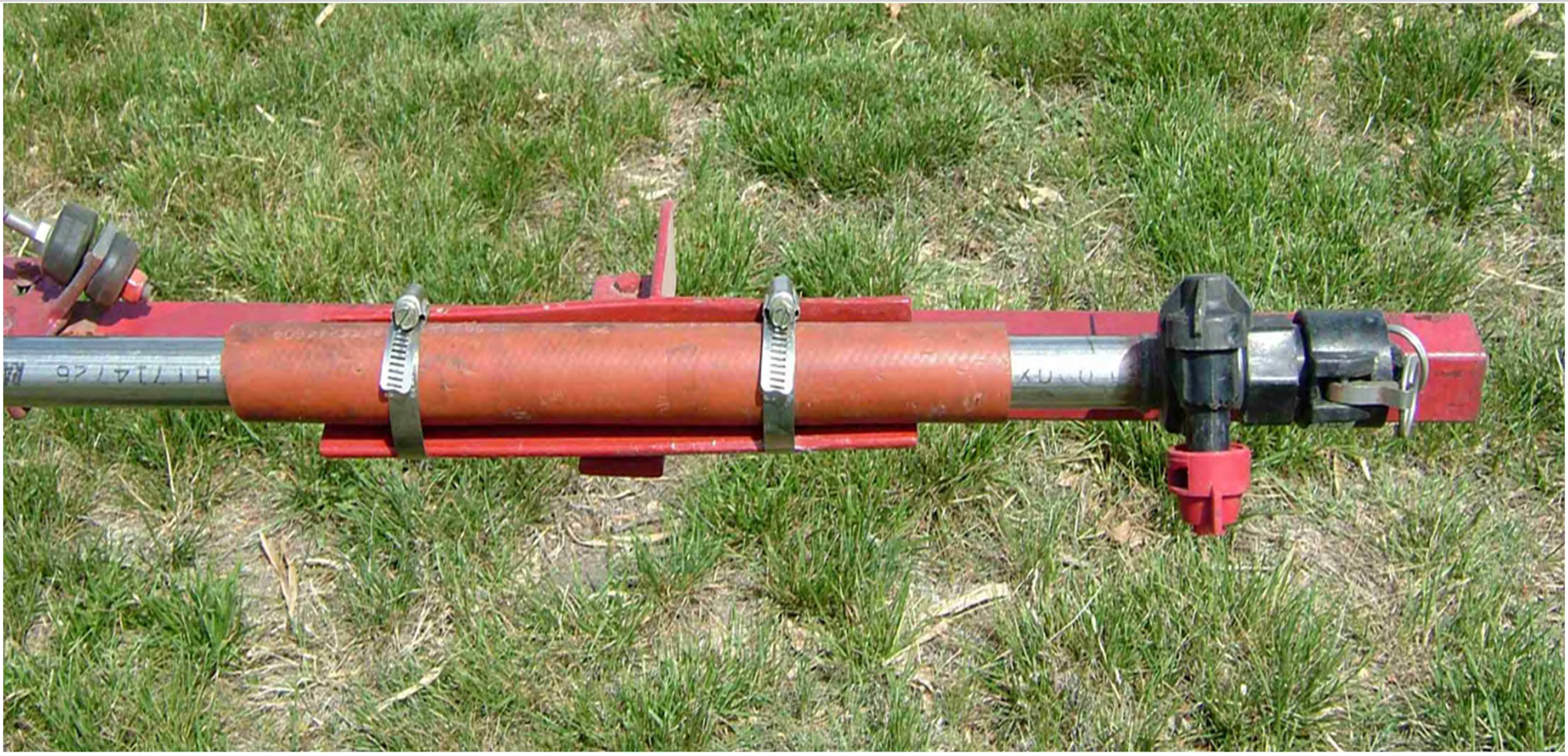
Wet boom nozzle body on and off boom.



Nozzle assemblies for dry and wet booms.



Multiple nozzle body on wet boom.



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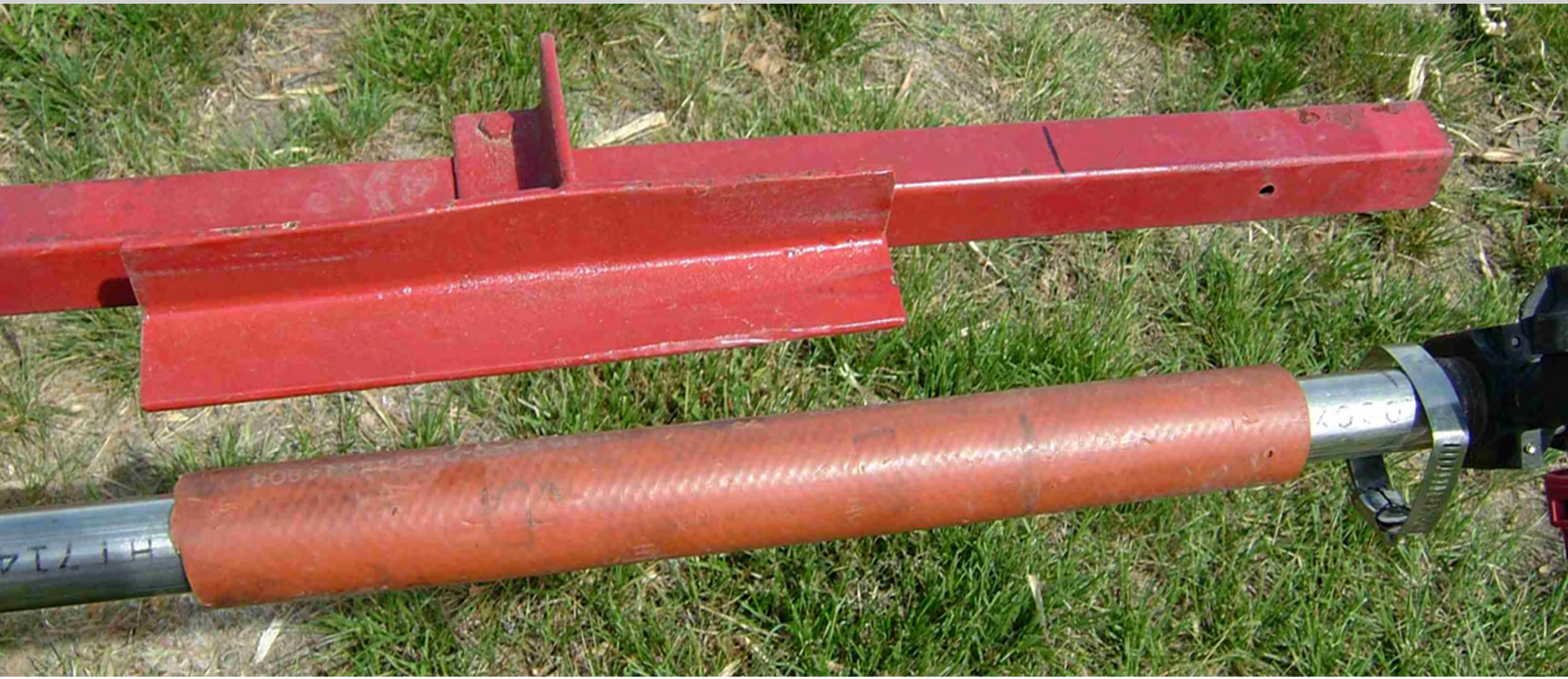

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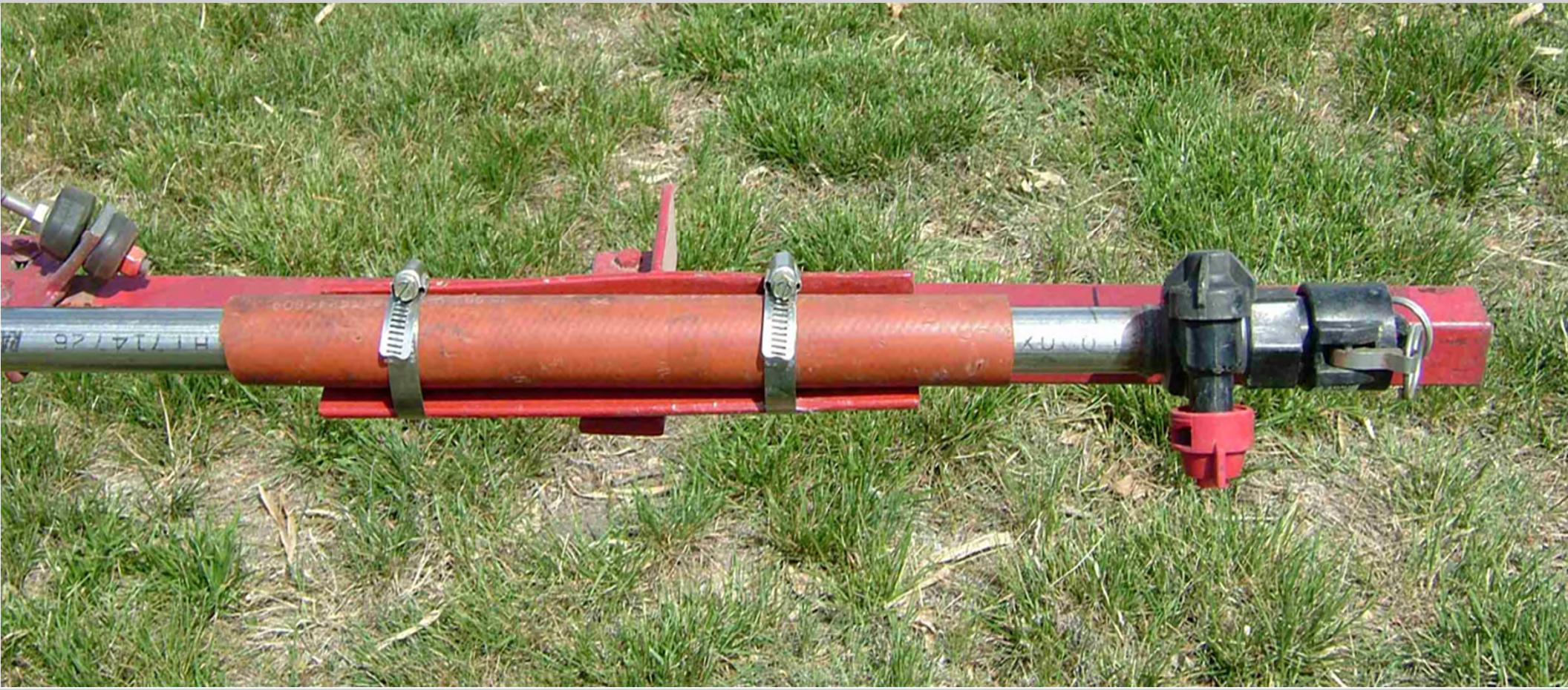

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When the spray boom height is raised from 2 feet to 4 feet, spray particle drift is increased ____ times.

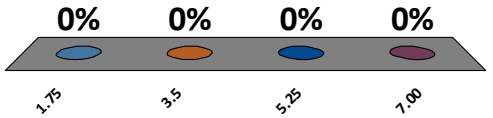
a. 175

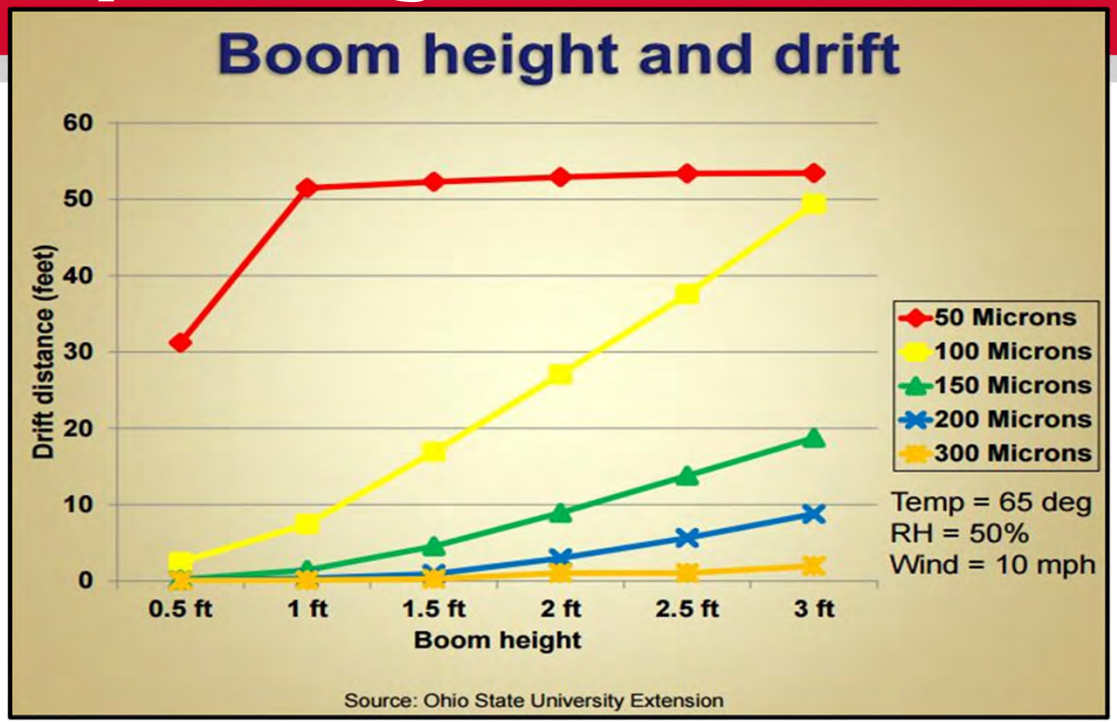
b. 3.5

c. 5.25

d. 7.00

Response Counter





Downwind drift distance for various spray droplets released from different boom heights.

Scott Bretthauer, University of Illinois Extension

Effect of Droplet Discharge Height and Wind Velocity

On drift distances of various size droplets discharged downward at 65 ft/sec toward a target (temperature: 70˚F; relative humidity: 50%)

Adapted from H. E. Ozkan, Ohio State University

Initial Droplet Size (micron)	Wind Velocity (mph)	Drift Distances (ft) with varying Nozzle Height (Noz Ht)	
		Noz Ht: 2 ft	Noz Ht: 3 ft
50	4	23.80*	23.98*
50	10	52.89*	53.43*
150	4	3.57	7.49
150	10	8.92	18.75
300	4	0.24	0.79
300	10	1.04	1.97

* Droplet completely evaporated before deposition.

Which sprayer had the best results

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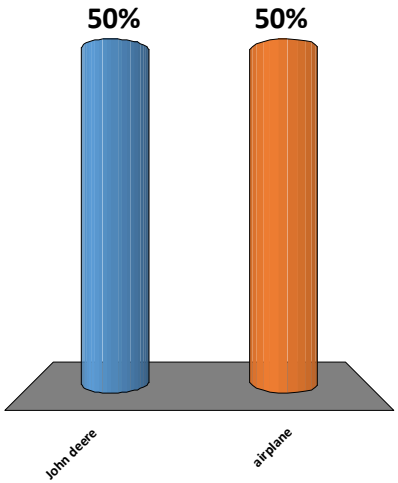
With all the precipitation in the spring, a farmer had a pilot spray herbicides for weed control. The farmer also sprayed with his new sprayer.

Who had the best weed control?

a. John Deere

b. Airplane



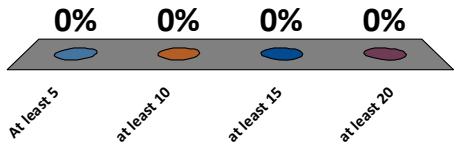
Results primarily depend nozzle selection

- Ceramic nozzle $6.59 ($3.95)
- Tip molded into cap-auto alignment
- 100 FT Boom 15-inch = 80 Nozzles
- Sprayers $425,000 and $1.2 million

XRC11004-VK

Life of ceramic nozzles as compared to stainless is up to _____ times greater.

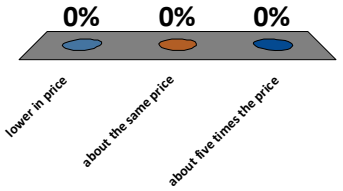
a. at least 2
b. at least 3
c. at least 4
d. at least 5



Response Counter

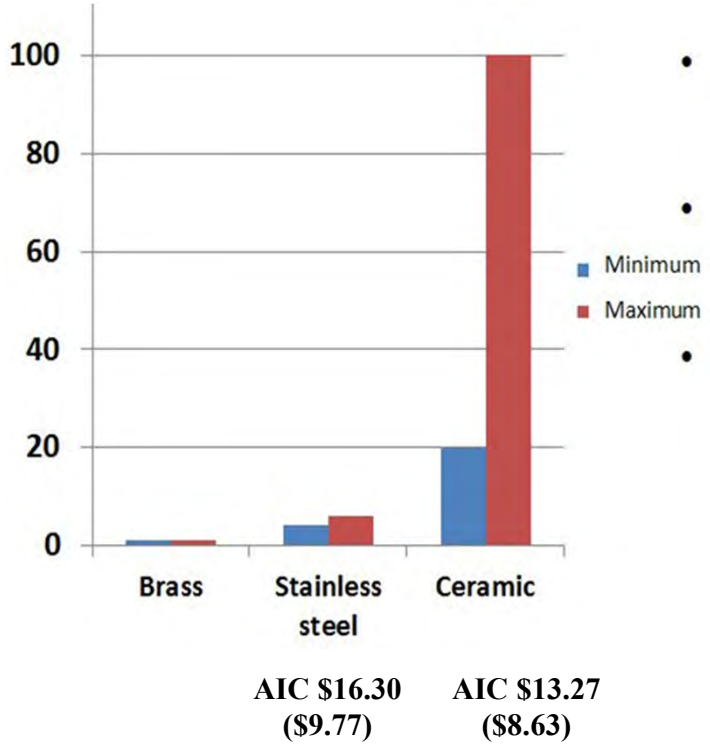
Ceramic nozzles from spraying systems are ____ than stainless steel nozzles.

a. lower in price
b. about the same price
c. about five times the price



Response Counter

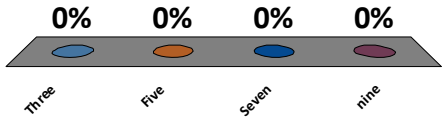
Longevity and Cost of Nozzles



- Life of ceramic nozzle is 5 to 16.7 times that of stainless steel
- For example, if brass nozzle lasts 1-month, stainless steel would last 4 to 6 months, ceramic would last 20 to 100 months.
- (Months are only given as an example for easy comparison of lifespan)

How many things does the spray nozzle tip do?

a. Three
b. Five
c. Seven
d. Nine



Response Counter

The spray nozzle tip is important because it:

1. Controls the amount applied – GPA
2. Determines the uniformity of application
3. Affects the coverage
4. Affects the spray drift potential
5. Breaks the mix into droplets
6. Forms the spray pattern
7. Propels droplets in the proper direction

Why did the aerial applicator get better control?

The farmer used a spray nozzle that produced Ultra Coarse (UC) spray droplets.

The recommended spray droplet size for those herbicides is Coarse (C).

	Spray Quality Categories ASABE Standard S-572.1			
	Category (symbol)	VMD	Color Code	
	Extra Fine (XF)		Purple	NEW
	Very Fine (VF)		Red	
	Fine (F)		Orange	
	Medium (M)		Yellow	
Recommended	Coarse (C)	341-403	Blue	
	Very Coarse (VC)		Green	
	Extra Coarse (XC)		White	
Farmer →	Ultra Coarse (UC)	>665	Black	NEW

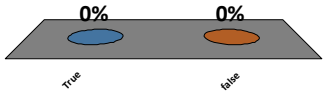
2009

S572

We use nozzle tips and pressures which give us larger spray droplets when applying fungicides and insecticides to increase coverage compared to applying herbicides.

a. True
b. False

Response Counter



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ASAE Standard				Comparative Size		
Symbol	Category	Code	Apx. VMD	Relative Size	Comparative Si…	
VF	Very Fine	Red	>150			
F	Fine	Orange	151-250		…ir Hair (100 Microns)	Fine Mist
M	Medium	Yellow	251-350		Sewing Thread (150 Microns)	Fine Drizzle
C	Coarse	Blue	351-450			
VC	Very Coarse	Green	451-550		Staple (420 Microns)	Light Rain
EC	Extremely Coarse	White	>551		#2 Pencil Lead (2000 Microns)	Thunderstorm
UC	Ultra Coarse	Black	>665			

Source: Crop Life – July 2002

Fungicides/Insecticides (200-300)

Herbicides (300-450)

TeeJet Technologies: Turbo TeeJet TT11004-VP

	Herbicides			Fungicides		Insecticides			
	SOIL APPLIED	POST-EMERGENCE		CONTACT	SYSTEMIC	CONTACT	SYSTEMIC	DRIFT MANAGE-MENT	PWM NOZZLE CONTROL
		CONTACT	SYSTEMIC						
Turbo TeeJet *Reference page 7*		VERY GOOD	VERY GOOD	VERY GOOD	VERY GOOD	VERY GOOD	VERY GOOD	VERY GOOD	EXCELLENT
Turbo TeeJet *at pressures below 30 PSI (2.0 bar)* *Reference page 7*	GOOD	GOOD	EXCELLENT	GOOD	EXCELLENT	GOOD	EXCELLENT	VERY GOOD	EXCELLENT

Pesticide Application

The two important factors

- Pesticide efficacy
- Spray drift management

Efficacy & Drift Ratings Influenced by:

Spray Characteristics
- Chemical
- Formulation
- Additives

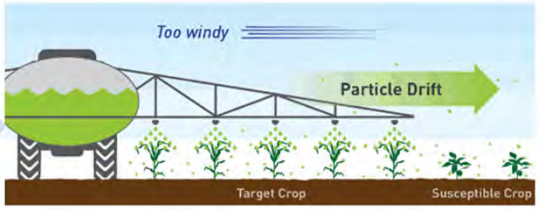
Weather, etc.
- Air Movement
  - Direction & velocity
- Temperature & Humidity
- Air Stability/Inversions
- Topography

Equipment & Application
- Nozzle Type
- Nozzle Size
- Nozzle Orientation
- Nozzle Pressure
- Technology
- Sprayer Speed

Off-Target Pesticide Movement

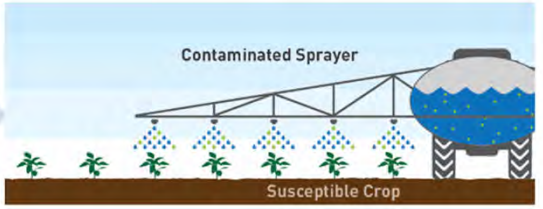
Physical Drift

- Physical movement of spray particles DURING spray application.



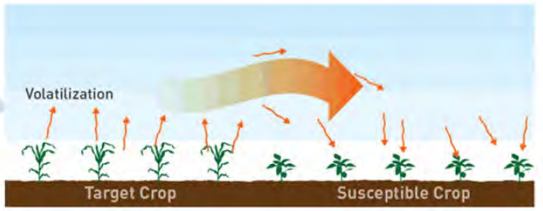
Sprayer Contamination

- Off-target movement from herbicide residue remaining in sprayer components



Volatility

- Movement of a herbicide as a gas or vapor AFTER spray application. **Least frequent** form of off-target movement



Drift Reduction: Recommended Techniques

1. Follow label directions.
 - Read label and use the *nozzle* manufacturer's guide for *nozzle* and pressure combinations.

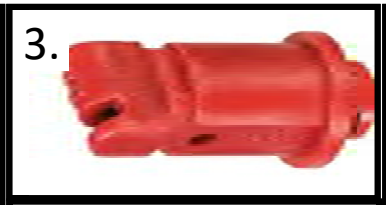
2. Select a *nozzle* to increase droplet size.
 - Large droplets – less prone to drift. Use largest Droplets that provide necessary coverage.

Nozzle Selection for Drift Management

1. TT11004

2. AIC110025-VK

3. TTI11004-VP



4. AIXR11005-VP

5. XRC11003-VK

6. AITTJ60-11006-VP

7. Wilger DR11004

8. Hypro PSULDQ2004

9. GreenLeaf TDXL11004-D

10. TCP11010

Teejet Technoligies: Turbo Teejet TT

	PSI										
	15	20	25	30	35	40	50	60	70	80	90
TT11001	C	C	M	M	M	M	M	F	F	F	F
TT110015	VC	C	C	M	M	M	M	F	F	F	F
TT11002	VC	VC	C	C	M	M	M	M	F	F	F
TT110025	VC	VC	C	C	M	M	M	M	F	F	F
TT11003	VC	VC	C	C	C	C	M	M	M	M	F
TT11004	XC	VC	VC	C	C	C	M	M	M	M	M
TT11005	XC	VC	VC	VC	VC	C	C	M	M	M	M
TT11006	XC	VC	VC	VC	VC	VC	C	C	C	M	M
TT11008	XC	VC	VC	VC	VC	C	C	C	C	M	M

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Nozzles – Recommended Use

flat spray

20 – 25 PSI

chamber

30 – 40 PSI

in between venturi

30 – 50 PSI

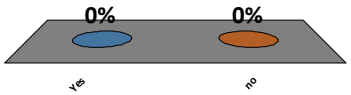
air induced/venturi

50 – 80 PSI

Is it possible to have a larger spray droplet size with a smaller air inclusion nozzle tip?

a.Yes

b. No



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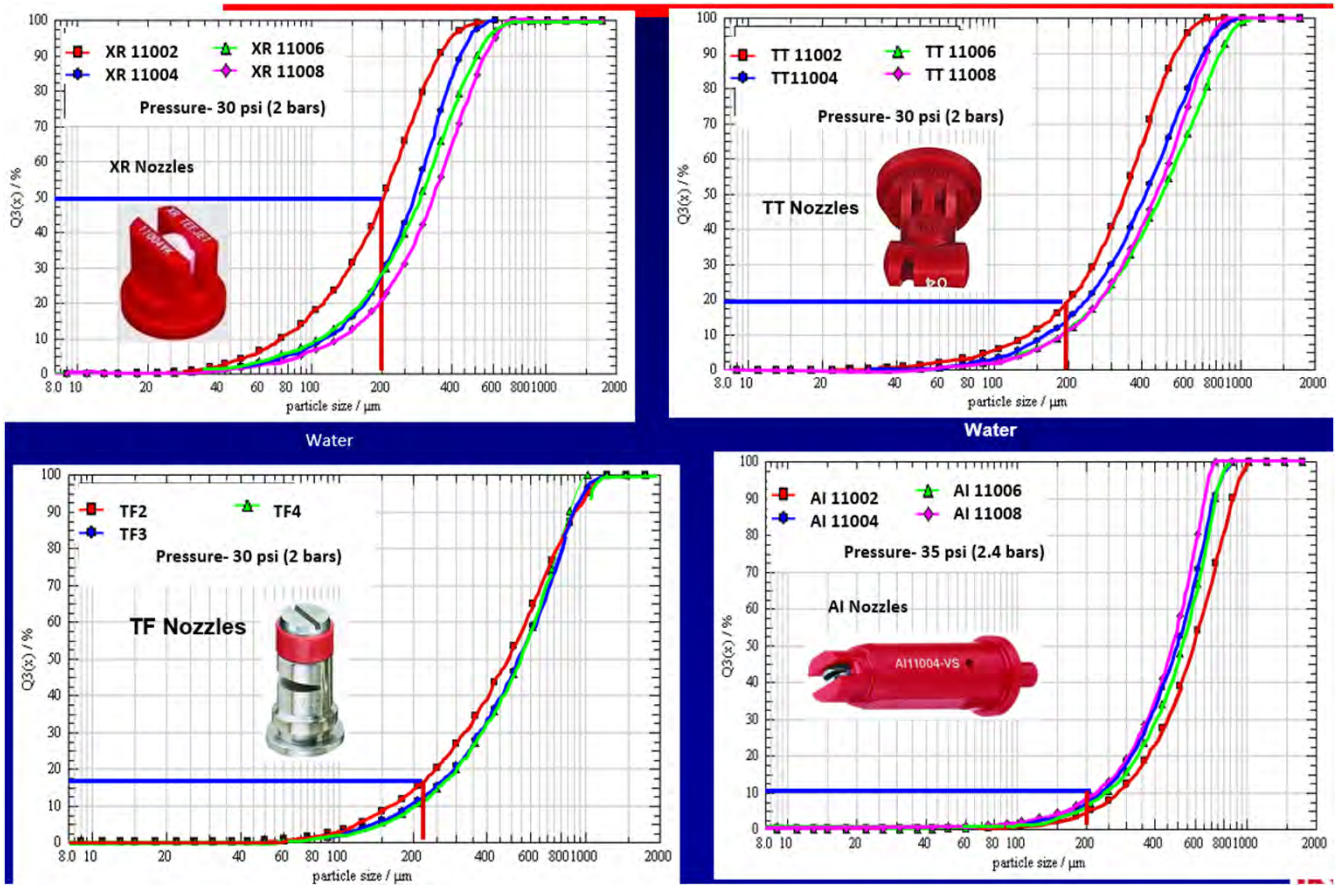

Questions?

Thank you!

Robert N. Klein
Western Nebraska Crops Specialist