Sprayer Calibration

Tom Getts UCCE Advisor

Some Slides Courtesy of: Lynn Wunderlich and Franz Niederholzer

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Calibration

- Uniform pesticide application
  - Approximately +- 5%

- Application rate
  - Quarts/acre
  - Pounds/acre

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Calibration

- Uniform pesticide application
  - Approximately +- 5%

- Application rate
  - Quarts/acre
  - Pounds/acre

- Sometimes Much less!!!!
  - Telar 1oz per acre
  - Shark 2oz per acre

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Calibration

- 1acre=little less than football field (no endzones)
  - (43,560^2 vs 48,000ft^2)
- Roundup-32 fl oz per acre
  - 1 quart = two pints
- Milestone- 7 fl oz/acre
  - 7 oz = Little more than ½ a can of beer
- Shark- 1oz
  - 1.5oz+shot of whiskey

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Why Does it Matter??

Why Does it Matter??

- Three Reasons
  - One: Economics Pesticides are expensive….
    - Telar 1 oz = $19.3
    - Milestone 7oz= $17.7
    - Labor?? 14$/hour Minimum wage….

Why Does it Matter??

- Three Reasons
  - One: Economics Pesticides are expensive....
    - Shark 1oz= $12
    - Telar 1 oz = $22-30
  - Two: Efficacy
    - Too little vs too much
    - Back to economics.... Failed application
    - Delay Resistance

Why Does it Matter??

- Three Reasons
  - One: Economics Pesticides are expensive….
    - Shark 1oz= $12
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  - Two: Efficacy
    - Too little vs too much
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    - Delay Resistance
  - Three: Legal/environmental
    - Label
    - Water, wildlife etc.

Proceedings CWSS 2012

- Carl Bell, Cheryl Wilen
- 80 Experienced Applicators
  - Backpack
  - Orchard Gun
  - Spot

Sprayer type	Mean GPA	GPA Range	1% glyphosate Gallons/acre
Backpack	41	10-100	0.41
Orchard Gun	127	24-352	1.3
Spot Spray	628	80-1560	6.3

Glyphosate-

- Keystone Pest Solution
  - 2.5 Gallons-$99.00
  - 1%-1.6% V/V spot

Roundup Cost

- Pastures
  - 0.8 Quarts- 2.25 Quarts
  - $7.92-$22.75/acre
  - 1 Acre Spot

- Volume to Volume?

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- Volume to Volume?

Roundup Pro Cost/Acre				
Gal/acre	1%	Dollars/ac	1.60%	Dollars/ac
20	0.20	7.92	0.32	12.67
40	0.40	15.84	0.64	25.34
60	0.60	23.76	0.96	38.02
80	0.80	31.68	1.28	50.69
100	1.00	39.60	1.60	63.36
150	1.50	59.40	2.40	95.04
600	6.00	237.60	9.60	380.16

What do you need to Know?

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What do you need to Know?

- Volume/area=Application rate
  - Gallons/acre
  - Liters/hectare

What do you need to Know?

- Volume/area=Application rate
  - Gallons/acre
  - Liters/hectare
- Gallons/acre=
Flow rate(gal/time) / Land rate(acres/time)

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What do you need to Know?

- Volume/area=Application rate
  - Gallons/acre
  - Liters/hectare
- Gallons/acre=
  Flow rate(gal/time) / Land rate(acres/time)
- Speed
- Pressure
- Orifice size
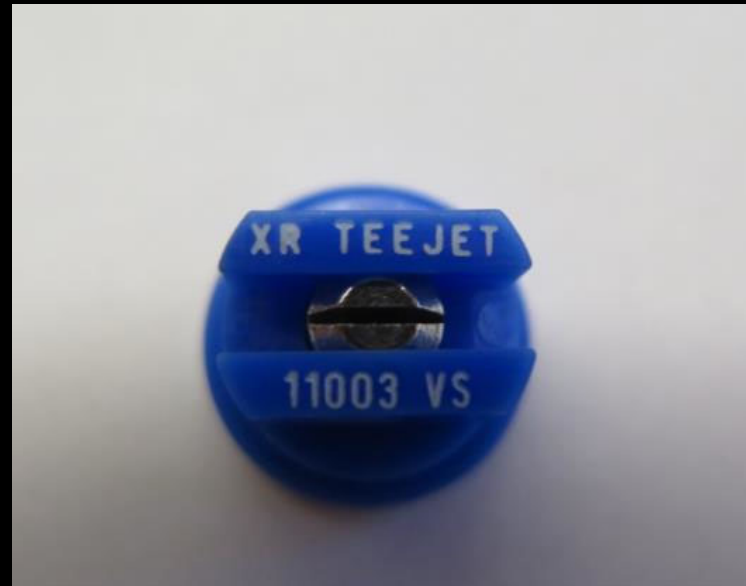
Step One

- Nozzle Selection
- What are you spraying?
    - Contact pesticide?
    - Systemic pesticide?
    - Target Gallons/acre?
    - Droplet Size?

Can you tell what flow rate this nozzle should deliver?
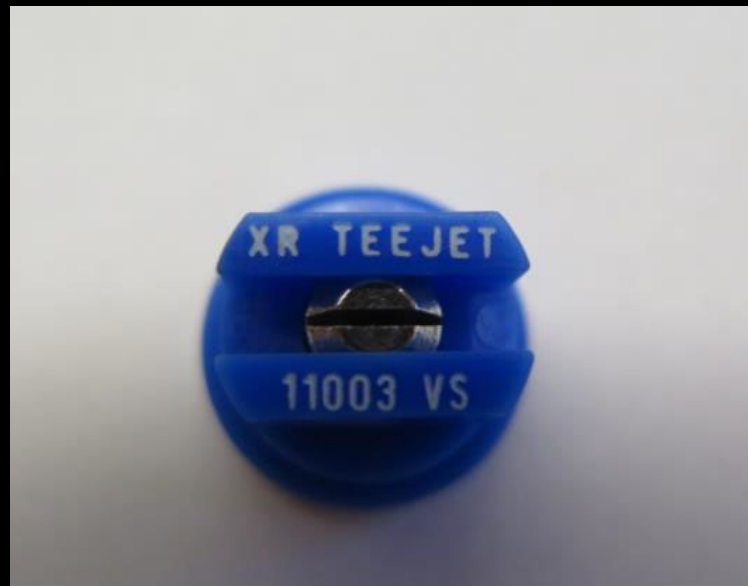
110 03

Can you tell what flow rate this nozzle should deliver?

This XR (extended range) flat fan nozzle is a 11003. It should deliver 0.3 gallons per minute at 40 psi with a spray angle of 110°. The VS stands for "visiflow", the nozzle body material (visiflow plastic).

Flow Rate

- Volume of liquid / Time
  - Nozzle orifice size
  - Number of nozzles
  - Pressure
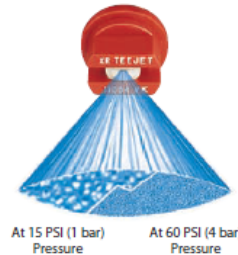 - Viscosity (oil vs water)

XR TeeJet® Extended Range Flat Spray Tips

Typical Applications:
See selection guide on page 4 for recommended typical applications for XR TeeJet tips.

Features:
- Excellent spray distribution over a wide range of pressures—15–60 PSI (1–4 bar).
- Ideal for rigs equipped with sprayer controllers.
- Reduces drift at lower pressures, better coverage at higher pressures.
- Available in stainless steel, ceramic and polymer in 80° and 110° spray angles with VisiFlo® color-coding.

- Ceramic is available with corrosive-resistant polypropylene VisiFlo color-coded tip holder in 80° capacities 03–08 and 110° capacities 02–08.
- XR110025 only available in VK.
- XR80025 and XR80035 only available in VS.
- Brass available in 110° only.
- Automatic spray alignment with 25612-*-NYR Quick TeeJet® cap and gasket. Reference page 64 for more information.
- Automatic spray alignment for sizes 10 and 15 with 25610-*-NYR Quick TeeJet cap and gasket. Reference page 64 for more information.

At 15 PSI (1 bar) Pressure   At 60 PSI (4 bar) Pressure

Tip	PSI	DROP SIZE 80°	DROP SIZE 110°	CAP. ONE NOZZLE IN GPM	CAP. ONE NOZZLE IN OZ./MIN.	GPA 4 MPH	5 MPH	6 MPH	8 MPH	10 MPH	12 MPH	15 MPH	20 MPH	GAL/1000 SQ FT 2 MPH	3 MPH	4 MPH	5 MPH
XR8001 / XR11001 (100)	15	F	F	0.061	7.8	4.5	3.6	3.0	2.3	1.8	1.5	1.2	0.91	0.21	0.14	0.10	0.08
	20	F	F	0.071	9.1	5.3	4.2	3.5	2.6	2.1	1.8	1.4	1.1	0.24	0.16	0.12	0.10
	30	F	F	0.087	11	6.5	5.2	4.3	3.2	2.6	2.2	1.7	1.3	0.30	0.20	0.15	0.12
	40	F	F	0.10	13	7.4	5.9	5.0	3.7	3.0	2.5	2.0	1.5	0.34	0.23	0.17	0.14
	50	F	F	0.11	14	8.2	6.5	5.4	4.1	3.3	2.7	2.2	1.6	0.37	0.25	0.19	0.15
	60	F	VF	0.12	15	8.9	7.1	5.9	4.5	3.6	3.0	2.4	1.8	0.41	0.27	0.20	0.16
XR80015 / XR110015 (100)	15	M	F	0.092	12	6.8	5.5	4.6	3.4	2.7	2.3	1.8	1.4	0.31	0.21	0.16	0.13
	20	F	F	0.11	14	8.2	6.5	5.4	4.1	3.3	2.7	2.2	1.6	0.37	0.25	0.19	0.15
	30	F	F	0.13	17	9.7	7.7	6.4	4.8	3.9	3.2	2.6	1.9	0.44	0.29	0.22	0.18
	40	F	F	0.15	19	11.1	8.9	7.4	5.6	4.5	3.7	3.0	2.2	0.51	0.34	0.26	0.20
	50	F	F	0.17	22	12.6	10.1	8.4	6.3	5.0	4.2	3.4	2.5	0.58	0.39	0.29	0.23
	60	F	F	0.18	23	13.4	10.7	8.9	6.7	5.3	4.5	3.6	2.7	0.61	0.41	0.31	0.24
XR8002 / XR11002 (50)	15	M	M	0.12	15	8.9	7.1	5.9	4.5	3.6	3.0	2.4	1.8	0.41	0.27	0.20	0.16
	20	M	F	0.14	18	10.4	8.3	6.9	5.2	4.2	3.5	2.8	2.1	0.48	0.32	0.24	0.19
	30	F	F	0.17	22	12.6	10.1	8.4	6.3	5.0	4.2	3.4	2.5	0.58	0.39	0.29	0.23
	40	F	F	0.20	26	14.9	11.9	9.9	7.4	5.9	5.0	4.0	3.0	0.68	0.45	0.34	0.27
	50	F	F	0.22	28	16.3	13.1	10.9	8.2	6.5	5.4	4.4	3.3	0.75	0.50	0.37	0.30
	60	F	F	0.24	31	17.8	14.3	11.9	8.9	7.1	5.9	4.8	3.6	0.82	0.54	0.41	0.33
XR80025 / XR110025 (50)	15	M	M	0.15	19	11.1	8.9	7.4	5.6	4.5	3.7	3.0	2.2	0.51	0.34	0.26	0.20
	20	M	M	0.18	23	13.4	10.7	8.9	6.7	5.3	4.5	3.6	2.7	0.61	0.41	0.31	0.24
	30	F	F	0.22	28	16.3	13.1	10.9	8.2	6.5	5.4	4.4	3.3	0.75	0.50	0.37	0.30
	40	F	F	0.25	32	18.6	14.9	12.4	9.3	7.4	6.2	5.0	3.7	0.85	0.57	0.43	0.34
	50	F	F	0.28	36	21	16.6	13.9	10.4	8.3	6.9	5.5	4.2	0.95	0.63	0.48	0.38
	60	F	F	0.31	40	23	18.4	15.3	11.5	9.2	7.7	6.1	4.6	1.1	0.70	0.53	0.42
XR8003 / XR11003 (50)	15	M	M	0.18	23	13.4	10.7	8.9	6.7	5.3	4.5	3.6	2.7	0.61	0.41	0.31	0.24
	20	M	M	0.21	27	15.6	12.5	10.4	7.8	6.2	5.2	4.2	3.1	0.71	0.48	0.36	0.29
	30	F	F	0.26	33	19.3	15.4	12.9	9.7	7.7	6.4	5.1	3.9	0.88	0.59	0.44	0.35
	40	F	F	0.30	38	22	17.8	14.9	11.1	8.9	7.4	5.9	4.5	1.0	0.68	0.51	0.41
	50	F	F	0.34	44	25	20	16.8	12.6	10.1	8.4	6.7	5.0	1.2	0.77	0.58	0.46
	60	F	F	0.37	47	27	22	18.3	13.7	11.0	9.2	7.3	5.5	1.3	0.84	0.63	0.50
XR80035 (50)	15	M		0.21	27	15.6	12.5	10.4	7.8	6.2	5.2	4.2	3.1	0.71	0.48	0.36	0.29
	20	M		0.25	32	18.6	14.9	12.4	9.3	7.4	6.2	5.0	3.7	0.85	0.57	0.43	0.34
	30	M		0.30	38	22	17.8	14.9	11.1	8.9	7.4	5.9	4.5	1.0	0.68	0.51	0.41
	40	M		0.35	45	26	21	17.3	13.0	10.4	8.7	6.9	5.2	1.2	0.79	0.60	0.48
	50	F		0.39	50	29	23	19.3	14.5	11.6	9.7	7.7	5.8	1.3	0.88	0.66	0.53
	60	F		0.43	55	32	26	21	16.0	12.8	10.6	8.5	6.4	1.5	0.97	0.73	0.58
XR8004 / XR11004 (50)	15	C	M	0.24	31	17.8	14.3	11.9	8.9	7.1	5.9	4.8	3.6	0.82	0.54	0.41	0.33
	20	M	M	0.28	36	21	16.6	13.9	10.4	8.3	6.9	5.5	4.2	0.95	0.63	0.48	0.38
	30	M	M	0.35	45	26	21	17.3	13.0	10.4	8.7	6.9	5.2	1.2	0.79	0.60	0.48
	40	M	M	0.40	51	30	24	19.8	14.9	11.9	9.9	7.9	5.9	1.4	0.91	0.68	0.54
	50	F	F	0.45	58	33	27	22	16.7	13.4	11.1	8.9	6.7	1.5	1.0	0.77	0.61
	60	F	F	0.49	63	36	29	24	18.2	14.6	12.1	9.7	7.3	1.7	1.1	0.83	0.67
XR8005 / XR11005 (50)	15	C	M	0.31	40	23	18.4	15.3	11.5	9.2	7.7	6.1	4.6	1.1	0.70	0.53	0.42
	20	C	M	0.35	45	26	21	17.3	13.0	10.4	8.7	6.9	5.2	1.2	0.79	0.60	0.48
	30	M	M	0.43	55	32	26	21	16.0	12.8	10.6	8.5	6.4	1.5	0.97	0.73	0.58
	40	M	M	0.50	64	37	30	25	18.6	14.9	12.4	9.9	7.4	1.7	1.1	0.85	0.68
	50	M	F	0.56	72	42	33	28	21	16.6	13.9	11.1	8.3	1.9	1.3	0.95	0.76
	60	F	F	0.61	78	45	36	30	23	18.1	15.1	12.1	9.1	2.1	1.4	1.0	0.83
XR8006 / XR11006 (50)	15	C	C	0.37	47	27	22	18.3	13.7	11.0	9.2	7.3	5.5	1.3	0.84	0.63	0.50
	20	C	C	0.42	54	31	25	21	15.6	12.5	10.4	8.3	6.2	1.4	1.0	0.71	0.57
	30	M	M	0.52	67	39	31	26	19.3	15.4	12.9	10.3	7.7	1.8	1.2	0.88	0.71
	40	M	M	0.60	77	45	36	30	22	17.8	14.9	11.9	8.9	2.0	1.4	1.0	0.82
	50	M	M	0.67	86	50	40	33	25	19.9	16.6	13.3	9.9	2.3	1.5	1.1	0.91
	60	M	M	0.73	93	54	43	36	27	22	18.1	14.5	10.8	2.5	1.7	1.2	0.99
XR8008	15	VC	C	0.49	63	36	29	24	18.2	14.6	12.1	9.7	7.3	1.7	1.1	0.83	0.67
	20	VC	C	0.57	73	42	34	28	21	16.9	14.1	11.3	8.5	1.9	1.3	0.97	0.78
	30		C	0.69	88	51	41	34	26	20	17.1	13.7	10.2	2.3	1.6	1.2	0.94

CONTACT PRODUCT	SYSTEMIC PRODUCT	DRIFT MANAGEMENT
EXCELLENT	GOOD	GOOD
GOOD*	VERY GOOD*	VERY GOOD*

*At pressures below 30 PSI (2.0 bar)
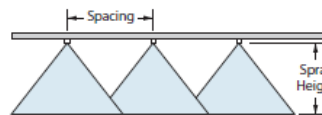
Optimum Spray Height

80°	30"
110°	20"

Spacing / Spray Height

How to order:
Specify tip number.
Examples:
XR8004VS – Stainless Steel with VisiFlo color-coding

The catalog has a lot of information on droplet size and gallons per acre -at a given pressure- at typical spacing and travel speeds.

Even if you have the manufacturer's listed rate from the catalog, it's still a good idea to measure the *actual* flow rate from the nozzle
(*why might these differ*?)

UC Statewide IPM Project
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Always good to measure!

- Worn nozzles

Always good to measure!

- Worn nozzles
  - 50 hours brass
  - 10-15% increase in flow rate
  - 50 hours steel
  - 2% increase flow rate

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Always good to measure!

- Worn nozzles
  - 50 hours brass
  - 10-15% increase in flow rate
  - 50 hours steel
  - 2% increase flow rate
- Clogged nozzles
- Incorrect pressure
  - Faulty pressure gauge??
- Hose lengths

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Tools you will need to measure flow rate.

Plus or minus 5%!

- Important to measure
- Average output of each nozzle
- Help detect worn/clogged nozzles

How to change flow rate?

- Increase or decrease pressure
- Change nozzle orifice size

Land Rate

- Speed*Swath = land rate
- How fast you cover "land"

Swath measurements

Swath Width = $W_1 + W_2 + W_3 + W_4 + W_5$
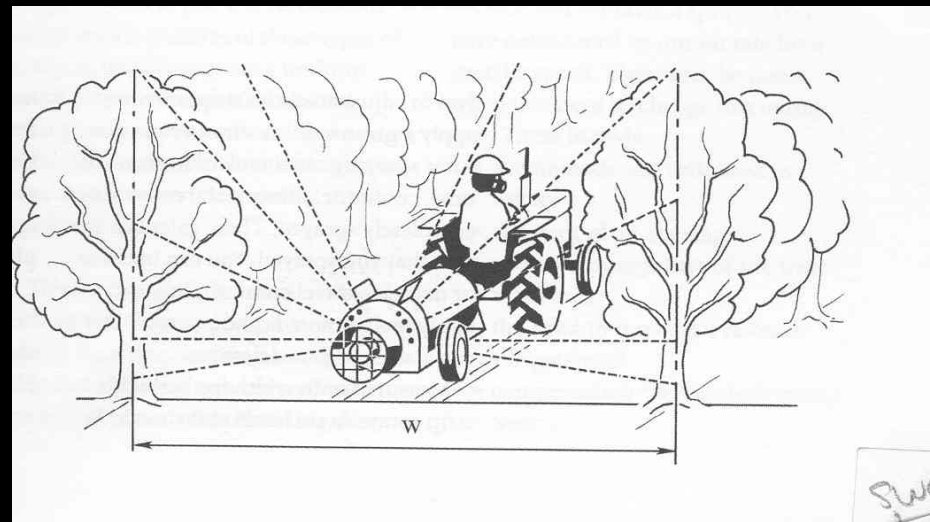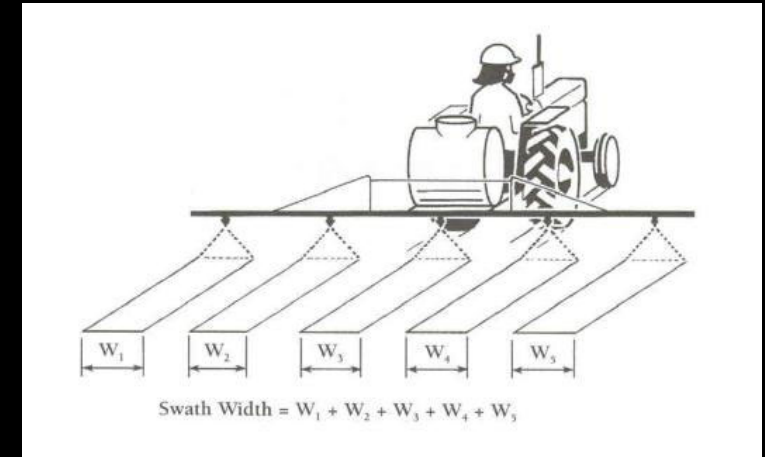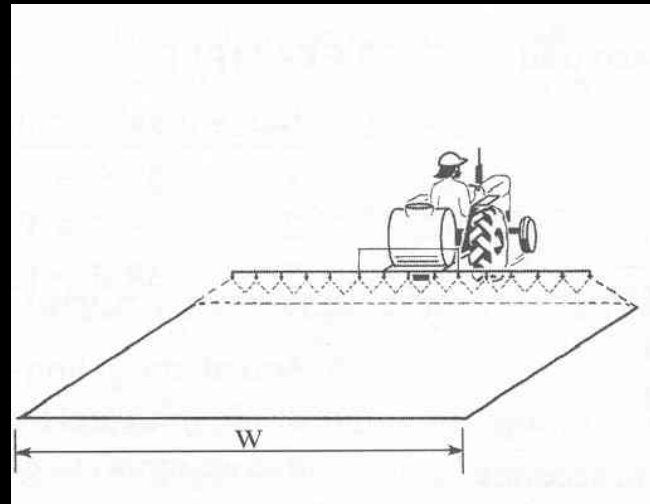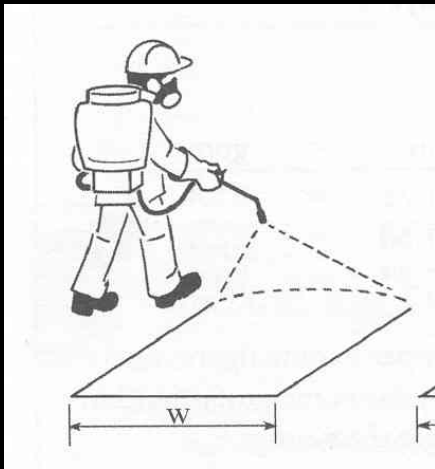
Swath

- Effective boom width
  - Nozzle spacing
  - Number of nozzles

  - Example
  - 6 nozzle's*20 inch spacing=120inches=10 ft. boom width

Speed

- ATV/tractor-test speedometer
  - Drive over application area
  - Fill spray tank half full (exact volume known)
  - GPS
  - Stopwatch distance
  - Tractor Mark Gears/RPM

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Speed

- ATV/tractor-test speedometer
  - Drive over application area
  - Fill spray tank half full (exact volume known)
  - GPS
  - Stopwatch distance
  - Tractor Mark Gears/RPM
- Walking consistent speed
  - Metronome

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How to change land rate

- Alter speed
- Alter Swath

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Application Rate

$$\frac{Gallons}{Acre} =$$

Application Rate

$$\frac{Gallons}{Acre} = \frac{Flow\ Rate}{Land\ Rate}$$

Application Rate

$$\frac{Gallons}{Acre} = \frac{Flow\ Rate}{Land\ Rate} = \frac{\dfrac{Gallons}{Time}}{\dfrac{Acres}{Time}}$$

Application Rate

$$\frac{Gallons}{Acre} = \frac{Flow\ Rate}{Land\ Rate} = \frac{\frac{Gallons}{Time}}{\frac{Acres}{Time}} = \frac{Gallons}{Time} * \frac{Time}{Acres}$$

Application Rate

$$\frac{Gallons}{Acre} = \frac{Flow\ Rate}{Land\ Rate} = \frac{\frac{Gallons}{Time}}{\frac{Acres}{Time}} = \frac{Gallons}{Time} * \frac{Time}{Acres}$$

Application Rate

$$\frac{Gallons}{Acre} = \frac{Flow\ Rate}{Land\ Rate} = \frac{\frac{Gallons}{Time}}{\frac{Acres}{Time}} = \frac{Gallons}{Time} * \frac{Time}{Acres}$$

Application Rate

- Gallons/acre
- Figure out how much pesticide to add to the tank!

How much pesticide goes in tank?

- 180 gallon/tank=Tank Size
- 15 gallons/acre= Application volume
- Desired application rate= 1.5oz Telar/acre

- How much Telar do you put in tank?

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How much pesticide goes in tank?

$$\frac{1\ acre}{15\ gallons} * \frac{180\ gallons}{1\ tank} =$$

How much pesticide goes in tank?

$$\frac{1 \; acre}{15 \; gallons} * \frac{180 \; gallons}{1 \; tank} = \frac{12 \; acres}{1 \; tank}$$

How much pesticide goes in tank?

$$\frac{1\ acre}{15\ gallons} * \frac{180\ gallons}{1\ tank} = \frac{12\ acres}{1\ tank}$$

$$\frac{1.5\ oz\ Telar}{1\ acre} * \frac{12\ acres}{1\ tank} =$$

How much pesticide goes in tank?

$$\frac{1\ acre}{15\ gallons} * \frac{180\ gallons}{1\ tank} = \frac{12\ acres}{1\ tank}$$

$$\frac{1.5\ oz\ Telar}{1\ acre} * \frac{12\ acres}{1\ tank} = \frac{18oz\ Telar}{1\ tank}$$

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Apps

PennState Extension MENU ∨ SEARCH

With a few of these apps on your phone or tablet, you should be able to quickly work through some common spraying hang-ups. By making sure that your sprayer is properly calibrated and the correct amounts of products are in the tank you can breathe easier knowing that you have one less thing to worry about.

	Company / Organization	iPhone	iPad	Android
Sprayer Calibration				
Calibrate My Sprayer	Clemson University	x	x	x
Sprayer Calibration Calculator	Univ. of Illinois	x	x	x
Ag Tools	Noble Research Institute	x	x	x
Nozzle Selection				
Spray Tips Guide	AgPhD / Hypro	x	x	x
SpraySelect	TeeJet	x	x	
NozzleCalc	GreenLeaf	x	x	x
Spray It	Hypro	x		x
Nozzle Select	John Deere	x	x	x
Hardi Nozzles(IOS) / HARDI(Android)	Hardi	x		x
TipWizard	Wilger	x	x	x
Mixing and Loading				
TankCalc US	Syngenta	x		
TankMix	DuPont	x		
Tank Mix Calculator	FarmLogic	x	x	x
Mix My Sprayer	Clemson University	x	x	x

Clemson

Sprayer

Load | Save

Sprayer Type	Broadcast
Nozzle Spacing	20 in
Nozzles	10 ct
Speed	5 mi/h
Time Caught	30 s
To Calculate	Volume/Area
Catch/Nozzle	400 mL

12.6 gal/ac

Calculate | Clear

Clemson

Outside

- Calibrate Backpack
  - Principles will work for all sprayers

- Calibrate where you will be spraying!
  - In the field
  - Too the vegetation
    - Ground vs 3 ft. tall

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No Math Method

- 1 Acre = 43560 ft^2

- 1 gallon = 128oz

- 43560/128 = 340 ft^2

- So number of oz used to cover 340 ft^2 = Gallons/acre!

- Time application, and collect liquid

No math

$$\frac{44oz}{340.31\ ft^2} * \frac{1 gallon}{128 oz} * \frac{42560 ft^2}{1\ acre} =$$

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No math

$$\frac{44oz}{340.31\ ft^2} * \frac{1gallon}{128oz} * \frac{42560ft^2}{1\ acre} = \frac{44\ gal}{1\ acre}$$

No Math Method

- How else can you get 340 ft^2?

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No Math Method

- 10 feet*34 feet =340

No Math Method

- 10 feet*34 feet =340
- What about bigger sprayers?
- 20 inch spacing
- 20/12=1.66666 feet
- 340/1.66666=204 feet

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No Math Method

- 20 inch spacing
- Seconds to travel 204 feet
- Collect spray volume 1 nozzle
- Number oz=gallons per acre

Data to collect ATV

- Land Rate
  - ATV Speed
  - ATV Swath width

- Flow Rate
  - Pressure
  - Nozzle size
  - Nozzle output per minute
    - Three nozzles- average output
    - +- 5%

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Data to collect for backpack

- Math less! kinda...
- 43,560ft^2 in acre
- 128 oz in gallon
- 43560/280=340ft.^2
- Time to spray 18.5*18.5 area (304 ft.^2)
- Volume sprayed over time

Outside!

Conversions you may find useful

- 1 mile=5280 ft.
- 1 acre=43560 ft^2
- 1 gallon=128 fl oz
- 1 oz=29.57 ml
- 1 hour= 3600 seconds

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ATV Sprayer

- Speed?
- 100 feet- how fast in seconds?

- We are interested in Area….

ATV Sprayer

- Boom Width
  - 3 nozzles
  - 20 inch Spacing
  - 3*20=60 inches
  - 60 inches=5 foot spray width
- Area Sprayed
  - 100 ft. long
  - 5 ft. wide
  - 500 Sq feet area sprayed in X seconds

Flow Rate

- 15 seconds collect nozzles
  - (go to excel sheet to do math)
  - Note pad

Lots of worksheets you can use

Sprayer Calibration

Lynn Wunderlich, Franz Niederholzer and John Roncoroni, UCCE Farm Advisors

Grower: _____ Sprayer: _____ Date: _____

Universal Equation (This formula works for all applications)

Application Rate (gal./sq. ft.) = Flow Rate (gal./min.) ÷ Land Rate: speed (ft./min.) x width (ft.)

Application Rate (gal./acre)= Flow Rate (gal./min.) ÷ Land Rate (acre/min.)

➢ Swath width must correlate to the coverage of the nozzle flow rate measured.

1. Calculate Flow Rate (gal./min.)

1A. Using the charts from the manufacturer's catalog

Manifold left or rt.	Nozzle Type	Nozzle size	PSac:___ CATALOG Rated Output (gal/min)	Actual PSI:___ ACTUAL Output (gal/min)
1				
2				
3				
4				
5				
6				

TOTAL gal/min =

____ gal./min. *Catalog* total flow	____ gal./min. **Actual** total flow rate

1B. Measure actual sprayer output

1. Park sprayer on level ground
2. Fill tank about 1/2 full
3. Turn on sprayer with nozzles open and adjust pressure to operating pressure
4. Open nozzle, place cup underneath to catch the flow

Example area based method

- Fill sprayer half way

- Spray area

- Measure how much liquid was used!

Example area based method

- Tractor sprayer
  - 30 ft. boom
  - 20 inch spacing
  - 18 nozzles
  - 11004 flat fan
  - 250 gallon tank
- Want to spray 2 qt's Roundup/acre over 160 acres

Example area based method

- Book says
  - 40 PSI
  - 11004 Nozzle will flow at .4 gallons per minute
  - 12.8oz -15 seconds
  - 24 gallons/acre at 5mph

Example area based method

- Fill tank half way up- spray for 300 feet
- Takes 42 seconds

Example area based method

- Fill tank half way up- spray for 300 feet
- Takes 42 seconds
- Land rate= 30 ft boom* 300 ft/ 42 seconds
- Land rate= 9000ft^2/42seconds

Example area based method

- Need flow rate
- Measure how much water was sprayed
- Fill tank back to halfway mark

Example area based method

- Need flow rate
- Measure how much water was sprayed
- Fill tank back to halfway mark
- 5.5 gallons sprayed
- So flow rate= 5.5 gallons/42 seconds

Example area based method

- So application rate?
- Land rate= 9000ft^2/42seconds
- So flow rate= 5.5 gallons/42 seconds
- 1 acre=42,560ft^2

Example area based method

$$\frac{5.5 \; gallons}{42 \; seconds} * \frac{42 \; seconds}{9000 ft \texttt{\^{}} 2} * \frac{43,560 ft \texttt{\^{}} 2}{1 acre} =$$

Example area based method

$$\frac{5.5 \; gallons}{42 \; seconds} * \frac{42 \; seconds}{9000 ft^2} * \frac{43,560 ft^2}{1 acre} = \frac{26.62 gal}{acre}$$

Example area based method

- 2 qt's per acre
- 250 gallon tank
- How much to put in?

Example area based method

- 2 qt's per acre

- 250 gallon tank

- How much to put in?

- $\frac{1\ acre}{26.2\ gal} * \frac{250\ gal}{1\ tank} = \underline{\ \ }$

Example area based method

- 2 qt's per acre

- 250 gallon tank

- How much to put in?

$$\frac{1\ acre}{26.2\ gal} * \frac{250\ gal}{1\ tank} = \frac{9.54\ acres}{1\ tank}$$

Example area based method

- 2 qt's per acre
- 250 gallon tank
- How much to put in?

$$\frac{1\ acre}{26.2\ gal} * \frac{250\ gal}{1\ tank} = \frac{9.54\ acres}{1\ tank} * \frac{2qt\ roundup}{1\ acre} = -$$

Example area based method

- 2 qt's per acre
- 250 gallon tank
- How much to put in?

$$\frac{1\ acre}{26.2\ gal} * \frac{250\ gal}{1\ tank} = \frac{9.54\ acres}{1\ tank} * \frac{2qt\ roundup}{1\ acre} = \frac{19.08\ qt\ r}{1\ tank}$$

Stationary Method

- Speed miles per hour to seconds to cover 204 feet

- $\dfrac{5\ miles}{1\ hour} * \dfrac{1\ hour}{60\ minute} * \dfrac{1\ minute}{60\ seconds} * \dfrac{5280\ ft}{1\ mile}$

Stationary Method

- Speed miles per hour to seconds to cover 204 feet

- $\dfrac{5\ miles}{1\ hour} * \dfrac{1\ hour}{60\ minute} * \dfrac{1\ minute}{60\ seconds} * \dfrac{5280\ ft}{1\ mile} = \dfrac{7.333\ feet}{1\ second}$

- $\dfrac{1\ second}{7.333\ feet} * 204\ \text{feet} =$

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Stationary Method

- Speed miles per hour to seconds to cover 204 feet

- $\dfrac{5\ miles}{1\ hour} * \dfrac{1\ hour}{60\ minute} * \dfrac{1\ minute}{60\ seconds} * \dfrac{5280\ ft}{1\ mile} = \dfrac{7.333\ feet}{1\ second}$

- $\dfrac{1\ second}{7.333\ feet} * 204$ feet=27.8 seconds

- On 20 inch spacing, 5 miles per hour, need to collect liquid for 27.8 seconds to get sprayer output

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