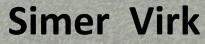
Spray Considerations and Technologies for Precision Pesticide Applications



Assistant Professor &

Extension Precision Ag Specialist University of Georgia XTENSION



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

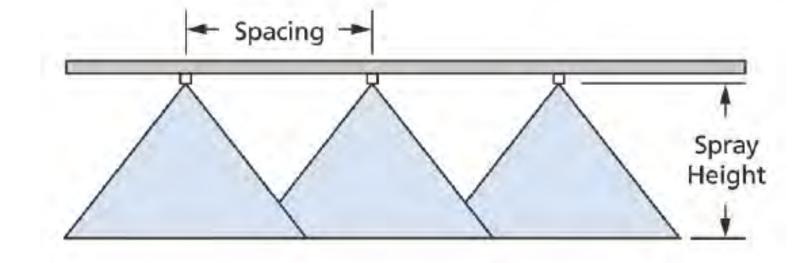
- Rate Controller
- PWM Systems
- Auto-boom Height Systems



Tapered Flat-Fan Spray Pattern

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

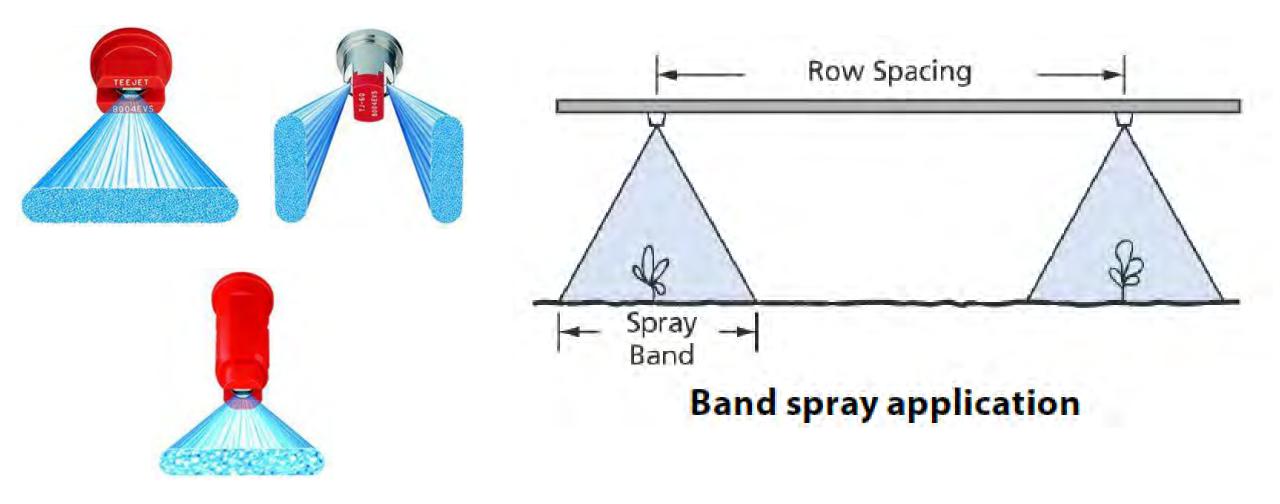




Overlap broadcast pattern



Even Flat Spray Pattern





Cone Spray Pattern

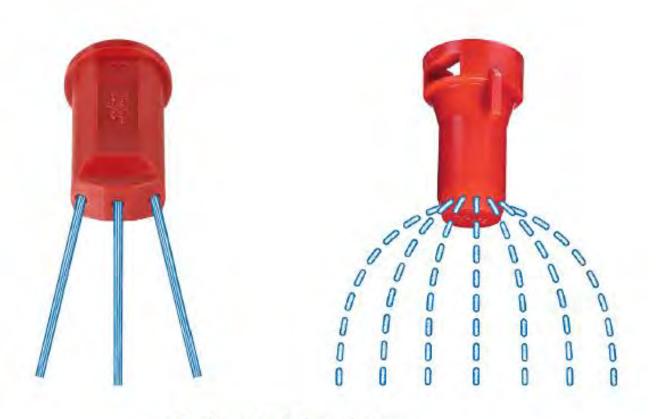


FIGURE 5: Hollow Cone Spray Pattern FIGURE 6: Air Induction Hollow Cone Spray Pattern

FIGURE 7: Full Cone Spray Pattern



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)

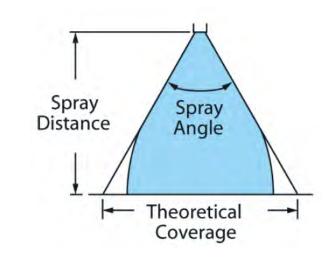
		Flow Rate
Tip Size	Colour	US gpm @ 40 psi
01	Orange	0.10
015	Green	0.15
02	Yellow	0.20
025	Lilac	0.25
03	Blue	0.30
035	Brown Red	0.35
04	Red	0.40
05	Brown	0.50
06	Gray	0.60
08	White	0.80

Nozzle Size

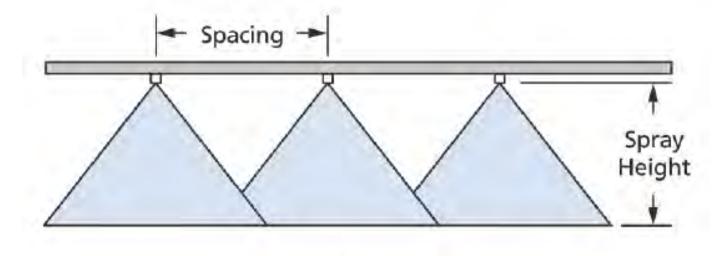




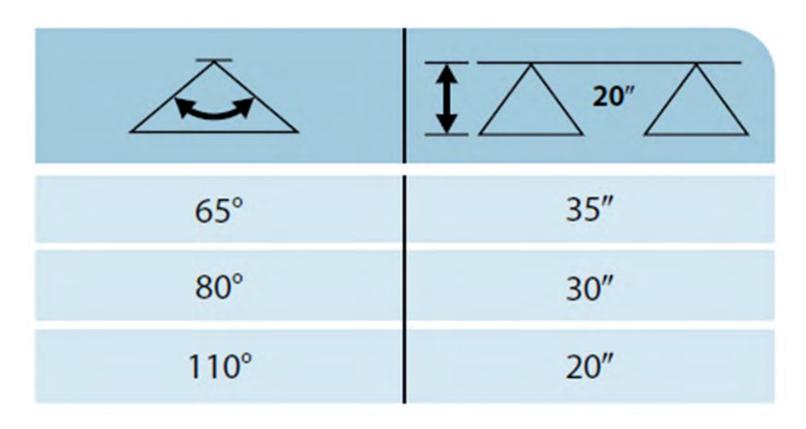
Spray Angle



- 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



- 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

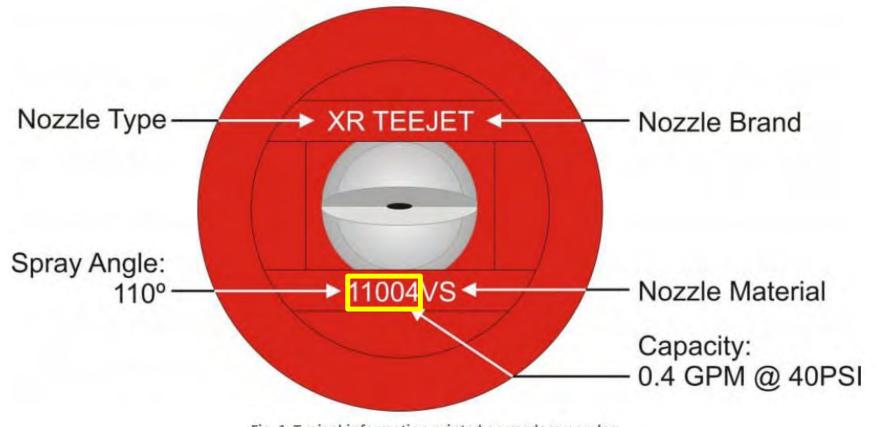
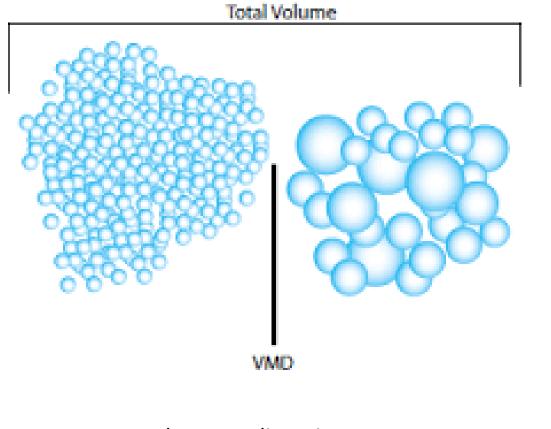


Fig. 1: Typical information printed on modern nozzles.

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; $1\mu = 0.001mm$)



Volume	Median	Diameter
--------	--------	----------

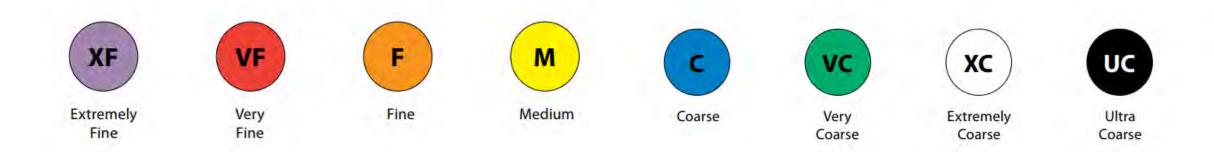
Degree of Atomization	Droplet Size (Microns)	Relative Size Related to Common Objects
Fog	Up to 25	Point of a Needle (25 Microns)
Fine Mist	20-100	Human Hair (100 Microns)
Fine Drizzle	100-250	Sewing Thread (150 Microns)
Heavy Drizzle	250-500	Toothbrush Bristle (300 Microns)
Light Rain	500-800	Staple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

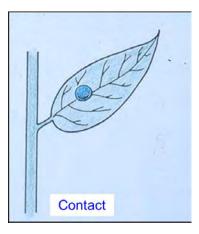
Droplet Size Classification

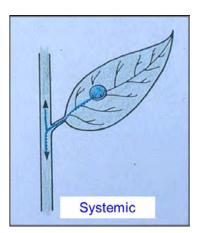
Category	Symbol	Approximate VMD ² (Microns)	
Extremely Fine	XF	~60	XF .
Very Fine	VF	61-105	VF 😐
Fine	F	106-235	F 😐
Medium	М	236-340	м 🔵
Coarse	С	341-403	c 🔵
Very Coarse	VC	404-502	vc 🔵
Extremely Coarse	XC	503-665	хс 🔾
Ultra Coarse	UC	>665	UC

 ^{2}VMD = Volume median diameter.

(ASABE Standard S572.3)







- 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)

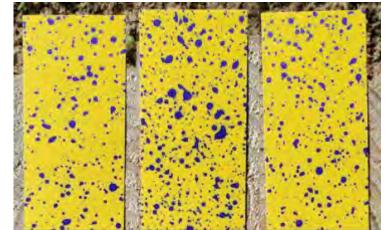


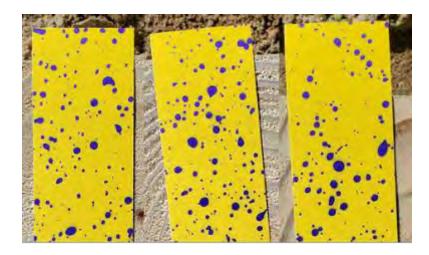
Ultra Coarse Droplet Nozzles

Turbo TeeJet Induction (TTI)



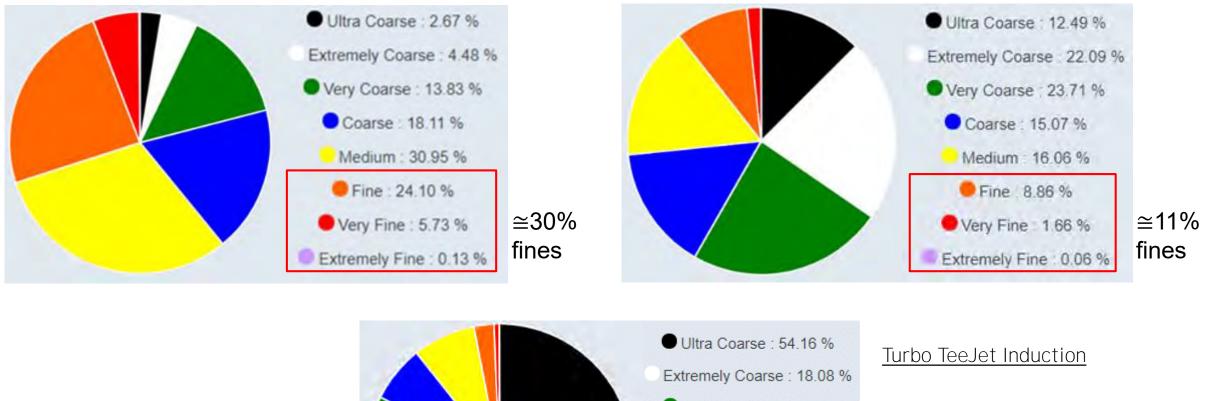






Standard Flat-fan (XR)







Example Nozzle Selection Chart

	(Pro)	1	110°XR/XRC	Π	TTJ60	AIXR	AI3070	AITTJ60	110°AI/AIC	TT160	П					
		PSI	15-60 PSI	15-90 PSI	20-90 PSI	15-90 PSI	20-90 PSI	20-90 PSI	30-115 PSI	20-90 PSI	15-100 PSI	GPM	4 mph	5 mph	6 mph	7 mph
- [20	F	С	-	VC	VC	-	- 1	-	UC	0.11	8.2	6.5	5.4	4.7
		30	F	С	-	C	С	-	UC	-	UC	0.13	9.7	7.7	6.4	5.5
	015	40	F	М		С	М	-	XC	-	UC	0.15	11.1	8.9	7.4	6.4
	AI AIC AIXR	50	F	М	-	М	М	-	VC	-	UC	0.17	12.6	10.1	8.4	7.2
	AI3070 TT TTI	60	F	М	-	М	М	-	VC	-	XC	0.18	13.4	10.7	8.9	7.6
	XR XRC	70	-	M	-	М	м	-	VC	_	XC	0.20	14.9	11.9	9.9	8.5
	(100)	80	-	F	-	М	F	-	VC	-	VC	0.21	15.6	12.5	10.4	8.9
		90	_	F	-	м	F	-	С	-	VC	0.23	17.1	13.7	11.4	9.8
	02	20	F	VC	C	VC	XC	XC	-	UC	UC	0.14	10.4	8.3	6.9	5.9
	AI AIC AIXR	30	F	C	С	VC	VC	VC	UC	UC	UC	0.17	12.6	10.1	8.4	7.2
	TT TTI TTI60	40	F	М	М	С	С	С	XC	XC	UC	0.20	14.9	11.9	9.9	8.5
	XR XRC	50	F	М	М	С	М	С	XC	XC	UC	0.22	16.3	13.1	10.9	9.3
	(50)	60	F	М	М	М	М	С	VC	VC	XC	0.24	17.8	14.3	11.9	10.2
	AI3070 AITTJ60	70		М	М	М	M	М	VC	VC	XC	0.26	19.3	15.4	12.9	11.0
	TTJ60	80	-	F	М	М	М	М	VC	VC	VC	0.28	21	16.6	13.9	11.9
	(100)	90		F	M	М	F	M	VC	VC	VC	0.30	22	17.8	14.9	12.7
	025	20	М	VC	VC	XC	XC	XC	_	UC	UC	0.18	13.4	10.7	8.9	7.6
	AI AIC AIXR	30	F	С	C	VC	VC	VC	UC	UC	UC	0.22	16.3	13.1	10.9	9.3
	TT TTI TTI60	40	F	М	C	VC	C	VC	XC	XC	UC	0.25	18.6	14.9	12.4	10.6
	XR XRC	50	F	М	М	C	C	C	XC	XC	UC	0.28	21	16.6	13.9	11.9
	(50)	60	F	М	М	C	М	C	XC	VC	UC	0.31	23	18.4	15.3	13.2
	AI3070 AITTJ60	70	-	M	M	C	М	М	VC	VC	XC	0.33	25	19.6	16.3	14.0
	TTJ60	80	-	F	M	C	M	M	VC	VC	XC	0.35	26	21	17.3	14.9
	(100)	90	-	F	M	M	M	M	VC	VC	VC	0.38	28	23	18.8	16.1
	03	20	M	VC	VC	XC	UC	UC	110	UC	UC	0.21	15.6	12.5	10.4	8.9
	AI AIC AIXR	30	F	VC	C	VC	VC	XC	UC	UC	UC	0.26	19.3	15.4	12.9	11.0
	AITTJ60 AI3070	40	F	C	C	VC	VC	VC	XC	UC	UC	0.30	22	17.8	14.9	12.7
	TT TTI TTI60	50	F	M	M	C	C	VC	XC	UC	UC	0.34	25	20	16.8	14.4
	XR XRC	60	F	M	M	C C	c c	C	VC	XC	UC	0.37	27	22	18.3	15.7
	(50)	70		M	M	C C	-	C	VC	XC	XC	0.40	30	24	19.8	17.0
	TTJ60 (100)	80	-	M	M		M M	C	VC VC	VC VC	XC	0.42	31	25	21	17.8
	(100)	90	-	F	М	М	IVI	M	VC	VC	XC	0.45	33	27	22	19.1

Nozzle Selection

What information do we need to select a nozzle?

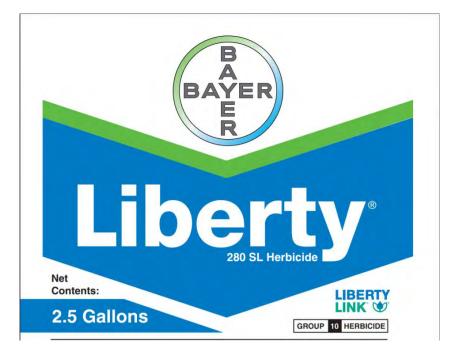
- Pesticide
- Mode of Action
- Application Rate
- Tolerance to Drift
- Ground Speed Range
- Operating Pressure Range
- Nozzle Spacing



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

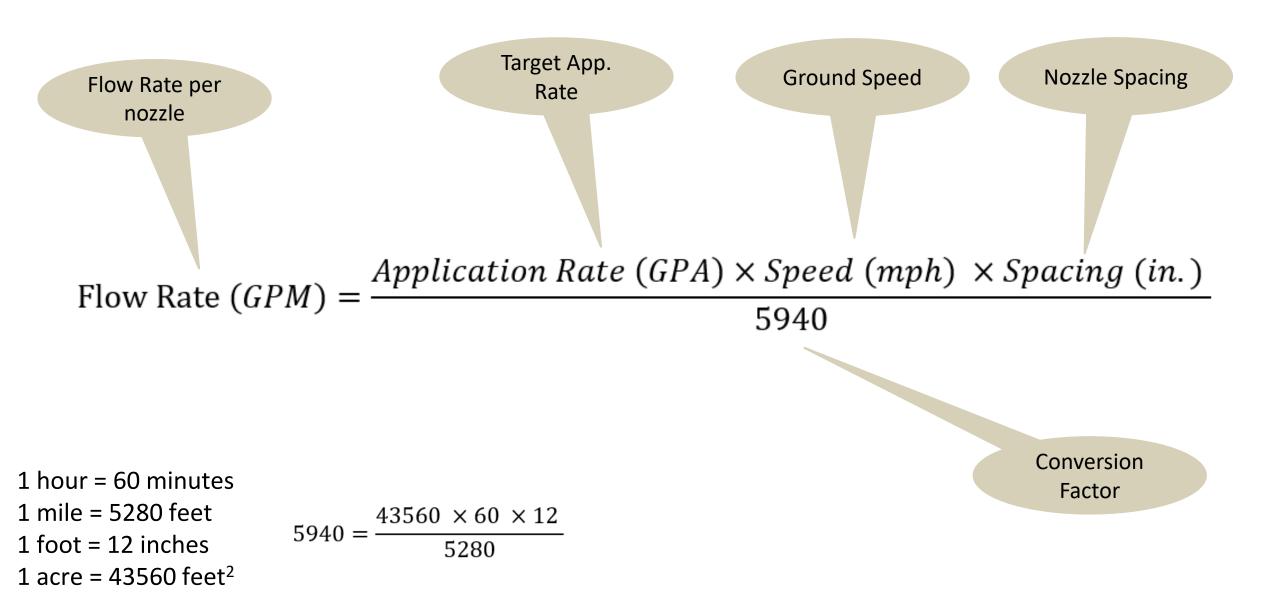
Nozzle Spacing = 20 inches

LL L									100							GP.	$A \sum$	20*	Δ					
) (S PSI	560 PS	5-90 PSI	20-90 PS	15-90 FS	20-90 PS	20-90 75	30-115 PS	20-90 P3	15-100 PS	GPIN	4 mph	S mph	6 mph	7 mph	8 mph	9 mph						20 mph	
	20	F	C C	-	VC C	VC	-	-	-	UC	0.11		6.5 7.7	5.4	4.7	4.1	3.6 4.3	3.3	2.7	2.3	2.0	1.B	1.6	
015	30 40	F	M	Ξ		C M	-	UC XC	Ξ	UC UC	0.13	9.7 11.1	8.9	6.4 7.4	5.5 6.4	4.8 5.6	4.5	3.9 4.5	3.2 3.7	2.8 3.2	2.8	2.5	22	
AI AICAI AI3070 TT	50	E	М	-	М	М	-	VC	-	UC	0.17	12.6	10.1	8.4	7.2	6.3	5.6	5.0	4.2	3.6	3.2	2.8	2.5	
XR XRC	60 70	F	M M	Ξ	M M	M M	Ξ	∀C VC	-	XC	0.18	13.4 14.9	10.7 11.9	8.9 9.9	7.6 8.5	6.7 7.4	5.9 6.6	5.3 5.9	4.5 5.0	3.8 4.2	3.3 3.7	3.0	2.7	
(100)	80 90	-	F	-	M	F	-	WC C	-	VC VC	0.21	15.6 17.1	125 13.7	10.4	8.9 9.8	7.8	6.9 7.6	6.2 6.8	5.2 5.7	4.5 4.9	3.9 4.3	3.5 3.8	3.1 3.4	
02	20	F	VC	C	VC	XC	XC	-	UC	UC	0.14		8.3	6.9	5.9	5.2	4.6	4.2	3.5	3.0	2.6	2.3	2.1	
AI AICAD		F	C M	.с М	VC C	WC C	WE C	UC	UC XC	UC	0.17	12.6 14.9	10.1	8.4 9.9	7.2	6.3 7.4	5.6 6.6	5.0 5.9	4.2	3.6	3.2	2.8	2.5	
TT TTI TTI XR XRC	50	F	M	M	č	M	č	XC	XC	UC	0.22	16.3	13.1	10.9	9.3	8.2	7.3	6.5	5.4	4.7	4.1	3.6	3.3	
(50) Al3070 AlTT	60 160 70	F	M	M	M M	M M	-C M	VC VC	VC VC	XC XC	0.24	17.8 19.3	14.3 15.4	11.9 12.9		8.9 9.7	7.9 8.6	7.1 7.7	5.9 6.4	5.1 5.5	4.5 4.8	4.0 4.3	3.6	
TTJ60	80		F	м	м	M	м	VC	VC	VC.	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	
(100)	90 20	 M	F VC	M VC	M XC	FXC	M XC	VC	VC UC	UC	0.30	13.4	17.8	14.9 8.9	12.7	11.1 6.7	9.9 5.9	8.9 5.3	7.4	6.4 3.8	5.6 3.3	5.0	4.5	
ALAICAD		F	C	c	МС	VC	MC	UC	UC	UC	0.22	16.3	13.1	10.9	9.3	8.2	7.3	6.5	5.4	4.7	4.1	3.6	3.3	
TT TTI TTI		F	M M	C M	VC C	C C	WC C	XC XC	XC XC	UC UC	0.25	18.6 21	14.9 16.6	12.4 13.9	10.6 11.9	9.3 10.4	8.3 9.2	7.4 8.3	6.2 6.9	5.3 5.9	4.6 5.2	4.1	3.7 4.2	
150)	60	F	M	M		М	C	XC	VC	UC	0.31	23	18.4	15.3	13.2	11.5	10.2	9.2	7.7	6.6	5.8	5.1	4.6	
A13070 AITT TTJ60	160 70 80	=	M	M M	c c	M M	M M	VC VC	VC VC	XC XC	0.33	25 26	19.6 21	16.3 17.3	14.0 14.9	12.3 13.0	10.9 11.6	9.8 10.4	8.2 8.7	7.0	6.1 6.5	5.4 5.8	4.9	
(100)	90	=	F	M	M	M	M	VC	VC	VC	0.38	28	23	18.8	16,1	14.1	12.5	11.3	9.4	8.1	7.1	6.3	5.6	
03	20	M	VC VC	VC C	XC VC	UC VC	UC XC	UC	UC	UC	0.21	15.6 19.3	12.5 15.4	10.4 12.9	8.9 11.0	7.8	6.9 8.6	6.2 7.7	5.2 6.4	4.5	3.9 4.8	3.5 4.3	3.1 3.9	
ALAICAD AITTJ60 AI3	70 40	F	C	C	VÆ	WC1	WC	XC	UC	UC	0.30	22	17.8	14.9	12.7	11.1	9.9	8.9	7.4	6.4	5.6	5.0	4.5	
TT TTI TTI XR XRC	0 50 60	F	M M	M	C C	C C	VC I	XC VC	UC XC	UC UC	0.34	25 27	20 22	16.8 18.3		12.6	11.2	10.1	8,4 9,2	7.2	6.3 6.9	5.6 6.1	5.0 5.5	
(50)	70	-	м	М		C	С	VC	XC	XC	0.40	30	24	19.8	17.0	14.9	13.2	11.9	9.9	8.5	7.4	6.6	5.9	
TTJ60 (100)	80 90	1 =	M	M	C M	M	C M	WC. WC	VC VC	XC XC	0.42	31 33	25 27	21	17.8 19.1	15.6 16.7	13.9 14.9	12.5	10.4	8.9 9.5	7.8	6.9 7.4	6.2 6.7	
11001	20	М	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	
04	30 60 40	M	C C	с с	XC V/C	XC	XC	UC XC	UC	UC	0.35	26 30	21 24	17.3 19.8	14.9	13.0 14.9	11.6 13.2	10.4 11.9	8.7 9.9	7.4	6.5 7.4	5.8	5.2	
ALAICAITT AIXR AI307	1 50	F	M	М	٧Ċ	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	
TTI TTI60 TT XR Xrc	160 60 70	F	M	M M		VC C	C C	VC VC	XC XC	UC XC	0.49	36 39	29 31	24 26	21 22	18.2	16.2 17.5	14.6 15.7	12.1	10.4	9.1 9.8	8.1 8.7	7.3	
(50)	80	-	М	М		C	М	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 20	M	F VC	M VC	C XC	C UC	M UC	WE	VC UC	UC	0.60	45 26	36	30 17.3	25	13.0	19.8 11.6	17.8	14.9 8.7	12.7	11.1 6.5	9.9 5.8	8.9	
05	30	M	C	C	XC	XC	XC	UC	ÜC	UC	0.43	32	26	21	18.2	16.0	14.2	12.8	10.6	9.1	8.0	7.1	6.4	
ALAICAITT AIXR AI30		M F	M M	C C	VC VC	WC WC	VC VC	XC	UC	UC UC	0.50	37 42	30 33	25 28	21 24	18.6 21	16.5 18.5	14.9 16.6	12.4	10.6 11.9	9.3 10.4	8.3 9.2	7.4 8.3	
ππιπι	0 60	F	м	M	VC	æ	WC	VC	XC	XC	0.61	45	36	30	26	23	20	18.1	15.1	12.9	11.3	10.1	9.1	
TTJ 60 XR X (50)	RE 70 80	1	M F	M M	C C	c c	C C	VC VC	XC VC	XC VC	0.66	49 53	39 42	33 35	28 30	25 26	22 23	19.6 21	16.3	14.0 15.1	12.3	10.9 11.7	9.8 10.5	
a second	90	-	F	M	¢	e	М	VE	VC	VC	0.75	56	45	37	32	28	25	22	18.6	15.9	13,9	12.4	11.1	
06	20 30	M	VC C	VC C	XC	3	UC XC	UC	UC UC	UC UC	0.42	31 39	25 31	21 26	17.8 22	15.6 19.3	13.9 17.2	12.5 15.4	10.4	8.9 11.0	7.8 9.7	6.9 8.6	6.2 7.7	
ALAIC	40	М	М	Ç	VC	-	WE	XC	UC	UC	0.60	45	36	30	25	22	19.8	17.8	14.9	12.7	11.1	9.9	8.9	
ATTI60 AL	10 C C C C C C C C C C C C C C C C C C C	M F	M M	C M	VC VC	11	VC C	XC XC	UC XC	XC XC	0.67	50 54	40 43	33 36	28 31	25 27	22 24	19.9 22	16.6 18.1	14.2	12.4 13.6		9.9 10.8	
TIJ60 KR H	RC 70	-	M	М	VC C	1		VC VC	XC	VC VC	0.79	59	47	39	34	29	26	23	19.6	16.8	14.7	13.0	11.7	
(50)	80 90	12	F	M M	C	-	M	WL. WE	XC	e	0.85	63 67	50 53	42 45	36 38	32 33	28 30	25 27	21 22	19.1	15.8 16.7	14.9	12.6 13.4	
08	20 30	C c	VC C	VC VC	UC XC	-	UCUC	UC	UC UC	UC UC	0.57	42	34 41	28 34	24 29	21 26	18.8 23	16.9 20	14.1 17.1	12.1 14.6	10.6 12.8	9.4 11.4	8.5 10.2	
AI AIC	40	M	M	C	XC	3	XC	UC	UC	UC	0.80	59	48	40	34	30	26	24	19.8	17.0	14.9	13.2	11.9	
AITTI TTI		M M	M M	C C	VC VC	-	XC	XC	UC	UC	0.89	66 73	53 58	44 49	38 42	33 36	29 32	26 29	22 24	18.9 21	16.5 18.2	14.7 16.2	13.2	
TIJ60 XR H	RC 70	-	F	c	₩C.	-		VC	UC	UC	1.06	79	63	52	45	39	35	31	26	22	22 19.7 17.5 15.7			
(50)	80 90	=	F	M M	C C		VC C	VC VC	UC XC	XC XC	1.13	84 89	67 71	56 59	48 51	42 45	37 40	34 36	28 30	24 25	21 22	18.6 19.8	16.8 17.8	
	20	e	XC	XC	UC	-	UC	-	-	UC	0.71	53	42	35	30	26	23	21	18	15	13	12	11	
10	30 40	M	VC VC	VC VC	UC XC	1	UC		Ξ	UC UC	0.87 1.00	65 74	52 59	43 50	37 42	32 37	29 33	26 30	22 25	18 21	16 19	14 17	13 15	
AITTJ60 TT (50)	⁶⁰ 50	M	c c	VE C	XC	-	XC	UC	-	UC	1.12	83	67	55	48	42	37	33	28	24	21	18	17	
AIC ADER TT	70	M —	C	C	VC VC	1	XC XC	XC XC	-	UC	1.22	98	72 78	60 65	52 56	45 49	40 44	36 39	30 33	26 28	23 25	20 22	18 20	
HR MRC	80 90	-	C M	c c	VC VC	-	XC	WC VC	-	XC XC	1.41 1.50		84 89	70 74	60 64	52 56	47 50	42 45	35 37	30 32	26 28	23 25	21	
	50	-				-					1.00			1-	. 97				-					
•			0	0	0			0			1	$\overline{\bigcirc}$		1	1	20"	\wedge				7	0	G	



	0	110%R/XRC	-	TTJ60	AIXR	AI3070	AITTJ60	110°AI/AK	TT160	П	CDM					GP	$A \ge$	20"									
	PSI	15-60 PSI	15-90 PSI	20-90 PSI	15-90 PSI	20-90 PSI	20-90 PSI	30-115 PSI	20-90 PSI	15-100 PSI	GPM	4 mph	5 mph			8 mph	9 mph	10 mph	12 mph	14 mph	16 mph	18 mph	20 mph				
1000	20	М	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				
04	30	М	C	С	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				
AI AIC AITTJ60	40	M	С	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				
AIXR AI3070 TT		F	М	М	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				
TTI TTI60 TTJ60	60	F	М	м	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				
XR XRC	70	-	м	М	С	C	С	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				
(50)	80	-	М	М	С	С	М	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	М	C	C	М	VC	VC	VC	0.60	45	36	30	25	22	19.8	17.8	14.9	12.7	11.1	9.9	8.9				
10000	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				
05	30	М	С	С	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				
AI AIC AITTJ60	40	М	М	С	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				
AIXR AI3070	50	F	М	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				
TT TTI TTI60	60	F	М	М	VC	С	VC	VC	XC	XC	0.61	45	36	30	26	23	20	18.1	15.1	12.9	11.3	10.1	9.1				
TTJ60 XR XRC	70	-	М	М	C	С	C	VC	XC	XC	0.66	49	39	33	28	25	22	19.6	16.3	14.0	12.3	10.9	9.8				
(50)	80	-	F	М	С	С	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	М	С	С	М	VC	VC	VC	0.75	56	45	37	32	28	25	22	18.6	15.9	13.9	12.4	11.1				
	20	М	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				
06	30	М	С	С	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				
AI AIC	40	М	М	С	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				
AITTJ60 AIXR	50	М	М	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				
TT TTI TTI60	60	F	М	М	VC	-	С	XC	XC	XC	0.73	54	43	36	31	27	24	22	18.1	15.5	13.6	12.0	10.8				
TTJ60 XR XRC	70	-	М	м	VC	-	С	VC	XC	VC	0.79	59	47	39	34	29	26	23	19.6	16.8	14.7	13.0	11.7				
(50)	80	-	F	М	C	-	С	VC	XC	VC	0.85	63	50	42	36						14.0	12.6					
	90	-	F	М	С	-	М	VC	XC	C	0.90	67	53	45	38	33	30	27	22	19.1	16.7	14.9	13.4				

Sprayer Calibration







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	Nozzle Spacing (in)	Distance (ft)
$1/128 \text{ acre} = 340 \text{ ft}^2$	12	340
1/120 acre = 540 rt	14	292
	16	255
4080	18	227
Distance to travel = $\frac{1000}{Nozzle Spacing (inches)}$	20	204
Nozzie Spacing (menes)	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

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

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



Answer = 20.5 GPA



	0	1109XR/XRC	П	TTJ60	AIXR	AI3070	AITTJ60	110°AI/AIC	TTI60							GP		20"	$ \ge $
	PSI	15-60 PSI	15-90 PSI	20-90 PSI	15-90 PSI	20-90 PSI	20-90 PSI	30-115 PSI	20-90 PSI	15-100 PSI	GPM	4 mph	5 mph	6 mph	7 mph	8 mph	9 mph	10 mph	12 mph
	20	М	VC	VC	XC	UC	UC	-	UC	UC	0.28	21	16.6	13.9	11.9	10.4	9.2	8.3	6.9
04	30	М	С	С	XC	XC	XC	UC	UC	UC	0.35	26	21	17.3	14.9	13.0	11.6	10.4	8.7
AI AIC AITTJ60	40	М	C	С	VC	VC	VC	XC	UC	UC	0.40	30	24	19.8	17.0	14.9	13.2	11.9	9.9
AIXR AI3070 TT	50	F	М	М	VC	VC	VC	VC	UC	UC	0.45	33	27	22	19.1	16.7	14.9	13.4	11.1
TTI TTI60 TTJ60	60	F	М	М	VC	VC	C	VC	XC	UC	0.49	36	29	24	21	18.2	16.2	14.6	12.1
XR XRC	70	-	М	М	C	С	С	VC	XC	XC	0.53	39	31	26	22	19.7	17.5	15.7	13.1
(50)	80	-	М	М	С	С	М	VC	VC	XC	0.57	42	34	28	24	21	18.8	16.9	14.1
100 B (100 B)	90	-	F	М	С	C	М	VC	VC	VC	0.60	45	36	30	25	22	19.8	17.8	14.9
The second state	20	М	VC	VC	XC	UC	UC		UC	UC	0.35	26	21	17.3	14.9	13.0	11.6	10.4	8.7
05	30	М	С	С	XC	XC	XC	UC	UC	UC	0.43	32	26	21	18.2	16.0	14.2	12.8	10.6
AI AIC AITTJ60	40	М	М	С	VC	VC	VC	XC	UC	UC	0.50	37	30	25	21	18.6	16.5	14.9	12.4
AIXR AI3070	50	F	М	С	VC	VC	VC	XC	UC	UC	0.56	42	33	28	24	21	18.5	16.6	13.9
TT TTI TTI60	60	F	М	М	VC	C	VC	VC	XC	XC	0.61	45	36	30	26	23	20	18.1	15.1
TTJ60 XR XRC	70	-	М	М	С	С	C	VC	XC	XC	0.66	49	39	33	28	25	22	19.6	16.3
(50)	80	-	F	М	C	С	С	VC	VC	VC	0.71	53	42	35	30	26	23	21	17.6
	90	-	F	M	C	C	М	VC	VC	VC	0.75	56	45	37	32	28	25	22	18.6
1	20	М	VC	VC	XC	-	UC	-	UC	UC	0.42	31	25	21	17.8	15.6	13.9	12.5	10.4
06	30	М	С	С	XC	-	XC	UC	UC	UC	0.52	52 39 31 26 22 19.3 17.2 15.4						12.9	
ALAIC	40	М	М	C	VC	-	VC	XC	UC	UC	0.60							14.9	
AITTJ60 AIXR	50	М	М	С	VC	-	VC	XC	UC	XC	0.67							16.6	
TT TTI TTI60	60	F	М	М	VC	-	С	XC	XC	XC	0.73							18.1	
TTJ60 XR XRC	70	-	М	М	VC	-	C	VC	XC	VC	0.79							19.6	
(50)	80	-	F	М	С	-	С	VC	XC	VC	0.85	5 63 50 42 36 32 28 25 2						21	
	90	-	F	М	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-calibratormodel-sc-1/

Using SpotOn[®] Digital Meter for Boom Sprayer Calibration

Simerjeet Virk and Eric Prostko Department of Crop & Soil Sciences, The University of Georgia

EXTENSION

The SpotOn® Sprayer Calibrator is a digital flow meter produced by Innoquest Inc. as a tool for verifying nozzle output (desired flow rate is measured in gallons per minute; gpm) and calibrating a sprayer quickly and easily. The SpotOn® meter has three electrodes prepositioned inside the tube that sense the rising water level and provide a flow rate by measuring the time it takes to fill the meter's tube. The meter works only with fluids that conduct electricity, such as water. The procedure outlined here is for using a SpotOn® meter (model SC-1; Figure 1) for calibrating a boom sprayer.

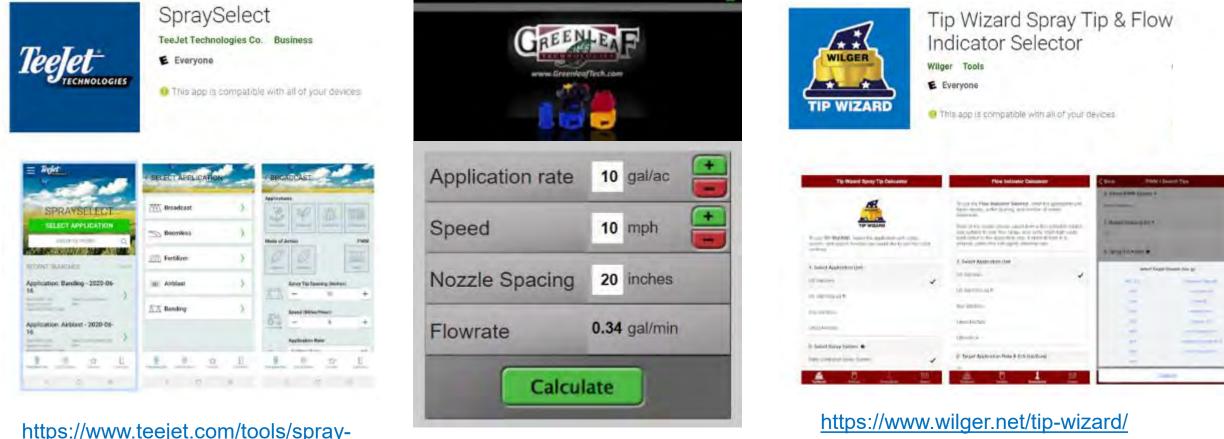


Figure 1. The SC-1 model of the SpotOn® Sprayer Calibrator.

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

Useful Resources & Applications

Nozzle Selection and Sprayer Calibration Apps



https://www.teejet.com/tools/spraynozzle_selection.aspx

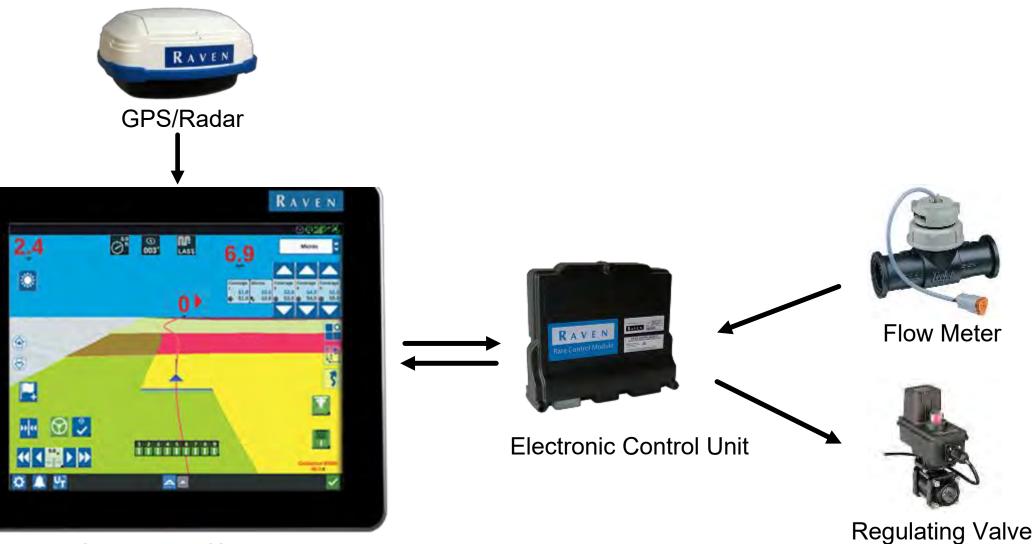
Basic Application Technology

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

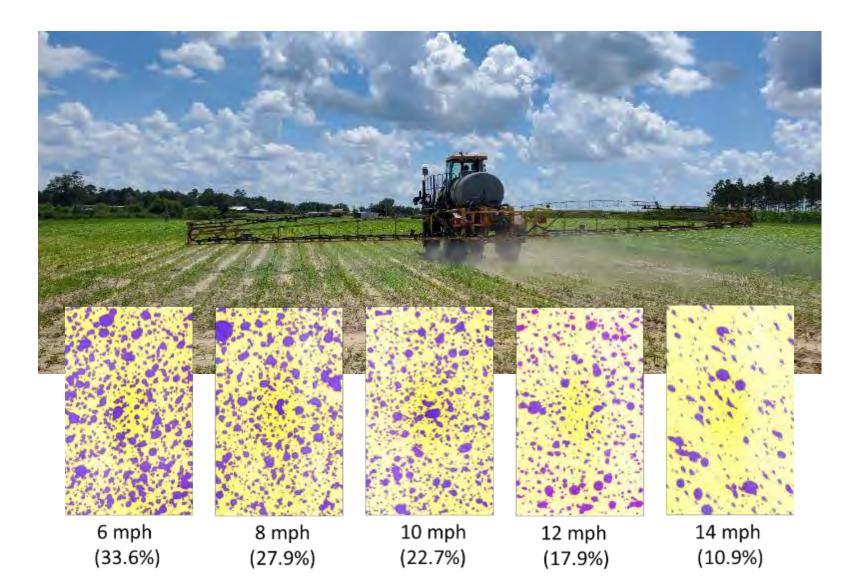


In-Cab Display/Computer

Ground Speed Effect on Spray Coverage (no rate controller)

Sprayer calibrated at 6 mph:

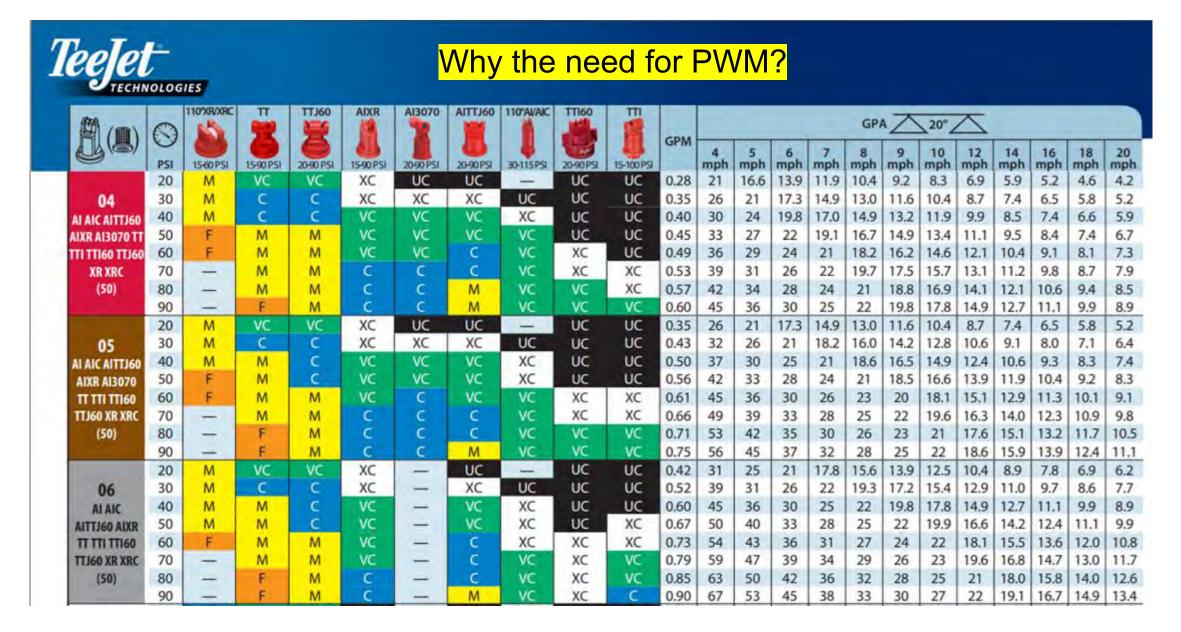
- 6 mph *(20 GPA)*
- 8 mph
- 10 mph
- 12 mph (10 GPA)
- 14 mph
- 16 mph (7 GPA)

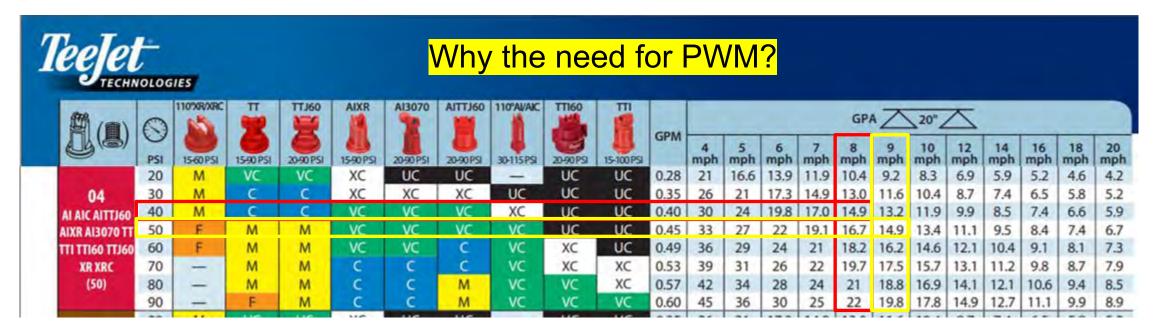


Automatic Section Control

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







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?



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

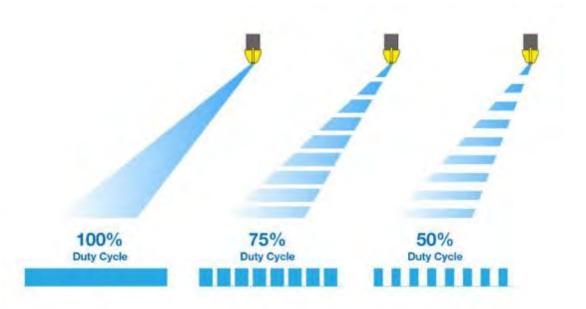


Image source: Dultmeier.com





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

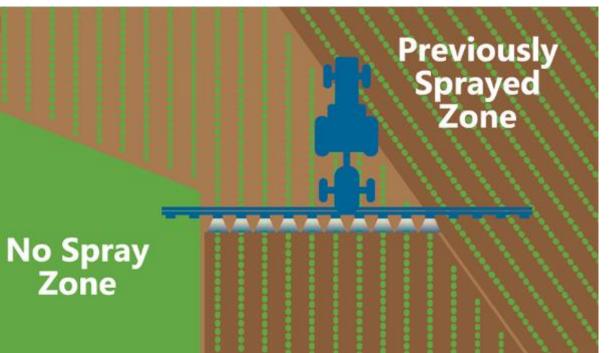


Individual Nozzle Control



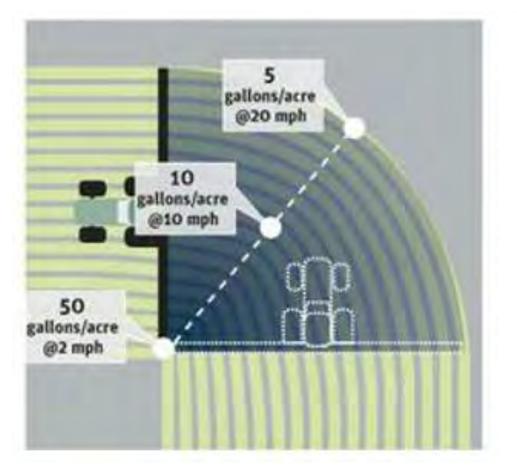
 Individual nozzles can turn ON/OFF as they come out of spray and nonspray/already sprayed areas.

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

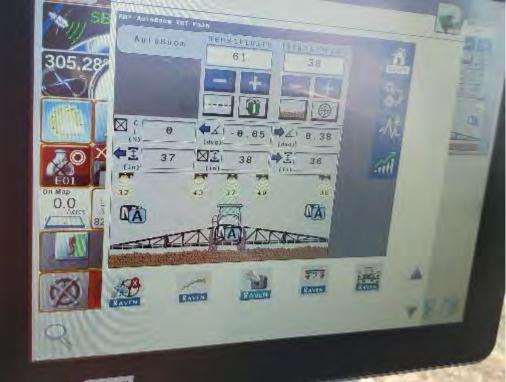


Turn Compensation

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



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)



Thanks!



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