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Application and Environmental factors that affect Post Herbicide Efficacy

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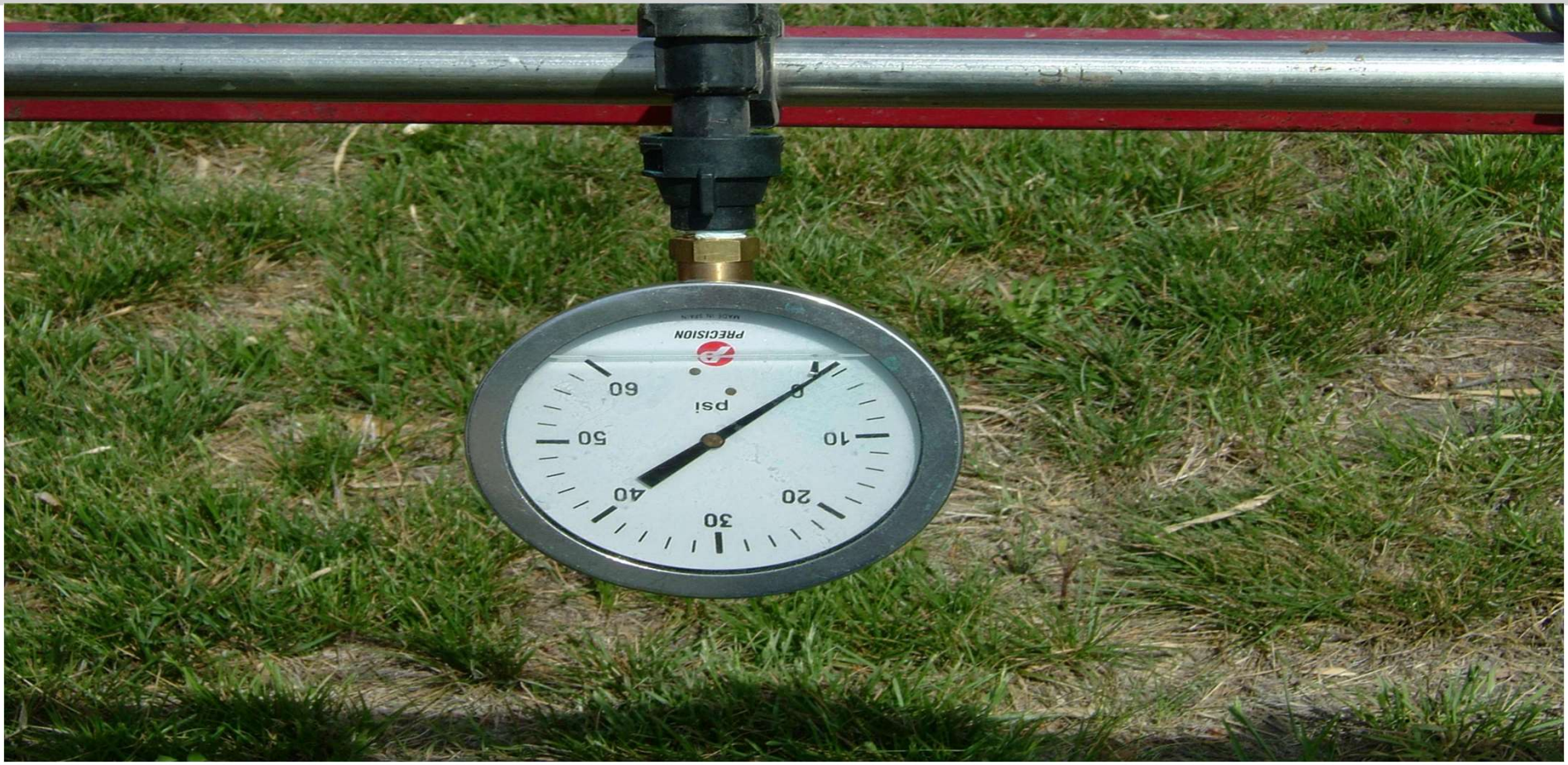

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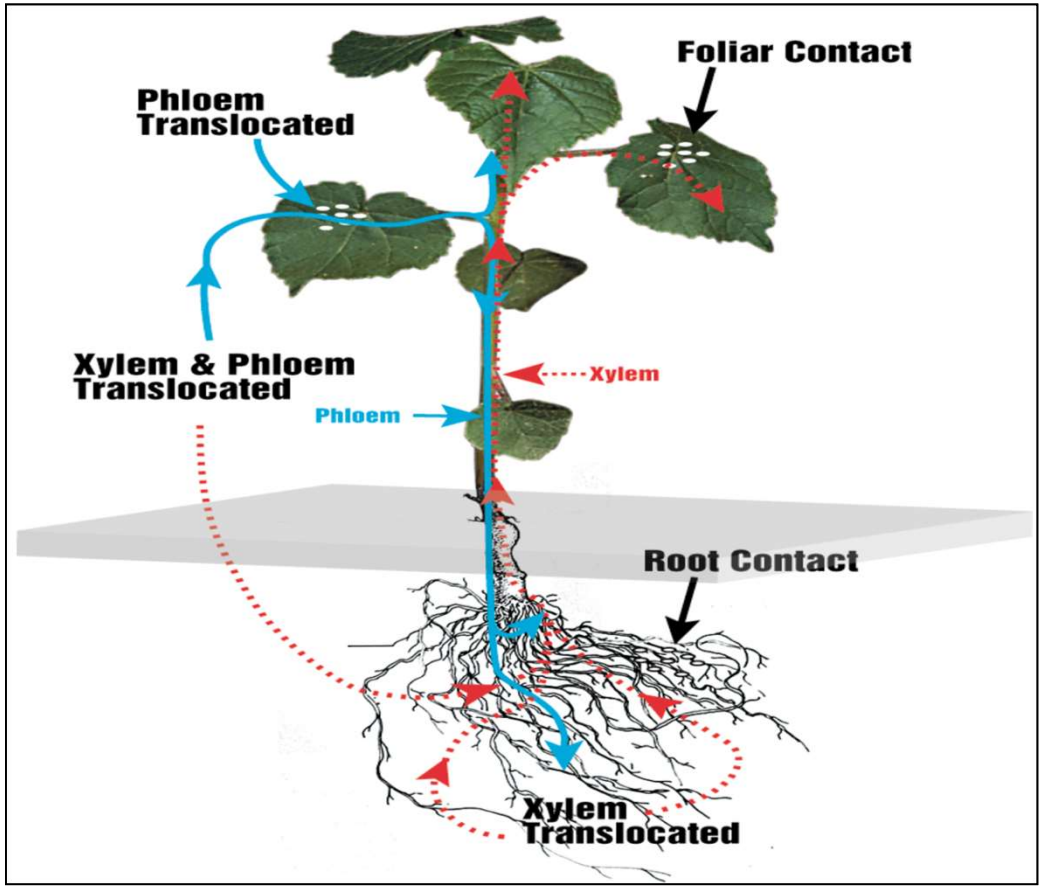
For Effective Weed Control the Application Must:

- **Adequately contact the weeds** *(ONTO)*
- **Be absorbed in sufficient quantities** *(INTO)*
- **Move within weed to "Site-of-action"** *(THRU)*
- **Reach toxic levels at the "Site-of-action"** *(DO)*



Factors Affecting Foliar Applied Crop Protection Products

- Water (carrier) volume, pressure, droplet size, and coverage.
- Herbicide rate
- Spray nozzle selection
- Water (carrier) quality
- Temperature before, during and after “Post” herbicide applications
- Relative Humidity
- Dew on plants
- Cloudiness/Sunshine
- Time of day when herbicide was applied
- Soil moisture
- Weed species, biotype, size, emergence pattern and population
- Dusty conditions during application
- Spray additives
- Herbicide antagonism
- Etc.

Big 3 – Complaint Calls

- ❑ Drift
- ❑ Tank Contamination
- ❑ Non-Performance

Cleaning the Sprayer

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Nozzle Types:

Flat Spray Tips:

- ✓ Extended Range Flat-fan
- ✓ Drift Reduction Flat-fan
- ✓ Turbo Flood Flat-fan
- ✓ Turbo Flat-fan
- ✓ Al Flat-fan
- ✓ TurboDrop

Cone Spray Tips:

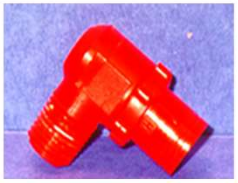
- ✓ Raindrop











Water Carrier Volume, Pressure and Droplet Size

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Treatment Parameters Used to Evaluate Three Nozzle Types

Trt	Nozzle	Spray Particle Size	Volume		Speed	
			(gpa)	(L/ha)	(mph)	(km/h)
1	XR11005	Medium	10	94	8.6	14
2	DG11005	Coarse	10	94	8.6	14
3	TF-VS2.5	Extremely Coarse	10	94	8.6	14
4	XR11004	Medium	7.5	70	9.2	15
5	DG11004	Coarse	7.5	70	9.2	15
6	TF-VS2	Extremely Coarse	7.5	70	9.2	15
7	XR1003	Fine	5.0	47	10.3	17
8	DG11003	Coarse	5.0	47	10.3	17
9	Untreated			-----		-----


XR Tee Jet


DG Tee Jet


Turbo Flood Jet

* All treatments applied at 30 psi (2 bars)
* Herbicide applied was Paraquat + Atrazine (0.31 + 0.5 lb/A) (0.35 + 0.56 kg ai/ha)

Relative Mobility of Herbicides in Plants

Contact (non-translocated)	Intermediate*	Systemic (translocated)	
Aim/Teamwork	Atrazine	Accent	Glyphosate
Authority	Princep/	Ally	Balance
Basagran	Simazine	Amber	Beacon
Blazer	Sencor	Assure II	Exceed, Spirit
Buctril/Moxy	Command	Callisto	Glean
Connect	Liberty (Ignite)	Classic	Permit
Cobra		Fusilade	Harmony
Gramoxone		Poast Plus	Peak
Flexstar		Banvel/Sterling	Stinger
Reflex		Clarity	Basis
Resource		2,4-D & 2,4-DB	Tordon
Bison		MCPA	Scepter
		Pursuit	

* Command & triazine herbicides move upward from roots to leaves when soil applied, but not down from foliage to the roots if post applied. Liquid fertilizer can provide contact action. Simazine is not as effective post as other triazines.

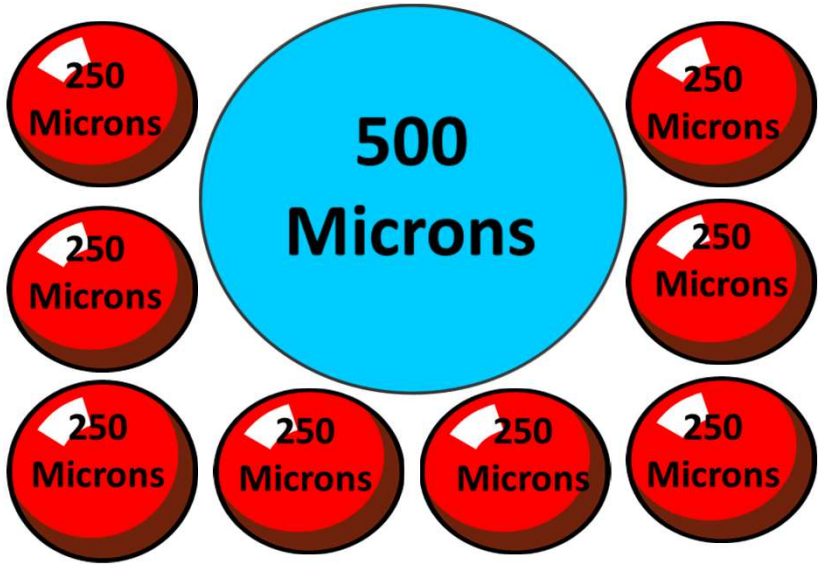
Application Methods

(Broadcast Equipment)

Ground Broadcast Application: Apply the recommended rate of Milestone as a coarse low-pressure spray. Spray volume should be sufficient to uniformly cover foliage. Increase spray volume to ensure thorough and uniform coverage when target vegetation is tall and/or dense. Higher volumes (greater than 10 gallons per acre) generally provide better coverage and better control, particularly in dense and/or tall foliage canopies situations. To enhance foliage wetting and coverage, an approved non-ionic agricultural surfactant may be added to the spray mixture as recommended by the surfactant manufacturer.

SPRAY VOLUME CUTTING DROPLET SIZE IN HALF RESULTS IN EIGHT TIMES THE NUMBER OF DROPLETS

Doubling the spray droplet size reduces the number of droplets used to apply the same amount of formulation from eight to one, reducing coverage.



Comparison of Micron Sizes for Various Items: (approximate values)

❑ pencil lead	2000 (μm)
❑ paper clip	850 (μm)
❑ staple	420 (μm)
❑ toothbrush bristle	300 (μm)
❑ sewing thread	150 (μm)
❑ human hair	100 (μm)

Nozzles – Droplet Size

- **Droplet size vs quantity**
- **At 1000um, 10 gpa: (Ultra Coarse)**
  - Droplets/acre = 7,210.009 Droplets/inch² = 12
- **At 500um, 10 gpa: (Very Coarse-Extremely Coarse)**
  - Droplets/acre = 578,368,350 Droplets/inch² = 92
- **At 250um, 10 gpa: (Medium 236-340)**
  - Droplets/acre = 4,626,946,801 Droplets/inch² = 738
- **At 150um, 10 gpa: (Very Fine-Fine)**
  - Droplets/acre = 62,425,040,836 Droplets/inch² = 9956

Cutting droplet diameter in half results 8 times as many droplets (X,Y,Z axis)

Coverage/Drift Potential

(Mean drops per square inch)

	GPA				
Vmd	**5**	**10**	**20**	**50**	**100**
250	369	738	1475	3688	7376
300	213	427	854	2134	4268
400	90	180	360	900	1801
500	46	92	184	461	922
600	27	53	107	267	534
800	11	23	45	113	225
1000	6	12	23	58	115

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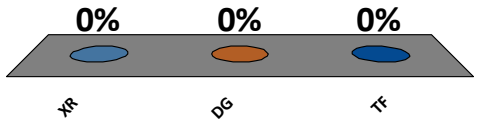
Which nozzle tip XR, DG or TF would you expect to give the best control with paraquat and atrazine?

a. XR

b. DG

c. TF



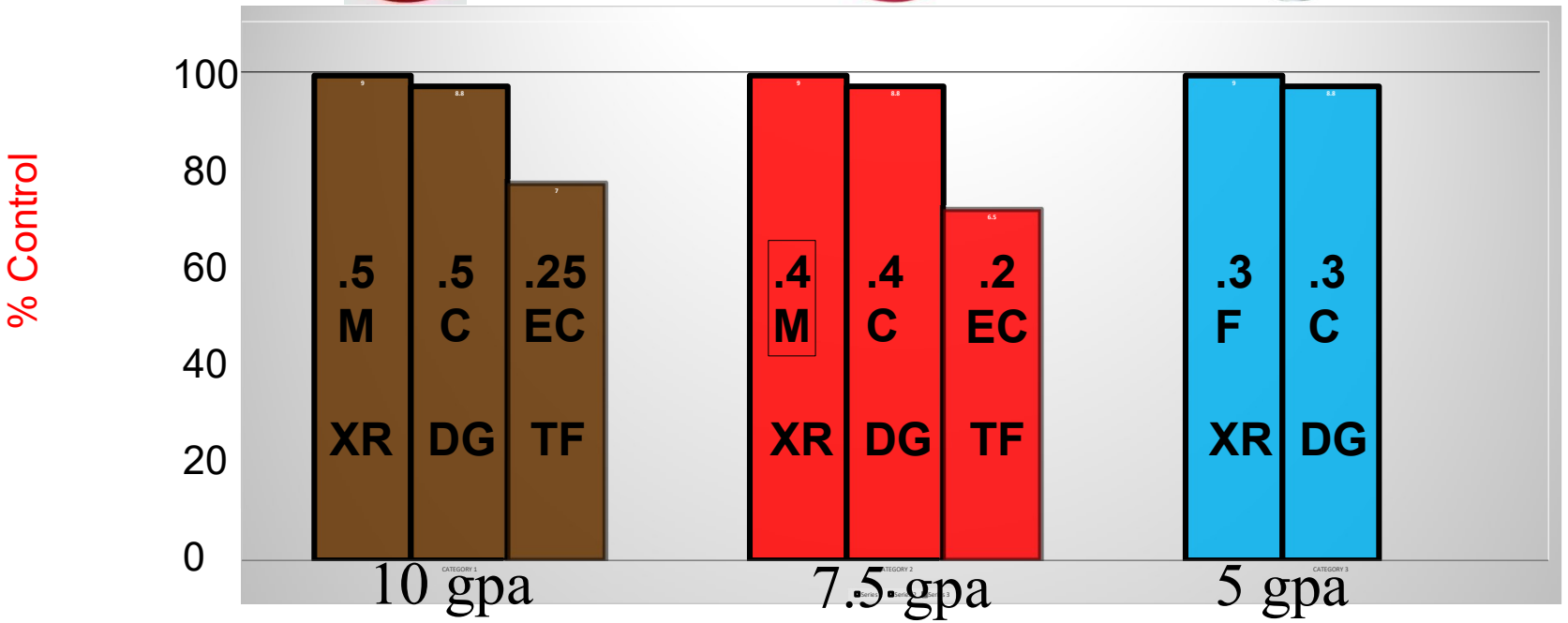
TR Kochia Control 9 DAT

with XR, DG, and TF Nozzles at 30 psi (2 bars) Paraquat + Atrazine (0.35 + 0.56 kg/ha)


XR Tee Jet


DG Tee Jet


Turbo Flood Jet



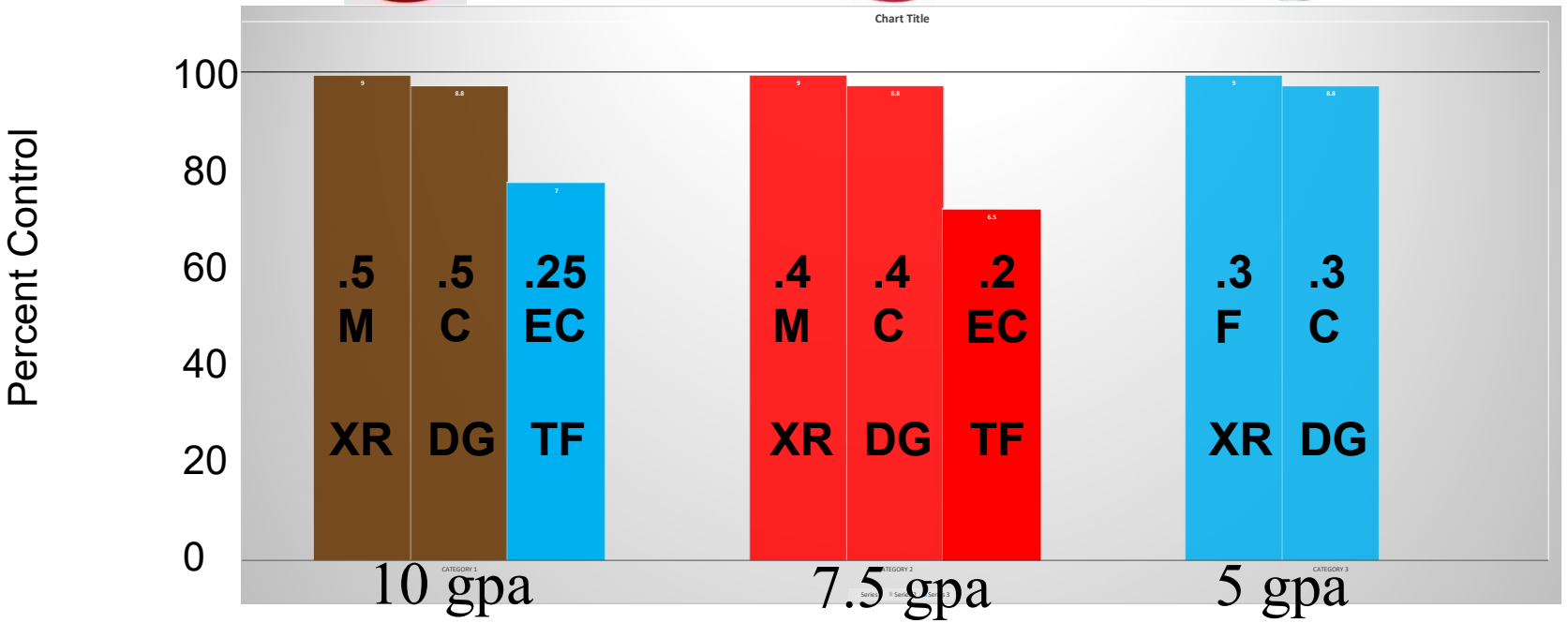
Green Foxtail Control 35 DAT

With XR, DG, and TF Nozzles – Paraquat + Atrazine (0.35 + 0.56 kg/ha)


XR Tee Jet


DG Tee Jet


Turbo Flood Jet



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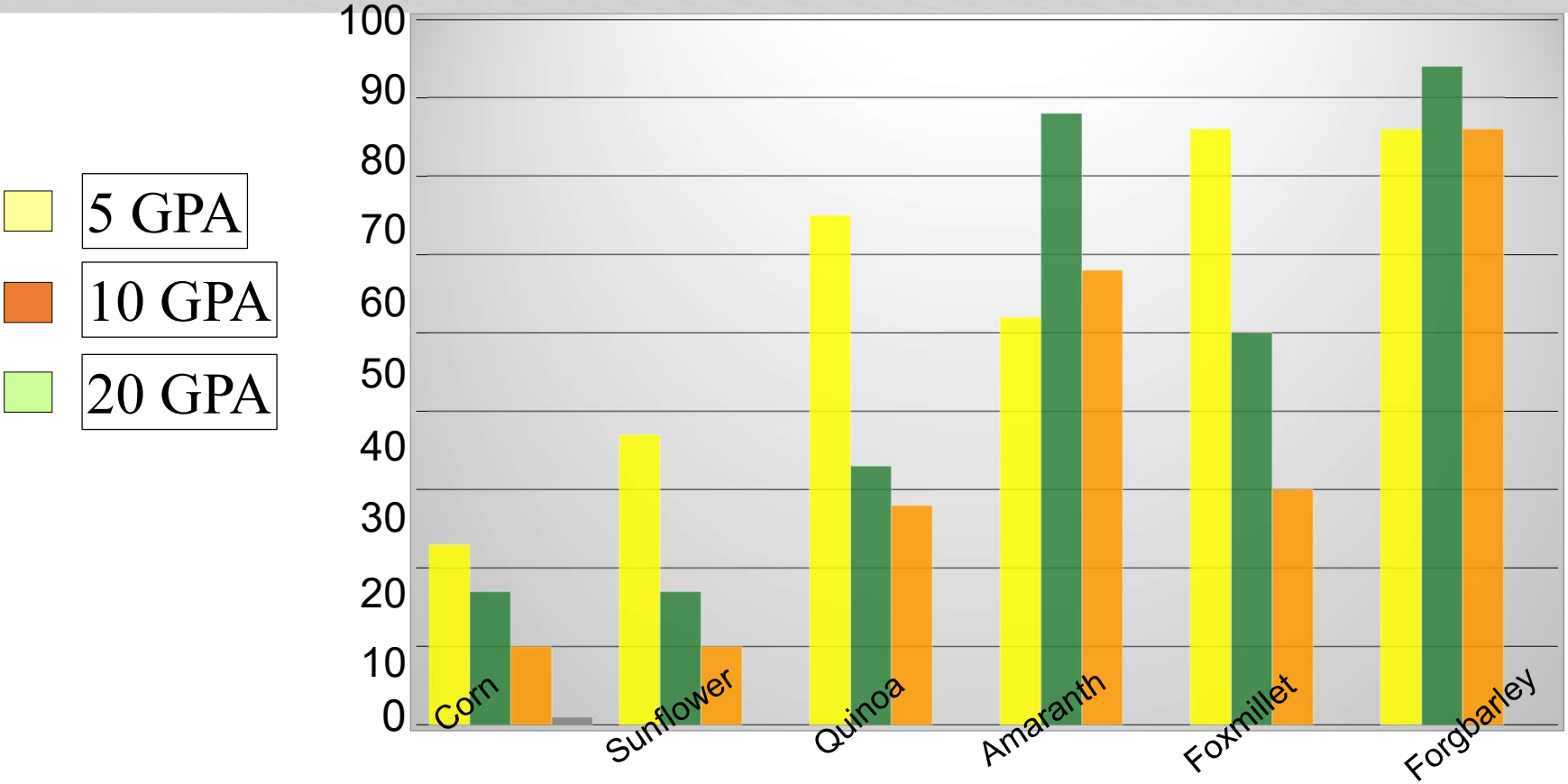
NDSU Ignite GPA Study



8 oz Ignite + 8.5 lbs/100 AMS sprayed with 8002TT @ 28PSI = Coarse Label NO Coarse Sprays

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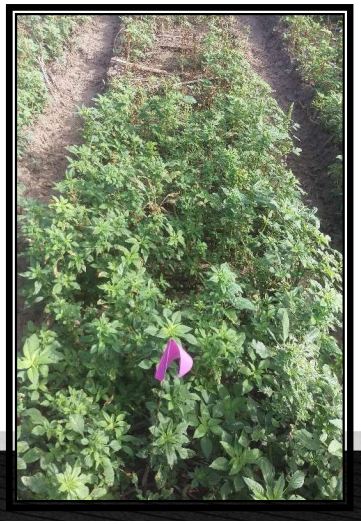


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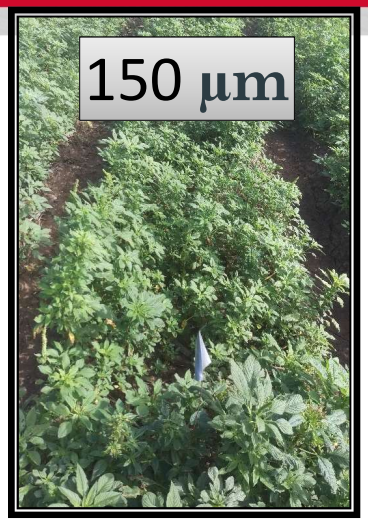
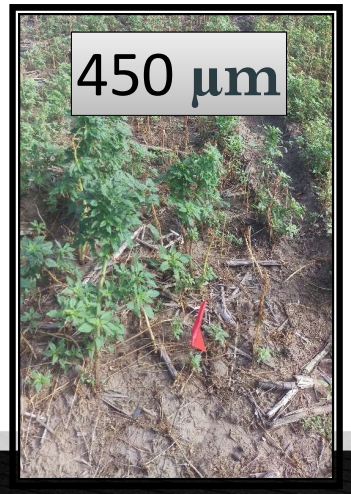
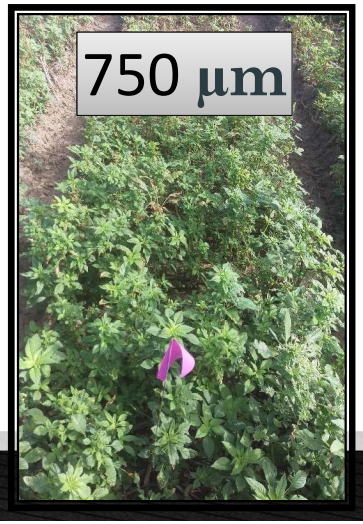
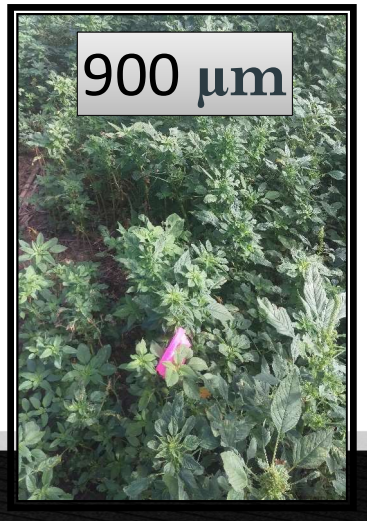
Glufosinate
(Liberty)
22 ounces

300 = Medium
14 DAA









Roundup Ready Corn: Medium & Coarse Droplets Showed Lower % Retention

Fine = XR 110015

Medium = TT 110015

Very Coarse = AI 110015

All Nozzles at 34 psi (2.3 bars)

% Retention

Droplet Size	(Actual over Calculated)
Fine	47 ? 2
Medium	37 ? 7
Very Coarse	38 ? 4

Paul Feng, Monsanto

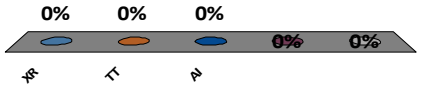
Which nozzle tip will give the most translocation of Roundup herbicide into the roots:

a. XR 

a. TT 

a. AI 

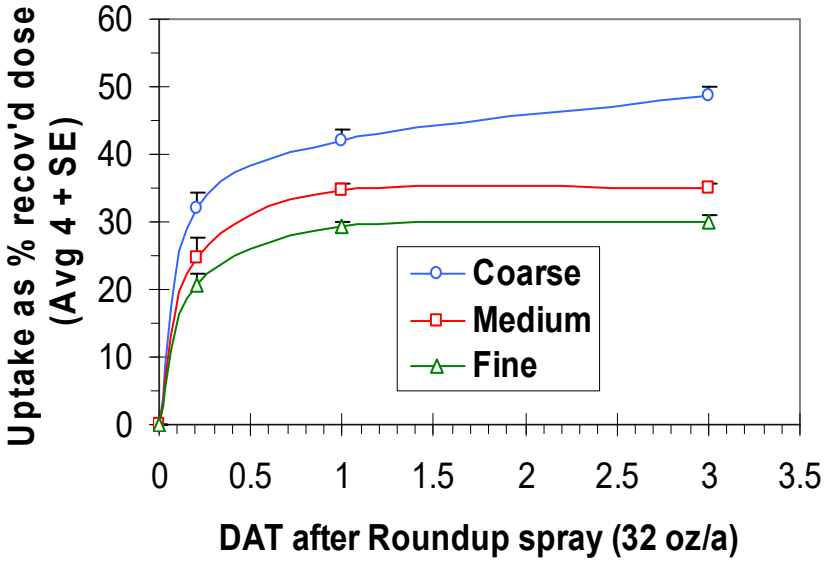
Droplet Size	% Retention (Actual over Calculated)
Fine	47 ? 2
Medium	37 ? 7
Very Coarse	38 ? 4



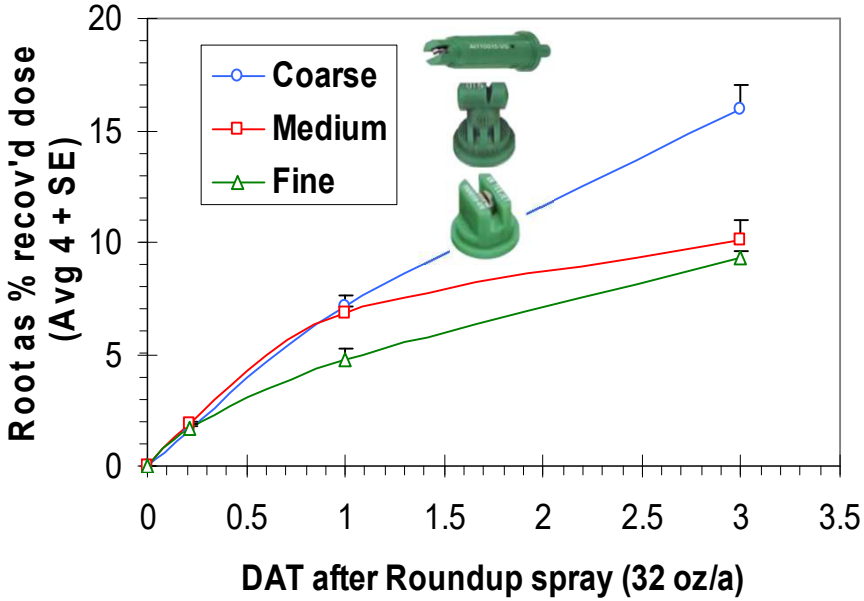
Paul Feng, Monsanto

Even at lower retention, large droplets showed higher uptake & translocation in RR corn

Total uptake



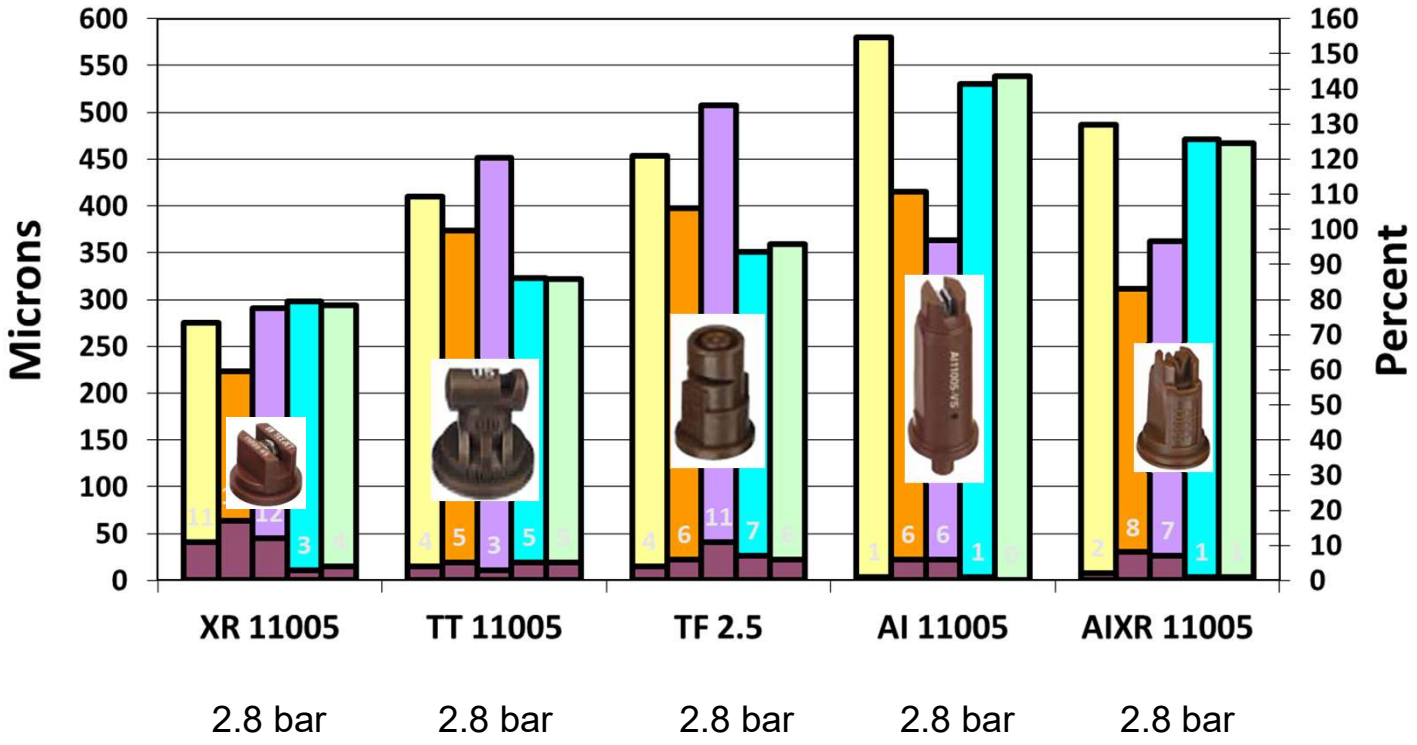
Root translocation



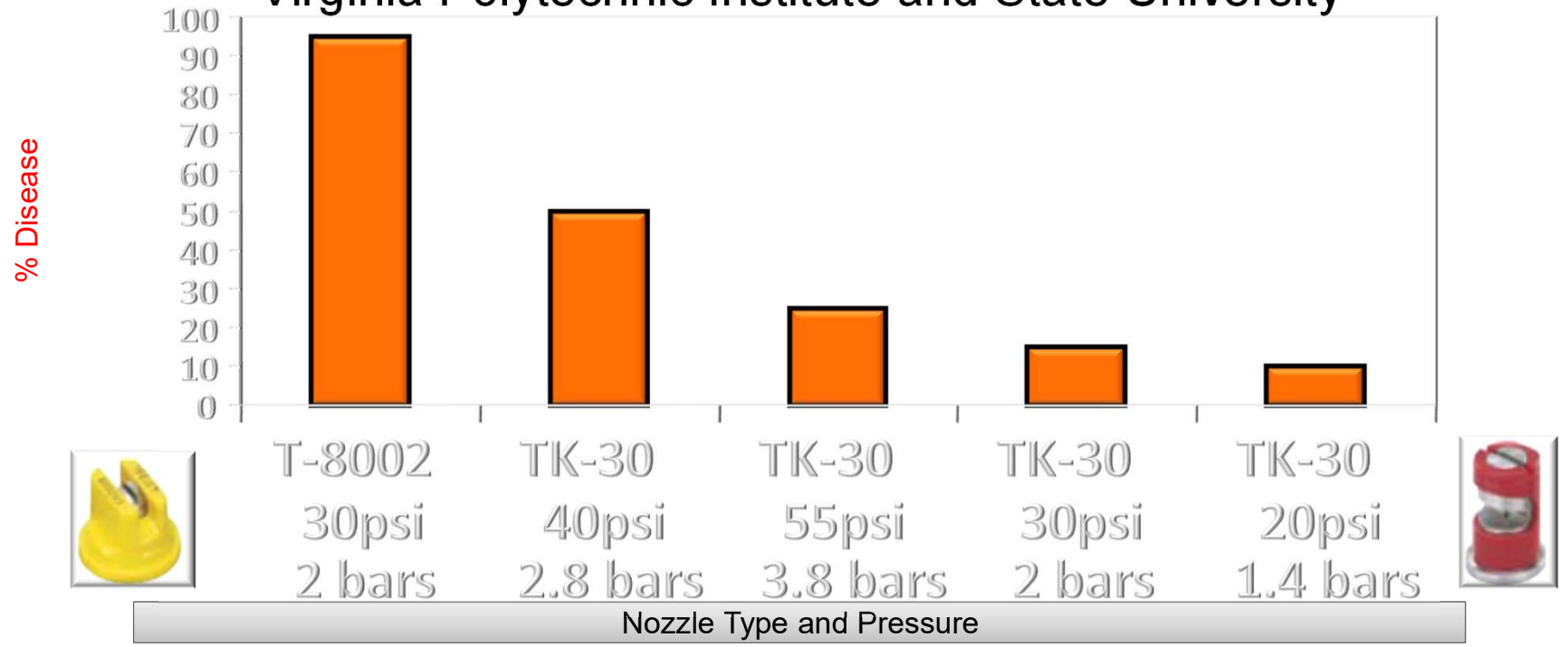
Feng, et al., Weed Sci, in press.
Paul Feng, Monsanto

Volume Median Diameter (VMD)

- Water
- RWM + 2% AMS
- RWM + 1% AMS + Array
- RWM + 2% AMS + In-Place
- RWM + 2% AMS + Interlock
- % less than 105 microns



Maximizing the Effectiveness of Fungicides,
Houston B. Couch
Virginia Polytechnic Institute and State University



Comparative effectiveness of Chipco 26019® in the control of Sclerotinia dollar sport when applied with Floodjet® TK-30 nozzles vs. flat fan T-8002 tips. 8002 at 30 psi (2 bars) is medium size spray droplet but close to fine in spraying systems book.

Water (carrier) Quality

AMS Effect on Roundup Ultra Efficacy			
Water Source	**Percent Weed Control**		
	Redroot Pigweed	Lambsquarter	Velvetleaf
Hard Water	99	77	70
Water pH 8.2	99	90	81
Deionized Water	99	97	82
Water 800 ppm Ca	99	83	72
Water 800 ppm Ca + AMS	99	98	98
			Minnesota

How much AMS do I need?

- Roundup label recommends 8.5 to 17 lbs per 100 gals

- NDSU equation
  - AMS (lbs per 100 gal water) = 0.009 (ppm calcium) + 0.005 (ppm sodium) + 0.002 (ppm potassium) + 0.014 (ppm magnesium)

What else does AMS do for us?

- Overcomes antagonisum on leaf surface
- Helps with movement of glyphosate through cuticles, epidermis, cell walls and membranes and vascular tissue
- Very weed specific
  - Velvetleaf vs. Lambsquarter

Soybean Canopy Penetration Study

- Application Notes
  - Sprayed September 15
  - 30” nozzle spacing
  - 50” boom height (17” above soybean canopy)
  - Soybean canopy 33”
    - Lower card placed at 5.5”
    - Middle card placed at 16.5”
    - Upper card placed at 27.5”

Can you drive droplets into the canopy?

Evaporation and Deceleration of Various Size Droplets*

Droplet Diameter (microns)	Terminal Velocity (ft/sec)	Final Drip diameter (microns)	Time to evaporate (sec)	Deceleration distance (in)
20	.04	7	0.3	<1
50	.25	17	1.8	3
100	.91	33	7	9
150	1.7	50	16	16
200	2.4	67	29	25

*Conditions assumed: 90 F, 36% R.H., 25 psi., 3.75 pesticide solution

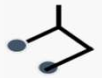
Nozzles Used in the Study

Travel Direction →

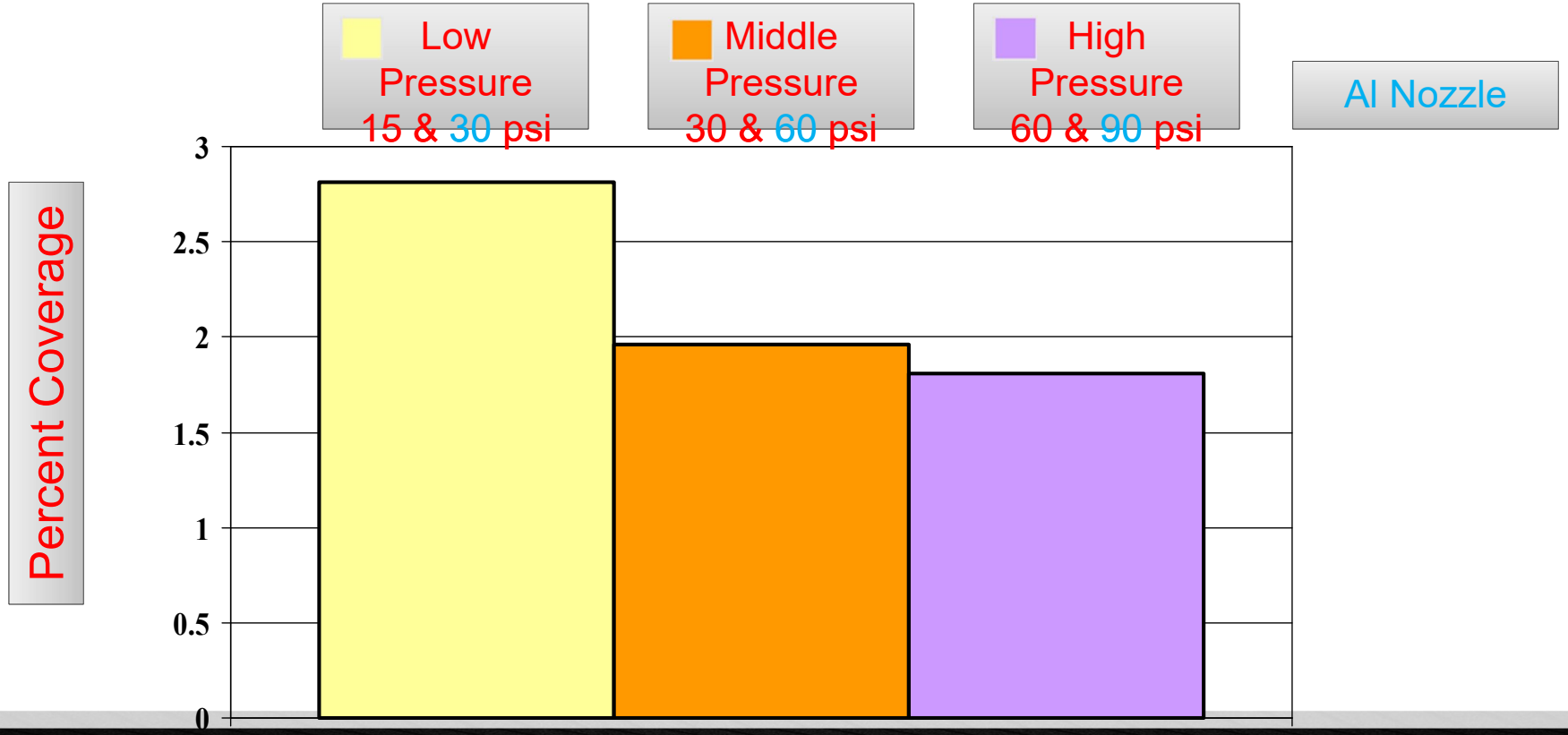
Treatment	Nozzle(s)	Pressure psi	Output gpm	Speed mph	Nozzle Position
		Total Nozzle			
1	 XRC 11003 (2)	15	0.36	3.6	
2		30	0.52	5.1	
3		60	1.74	7.3	
4	 XRC 11003 (2)	15	0.36	3.6	
5		30	0.52	5.1	
6		60	0.74	7.3	
7	 XRC 11006	15	0.37	3.6	
8		30	0.52	5.1	
9		60	0.73	7.3	
10	 XRC 11006	15	0.37	3.6	
11		30	0.52	5.1	
12		60	0.73	7.3	

Nozzles Used in the Study

Travel Direction →

Total Nozzle						
Treatment		Nozzle(s)	Pressure psi	Output gpm	Speed mph	Nozzle Position
13		TT 11003 (2)	15	0.36	3.6	
14			30	0.52	5.1	
15			60	1.74	7.3	
16		TT 11006	15	0.36	3.6	
17			30	0.52	5.1	
18			60	0.74	7.3	
19		AIC 110025 (2)	30	0.37	3.6	
20			60	0.52	5.1	
21			90	0.73	7.3	
22		AIC 11005	30	0.37	3.6	
23			60	0.52	5.1	
24			90	0.73	7.3	

Percent Coverage Averaged Over Treatments and Card Positions



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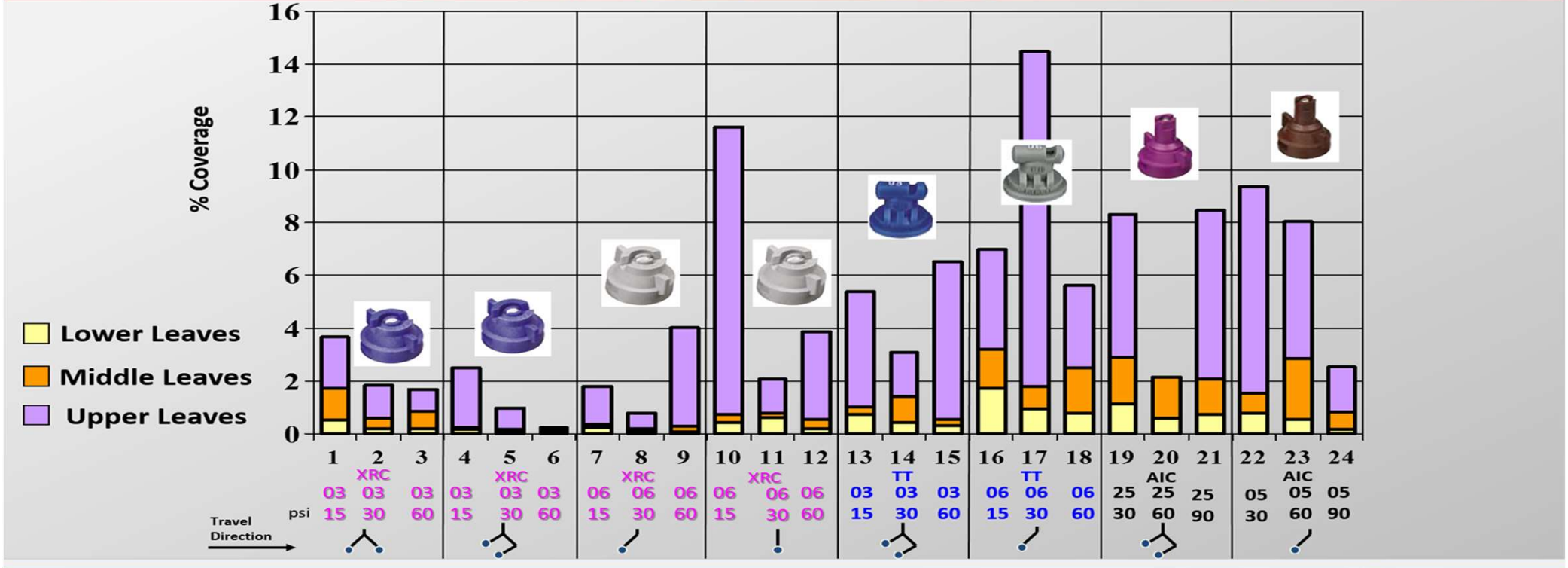
EXTENSION

Research Funded by Nebraska Soybean Board

Coverage of Spray Droplets on Soybean Canopy

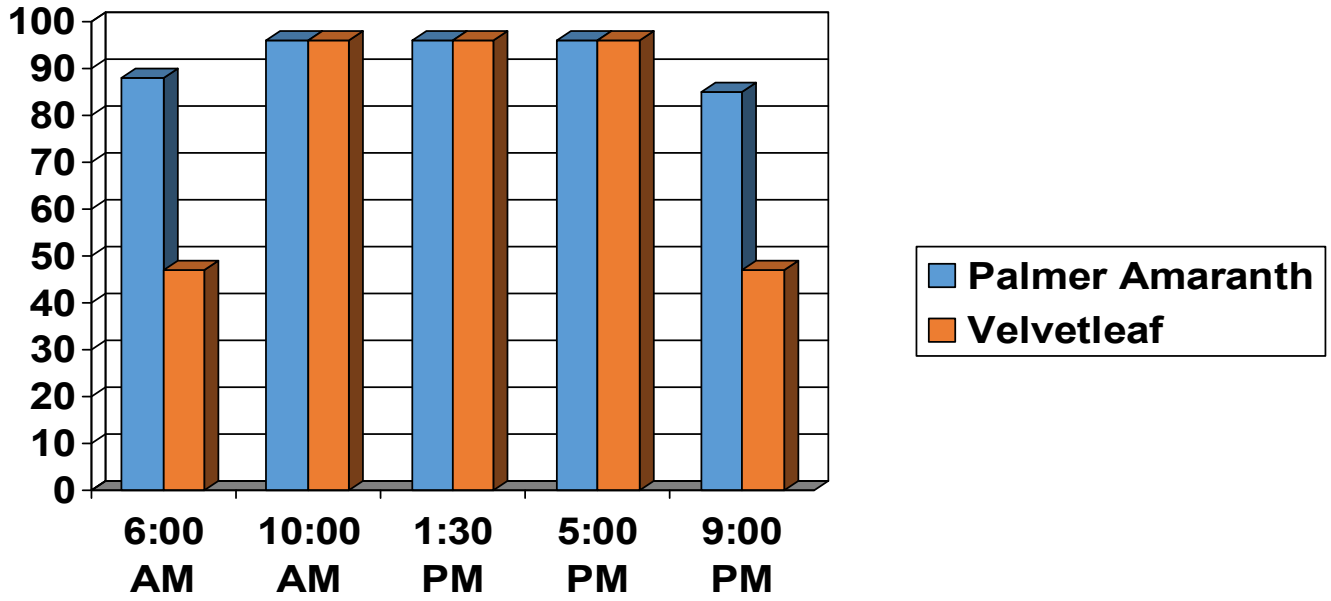


Application – Time of Day

Time of Day

- Weed control obtained by “Post” herbicides can be affected by the time of day at which they are applied.
  - Liberty and Roundup efficacy is best if applied within a couple of hours after dawn and before dusk.
  - It is not well understood, but reduced weed control may be the result of diurnal movement (leaf orientation) of the weeds leaves and/or the effect of light on physiological interactions within the plant.

Influence of time of day on glyphosate efficacy



Source – K State
24 oz. Roundup Ultra, Palmer Amaranth <12", Velvetleaf <8"

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Effect of Time-of-Day Application on Roundup

6 A.M.

10 A.M.

1:30 PM

5 P.M.

9 P.M.

Temperature Before, During and After Application

Effect of Time-of-Day Application on Roundup

- If moisture is limiting and accompanied with high temperatures, plants develop thicker cuticles.

- If temperatures prior to, during or after applications drop below 50 degrees, basic plant process slow down for at least 48 hours.

Effect of temperature on control of green foxtail and redroot pigweed With accent applied Post
(% reduction in dry weight). [1]

Temperature	Green Foxtail	Redroot Pigweed
50	56	95
68	95	95
86	95	97

[1] Weed Technology. 1991. Vol. 5: 92 – 96. Nalewaja, Woznica and Manthey.

Plant stress affects glyphosate efficacy: velvetleaf seedlings

Zhou et al. 2007. Weed Sci. 55:240 - 244

Source of stress	**Percent control**	
	No adjuvant	*Surf. & AMS*
None	84	93
Cold	68	80
Drought	46	67
Flooding	50	68

Dusty Conditions During Application

Dusty Conditions During Application "Wheel – Tracks"

- Some herbicides, in particular Gramoxone, Touchdown, Roundup (and other glyphosate formulations) are deactivated when they come in contact with soil particles including dust brought up by applications equipment and/or dust on leaf surfaces.

Glyphosate is adsorbed to soil

- Glyphosate is immediately inactivated upon contact with soil (or dirty water)
- Glyphosate efficacy is reduced by dust on weed leaves (Zhou et al. 2006. Weed Sci. 54:1132-1136)

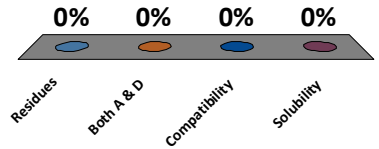
Treatment	Control
Plant without dust	81%
Plant with dust	60%

Sprayed with 22 oz. RT3

Wheel tract issues 5 weeks later.

_____ should be checked when mixing differing pesticides to avoid a loss of effectiveness, clogging of nozzles and changes in toxicity.

a. Residues
b. Both A & D
c. Compatibility
d. Solubility



General Standards

Questions?

Thank you!

Robert N. Klein
Western Nebraska Crops Specialist