Spray Considerations and Technologies for Precision Pesticide Applications

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Topics Covered

Nozzle Selection

- Nozzle Types – Spray Patterns
- Nozzle Size and Color Coding
- Spray Angle and Spray Height
- Nozzle Identification
- Droplet Size

Sprayer Calibration

- Calibration Methods
- Useful Formulas
- Calibration Tools
- Calibration & Nozzle Selection Apps

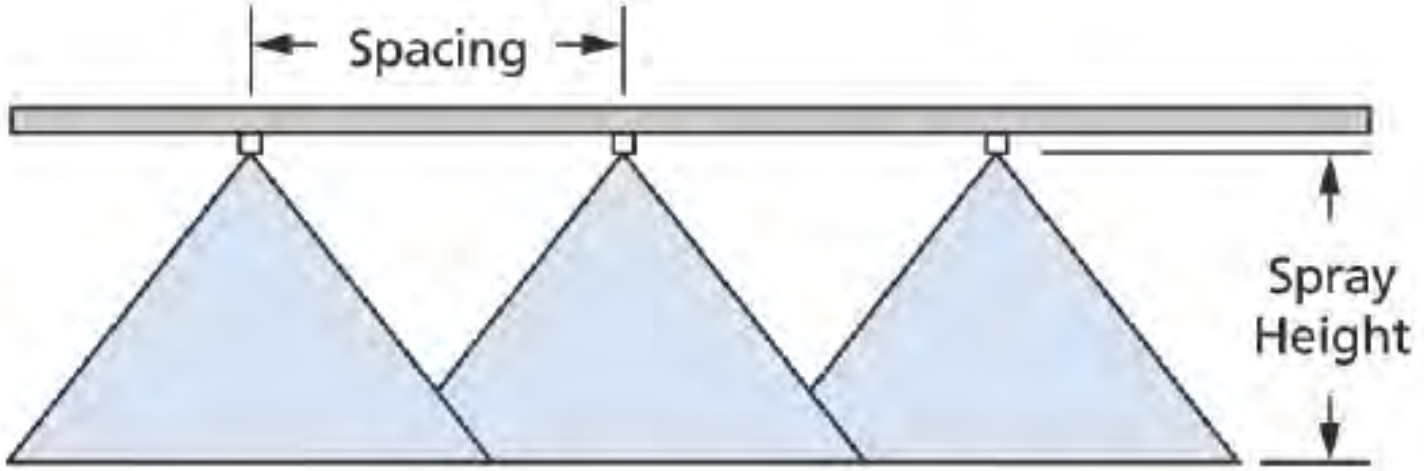
Spray Technologies

- Rate Controller
- PWM Systems
- Auto-boom Height Systems

Nozzle Types

Tapered Flat-Fan Spray Pattern

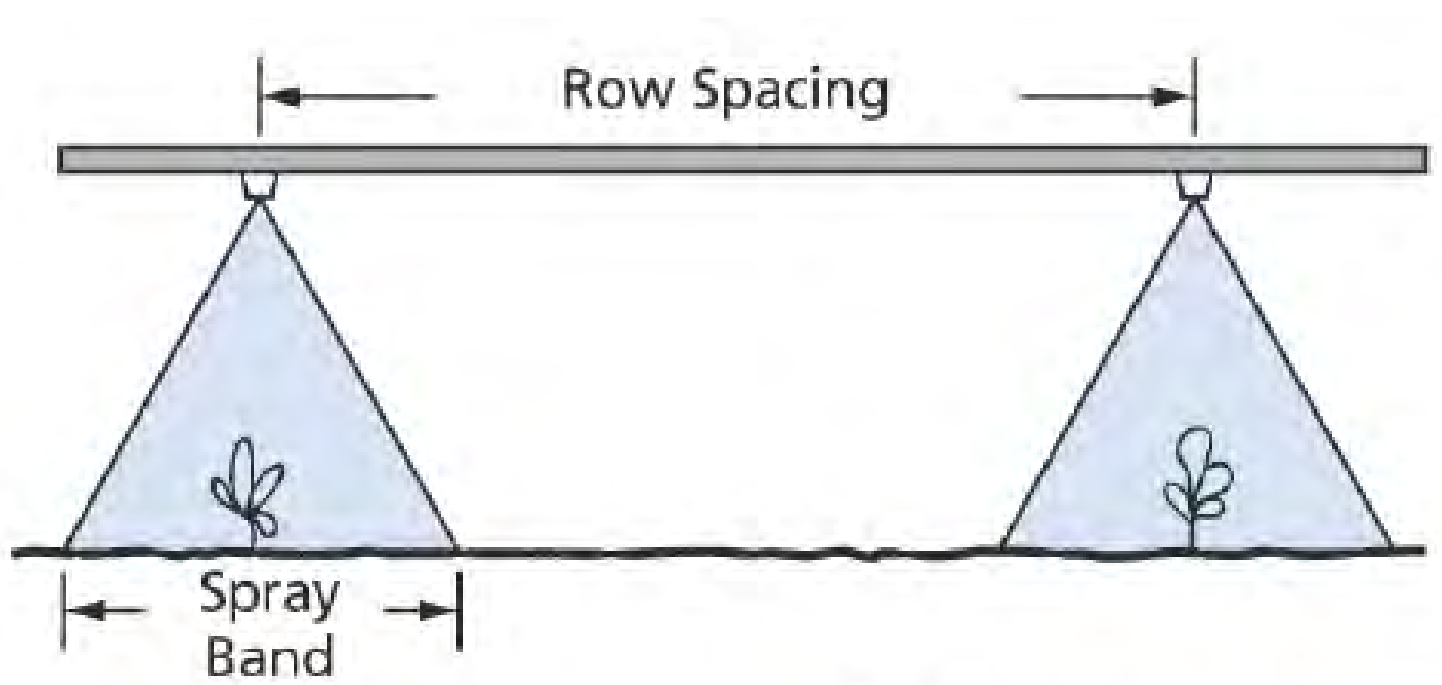
Uniform distribution is achieved when spacing, height, and overlap are optimized



Overlap broadcast pattern

Nozzle Types

Even Flat Spray Pattern



Band spray application

Nozzle Types

Cone Spray Pattern

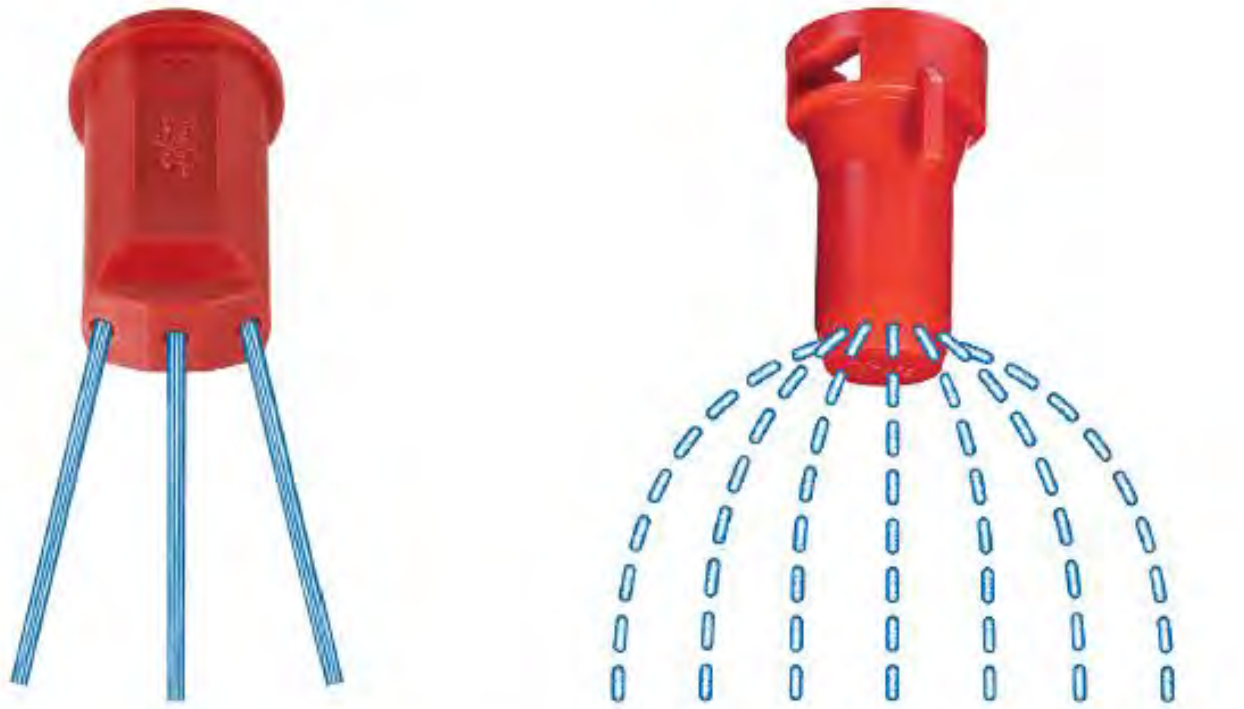
FIGURE 5:
Hollow Cone Spray Pattern

FIGURE 6:
Air Induction Hollow Cone Spray Pattern

FIGURE 7:
Full Cone Spray Pattern

Nozzle Types

Streaming Nozzles



Fertilizer Nozzle Spray Patterns

Nozzle Size

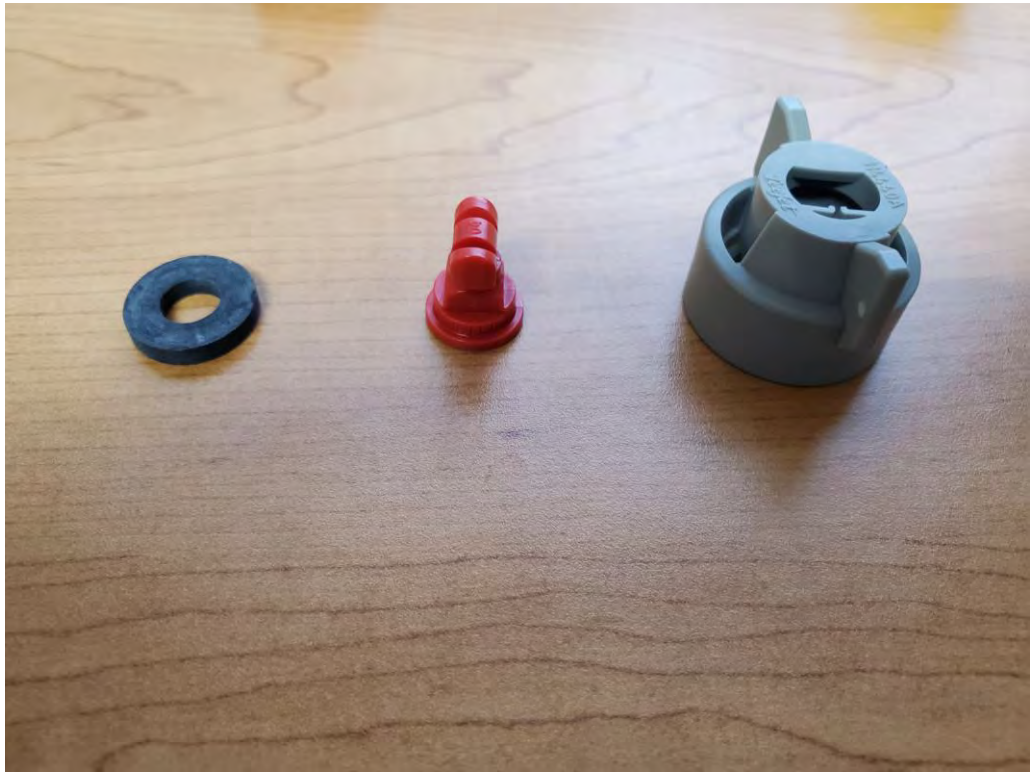
Nozzles are color coded based on their capacity at (flow rate) at 40 PSI

(Flow Rate is a function of orifice size and pressure)

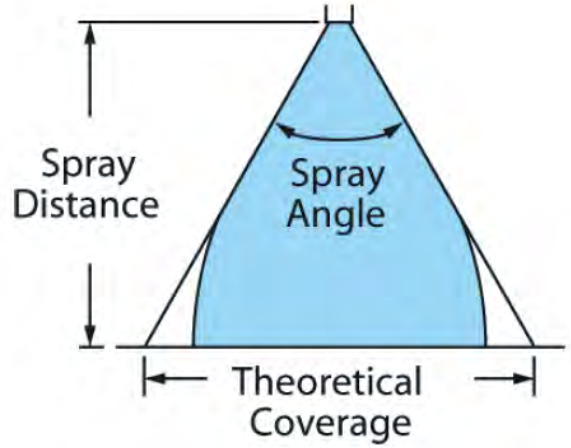
(ISO Standard 10625)

Tip Size	Colour	Flow Rate US gpm @ 40 psi
01	Orange	0.10
015	Green	0.15
02	Yellow	0.20
025	Lilac	0.25
03	Blue	0.30
035	Brown Red	0.35
04	Red	0.40
05	Brown	0.50
06	Gray	0.60
08	White	0.80

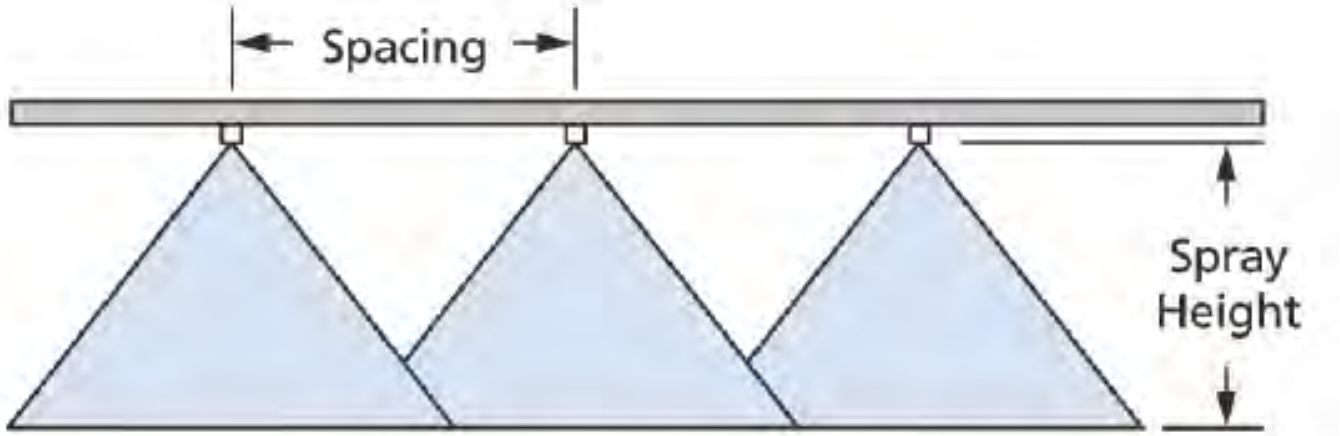
Nozzle Size



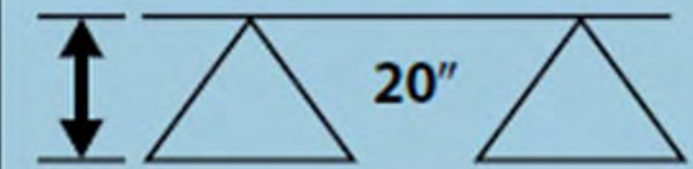
Spray Angle



- Tapered flat fan nozzles are mostly available in 80° or 110°
- For most tapered spray patterns, a minimum 30% spray pattern overlap is recommended
- Most new tips offered today are 110°



Spray Height

	
65°	35″
80°	30″
110°	20″

- Optimal spray height is needed to provide the overlap required for uniform distribution
- In most cases, typical height adjustment is based on 1:1 ratio of nozzle spacing to height.

Nozzle Identification

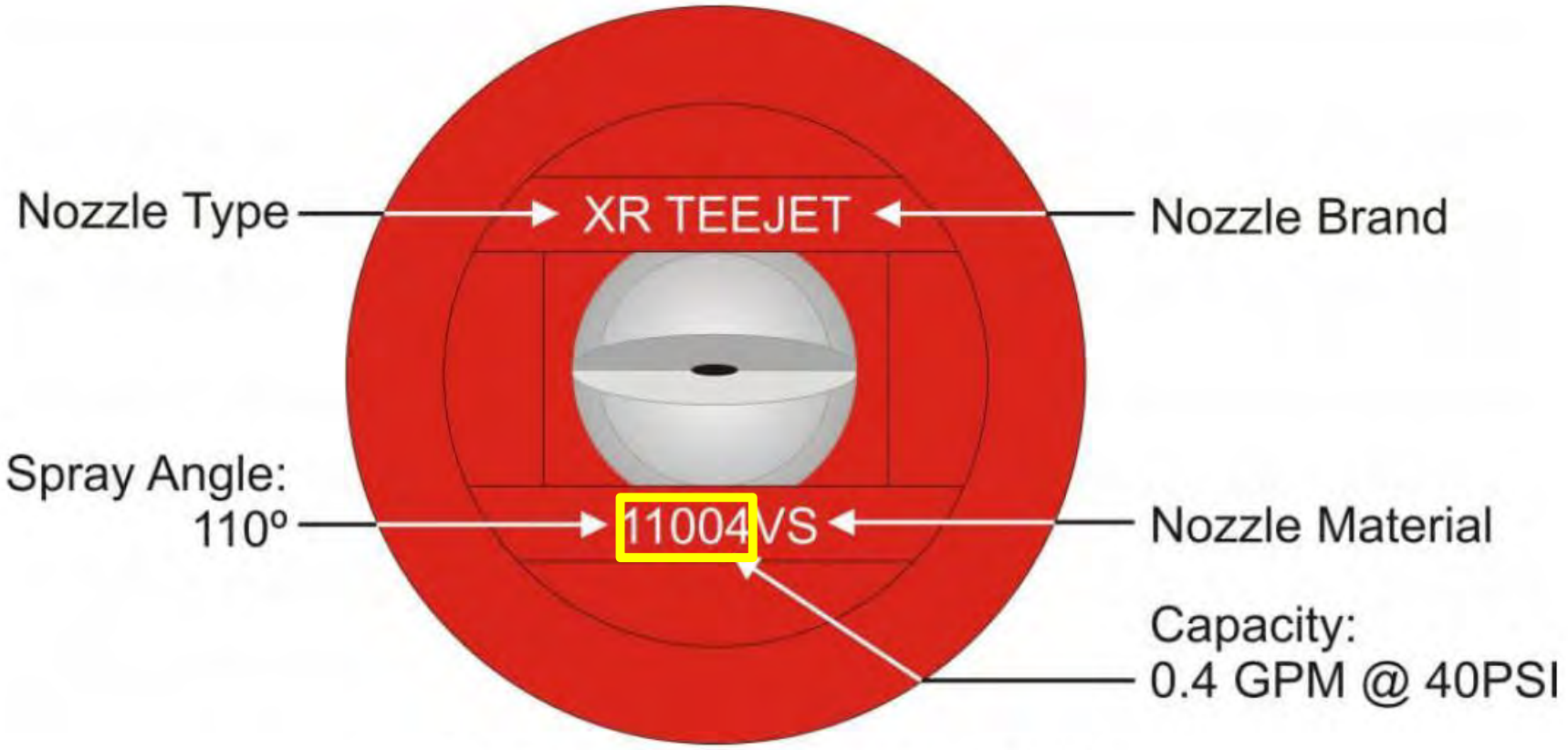
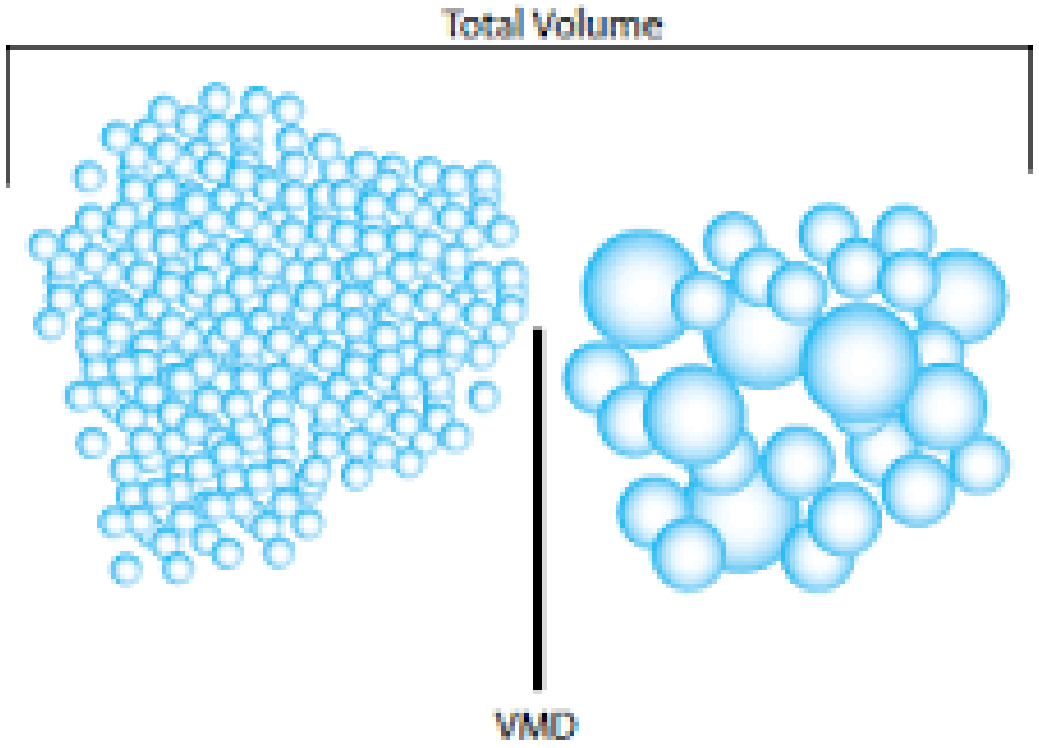


Fig. 1: Typical information printed on modern nozzles.

XR – flat-fan; AI – Air-Induction, TTJ – Turbo Twin-Jet
VS – stainless steel; VP – polymer; VC – Ceramic

Droplet Size

Spray is made up of droplets of varying sizes
(size is expressed in microns; 1µ = 0.001mm)

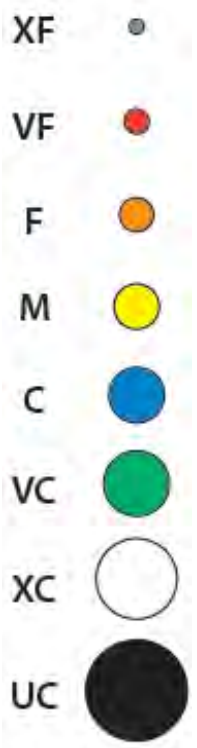


Volume Median Diameter

Degree of Atomization	Droplet Size (Microns)	Relative Size Related to Common Objects
Fog	Up to 25	Point of a Needle (25 Microns)
Fine Mist	20-100	Human Hair (100 Microns)
Fine Drizzle	100-250	Sewing Thread (150 Microns)
Heavy Drizzle	250-500	Toothbrush Bristle (300 Microns)
Light Rain	500-800	Staple (550 Microns)
Heavy Rain	800-1000	Paper Clip (850 Microns)
Thunderstorm Rain	1000-4000	#2 Pencil Lead (2000 Microns)

Droplet Size Classification

Category	Symbol	Approximate VMD[2] (Microns)
Extremely Fine	XF	~60
Very Fine	VF	61-105
Fine	F	106-235
Medium	M	236-340
Coarse	C	341-403
Very Coarse	VC	404-502
Extremely Coarse	XC	503-665
Ultra Coarse	UC	>665



[2]VMD = Volume median diameter.

(ASABE Standard S572.3)

XF Extremely Fine

VF Very Fine

F Fine

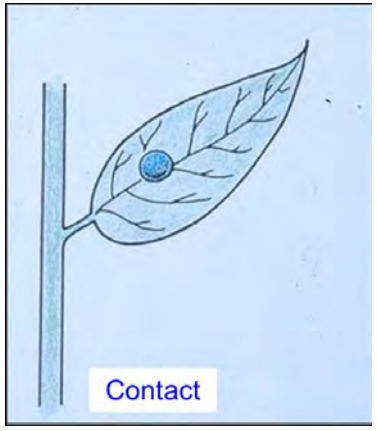
M Medium

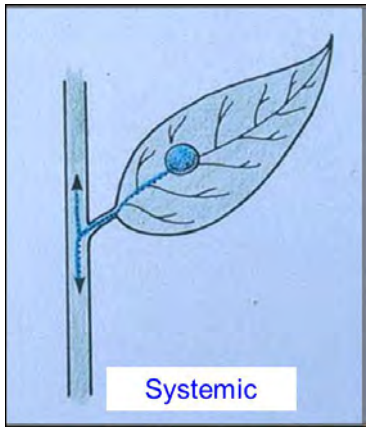
C Coarse

VC Very Coarse

XC Extremely Coarse

UC Ultra Coarse



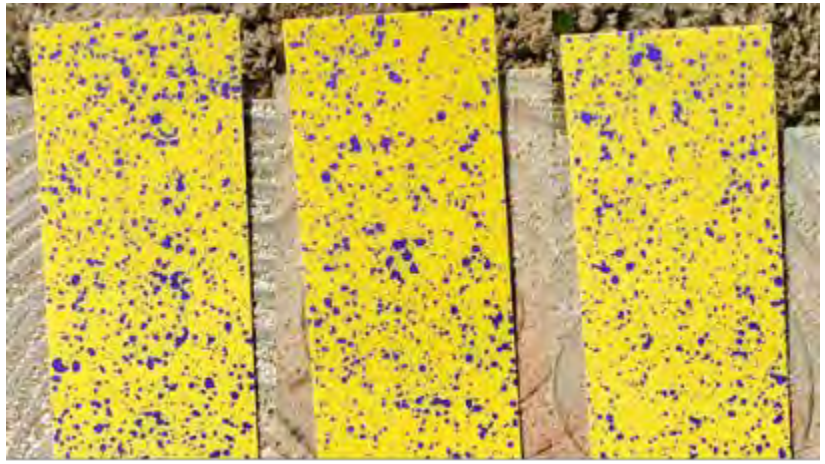


- When coverage is critical, such as in post-emergence contact applications, nozzles with finer droplets are used because of the excellent coverage on leaf surfaces.
- Nozzles producing mid-range droplets are most commonly used for application of contact and systemic herbicides, insecticides and fungicides.
- Nozzles producing coarser droplets are typically used for systemic herbicides and pre-emergence soil applied herbicides while minimizing drift.

Common Nozzles used for Pesticide Applications

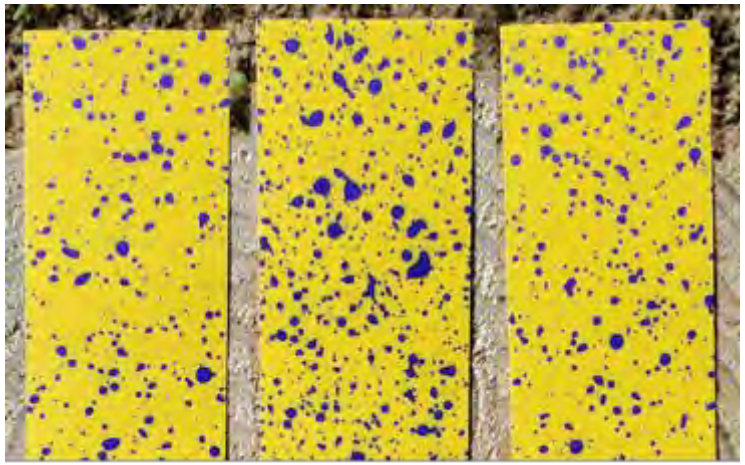
Medium Droplet Nozzles

Standard Flat-fan (XR)



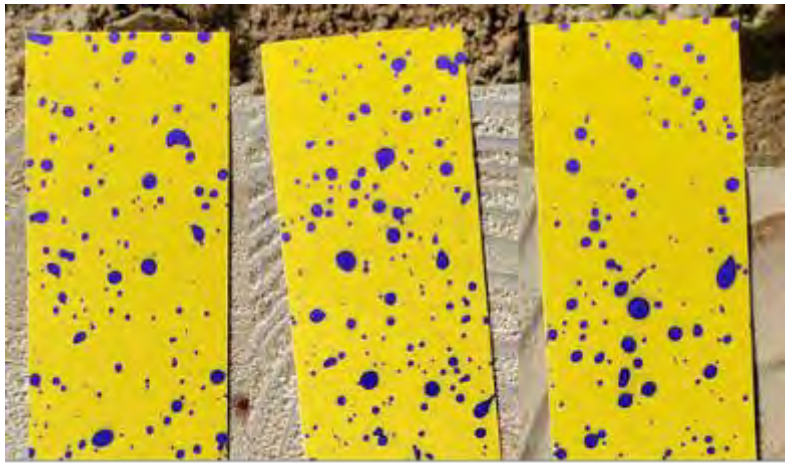
Coarser Droplet Nozzles

Air Induction (AIXR)

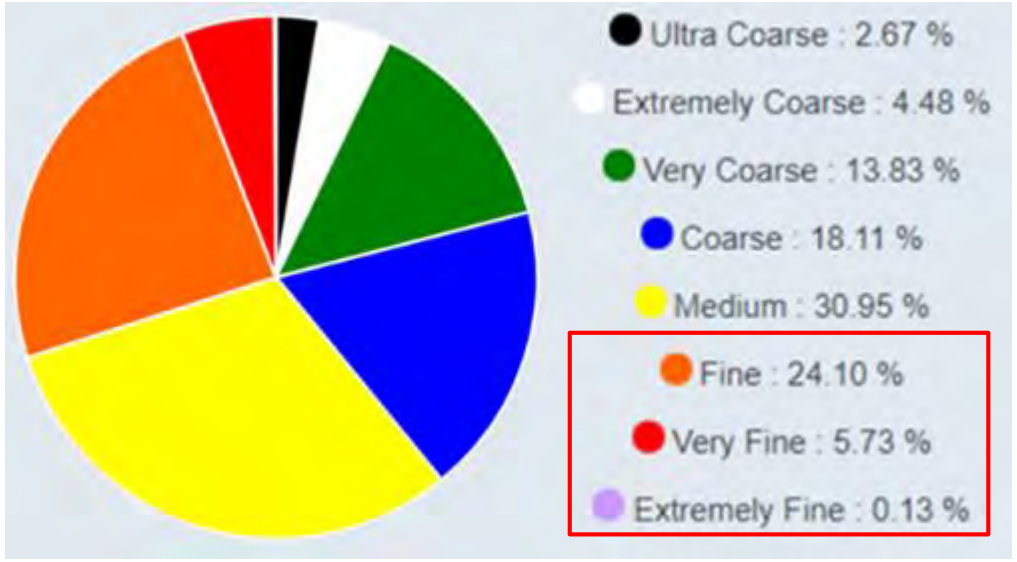


Ultra Coarse Droplet Nozzles

Turbo TeeJet Induction (TTI)

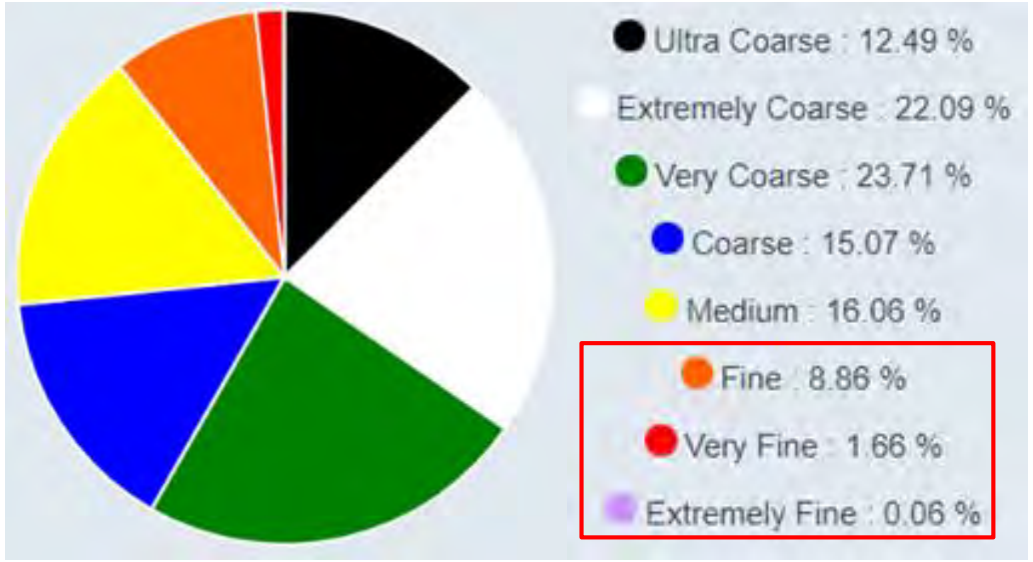


Standard Flat-fan (XR)



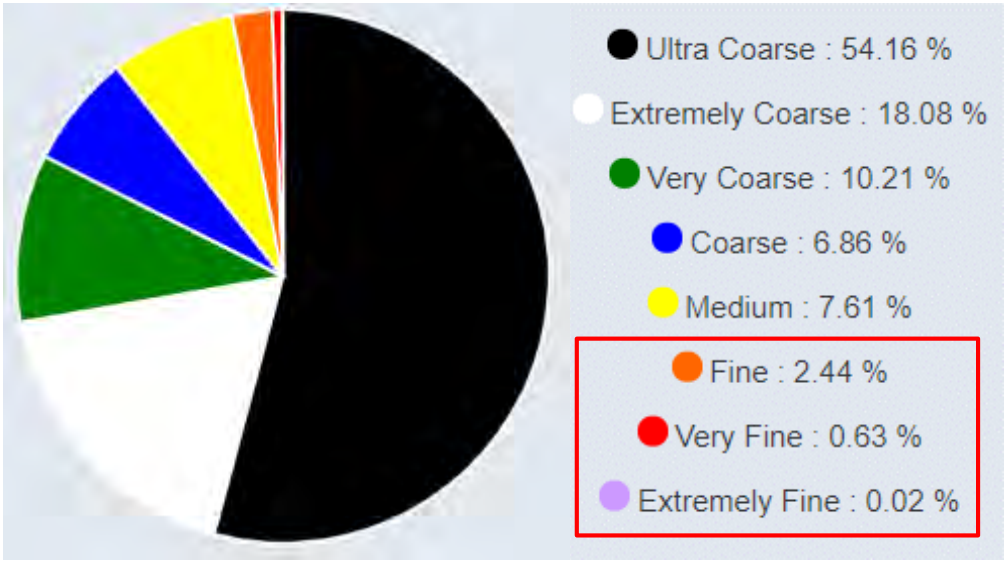
≅30% fines

Air Induction (AIXR)



≅11% fines

Turbo TeeJet Induction



≅3% fines

Example Nozzle Selection Chart

	PSI	110°XR/XRC 15-60 PSI	TT 15-90 PSI	TTJ60 20-90 PSI	AIXR 15-90 PSI	AI3070 20-90 PSI	AITTJ60 20-90 PSI	110°AI/AIC 30-115 PSI	TTI60 20-90 PSI	TTI 15-100 PSI	GPM	4 mph	5 mph	6 mph	7 mph
015 AI AIC AIXR AI3070 TT TTI XR XRC (100)	20	F	C	—	VC	VC	—	—	—	UC	0.11	8.2	6.5	5.4	4.7
	30	F	C	—	C	C	—	UC	—	UC	0.13	9.7	7.7	6.4	5.5
	40	F	M	—	C	M	—	XC	—	UC	0.15	11.1	8.9	7.4	6.4
	50	F	M	—	M	M	—	VC	—	UC	0.17	12.6	10.1	8.4	7.2
	60	F	M	—	M	M	—	VC	—	XC	0.18	13.4	10.7	8.9	7.6
	70	—	M	—	M	M	—	VC	—	XC	0.20	14.9	11.9	9.9	8.5
	80	—	F	—	M	F	—	VC	—	VC	0.21	15.6	12.5	10.4	8.9
	90	—	F	—	M	F	—	C	—	VC	0.23	17.1	13.7	11.4	9.8
02 AI AIC AIXR TT TTI TTI60 XR XRC (50) AI3070 AITTJ60 TTJ60 (100)	20	F	VC	C	VC	XC	XC	—	UC	UC	0.14	10.4	8.3	6.9	5.9
	30	F	C	C	VC	VC	VC	UC	UC	UC	0.17	12.6	10.1	8.4	7.2
	40	F	M	M	C	C	C	XC	XC	UC	0.20	14.9	11.9	9.9	8.5
	50	F	M	M	C	M	C	XC	XC	UC	0.22	16.3	13.1	10.9	9.3
	60	F	M	M	M	M	C	VC	VC	XC	0.24	17.8	14.3	11.9	10.2
	70	—	M	M	M	M	M	VC	VC	XC	0.26	19.3	15.4	12.9	11.0
	80	—	F	M	M	M	M	VC	VC	VC	0.28	21	16.6	13.9	11.9
	90	—	F	M	M	F	M	VC	VC	VC	0.30	22	17.8	14.9	12.7
025 AI AIC AIXR TT TTI TTI60 XR XRC (50) AI3070 AITTJ60 TTJ60 (100)	20	M	VC	VC	XC	XC	XC	—	UC	UC	0.18	13.4	10.7	8.9	7.6
	30	F	C	C	VC	VC	VC	UC	UC	UC	0.22	16.3	13.1	10.9	9.3
	40	F	M	C	VC	C	VC	XC	XC	UC	0.25	18.6	14.9	12.4	10.6
	50	F	M	M	C	C	C	XC	XC	UC	0.28	21	16.6	13.9	11.9
	60	F	M	M	C	M	C	XC	VC	UC	0.31	23	18.4	15.3	13.2
	70	—	M	M	C	M	M	VC	VC	XC	0.33	25	19.6	16.3	14.0
	80	—	F	M	C	M	M	VC	VC	XC	0.35	26	21	17.3	14.9
	90	—	F	M	M	M	M	VC	VC	VC	0.38	28	23	18.8	16.1
03 AI AIC AIXR AITTJ60 AI3070 TT TTI TTI60 XR XRC (50) TTJ60 (100)	20	M	VC	VC	XC	UC	UC	—	UC	UC	0.21	15.6	12.5	10.4	8.9
	30	F	VC	C	VC	VC	XC	UC	UC	UC	0.26	19.3	15.4	12.9	11.0
	40	F	C	C	VC	VC	VC	XC	UC	UC	0.30	22	17.8	14.9	12.7
	50	F	M	M	C	C	VC	XC	UC	UC	0.34	25	20	16.8	14.4
	60	F	M	M	C	C	C	VC	XC	UC	0.37	27	22	18.3	15.7
	70	—	M	M	C	C	C	VC	XC	XC	0.40	30	24	19.8	17.0
	80	—	M	M	C	M	C	VC	VC	XC	0.42	31	25	21	17.8
	90	—	F	M	M	M	M	VC	VC	XC	0.45	33	27	22	19.1

Nozzle Selection

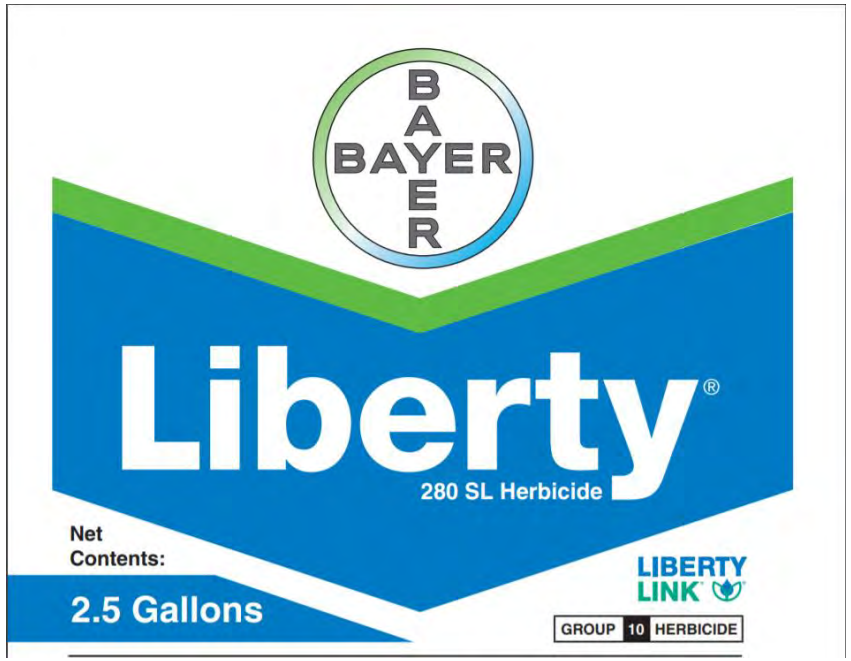
What information do we need to select a nozzle?

- Pesticide
- Mode of Action
- Application Rate
- Tolerance to Drift
- Ground Speed Range
- Operating Pressure Range
- Nozzle Spacing

Nozzle Selection:

First Step

- **Check Pesticide Label**



LIBERTY 280 SL HERBICIDE:

- apply to actively growing small weeds as recommended in the Weed Control for Row Crops section.
- LIBERTY 280 SL HERBICIDE is a contact herbicide and requires uniform thorough spray coverage.

GROUND APPLICATION

- Apply early when weeds are small with directed rates as identified in the Rate Tables for each crop.
- Use nozzles and pressure that generate a MEDIUM to COARSE size spray droplet. NOTE: Weed control with very coarse, extremely coarse or ultra-coarse nozzles will not provide adequate coverage and will cause unsatisfactory weed control.
- Apply LIBERTY 280 SL HERBICIDE in a minimum of 15 gallons of water per acre. Increase to 20 gallons of water per acre if dense weed canopy exists.
- Apply at ground speed of less than 15 mph to attain adequate coverage.
- Apply when wind speeds are between 2 mph and 10 mph. DO NOT apply when winds are gusty, or when conditions will favor movement of spray particles off the desired spray target. See the *Spray Drift Management* section of this label for additional information on proper application of LIBERTY 280 SL HERBICIDE.
- **Do not use flood jet nozzles, controlled droplet application equipment, or air-assisted spray equipment.**

SPRAY DRIFT MANAGEMENT

Spray drift may result in injury to non-target crops or vegetation. To avoid spray drift, do not apply when wind speed is greater than 10 MPH or during periods of temperature inversions. Do not apply when weather conditions, wind speed, or wind direction may cause spray drift to non-target areas. AVOIDING SPRAY DRIFT AT THE APPLICATION SITE IS THE RESPONSIBILITY OF THE APPLICATOR.

- All aerial and ground application equipment must be properly maintained and calibrated using appropriate carriers.
- For all non-aerial applications, wind speed must be measured adjacent to the application site, on the upwind side, immediately prior to application.

Nozzle Selection

Pesticide = Herbicide

Mode of Action = Contact

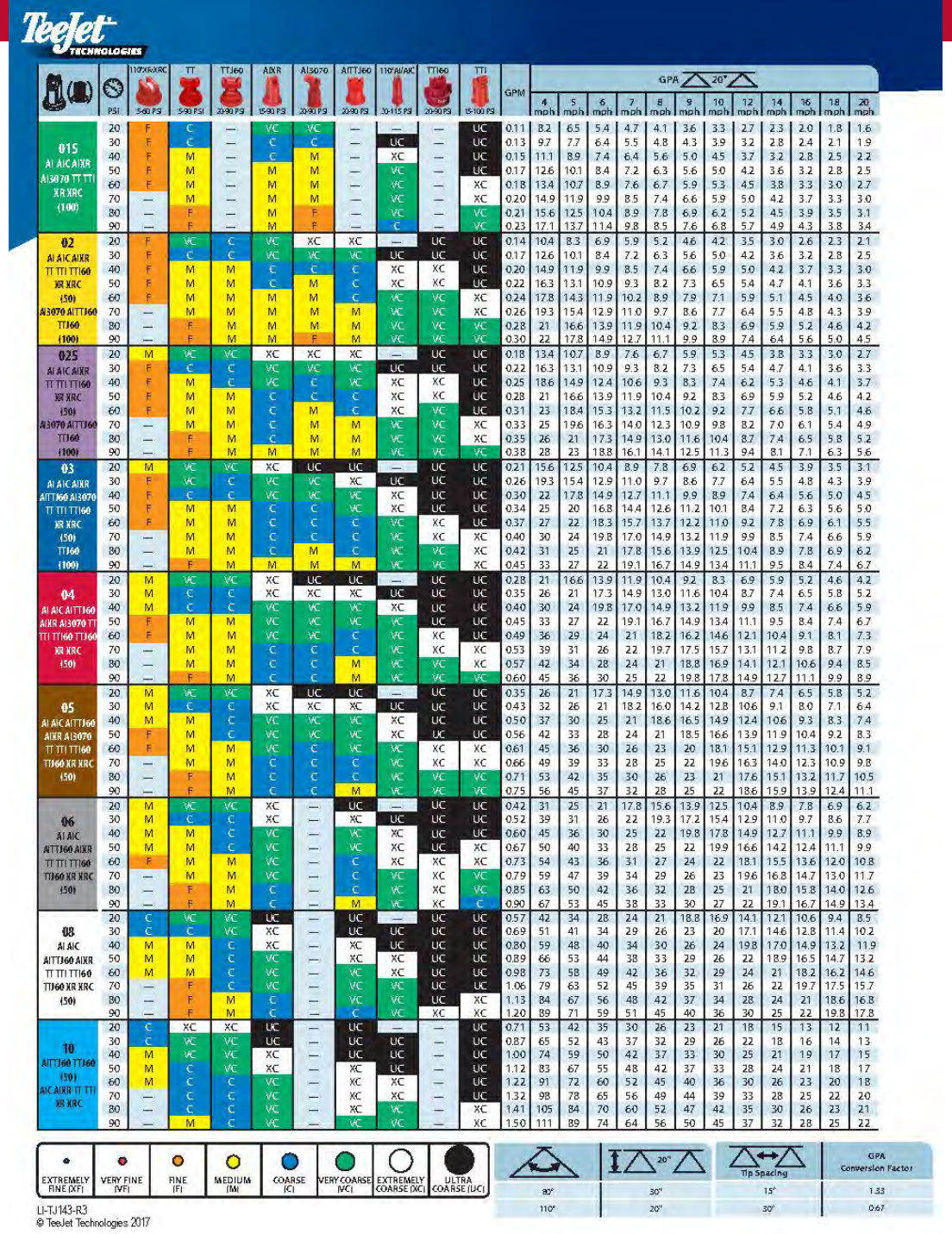
Application Rate = 15 GPA

Droplet Size = medium to coarse

Ground Speed Range < 15 mph

Operating Pressure Range = 30-50 PSI

Nozzle Spacing = 20 inches



TeeJet TECHNOLOGIES

	PSI	110°XR/XRC 15-60 PSI	TT 15-90 PSI	TTJ60 20-90 PSI	AIXR 15-90 PSI	AI3070 20-90 PSI	AITTJ60 20-90 PSI	110°AI/AIC 30-115 PSI	TTI60 20-90 PSI	TTI 15-100 PSI	GPM	GPA 20" 4 mph	5 mph	6 mph	7 mph	8 mph	9 mph	10 mph	12 mph	14 mph	16 mph	18 mph	20 mph
04 AI AIC AITTJ60 AIXR AI3070 TT TTI TTI60 TTJ60 XR XRC (50)	20	M	VC	VC	XC	UC	UC	—	UC	UC	0.28	21	16.6	13.9	11.9	10.4	9.2	8.3	6.9	5.9	5.2	4.6	4.2
	30	M	C	C	XC	XC	XC	UC	UC	UC	0.35	26	21	17.3	14.9	13.0	11.6	10.4	8.7	7.4	6.5	5.8	5.2
	40	M	C	C	VC	VC	VC	XC	UC	UC	0.40	30	24	19.8	17.0	14.9	13.2	11.9	9.9	8.5	7.4	6.6	5.9
	50	F	M	M	VC	VC	VC	VC	UC	UC	0.45	33	27	22	19.1	16.7	14.9	13.4	11.1	9.5	8.4	7.4	6.7
	60	F	M	M	VC	VC	C	VC	XC	UC	0.49	36	29	24	21	18.2	16.2	14.6	12.1	10.4	9.1	8.1	7.3
	70	—	M	M	C	C	C	VC	XC	XC	0.53	39	31	26	22	19.7	17.5	15.7	13.1	11.2	9.8	8.7	7.9
	80	—	M	M	C	C	M	VC	VC	XC	0.57	42	34	28	24	21	18.8	16.9	14.1	12.1	10.6	9.4	8.5
	90	—	F	M	C	C	M	VC	VC	VC	0.60	45	36	30	25	22	19.8	17.8	14.9	12.7	11.1	9.9	8.9
05 AI AIC AITTJ60 AIXR AI3070 TT TTI TTI60 TTJ60 XR XRC (50)	20	M	VC	VC	XC	UC	UC	—	UC	UC	0.35	26	21	17.3	14.9	13.0	11.6	10.4	8.7	7.4	6.5	5.8	5.2
	30	M	C	C	XC	XC	XC	UC	UC	UC	0.43	32	26	21	18.2	16.0	14.2	12.8	10.6	9.1	8.0	7.1	6.4
	40	M	M	C	VC	VC	VC	XC	UC	UC	0.50	37	30	25	21	18.6	16.5	14.9	12.4	10.6	9.3	8.3	7.4
	50	F	M	C	VC	VC	VC	XC	UC	UC	0.56	42	33	28	24	21	18.5	16.6	13.9	11.9	10.4	9.2	8.3
	60	F	M	M	VC	C	VC	VC	XC	XC	0.61	45	36	30	26	23	20	18.1	15.1	12.9	11.3	10.1	9.1
	70	—	M	M	C	C	C	VC	XC	XC	0.66	49	39	33	28	25	22	19.6	16.3	14.0	12.3	10.9	9.8
	80	—	F	M	C	C	C	VC	VC	VC	0.71	53	42	35	30	26	23	21	17.6	15.1	13.2	11.7	10.5
	90	—	F	M	C	C	M	VC	VC	VC	0.75	56	45	37	32	28	25	22	18.6	15.9	13.9	12.4	11.1
06 AI AIC AITTJ60 AIXR TT TTI TTI60 TTJ60 XR XRC (50)	20	M	VC	VC	XC	—	UC	—	UC	UC	0.42	31	25	21	17.8	15.6	13.9	12.5	10.4	8.9	7.8	6.9	6.2
	30	M	C	C	XC	—	XC	UC	UC	UC	0.52	39	31	26	22	19.3	17.2	15.4	12.9	11.0	9.7	8.6	7.7
	40	M	M	C	VC	—	VC	XC	UC	UC	0.60	45	36	30	25	22	19.8	17.8	14.9	12.7	11.1	9.9	8.9
	50	M	M	C	VC	—	VC	XC	UC	XC	0.67	50	40	33	28	25	22	19.9	16.6	14.2	12.4	11.1	9.9
	60	F	M	M	VC	—	C	XC	XC	XC	0.73	54	43	36	31	27	24	22	18.1	15.5	13.6	12.0	10.8
	70	—	M	M	VC	—	C	VC	XC	VC	0.79	59	47	39	34	29	26	23	19.6	16.8	14.7	13.0	11.7
	80	—	F	M	C	—	C	VC	XC	VC	0.85	63	50	42	36	32	28	25	21	18.0	15.8	14.0	12.6
	90	—	F	M	C	—	M	VC	XC	C	0.90	67	53	45	38	33	30	27	22	19.1	16.7	14.9	13.4

Sprayer Calibration

Flow Rate per nozzle

Target App. Rate

Ground Speed

Nozzle Spacing

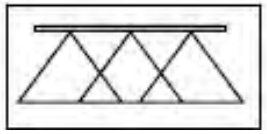
$$\text{Flow Rate } (GPM) = \frac{Application\ Rate\ (GPA) \times Speed\ (mph) \times Spacing\ (in.)}{5940}$$

Conversion Factor

1 hour = 60 minutes
1 mile = 5280 feet
1 foot = 12 inches
1 acre = 43560 feet^2

$$5940 = \frac{43560 \times 60 \times 12}{5280}$$

Sprayer Calibration



Broadcast Application

Nozzle output = 0.51 GPM

1 Gallon = 128 oz.
1 Minute = 60 sec.

Nozzle output = (0.51 x 128)/60 = 1.1 oz/sec

Time (s)	Volume to Catch (oz.)
10	11.0
15	16.5
20	22.0

Ounce (1/128th acre) method

1 Gallon = 128 oz.
1 acre = 43560 ft^2
1/128 acre = 340 ft^2

$$\text{Distance to travel} = \frac{4080}{Nozzle\ Spacing\ (inches)}$$

Nozzle Spacing (in)	Distance (ft)
12	340
14	292
16	255
18	227
20	204
24	170

Record the time (seconds) to travel the selected distance & then collect the spray output for the same time from each nozzle

Volume collected (oz.) = Application Rate (GPA)

Ounce (1/128th acre) method

Lets take an example:

- Application Rate = 15 GPA
- Ground Speed = 10 mph
- Nozzle Spacing = 20 inches

Nozzle Spacing (in)	Distance (ft)
12	340
14	292
16	255
18	227
20	204
24	170

Record the time (seconds) to travel 204 ft. & then collect the spray output for the same time from each nozzle

Volume collected (oz.) = Application Rate (GPA)

Volume collected = 15 oz.

Spot-On Spray Calibrator

- Best for flow rates below 1 GPM
- Press START button and hold the meter under nozzle at slight angle
- Allow the meter to fill until the display shows a flow rate

(The sprayer calibrator has two metal electrodes that senses the water level and calculates GPM based on time it takes to fill a known volume)

- Display holds reading for 90 seconds. Empty the meter and perform calibration on next nozzle

https://www.amazon.com/Spot-On-SpotOn-Sprayer-Calibrator/dp/B00JRD6UA0

Using Spot-On Spray Calibrator

Lets take an example:

- Flow Rate /nozzle = 0.69 GPM
- Speed = 10 mph
- Nozzle Spacing = 20 inches

$$\text{Application Rate } (GPA) = \frac{Nozzle\ flow\ Rate\ (GPM) \times 5940}{Speed\ (mph)\ \times Spacing\ (inches)}$$

$$\text{Application Rate } (GPA) = \frac{0.69 \times 5940}{10\ \times 20}$$

Answer = 20.5 GPA

TeeJet TECHNOLOGIES

	PSI	110°XR/XRC 15-60 PSI	TT 15-90 PSI	TTJ60 20-90 PSI	AIXR 15-90 PSI	AI3070 20-90 PSI	AITTJ60 20-90 PSI	110°AI/AIC 30-115 PSI	TTI60 20-90 PSI	TTI 15-100 PSI	GPM	GPA 20" 4 mph	5 mph	6 mph	7 mph	8 mph	9 mph	10 mph	12 mph
04 AI AIC AITTJ60 AIXR AI3070 TT TTI TTI60 TTJ60 XR XRC (50)	20	M	VC	VC	XC	UC	UC	—	UC	UC	0.28	21	16.6	13.9	11.9	10.4	9.2	8.3	6.9
	30	M	C	C	XC	XC	XC	UC	UC	UC	0.35	26	21	17.3	14.9	13.0	11.6	10.4	8.7
	40	M	C	C	VC	VC	VC	XC	UC	UC	0.40	30	24	19.8	17.0	14.9	13.2	11.9	9.9
	50	F	M	M	VC	VC	VC	VC	UC	UC	0.45	33	27	22	19.1	16.7	14.9	13.4	11.1
	60	F	M	M	VC	VC	C	VC	XC	UC	0.49	36	29	24	21	18.2	16.2	14.6	12.1
	70	—	M	M	C	C	C	VC	XC	XC	0.53	39	31	26	22	19.7	17.5	15.7	13.1
	80	—	M	M	C	C	M	VC	VC	XC	0.57	42	34	28	24	21	18.8	16.9	14.1
	90	—	F	M	C	C	M	VC	VC	VC	0.60	45	36	30	25	22	19.8	17.8	14.9
05 AI AIC AITTJ60 AIXR AI3070 TT TTI TTI60 TTJ60 XR XRC (50)	20	M	VC	VC	XC	UC	UC	—	UC	UC	0.35	26	21	17.3	14.9	13.0	11.6	10.4	8.7
	30	M	C	C	XC	XC	XC	UC	UC	UC	0.43	32	26	21	18.2	16.0	14.2	12.8	10.6
	40	M	M	C	VC	VC	VC	XC	UC	UC	0.50	37	30	25	21	18.6	16.5	14.9	12.4
	50	F	M	C	VC	VC	VC	XC	UC	UC	0.56	42	33	28	24	21	18.5	16.6	13.9
	60	F	M	M	VC	C	VC	VC	XC	XC	0.61	45	36	30	26	23	20	18.1	15.1
	70	—	M	M	C	C	C	VC	XC	XC	0.66	49	39	33	28	25	22	19.6	16.3
	80	—	F	M	C	C	C	VC	VC	VC	0.71	53	42	35	30	26	23	21	17.6
	90	—	F	M	C	C	M	VC	VC	VC	0.75	56	45	37	32	28	25	22	18.6
06 AI AIC AITTJ60 AIXR TT TTI TTI60 TTJ60 XR XRC (50)	20	M	VC	VC	XC	—	UC	—	UC	UC	0.42	31	25	21	17.8	15.6	13.9	12.5	10.4
	30	M	C	C	XC	—	XC	UC	UC	UC	0.52	39	31	26	22	19.3	17.2	15.4	12.9
	40	M	M	C	VC	—	VC	XC	UC	UC	0.60	45	36	30	25	22	19.8	17.8	14.9
	50	M	M	C	VC	—	VC	XC	UC	XC	0.67	50	40	33	28	25	22	19.9	16.6
	60	F	M	M	VC	—	C	XC	XC	XC	0.73	54	43	36	31	27	24	22	18.1
	70	—	M	M	VC	—	C	VC	XC	VC	0.79	59	47	39	34	29	26	23	19.6
	80	—	F	M	C	—	C	VC	XC	VC	0.85	63	50	42	36	32	28	25	21
	90	—	F	M	C	—	M	VC	XC	C	0.90	67	53	45	38	33	30	27	22

Useful Resources & Applications

Spot-On Sprayer Calibrator:

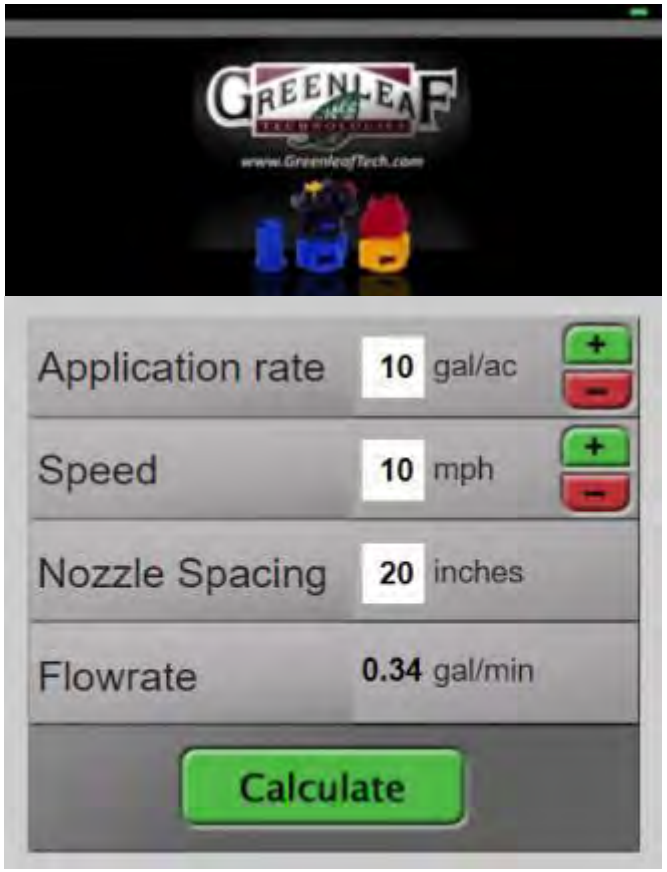
https://innoquestinc.com/product/spoton-sprayer-calibrator-model-sc-1/

https://extension.uga.edu/publications/detail.html?number=C1252

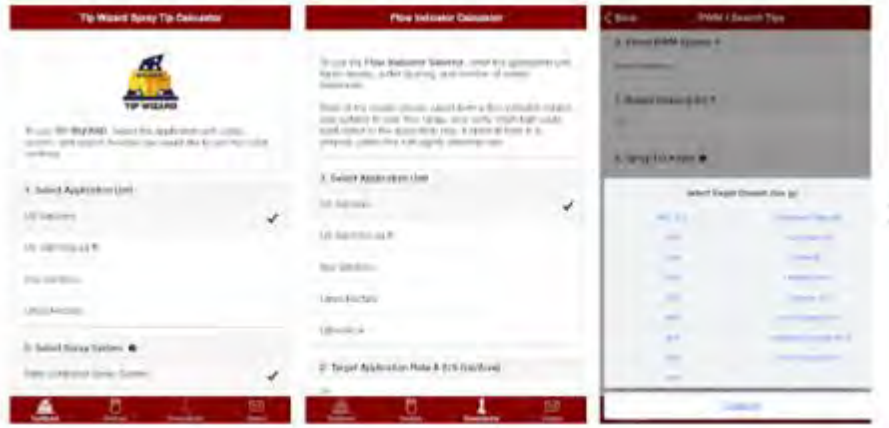
Useful Resources & Applications

Nozzle Selection and Sprayer Calibration Apps

https://www.teejet.com/tools/spray-nozzle_selection.aspx



https://greenleaftech.com/dynamic.php?pg=Choosing_the_Right_Nozzle/Nozzle_Calculator



https://www.wilger.net/tip-wizard/

Basic Application Technology

Rate Controller:

- Maintain a target application rate (gallons per acre; GPA) despite changes in ground speed
- Flow rate changes are accomplished by regulating spray pressure as ground speed increases or decreases.

Speed (mph)	Without Rate Controller (GPA)
5	20
8	12
10	10
12	8
20	5

Components of a Rate Control System

GPS/Radar

In-Cab Display/Computer

Electronic Control Unit

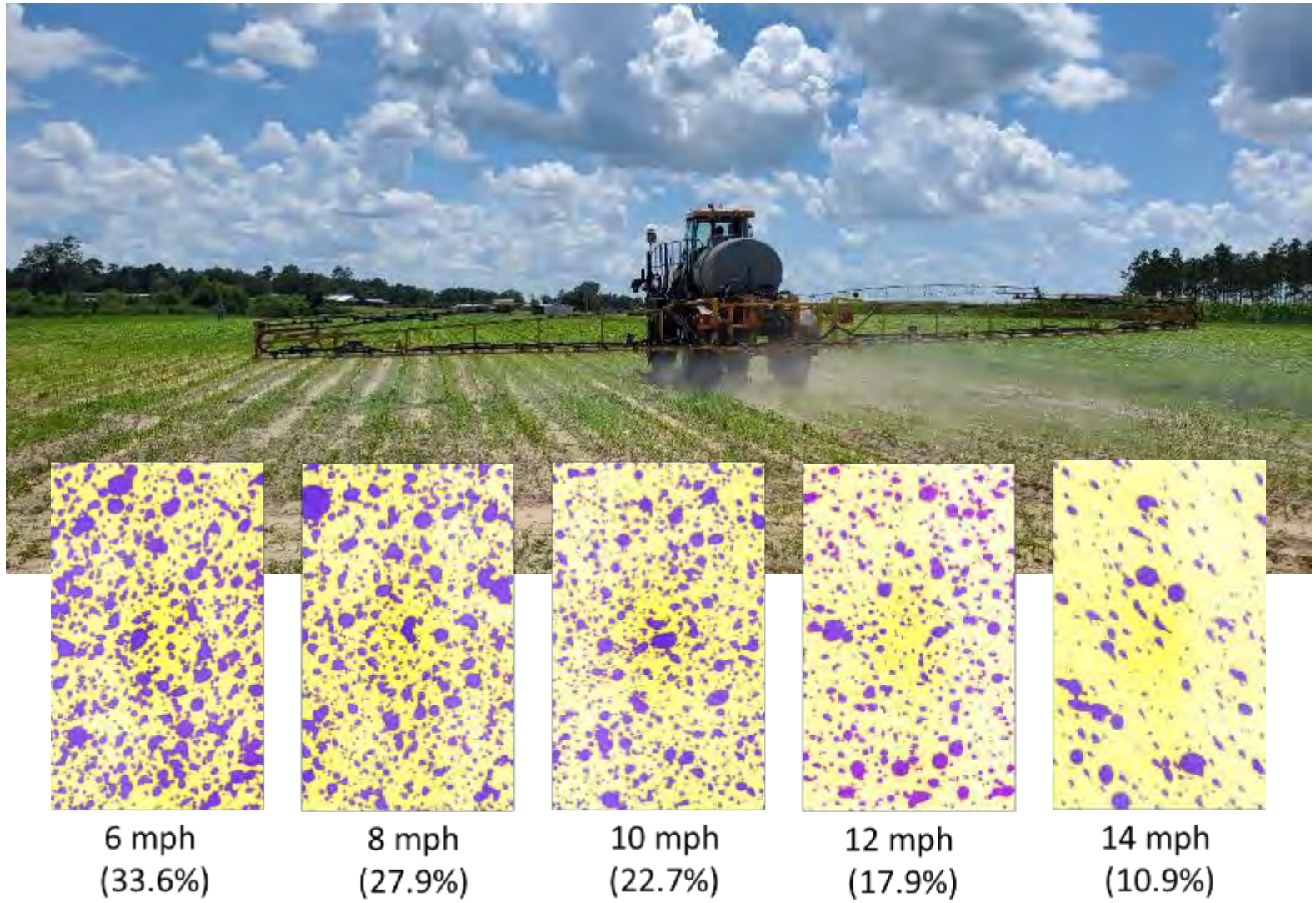
Flow Meter

Regulating Valve

Ground Speed Effect on Spray Coverage (no rate controller)

Sprayer calibrated at 6 mph:

- 6 mph *(20 GPA)*
- 8 mph
- 10 mph
- 12 mph *(10 GPA)*
- 14 mph
- 16 mph *(7 GPA)*

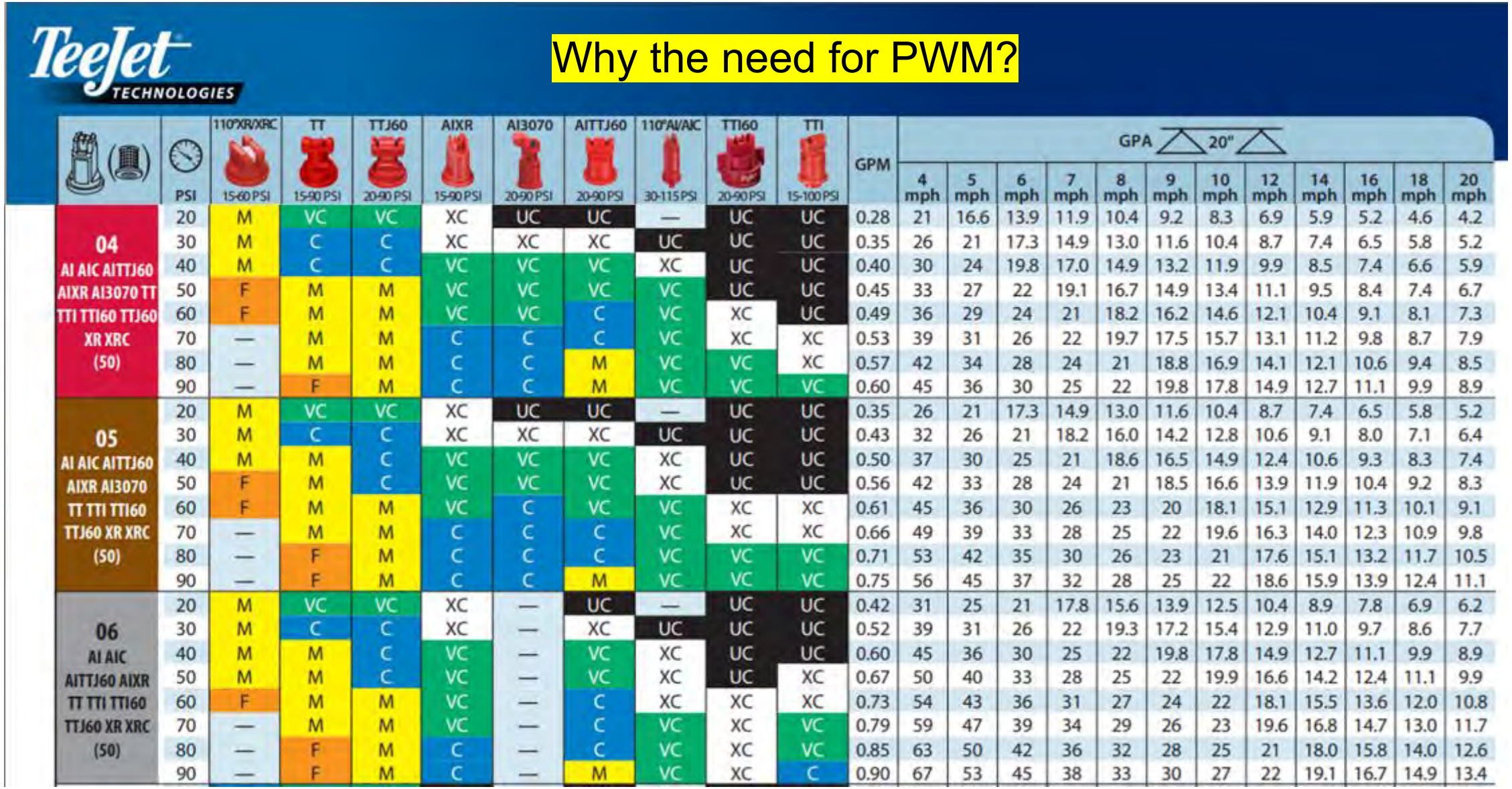


Automatic Section Control

- Reduce over-application by turning sections ON/OFF as needed (5, 7, 9, 11, & 13 sections)

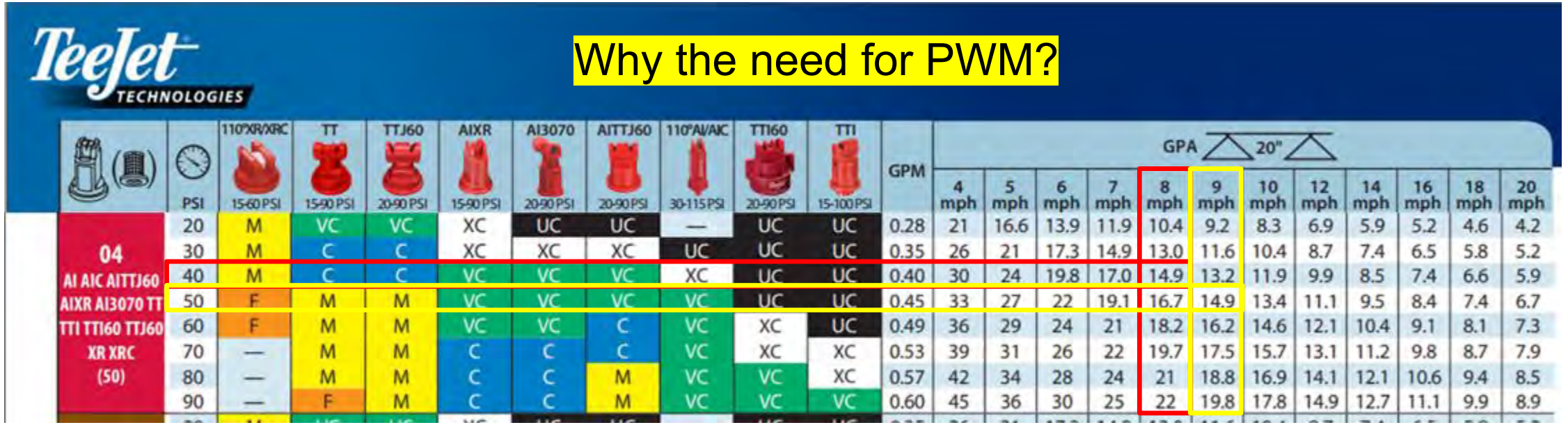
Section valves used for ASC

Pulse-Width Modulation (PWM) Technology



	PSI	110°XR/XRC 15-60 PSI	TT 15-90 PSI	TTJ60 20-90 PSI	AIXR 15-90 PSI	AI3070 20-90 PSI	AITTJ60 20-90 PSI	110°AI/AIC 30-115 PSI	TTI60 20-90 PSI	TTI 15-100 PSI	GPM	GPA 20" 4 mph	5 mph	6 mph	7 mph	8 mph	9 mph	10 mph	12 mph	14 mph	16 mph	18 mph	20 mph
04 AI AIC AITTJ60 AIXR AI3070 TT TTI TTI60 TTJ60 XR XRC (50)	20	M	VC	VC	XC	UC	UC	—	UC	UC	0.28	21	16.6	13.9	11.9	10.4	9.2	8.3	6.9	5.9	5.2	4.6	4.2
	30	M	C	C	XC	XC	XC	UC	UC	UC	0.35	26	21	17.3	14.9	13.0	11.6	10.4	8.7	7.4	6.5	5.8	5.2
	40	M	C	C	VC	VC	VC	XC	UC	UC	0.40	30	24	19.8	17.0	14.9	13.2	11.9	9.9	8.5	7.4	6.6	5.9
	50	F	M	M	VC	VC	VC	VC	UC	UC	0.45	33	27	22	19.1	16.7	14.9	13.4	11.1	9.5	8.4	7.4	6.7
	60	F	M	M	VC	VC	C	VC	XC	UC	0.49	36	29	24	21	18.2	16.2	14.6	12.1	10.4	9.1	8.1	7.3
	70	—	M	M	C	C	C	VC	XC	XC	0.53	39	31	26	22	19.7	17.5	15.7	13.1	11.2	9.8	8.7	7.9
	80	—	M	M	C	C	M	VC	VC	XC	0.57	42	34	28	24	21	18.8	16.9	14.1	12.1	10.6	9.4	8.5
	90	—	F	M	C	C	M	VC	VC	VC	0.60	45	36	30	25	22	19.8	17.8	14.9	12.7	11.1	9.9	8.9
05 AI AIC AITTJ60 AIXR AI3070 TT TTI TTI60 TTJ60 XR XRC (50)	20	M	VC	VC	XC	UC	UC	—	UC	UC	0.35	26	21	17.3	14.9	13.0	11.6	10.4	8.7	7.4	6.5	5.8	5.2
	30	M	C	C	XC	XC	XC	UC	UC	UC	0.43	32	26	21	18.2	16.0	14.2	12.8	10.6	9.1	8.0	7.1	6.4
	40	M	M	C	VC	VC	VC	XC	UC	UC	0.50	37	30	25	21	18.6	16.5	14.9	12.4	10.6	9.3	8.3	7.4
	50	F	M	C	VC	VC	VC	XC	UC	UC	0.56	42	33	28	24	21	18.5	16.6	13.9	11.9	10.4	9.2	8.3
	60	F	M	M	VC	C	VC	VC	XC	XC	0.61	45	36	30	26	23	20	18.1	15.1	12.9	11.3	10.1	9.1
	70	—	M	M	C	C	C	VC	XC	XC	0.66	49	39	33	28	25	22	19.6	16.3	14.0	12.3	10.9	9.8
	80	—	F	M	C	C	C	VC	VC	VC	0.71	53	42	35	30	26	23	21	17.6	15.1	13.2	11.7	10.5
	90	—	F	M	C	C	M	VC	VC	VC	0.75	56	45	37	32	28	25	22	18.6	15.9	13.9	12.4	11.1
06 AI AIC AITTJ60 AIXR TT TTI TTI60 TTJ60 XR XRC (50)	20	M	VC	VC	XC	—	UC	—	UC	UC	0.42	31	25	21	17.8	15.6	13.9	12.5	10.4	8.9	7.8	6.9	6.2
	30	M	C	C	XC	—	XC	UC	UC	UC	0.52	39	31	26	22	19.3	17.2	15.4	12.9	11.0	9.7	8.6	7.7
	40	M	M	C	VC	—	VC	XC	UC	UC	0.60	45	36	30	25	22	19.8	17.8	14.9	12.7	11.1	9.9	8.9
	50	M	M	C	VC	—	VC	XC	UC	XC	0.67	50	40	33	28	25	22	19.9	16.6	14.2	12.4	11.1	9.9
	60	F	M	M	VC	—	C	XC	XC	XC	0.73	54	43	36	31	27	24	22	18.1	15.5	13.6	12.0	10.8
	70	—	M	M	VC	—	C	VC	XC	VC	0.79	59	47	39	34	29	26	23	19.6	16.8	14.7	13.0	11.7
	80	—	F	M	C	—	C	VC	XC	VC	0.85	63	50	42	36	32	28	25	21	18.0	15.8	14.0	12.6
	90	—	F	M	C	—	M	VC	XC	C	0.90	67	53	45	38	33	30	27	22	19.1	16.7	14.9	13.4

Pulse-Width Modulation (PWM) Technology



	PSI	110°XR/XRC 15-60 PSI	TT 15-90 PSI	TTJ60 20-90 PSI	AIXR 15-90 PSI	AI3070 20-90 PSI	AITTJ60 20-90 PSI	110°AI/AIC 30-115 PSI	TTI60 20-90 PSI	TTI 15-100 PSI	GPM	GPA 20" 4 mph	5 mph	6 mph	7 mph	8 mph	9 mph	10 mph	12 mph	14 mph	16 mph	18 mph	20 mph
04 AI AIC AITTJ60 AIXR AI3070 TT TTI TTI60 TTJ60 XR XRC (50)	20	M	VC	VC	XC	UC	UC	—	UC	UC	0.28	21	16.6	13.9	11.9	10.4	9.2	8.3	6.9	5.9	5.2	4.6	4.2
	30	M	C	C	XC	XC	XC	UC	UC	UC	0.35	26	21	17.3	14.9	13.0	11.6	10.4	8.7	7.4	6.5	5.8	5.2
	40	M	C	C	VC	VC	VC	XC	UC	UC	0.40	30	24	19.8	17.0	14.9	13.2	11.9	9.9	8.5	7.4	6.6	5.9
	50	F	M	M	VC	VC	VC	VC	UC	UC	0.45	33	27	22	19.1	16.7	14.9	13.4	11.1	9.5	8.4	7.4	6.7
	60	F	M	M	VC	VC	C	VC	XC	UC	0.49	36	29	24	21	18.2	16.2	14.6	12.1	10.4	9.1	8.1	7.3
	70	—	M	M	C	C	C	VC	XC	XC	0.53	39	31	26	22	19.7	17.5	15.7	13.1	11.2	9.8	8.7	7.9
	80	—	M	M	C	C	M	VC	VC	XC	0.57	42	34	28	24	21	18.8	16.9	14.1	12.1	10.6	9.4	8.5
	90	—	F	M	C	C	M	VC	VC	VC	0.60	45	36	30	25	22	19.8	17.8	14.9	12.7	11.1	9.9	8.9

Rate Controller – Adjusts spray pressure to maintain target application rate with changes in ground speed

- Changes in spray pressure affects spray pattern and quality (droplet size)
- Can application rate be maintained without changing spray pressure?

Pulse-Width Modulation (PWM) Technology

- Constant spray pressure across the boom
- Flow (rate) changes are accomplished by varying duty cycle

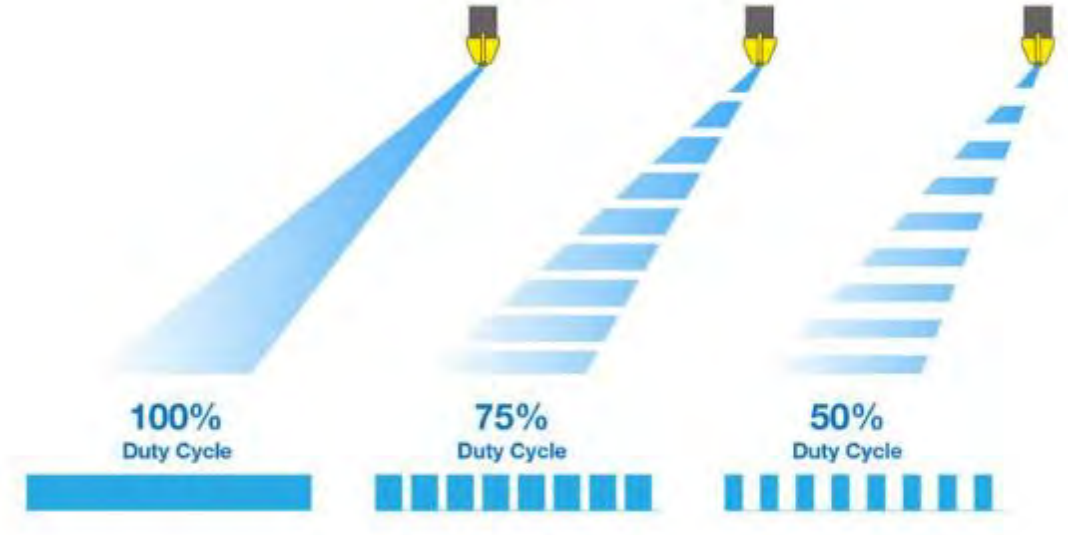


Image source: Dultmeier.com


10 GPA - 50 PSI


15 GPA - 50 PSI

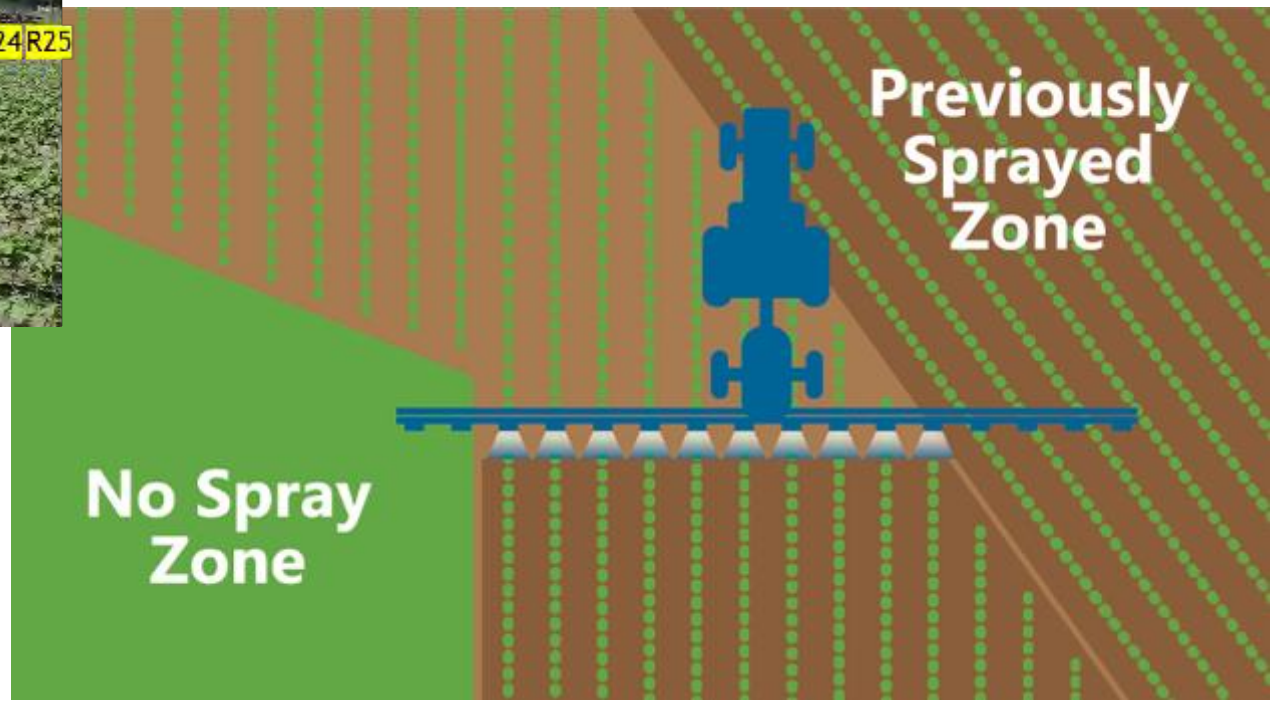
Pulse-Width Modulation (PWM) Technology

Benefits:

- Higher application accuracy across wide range of ground speeds.
- Improved drift control [constant pressure (droplet size) across varying rates and speeds]
- Individual nozzle control and turn compensation control

Individual Nozzle Control

- Individual nozzles can turn ON/OFF as they come out of spray and non-spray/already sprayed areas.



- Reduction in over-application and application in environmentally sensitive areas.

Image source: Raven Industries

Turn Compensation

- Nozzle output compensates for speed changes across the boom during a turn (consistent application rate across the boom in a turn)

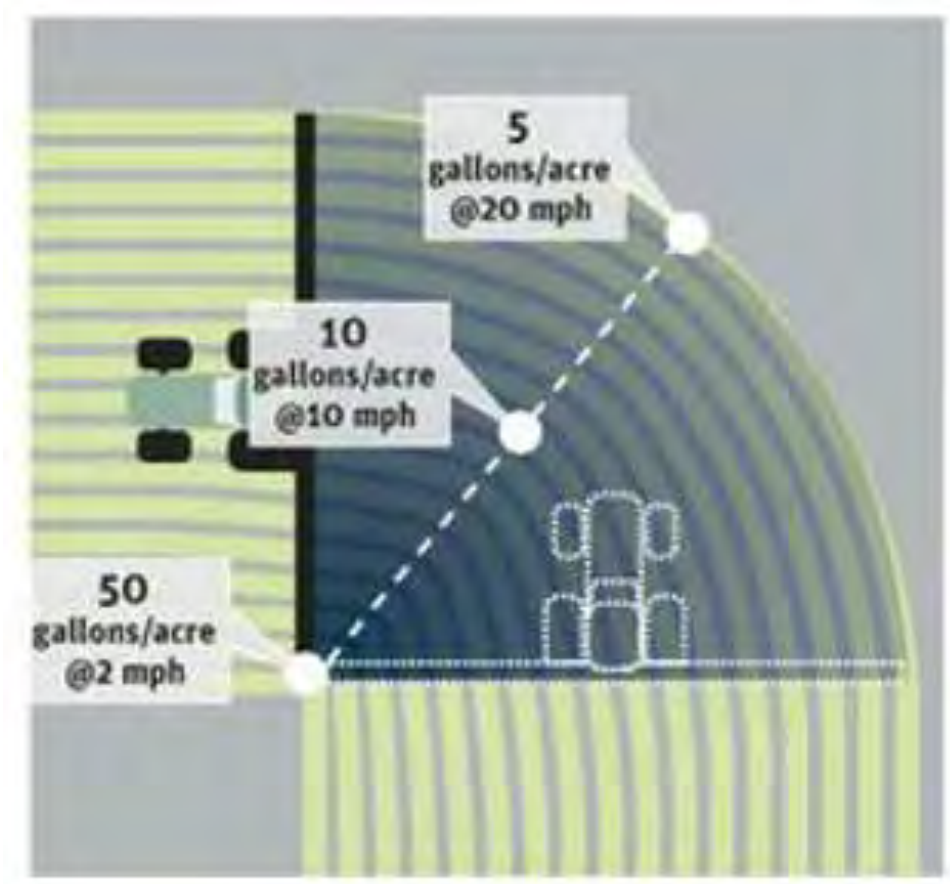
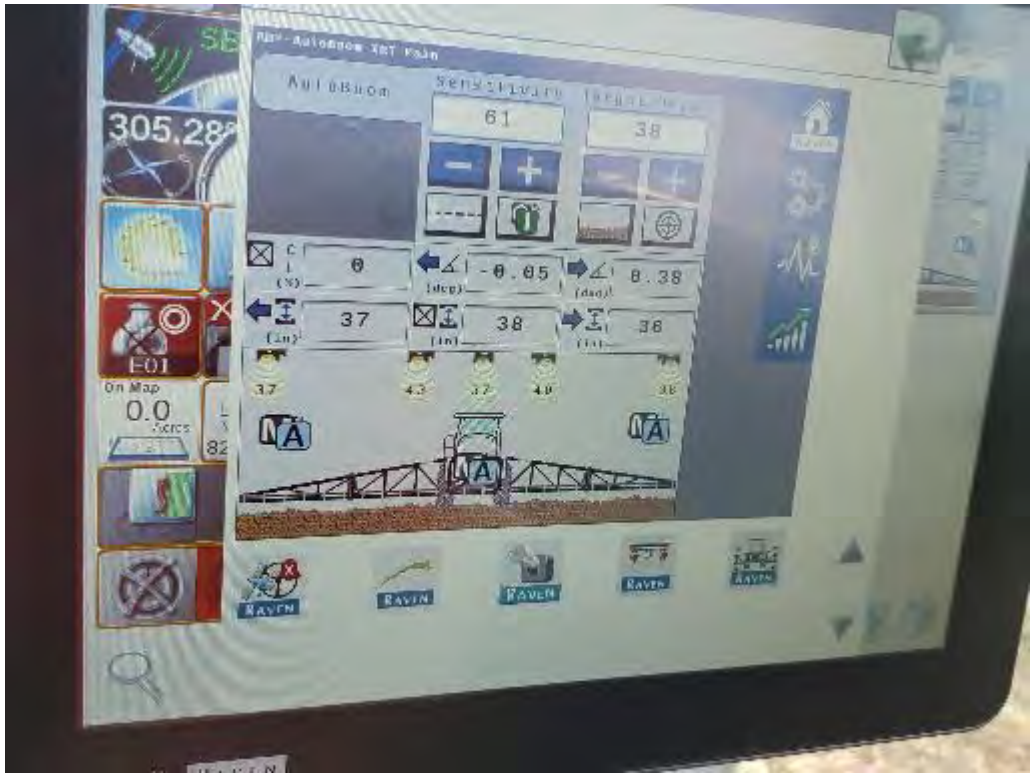


Image source: www.Dultmeier.com

Auto-Boom Height Control



- Minimizes variability in boom height across the field (reduces overapplication & drift)

Site-Specific Pesticide Application Technology

See & Spray Select: Broadcast and targeted spray on fallow ground (green-on-brown)

See & Spray Ultimate: Targeted spray in the crop (corn, soybean and cotton; green-on-green)

Image source: John Deere

Thanks!

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