



Spreader Calibration

Nutrient Management Plan application rates are determined through scientific methods to help the producer maximize both crop production and manure nutrient use, while offering environmental protection. Application rates are based on a nutrient balance between manure nutrient levels and expected nutrient crop removal rates. Plan application rates are of little use if application equipment is not calibrated.

Here are three methods to help determine application rates:

1. **Tarp Method** – Best for *solid manure*. A swath of manure is applied over top of a tarp of known size. The weight of manure on the tarp can then be used to determine the application rate in Tons per acre using the attached table.
2. **Swath Width and Distance Method** – For either *solid or liquid manure*. Follow the steps below to determine application rate.

Step 1: Find Area Covered in Acres. Note: 1 Acre = 43,560 ft²

$\frac{\text{Acreage Covered}}{43,560 \text{ ft}^2} = \frac{\text{Swath Length (feet)} \times \text{Swath Width (feet)}}{43,560 \text{ ft}^2}$
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*Area covered can be determined using width and speed of travel as well.
 The attached table can also be used to find this value.*

$\text{Swath Length} = \text{MPH traveled} \times 1.46 \text{ feet per second} \times \text{number of seconds traveled}$
$\frac{\text{Acreage Covered}}{43,560 \text{ ft}^2} = \frac{\text{Swath Length (feet)} \times \text{Swath Width (feet)}}{43,560 \text{ ft}^2}$

Step 2: Find application rate using spreader volume in gallons. Note: Tons can be used in place of gallons if you know the weight of solid manure in a spreader.

$\frac{\text{Application Rate}}{\text{Area Covered}} = \frac{\text{Spreader Volume (gallons)}}{\text{Area Covered}}$
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3. **Loads per Field Method** – Good for *solid or liquid manure*. You must know the acreage of the field and the gallons or tons of manure the equipment holds. Use this method to check your work as you go.

$\frac{\text{Number of loads needed}}{\text{Gallons or Tons per load}} = \frac{\text{Application Rate from Nutrient Management Plan} \times \text{Acres in Field}}{\text{Gallons or Tons per load}}$	
<i>Or, use another convenient version.</i>	
$\frac{\text{Application Rate}}{\text{Acres in the Field}} = \frac{\text{Number of loads applied to field} \times \text{Gallons or Tons per load}}{\text{Acres in the Field}}$	

Table 1: Application rates in tons per acre for four common tarp sizes (Mancl, 1996).

Lbs of manure applied to tarp	Tarp size (in feet)			
	6x6	8x8	10x10	10x12
	Tons manure/acre			
10	6.1	3.4	2.2	1.8
11	6.7	3.7	2.4	2.0
12	7.3	4.1	2.6	2.2
13	7.9	4.4	2.8	2.4
14	8.5	4.8	3.1	2.5
15	9.1	5.1	3.3	2.7
16	9.7	5.5	3.5	2.9
17	10.3	5.8	3.7	3.1
18	10.9	6.1	3.9	3.3
19	11.5	6.5	4.1	3.5
20	12.1	6.8	4.4	3.6
21	12.7	7.2	4.6	3.8
22	13.3	7.5	4.8	4.0
23	13.9	7.8	5.0	4.2
24	14.5	8.2	5.2	4.4
25	15.1	8.5	5.5	4.5
26	15.7	8.9	5.7	4.7
27	16.3	9.2	5.9	4.9
28	16.9	9.5	6.1	5.1
29	17.6	9.9	6.3	5.3
30	18.2	10.2	6.5	5.5
31	18.8	10.6	6.8	5.6
32	19.4	10.9	7.0	5.8
33	20.0	11.2	7.2	6.0
34	10.6	11.6	7.4	6.2
35	21.2	11.9	7.6	6.4
36	21.8	12.3	7.8	6.5
37	22.4	12.6	8.1	6.7
38	23.0	12.9	8.3	6.9
39	23.6	13.3	8.5	7.1
40	24.2	13.6	8.7	7.3
41	24.8	14.0	8.9	7.4
42	25.4	14.3	9.2	7.6
43	26.0	14.6	9.4	7.8
44	26.6	15.0	9.6	8.0
45	27.2	15.3	9.8	8.2
46	27.8	15.7	10.0	8.4
47	28.4	16.0	10.2	8.5
48	29.0	16.3	10.5	8.7
49	29.7	16.7	10.7	8.9
50	30.3	17.0	10.9	9.1

Swath Length (in feet) as Determined by Speed

Miles per hour	Feet travelled per second	Number of Seconds Travelled														
		1 min.			2 min.			3 min.			4 min.			5 min.		
		40	60	80	100	120	140	160	180	200	220	240	260	280	300	
1	1.46	58	88	117	146	175	204	234	263	292	321	350	380	409	438	
1.5	2.19	88	131	175	219	263	307	350	394	438	482	526	569	613	657	
2	2.92	117	175	234	292	350	409	467	526	584	642	701	759	818	876	
2.5	3.65	146	219	292	365	438	511	584	657	730	803	876	949	1022	1095	
3	4.38	175	263	350	438	526	613	701	788	876	964	1051	1139	1226	1314	
3.5	5.11	204	307	409	511	613	715	818	920	1022	1124	1226	1329	1431	1533	
4	5.84	234	350	467	584	701	818	934	1051	1168	1285	1402	1518	1635	1752	
4.5	6.57	263	394	526	657	788	920	1051	1183	1314	1445	1577	1708	1840	1971	
5	7.30	292	438	584	730	876	1022	1168	1314	1460	1606	1752	1898	2044	2190	
5.5	8.03	321	482	642	803	964	1124	1285	1445	1606	1767	1927	2088	2248	2409	
6	8.76	350	526	701	876	1051	1226	1402	1577	1752	1927	2102	2278	2453	2628	
6.5	9.49	380	569	759	949	1139	1329	1518	1708	1898	2088	2278	2467	2657	2847	
7	10.22	409	613	818	1022	1226	1431	1635	1840	2044	2248	2453	2657	2862	3066	
7.5	10.95	438	657	876	1095	1314	1533	1752	1971	2190	2409	2628	2847	3066	3285	
8	11.68	467	701	934	1168	1402	1635	1869	2102	2336	2570	2803	3037	3270	3504	
8.5	12.41	496	745	993	1241	1489	1737	1986	2234	2482	2730	2978	3227	3475	3723	
9	13.14	526	788	1051	1314	1577	1840	2102	2365	2628	2891	3154	3416	3679	3942	
9.5	13.87	555	832	1110	1387	1664	1942	2219	2497	2774	3051	3329	3606	3884	4161	
10	14.60	584	876	1168	1460	1752	2044	2336	2628	2920	3212	3504	3796	4088	4380	

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MANURE APPLICATOR CALIBRATION GUIDE

1. **Spreader Capacity is Known.** From chart below, select 1) Spreader Capacity: _____ lbs. or gallons; 2) Distance traveled (length) to empty spreader: _____ feet; and 3) Spread pattern width or distance between individual passes: _____ feet. 4) Intersection indicates application rate: _____ tons per acre. If appropriate values cannot be found in table below: Rate per acre = Spreader Capacity x 43560 / (Width X Length). *Example: 3000 gallon tank spreader that makes a pass every 4 30' corn rows (10 feet) and empties spreader in 1200 feet is applying 11,000 gallons per acre.*

Speed Width→	2000 Gallon tank					2500 gallon tank					3000 gallon tank					3500 gallon tank					4000 gallon tank					4500 gallon tank													
	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'
Length	600'	15	10	7	6	5	4	18	12	9	7	6	5	4	25	17	13	8	6	5	29	19	15	10	7	6	33	22	16	11	8	7							
800'	11	7	5	4	4	3	14	9	7	5	5	4	3	19	13	10	6	5	4	22	15	11	7	5	4	25	16	12	8	6	5								
1000'	9	6	4	3	3	2	11	7	5	4	4	3	3	15	10	8	5	4	3	17	12	9	6	4	3	20	13	10	7	5	4								
1200'	7	5	4	3	2	2	9	6	5	4	3	3	3	11	7	5	4	3	2	13	8	6	4	3	3	15	10	7	5	4	3								
1400'	6	4	3	2	2	2	8	5	4	3	3	2	2	11	7	5	4	3	2	12	8	6	4	3	2	14	9	7	5	4	3								
1600'	5	4	3	2	2	2	7	5	3	3	2	2	2	10	6	5	4	3	2	11	7	5	4	3	2	12	8	6	4	3	2								
1800'	5	3	2	2	2	2	6	4	3	2	2	2	2	9	6	4	3	2	2	10	6	5	3	2	2	11	7	5	4	3	2								
2000'	4	3	2	2	2	2	5	4	3	2	2	2	2	8	5	4	3	2	2	9	6	4	3	2	2	10	7	5	3	2	2								
2500'	3	2	2	2	2	2	4	3	2	2	2	2	2	7	4	3	2	2	2	8	5	3	2	2	2	9	6	4	3	2	2								
3000'	3	2	2	2	2	2	4	3	2	2	2	2	2	6	4	3	2	2	2	7	5	3	2	2	2	8	5	4	3	2	2								

Speed Width→	5000 Gallon tank					5500 gallon tank					6000 gallon tank					3 ton spreader (90 bushel)					4 ton spreader (120 bushel)					6 ton spreader (175 bushel)										
	10'	15'	20'	30'	40'	10'	15'	20'	30'	40'	10'	15'	20'	30'	40'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	
Length	36	24	18	12	9	7	40	27	20	13	10	8	44	29	22	15	11	9	22	15	11	9	7	6	29	19	15	12	10	8	44	29	22	17	15	12
800'	27	18	14	9	7	5	30	20	15	10	7	6	33	22	16	11	8	7	16	11	8	7	5	5	22	15	11	9	7	6	33	22	16	13	11	9
1000'	22	15	11	7	5	4	24	16	12	8	6	5	26	17	13	9	7	5	13	9	7	5	4	4	17	12	9	7	6	5	26	17	13	10	9	7
1200'	18	12	9	6	5	4	20	13	10	7	5	4	22	15	11	7	5	4	11	7	5	4	4	3	15	10	7	6	5	4	22	15	11	9	7	6
1400'	16	10	8	5	4	3	17	11	9	6	4	3	19	12	9	6	5	4	9	6	5	4	3	3	12	8	6	5	4	4	19	12	9	7	6	5
1600'	14	9	7	5	3	3	15	10	7	5	4	3	16	11	8	5	4	3	8	5	4	3	3	2	11	7	5	4	3	3	16	11	8	7	5	5
1800'	12	8	6	4	3	2	13	9	7	4	3	3	15	10	7	5	4	3	7	5	4	3	2	2	10	6	5	4	3	3	15	10	7	6	5	4
2000'	11	7	5	4	3	2	12	8	6	4	3	2	13	9	7	4	3	3	7	4	3	2	2	2	9	6	4	3	2	2	13	9	7	5	4	4
2500'	9	6	4	3	2	2	10	6	5	3	2	2	10	7	5	3	3	2	5	3	3	2	2	2	7	5	3	2	2	2	10	7	5	4	3	3
3000'	7	5	4	2	2	2	8	5	4	3	2	2	9	6	4	3	2	2	4	3	2	2	2	2	6	4	3	2	2	2	9	6	4	3	3	2

Speed Width→	8 ton spreader (230 bushel)					10 ton spreader (290 bushel)					12 ton spreader (350 bushel)					14 ton spreader (410 bushel)					16 ton spreader (470 bushel)					18 ton spreader (530 bushel)										
	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	10'	15'	20'	25'	30'	
Length	58	39	29	23	19	17	73	48	36	29	24	21	87	58	44	35	29	25	102	68	51	41	34	29	116	77	58	46	39	33	131	87	65	52	44	37
800'	44	29	22	17	15	12	54	36	27	22	18	16	65	44	33	26	22	19	76	51	38	30	25	22	87	58	44	35	29	25	98	65	49	39	33	28
1000'	35	23	17	14	12	10	44	29	22	17	15	12	52	35	26	21	17	15	61	41	30	24	20	17	70	46	35	28	23	20	78	52	39	31	26	22
1200'	29	19	15	12	10	8	36	24	18	15	12	10	44	29	22	17	15	12	51	34	25	20	17	15	58	39	29	23	19	17	65	44	33	26	22	19
1400'	25	17	12	10	8	7	31	21	16	12	10	9	37	25	19	15	12	11	44	29	22	17	15	12	50	33	25	20	17	14	56	37	28	22	19	16
1600'	22	15	11	9	7	6	27	18	14	11	9	8	33	22	16	13	11	9	38	25	19	15	13	11	44	29	22	17	15	12	49	33	25	20	16	14
1800'	19	13	10	8	6	6	24	16	12	10	8	7	29	19	15	12	10	8	34	23	17	14	11	10	39	26	19	15	13	11	44	29	22	17	15	12
2000'	17	12	9	7	6	5	22	15	11	9	7	6	26	17	13	10	9	7	30	20	15	12	10	9	35	23	17	14	12	10	39	26	20	16	13	11
2500'	14	9	7	6	5	4	17	12	9	7	6	5	21	14	10	8	7	6	24	16	12	10	8	7	28	19	14	11	9	8	31	21	16	13	10	9
3000'	12	8	6	5	4	3	15	10	7	6	5	4	17	12	9	7	6	5	20	14	10	8	7	6	23	15	12	9	8	7	26	17	13	10	9	7

Source: Nebraskas CNMP Manure Application Workbook. University of Nebraska - Lincoln Extension. 2004.

Pattern Uniformity/Determining Overlap

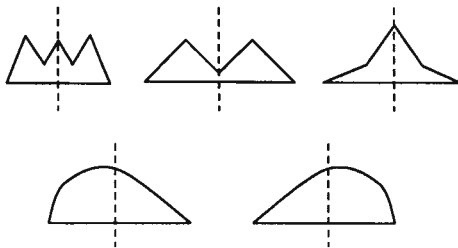
1. Use vertical sided trays/containers.
2. Trays should be about 4 inches deep.
3. Place the trays across the swath width 2-4 feet apart



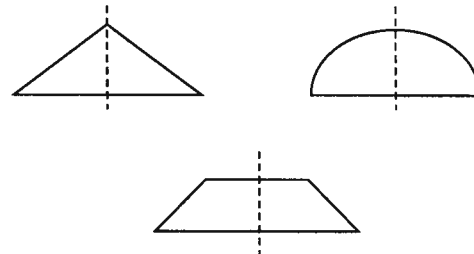
Pattern Uniformity/Determining Overlap

4. Make an application over the trays
6. Measure the depth of liquid (or weight of solid manure) in each tray.
7. Determine if pattern is desirable.

Undesirable Application Patterns



Desirable Application Patterns

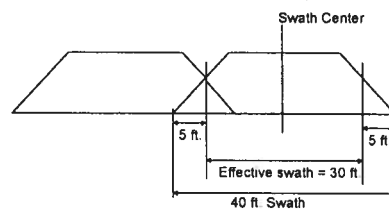


Find Effective Spread Width

7. Effective spread width can be located by finding the point on either side of the swath center where the manure contents are 1/2 of what they are in the middle.

Swath Overlap

Effective spread width =
 $40\text{ft.} - 5\text{ft.} - 5\text{ft.} = 30\text{ft.}$



Calibration Exercises

Exercise 1 – Swath & Distance Method using Speed

Spreader Capacity	_____
Width of Swath	_____
Speed of Travel	_____
Time of Travel	_____
Length of Travel	_____
Area Covered	_____
Acreage Covered	_____
Application Rate	_____

Exercise 2 – Swath & Distance Method using Measurement

Spreader Capacity	_____
Width of Swath	_____
Length of Swath	_____
Area Covered	_____
Acreage Covered	_____
Application Rate	_____