Morgan County Cattlemen's Meeting
March 6, 2023

Precision Ag Options for Hay and Livestock Producers

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UNIVERSITY OF GEORGIA EXTENSION

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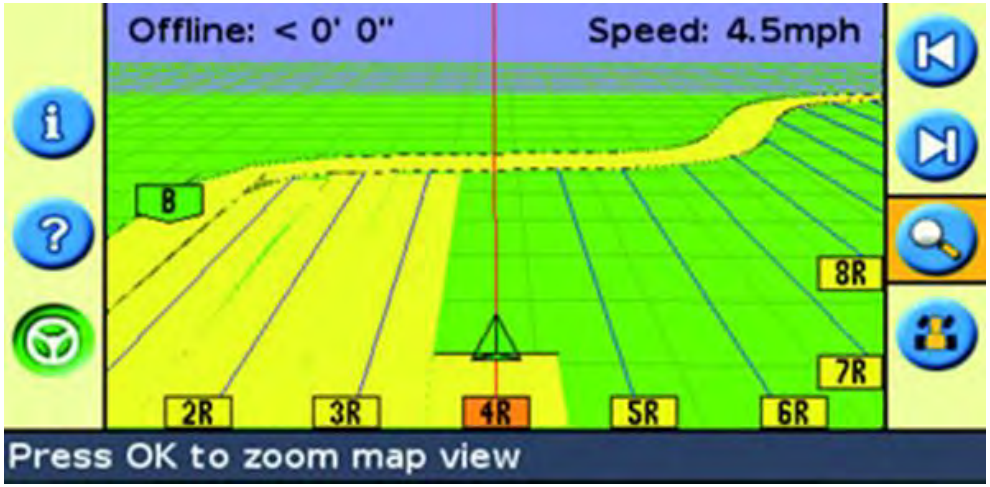
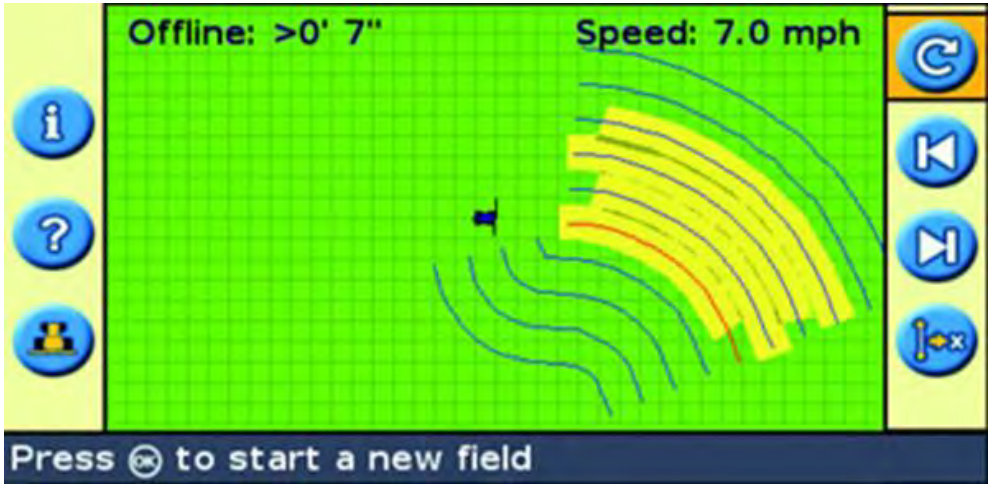
GPS Guidance Systems

Straight Guidance Paths



Curved Guidance Paths (almost any sort of guidance today)



Benefits of GPS Guidance:

- Savings on inputs (avoid skips/overlap; 3 – 10 %)
- Faster operating speed (0.5 – 2.0 mph)
- Less fatigue (adding 2 to 4 extra hours per day)
- Nighttime operation more feasible (as accurate as day time)

GPS Guidance Systems - Types

Lightbar (Entry-Level) Guidance

Auto-Steer Guidance

Lightbar Guidance Systems - Cost

Trimble – EZ250/500

Used Options
$1,000 - $1,500

Outback SLite

Topcon – GX-45

Lightbar Guidance Systems - Cost

TeeJet – Matrix 430

$1,500 - $2,000

Trimble – GFX 350

$3,000 - $3,500

Lightbar Guidance Systems - Cost

Raven – CR7

$3,200 - $4,000

AgLeader – InCommand 800/2050

$3,500 - $4,000

Assisted-Steering Systems - Cost

Trimble – EZ-Steer

Raven – Smartrax MD

$7,500 - $12,000

Auto-Steer Systems - Cost

John Deere

Trimble

$1,5000 - $30,000

Cost Vs Benefits of GPS Guidance

Let's take an example of $2,500 guidance system, which may seem expensive but lets do the math:

Size of Farm: 100 acres

Life: 8 – 10 years

Average savings: 3% - 10%

Savings from using guidance: $10 x 100 = $1000 (assuming $10/ac)

Time it will take to pay back for this guidance system = 2.5 years

Return on Investment

Following University of Georgia Cooperative Extension recommendations, we assumed that fertilizer was applied at a rate of 300 lb N, 60 lb P_2O_5, and 250 lb K_2O per acre for hayfields; and 200 lb N, 30 lb P_2O_5, and 120 lb K_2O per acre for pastures. Nitrogen was applied as urea-ammonium nitrate (32% N), phosphorus was applied as monoammonium phosphate (52% P_2O_5), and potassium was applied as muriate of potash (60% K_2O). Calculations included one ton of dolomitic limestone, regardless of management. All fertilizer and lime prices were based on DTN reports from January 2021.

Since UGA offers a variety of herbicide recommendations, we followed a typical protocol based on producer calls from the past year. For the hayfield scenarios, we assumed indaziflam was applied at 6 oz per acre per year, nicosulfuron + metsulfuron at 1.5 oz per acre per year, and aminopyralid + 2,4-D at 20 oz per acre per year. For the pasture scenarios, we assumed aminopyralid + 2,4-D was applied at 20 oz per acre per year. All herbicide prices were based on average quotes from farm supply stores in southwest Georgia.

Most livestock producers overseed their bermudagrass pastures with a winter annual forage to extend the grazing season. For our calculations, we assumed rye was planted at 90 lb of pure live seed per acre and fertilized with 100 lb N (urea-ammonium nitrate) per acre.

Source: UGA Extension Publication B1546 – GPS Guidance Options for Forage Systems

Return on Investment

Table 2. Estimated costs of common inputs when overapplied to hybrid bermudagrass forage.

	Total cost per acre	
Percent overlapped	**Hayfield[1]**	**Pasture[2]**
10%	$376.65	$260.47
5%	$359.53	$248.63
1%	$345.83	$239.16
Average standard application cost	$342.41	$236.79

Note. Please refer to the text under "return on investment" for the full list of assumptions.

[1] Hayfield costs assume anticipated fertilizer and herbicide expenses.

[2] Pasture costs assume anticipated fertilizer, herbicide, and winter annual forage expenses.

Return on Investment

Table 3. Estimated additional costs or savings of common inputs over- or underapplied to hybrid bermudagrass forage.

	Added cost or savings	
Percentage overlapped or skipped	Hayfield	Pasture
Difference for 1 acre		
1%	$3.42	$2.37
5%	$17.12	$11.84
10%	$34.24	$23.68
Difference for 100 acres		
1%	$342.41	$236.79
5%	$1,712.05	$1,183.97
10%	$3,424.10	$2,367.93
Difference for 250 acres		
1%	$856.02	$591.98
5%	$4,280.12	$2,959.91
10%	$8,560.24	$5,919.83

Precision Soil Sampling and VR Fertilization

Traditional Soil Sampling

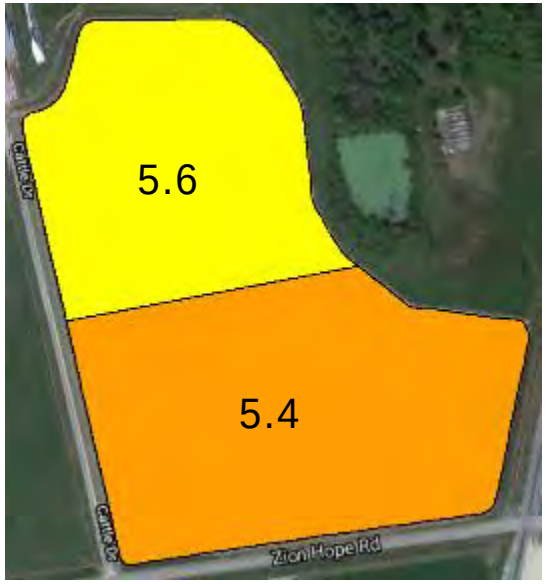
(1-2 composite sample)

Grid Soil Sampling

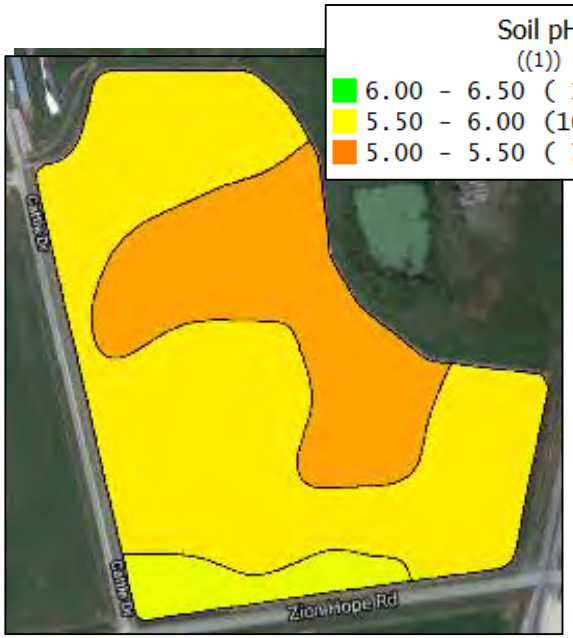
(uniform sized grids)

Zone Soil Sampling

(zones based on certain soil/crop properties)

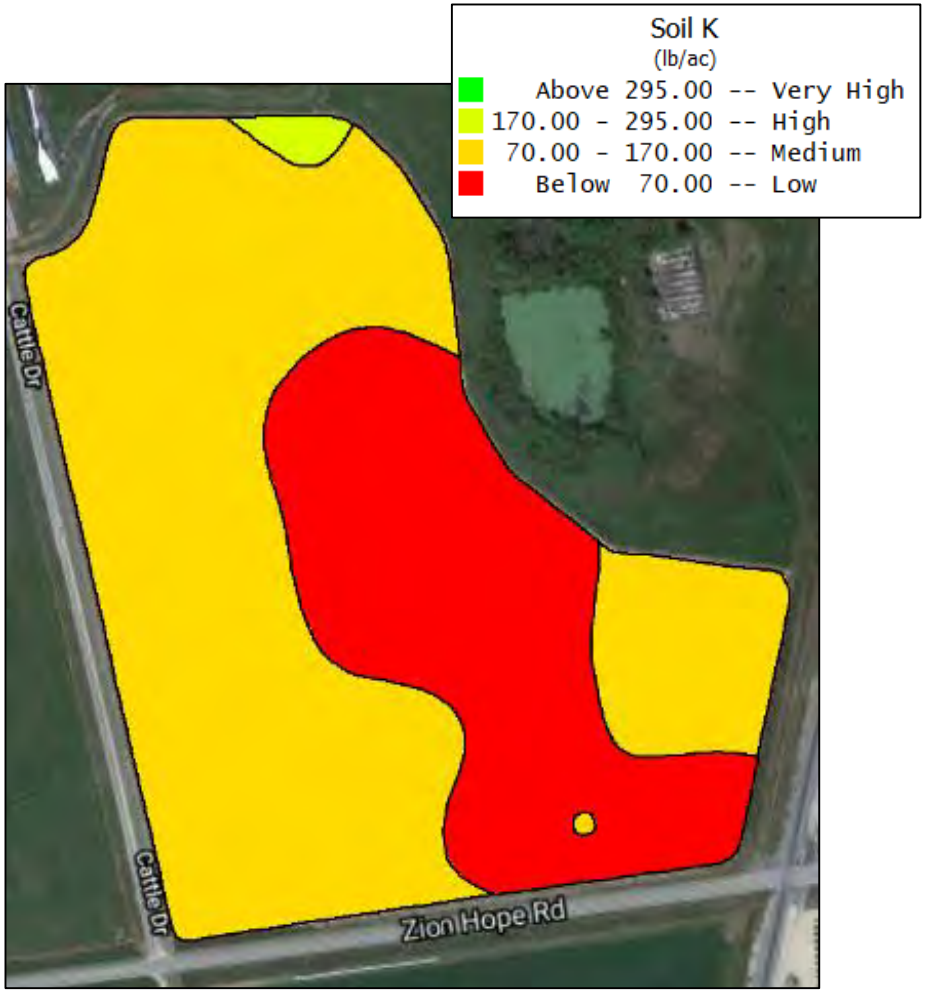


Field	Size (acres)	Rate (lbs/ac)	Total Lime (lbs)	Total Cost ($)
		-------- Uniform Application --------		
Zone 1	26.0	2000	52,000	$494
Total			**26 ton**	**$494**

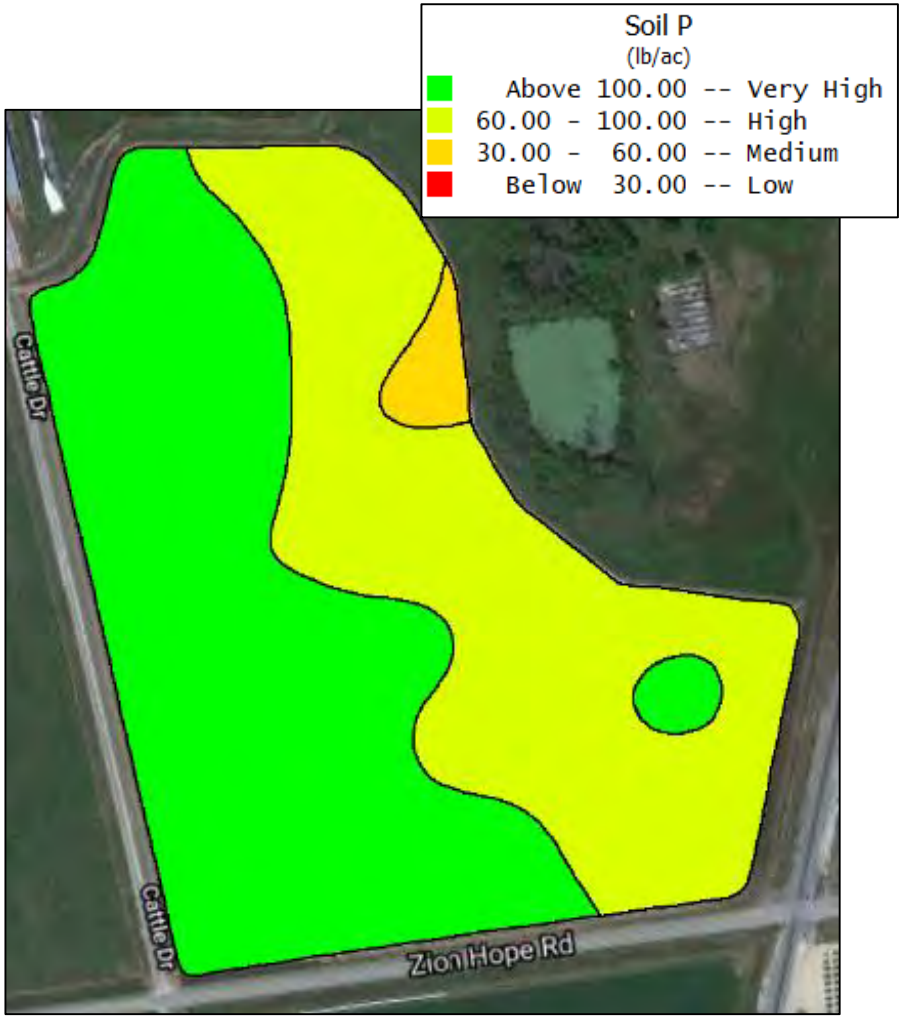


Field	Size (acres)	Rate (lbs/ac)	Total Lime (lbs)	Total Cost ($)
		---- Variable-Rate Application ----		
Zone 1	7.5	1500	11,250	$107
Zone 2	16.8	1000	16,800	$160
Zone 3	1.7	0	0	$0
Total			**14 ton**	**$267**

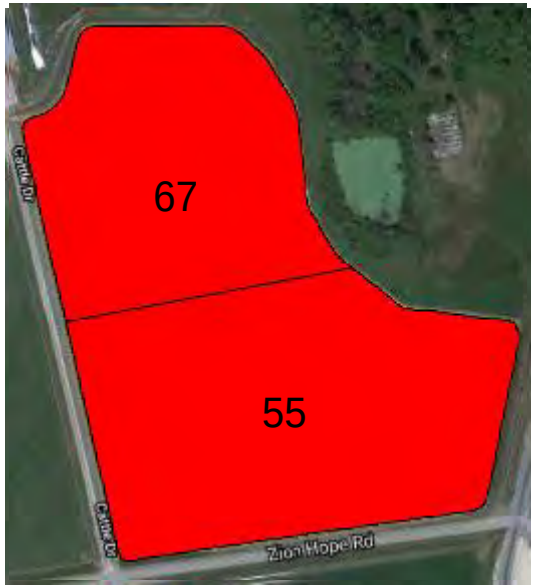
$23 / acre



Potassium



Phosphorus



Total: N-P-K : 75 - 0 - 110 lbs/ac

Pre-plant: N-P-K : 30 - 0 - 110 lbs/ac

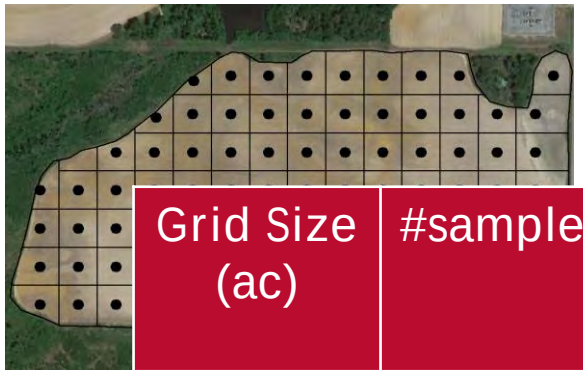
30 - 0 - 110 lbs/ac

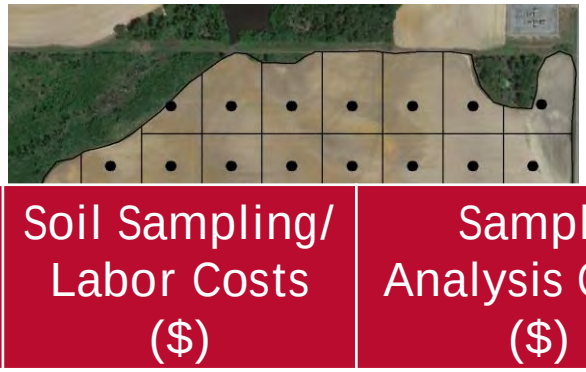
Field	Size (acres)	Uniform Application Cost ($/ac)	Total Cost ($)
Field	26.0	124	3,224
Total			**$3,224**

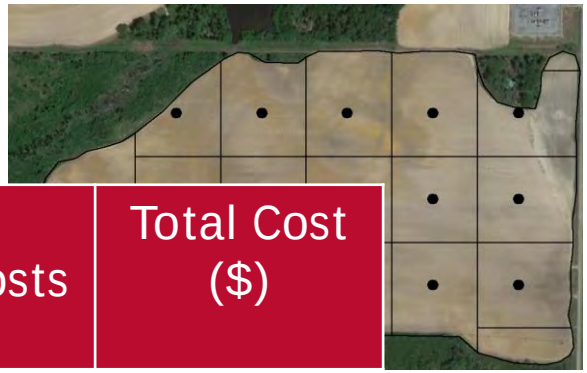
	Field	Size (acres)	Variable-Rate Application Cost ($/ac)	Total Cost ($)
30 - 0 - 70 lbs/ac	Field	26.0	89	2,314
0 - 0 - 40 lbs/ac	Zone 2	9.0	28	252
	Total			**$2,566**

$658 - $25/acre

Optimal Grid Size for Soil Sampling?







Grid Size (ac)	#samples	Soil Sampling/ Labor Costs ($)	Sample Analysis Costs ($)	Total Cost ($)
1.0	92	460	552	1012
2.5	35	414	210	624
5.0	17	368	102	470
7.5	13	368	78	446
10.0	8	368	48	416

7.5 ac

10.0 ac

Optimal Grid Size for Soil Sampling?

(2022 - Tift, Worth, Colquitt, Terrell, Jefferson)

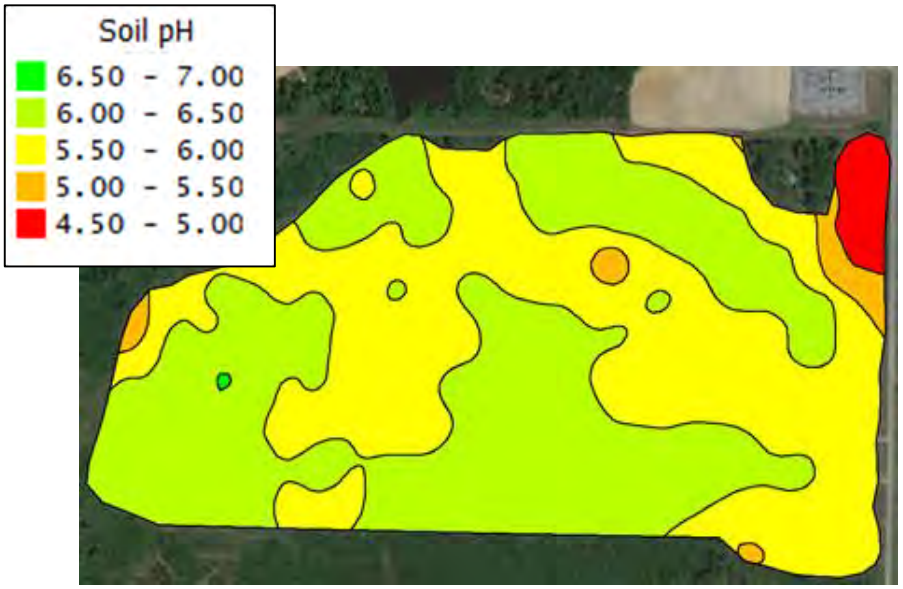
1.0 ac

2.5 ac

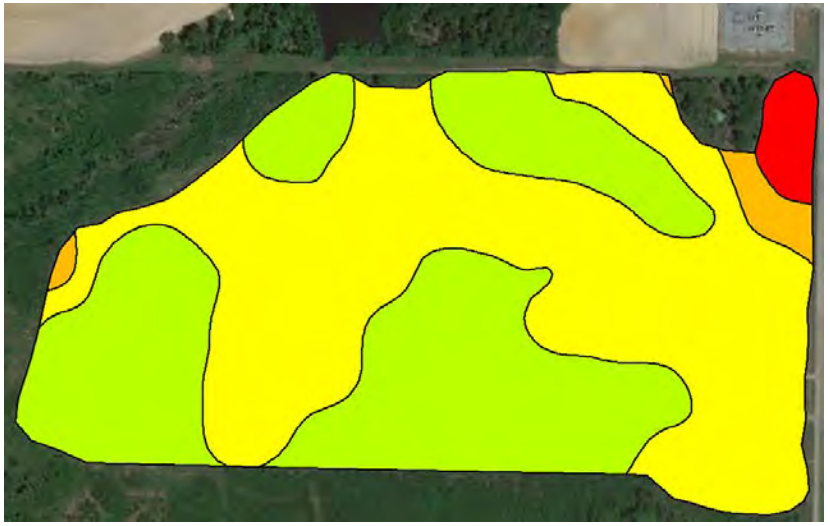
5.0 ac

7.5 ac

10.0 ac



Actual Soil pH Variability (163 Samples)

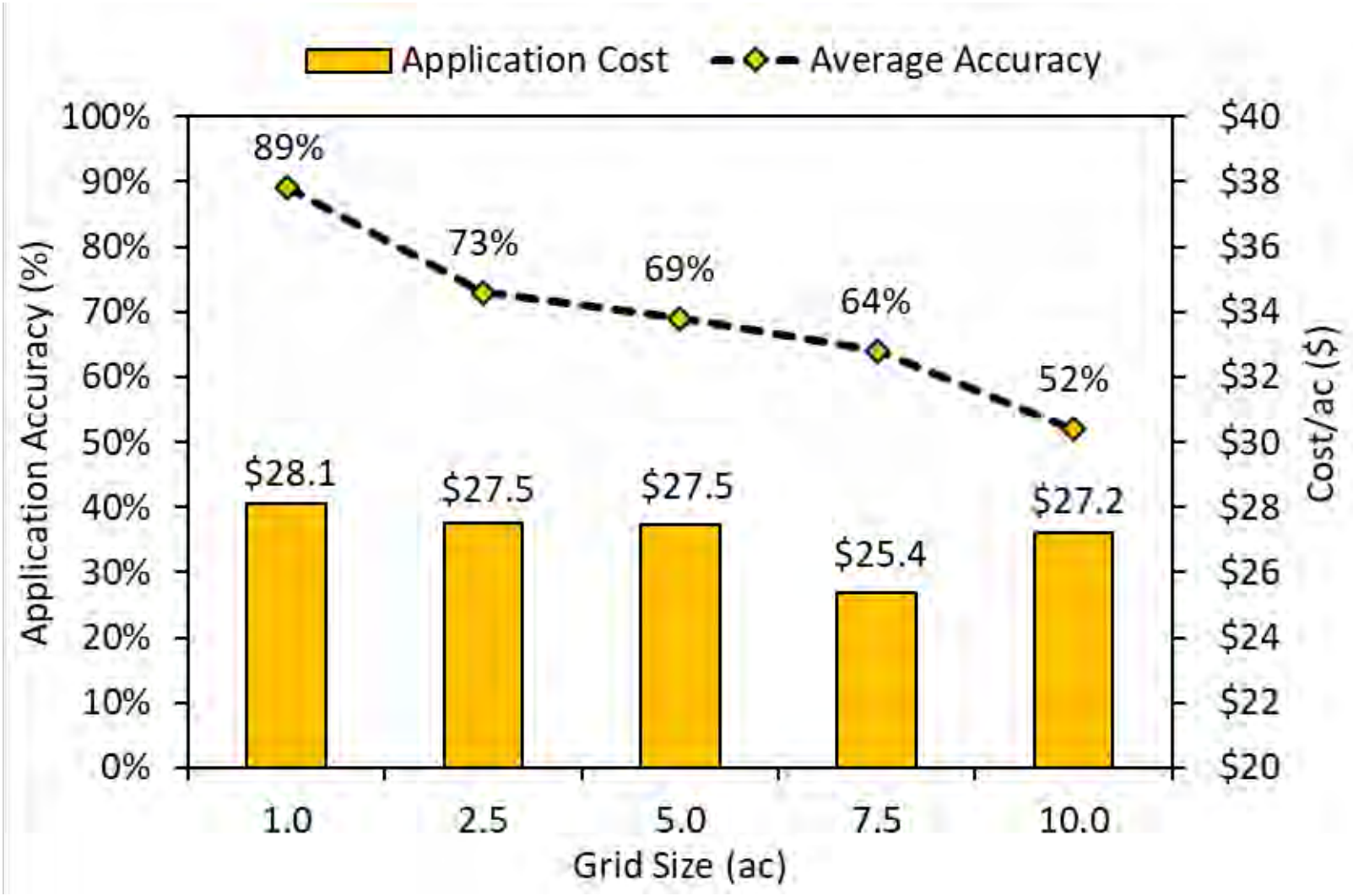


1 ac (92 samples)

2.5 ac (35 samples)

5 ac (17 samples)

Lime


Application Cost
Average Accuracy
Application Accuracy (%)
Cost/ac ($)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
$40
$38
$36
$34
$32
$30
$28
$26
$24
$22
$20
89%
73%
69%
64%
52%
$28.1
$27.5
$27.5
$25.4
$27.2
1.0
2.5
5.0
7.5
10.0
Grid Size (ac)

Broadcast Spinner-Spreader Calibration:

Standard Pan Testing

- Rate of Application
- Spread Uniformity
- Effective Swath Width

Standard Pan Test Set-Up:

- Collection pans with a gridded baffle placed in the bottom of the pan
- A 100 – 200 foot measuring tape or a rope marked at equal intervals (2.5 - 5.0 ft.)
- Flags for marking pan locations along the swath
- A test tube rack with test tubes (numbered same as pans) and a funnel to collect material from the pans into the tubes
- Optional - A weighing scale with a measurement accuracy of 0.1 grams or higher accuracy

- Place collection pans at 5.0 feet intervals along the swath on each side of spreader centerline
- Collect the material in each pan after spreader makes a pass spreading the fertilizer
- Evaluate the spreader performance by analyzing material collected in each pan

Calculate Applied Rate

Pan Area = 10.5 in. x 14.5 in. = 1.06 square ft

Weight of material = 1.45 grams

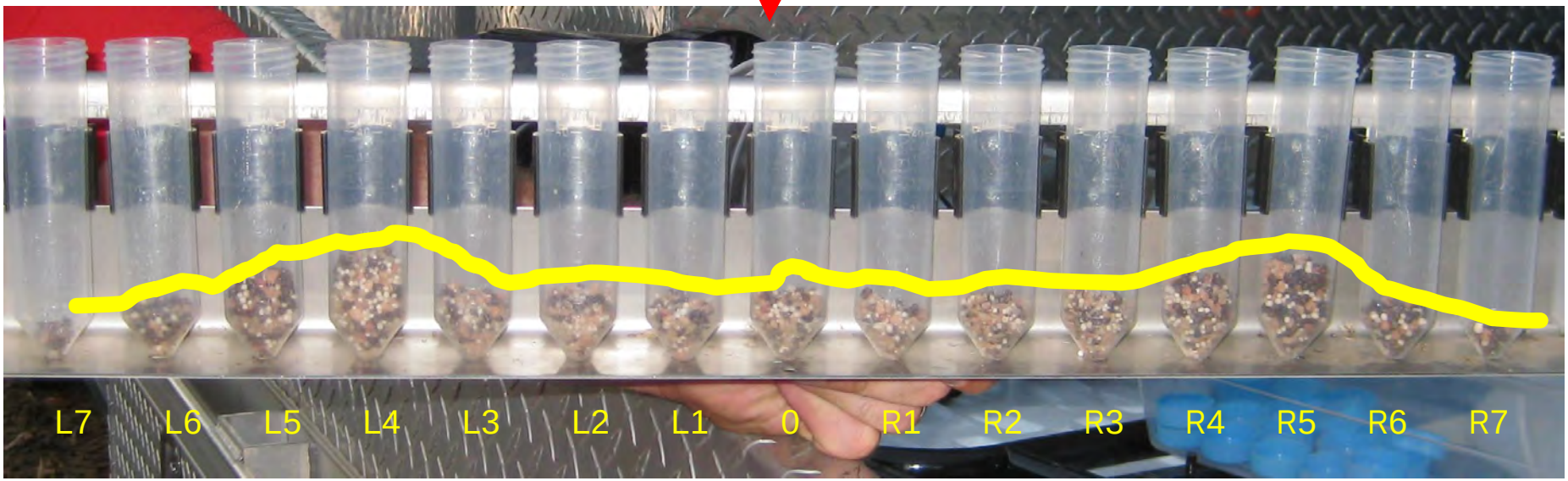
Applied Rate = 132 lb/ac

1 pound = 453.6 grams

1 foot = 12 inches

1 acre = 43560 square foot

Analyze Spread Pattern



Using data sheets to analyze spread pattern

Data Recording

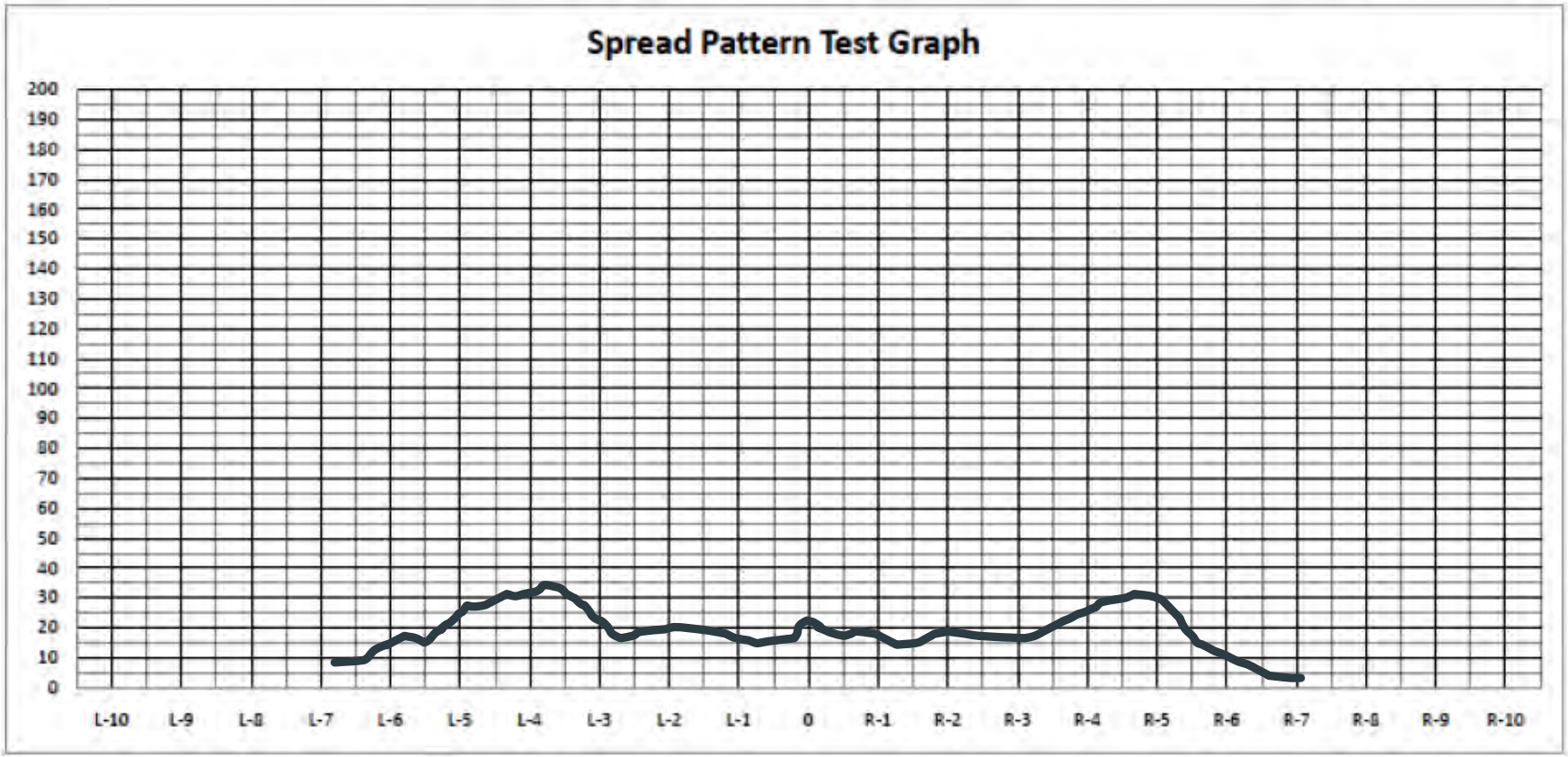
Date _____ Model _____ Gate Setting _____ Spread Width _____ ft.

Run No. _____ Serial No. _____ Flow Divder Setting _____ Height To Spinners _____ in.

No. of Passes _____ Chain Type _____ Spinner Speed _____ rpm Wind _____ @ _____ mph

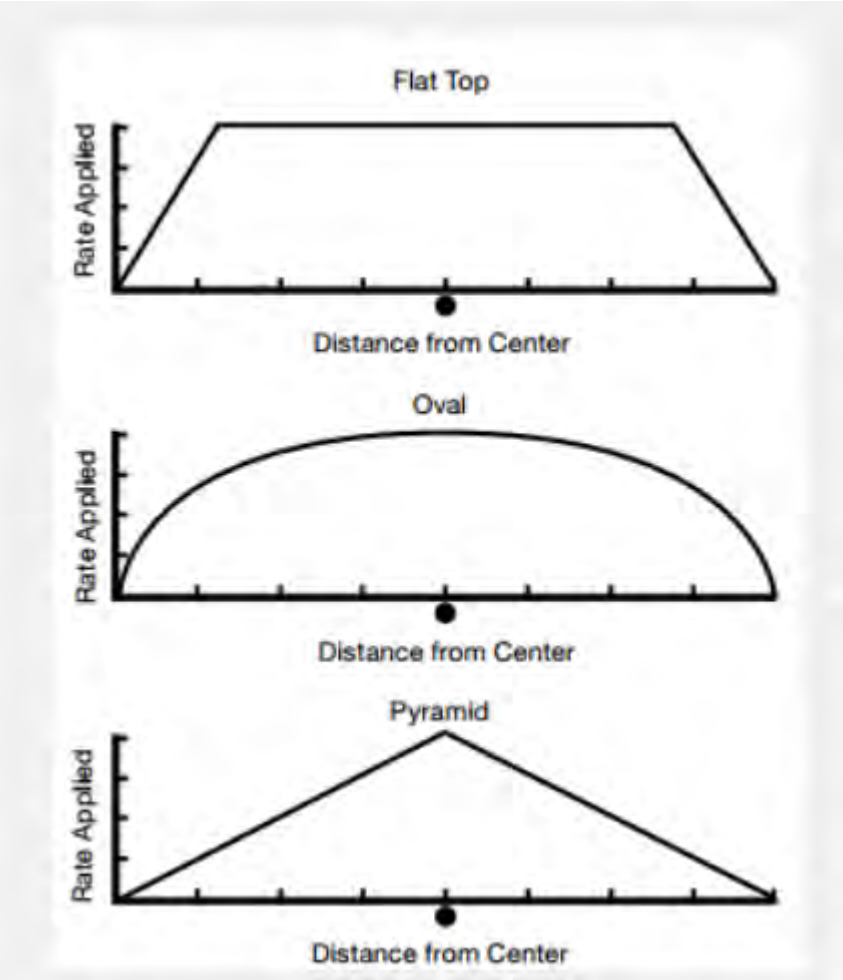
lb./Acre _____ Material _____ Spinner Valve Setting _____ Driving Method _____

Test Site _____ Material Density ____ lb./cu.ft. Blade Settings L _____ R _____ Pan Spacing _____ ft.



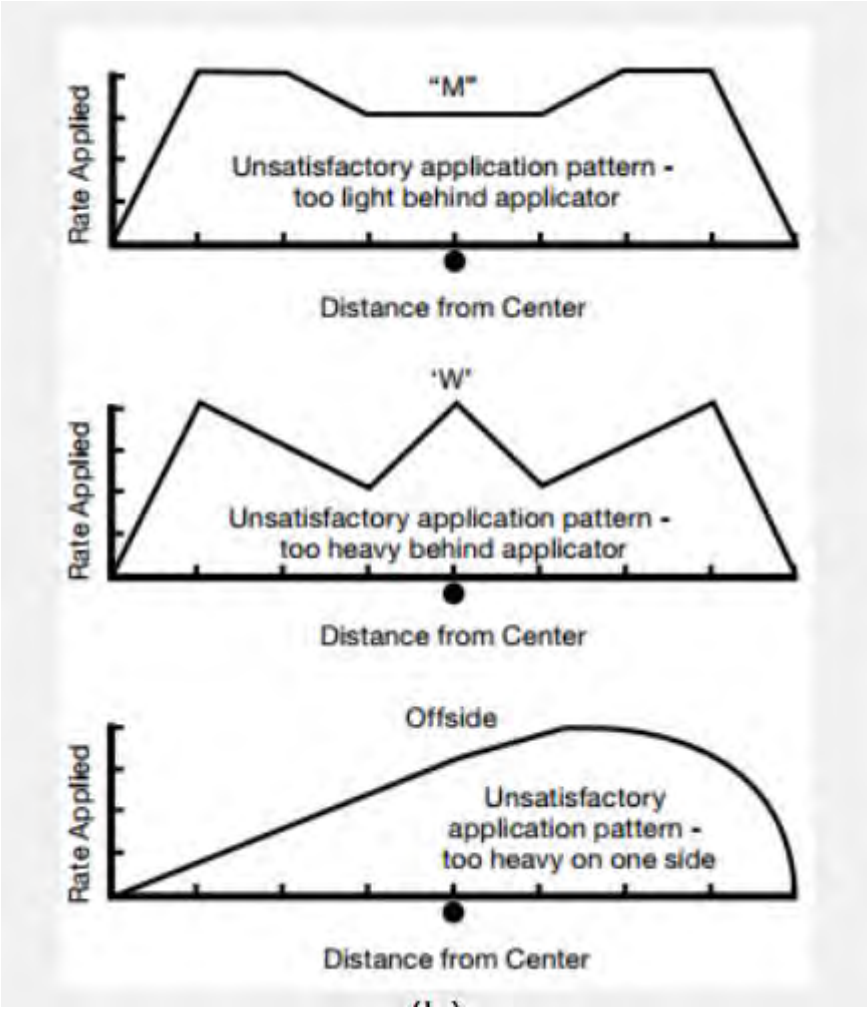
Typical Spread Patterns

Acceptable patterns that provide uniform spread



Typical Spread Patterns

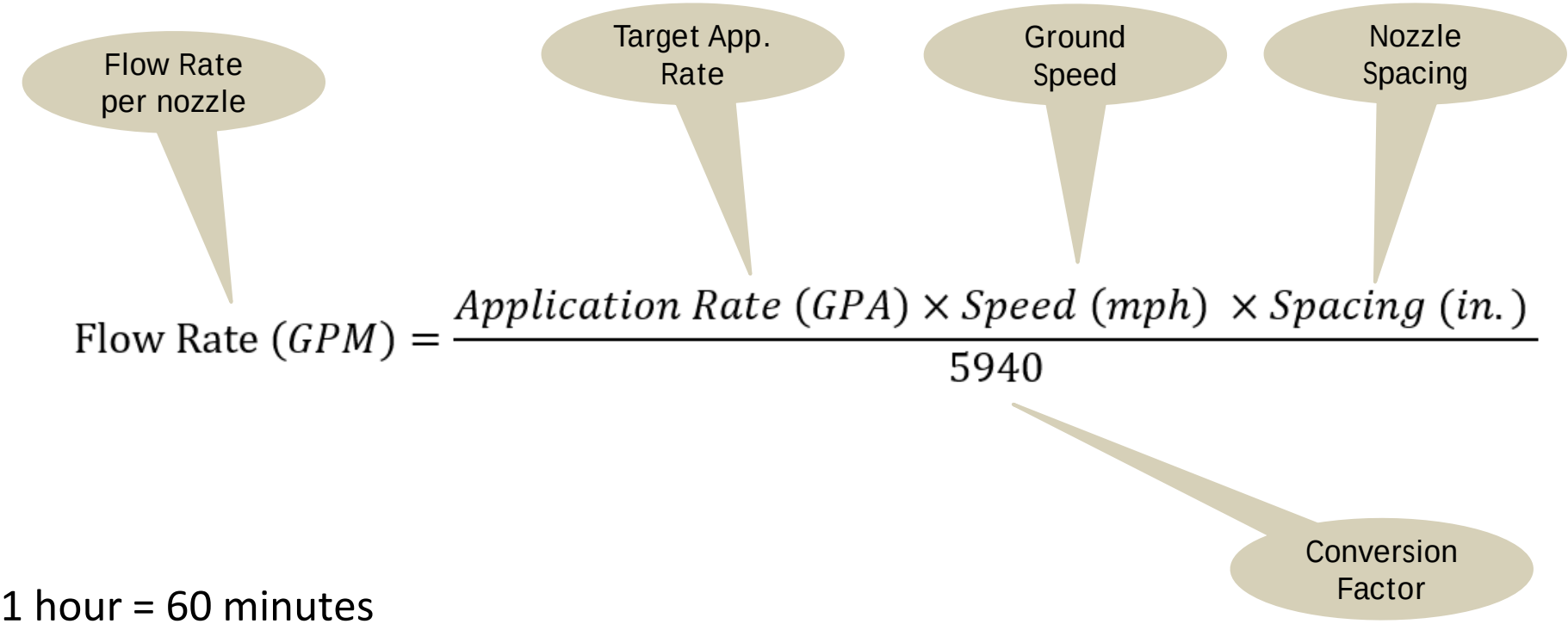
Unacceptable patterns that requires spreader adjustment



Recommendation

- Move flow divider inwards to change material delivery point
- Move flow divider outwards and check feed gate height
- Check for speed differences between spinner discs and uneven material flow

Sprayer Calibration



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

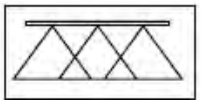
1 hour = 60 minutes
1 mile = 5280 feet
1 foot = 12 inches
1 acre = 43560 feet^2

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

Sprayer Calibration

Lets take an example:

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



Broadcast Application

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

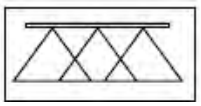
$$\text{Flow Rate (GPM)} = \frac{15 \times 10 \times 20}{5940}$$

Answer = 0.505 GPM

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

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

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

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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)

Volume collected = 15 oz.

Spot-On Spray Calibrator

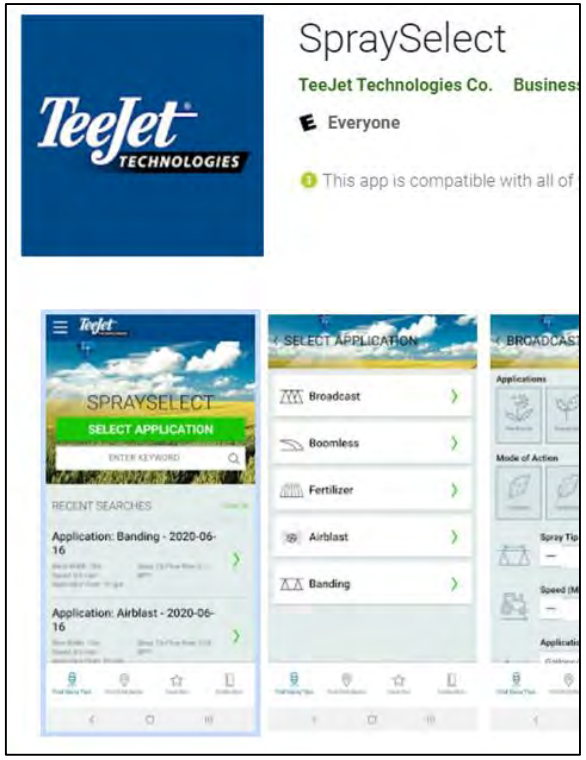
- Best for flow rates below 1 GPM
- Press START button and hold the meter under nozzle at slight angle
- Allow the meter to fill until the display shows a flow rate

(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)

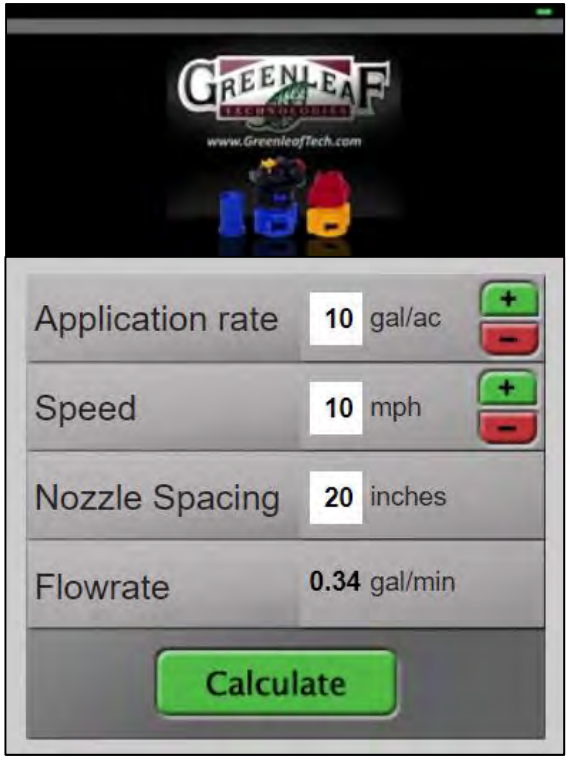
- Display holds reading for 90 seconds. Empty the meter and perform calibration on next nozzle

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

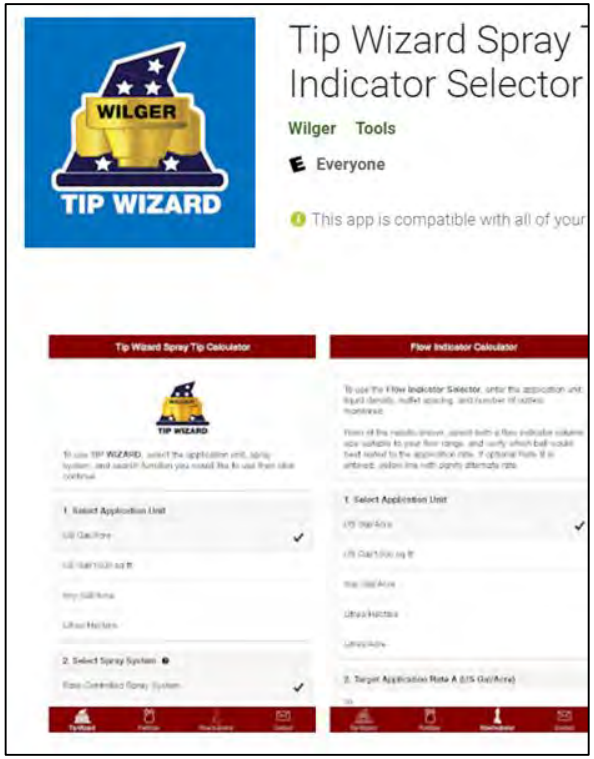
Useful Nozzle Selection and Sprayer Calibration Apps



TeeJet
Spray Select



GreenLeaf
Nozzle Calculator



Wilger
Tip Wizard

Thanks!

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