C R O P S E R I E S

SOIL

Manure Spreader Calibration no. 0.561

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Quick Facts...

Correct calibration of manure spreaders saves money and minimizes nitrogen loss to groundwater and the environment.

Select an application rate that meets but does not exceed crop requirements.

Calibrate the spreader to that rate.

Manure application to land has been an integral part of agriculture for centuries. As an amendment to cropland, manure contains nutrients that promote plant growth and improve soil quality.

Correct calibration of manure spreaders saves money by controlling the rate at which manure is applied on the field. This will prevent overfertilization and minimize nitrogen loss to groundwater and the environment. Select a manure application rate that meets but does not exceed crop nutrient requirements.Then calibrate the manure spreader to achieve that rate.

For more information on determining manure application rates using soil and manure testing, see XCM-174, *Best Management Practices for Manure Utilization,* or fact sheet 0.560, *Cattle Manure Application Rates.*

Calibration Methods

Manure spreaders may be calibrated in one of three ways (Koelsch, 1995):

1. **The tarp method.** Place a tarp on the field. Spread manure on the tarp, then weigh the manure to gauge the application rate.
2. **Swath width and distance method.** Determine your swath width and how far you travel to empty a full load. From these measurements and the weight of a spreader load, calculate how much manure you are applying per acre.
3. **Loads per field method.** Count the number of loads of manure applied to the whole field and divide by the acreage of the field.

After determining the spreader application rate, adjust the spreader and measure the application rate again until the desired rate is achieved. To adjust the application rate:

- change driving speed,
- change speed of conveyor if the spreader design has sprockets or a hydraulic conveyor drive to allow rate control, or
- change the height of the endgate if the spreader design includes hydraulic-powered endgates.

When purchasing a manure spreader, consider the degree of control that you have to set application rates.

The Tarp Method

To calibrate a spreader and determine its application rate with the tarp method, you need a bucket, a sheet of plastic or canvas (plastic sheets tear easily), and a scale with a capacity of about 50 to 100 lbs. The tarp should be big enough for the spreader to cover in one pass. Weigh the bucket empty and again with the tarp in it.

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Tarp Method

Advantages

- *The application rate can be determined before you start spreading.*
- *It can be used when manure amounts or moisture contents differ from load to load.*
- *A load scale is not necessary.*
- *It is suitable for any size operation.*
- *The variation in application rate can be visualized and calculated.*

Disadvantages

- *It does not determine the swath pattern to estimate overlap.*
- *It is time consuming and dirty.*
- *Each spreader must be calibrated separately.*

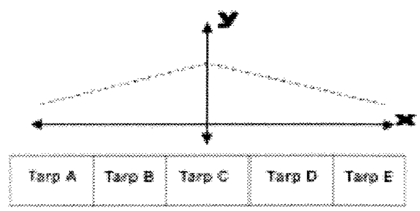

Figure 1: Tarp layout for swath width and distance method. Y indicates direction of travel.

Swath Width and Distance Method

Advantages

- *It lets the spreader operator know if there is an uneven spread pattern.*
- *It can improve uniformity of application due to determination of optimum overlap distance.*

Disadvantages

- *It is time consuming to measure distance traveled and do the calculations.*
- *You have to know the weight of a load of manure and fill every load to that amount.*

Lay the tarp on the field and secure it. Drive at the desired speed over the center of the tarp. (Four mph is too slow and 8 mph is approaching an unsafe speed.) If there is overlap from adjacent passes, the tarp should remain secure until the adjacent passes are complete.

Depending on how sticky the manure is, there are two options to weigh it:

1. If it is dry, carefully pull up the tarp and pour the manure into the bucket. Weigh the bucket and manure. Subtract the weight of the empty bucket.This yields the pounds of manure applied to the tarp.
2. If it is sticky, carefully pull up the tarp, fold it, and place all the materials in the bucket. Weigh the bucket with the tarp and manure. Subtract the weight of the tarp and bucket to determine the weight of the manure applied to each tarp.

Repeat this at least three times (or use three tarps) to determine an average weight applied by the spreader. Our research has shown up to 30 percent variation from one tarp to the next, so repetition is critical to accurately determine the average application rate. If the size of the tarp is 6 ft x 6 ft, 8 ft x 8 ft, 10 ft x 10 ft, or 10 ft x 12 ft, the application rate can be determined by using Table 1. If the tarp is a different size than shown in Table 1, then calculate the manure application rate in tons per acre according to this formula:

$$\frac{\text{Lbs manure on tarp}}{\text{Tarp area (ft}^2\text{)}} \times \frac{43{,}650 \text{ ft}^2}{\text{acre}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = \frac{\text{Application rate}}{\text{(tons/acre)}}$$

Swath Width and Distance Method

This method uses the swath width of your spreader and the distance that it takes to spread a given amount of manure. The swath width and distance method also helps you determine the amount of overlap needed to get a uniform spread pattern across the field.

You need to know the amount of manure in a spreader load and keep it about the same for every load. This requires a load scale to weigh the spreader during loading. You also need a bucket; five tarps; a flag; a scale with a capacity of about 50 to 100 lbs; a tape, wheel or other device to measure the distance traveled; graph paper; and a ruler.

1. Weigh the individual tarps and bucket.
2. Lay the tarps in a line perpendicular to the travel of the spreader (Figure 1). Fasten the tarps to the ground at each corner, overlapping about 1 inch.
3. Put a flag in the ground to mark the middle of the center tarp. This helps the driver center the spreader while driving over the tarps.
4. Drive the spreader over the tarps at normal operating speed.
5. Weigh the manure as described for the tarp method.
6. Calculate the lbs manure per square foot of tarp by using this formula:

   $$\frac{\text{Lbs manure on each tarp}}{\text{Tarp area (ft}^2\text{)}} = \text{Amount of manure per square foot}$$

7. Plot the calculated weights on a graph (Figure 2).The "y" axis is the amount of manure per square foot and the "x" axis is the distance from the center of the spreader to the center of the tarps. The effective swath width is the distance on the "x" axis where the "y" value is half of the maximum. By overlapping swaths on each trip up and down the field, a more even distribution can be achieved.

   Plotting the swath width allows identification of uneven patterns of manure distribution, a benefit not seen in a visual inspection.

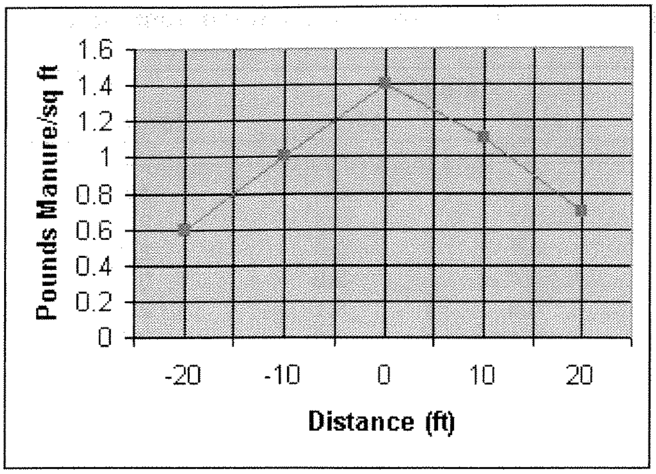

Figure 2: Plot the amount per square foot on the "y" axis at the point on the "x" axis that is the center of that tarp. Example shown above. Distance in feet is from center of spread pattern. (Hammond and Adkins, 1994.)

This helps the operator make corrections in the spread pattern and prevents excessive overlapping of manure as it is spread on the field.

Example: Tarps used were 10 ft x 10 ft square, and manure weights on each tarp (from step 6) were:

Tarp:	A	B	C	D	E
Weight (lbs manure/ft^2)	0.6	1.0	1.4	1.1	0.7

The center tarp is considered distance zero. Since the tarps were 10 ft wide, the tarp positions based on their widths would be -20, -10, 0, 10, and 20. See Figure 2.

The spread pattern is slightly off balance. The right side has slightly higher weights than the left side. Since the maximum is 1.4 lbs/sq ft, half of that would be 0.7 lbs/sq ft. If we look for the distance when the poundage is 0.7, we'll find the swath width. On the left side, we see a swath width of 17.5 ft; on the right side it is 20 ft. If we average the two, we get a swath width of 18.8 ft or about 19 ft.

8. After determining the width of the swath, measure the distance that it takes to spread a known amount of manure. This can be done with a measuring wheel or tape. After measuring the distance, use this formula to calculate the application rate:

$$\frac{\text{Spreader net weight (lb)} \times 22^*}{\text{Distance traveled (ft)} \times \text{width (ft)}} = \text{Application rate (tons/acre)}$$

*22 is a factor for converting pounds to tons and square feet to acres.

Loads per Field Method

Advantages

- *It is easy to do.*
- *It takes very little time.*
- *It gives an average application rate for the entire field.*

Disadvantages

- *It doesn't show the variability of the application rate.*
- *It gives the rate after the application is complete.*
- *You must weigh several loads.*

Loads per Field Method

This method is the easiest to do and gives a good average field application rate.

1. Measure the size of the field.
2. Weigh at least three loads and calculate the average weight.
3. Count the number of loads applied to the field.
4. Divide the amount of manure (tons per load times number of loads) by the acres in the field to get an average rate applied to the field:

Tons/load x No. of loads/no. of acres = Application rate (tons/acre)

This method estimates the application rate after the manure has been applied and assumes that the manure is spread uniformly across the field. Uniformity of application depends on the commitment of the operator, variability and moisture content of the manure, and spreader characteristics.

Conclusion

Calibration is essential to know the rate of manure nutrient application. The best calibration method for you depends on your operation. By using one of these methods you can reduce over-fertilization of crops and lower the potential for nitrate leaching. Because of environmental concerns and fertilizer costs, producers can no longer overlook over-application. Good record keeping also helps you more effectively manage nutrient application.

References

Hammond, Cecil and Wayne Adkins. October 1994. Calibration of manure spreader including swath width. *University of Georgia.Circular 825.*

Koelsch, Rick. 1995. Manure applicator calibration. *University of Nebraska. NebGuide G95-1267-A.*

Manel, Karen. 1996. Land application of waste...spreading and injection. *Ohio State University Bulletin AEX-707.*

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

Lbs of manure	Tarp size			
applied to tarp	6′x6′	8′x8′	10′x10′	10′x12′
	--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

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