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# Calibrating Manure Spreaders

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Land application of livestock manure is receiving increased attention for environmental and economic reasons. It is often assumed that producers estimate their application rates correctly. However, it has been found through a series of Minnesota Department of Agriculture (MDA) and University of Minnesota Extension Service surveys in the 1990s that many Minnesota producers—especially livestock producers—are applying excessive amounts of nutrients to crop fields.

The over-application of nutrients is especially a problem with solid manure, where differences between estimated and actual manure application rates may be 50% or more. For instance, a producer may estimate that his application rate is 15 tons per acre but upon spreader calibration he may find that it is actually 20 or even 25 tons per acre.

Applying excessive amounts of nutrients can represent a hazard to ground water and surface water; moreover, the over-applications reduce the economic efficiency of crop production. Based on MDA surveys, producers can reduce fertilizer costs by \$5 to \$15 per acre by improving nutrient management.

## *Know your manure application rate*

Knowing your manure application rate is a critical component of manure application planning. Using load cells\* is a fast, economical way of calculating manure application rates. This publication describes how manure applicators can use load cells to answer the following questions:

### What is my current manure application rate?

There are two methods for determining your current manure application rate. Use method 1 if you have already applied the manure and know how many loads were applied to the field. Use method 2 if you want to determine the application rate based on the area covered by a single load of manure.

**Method 1.     Based on Loads Applied per Field**

Instructions:   Complete Section 1 and Section 2

**Method 2.     Based on Acres Covered by One Load**

Instructions:   Complete Section 1 and Section 3

### How can I apply manure at my target manure application rate?

In order to answer this question, you must have a target manure application rate already calculated. Your target rate can be applied either by determining the number of loads needed per field (method 1) or by determining the distance the spreader needs to travel per load (method 2).

**Method 1.     Loads Needed per Field**

Instructions:   Complete Section 1 and Section 4

**Method 2.     Distance Traveled per Load**

Instructions:   Complete Section 1 and Section 5

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\*Load cells are portable scales that may be available through your local University of Minnesota Extension Office, Soil and Water Conservation District or local NRCS office. Some crop consultants may also have load cells.

## Section 1. Calculate the Tons or 1,000-Gallons of Manure per Load

### Determine Manure Weight

Procedure:

1. Place load cells in front of manure spreader tires (Figure 1).
2. Turn on load cells. If load cells don't read zero, press the "zero test" button to reset the load cell.
3. Pull manure spreader tires up onto the load cells, making sure that the tire weight is completely supported by the load cell.
4. With the manure spreader still hitched to the tractor, place an additional load cell beneath the tongue of the manure spreader. Place a jack on the load cell and raise the tongue up with a jack until the manure spreader tongue weight is off the tractor hitch (Figure 2).
5. Record the load cell weights for each load cell on the chart to the right.
6. Complete steps 1-5 for empty and full manure spreaders.
7. Subtract empty manure spreader weights from full weights to determine pounds of manure per load.

**Table 1. Pounds of manure per load**

Load Cell	Empty Weight (lbs.)	Full Weight (lbs.)
1		
2	+	+
3	+	+
4	+	+
5	+	+
<b>Totals</b>	=	=
Total Full (lbs.)		
Total Empty (lbs.)		-
<b>Lbs. of Manure per Load</b>		=

### Calculate Tons or 1,000-Gallons of Manure

Procedure:

1. Enter the pounds of manure per load from Table 1 into the first row of Table 2.
2. Divide pounds of manure per load by pounds per ton (solid manure) or by pounds per thousand-gallon units (liquid manure).

For solid manure:

Divide pounds of manure per load by 2,000 to determine tons of manure.

For liquid manure:

Divide pounds of manure per load by 8,300 to determine amount in 1000-gallon units.

**Table 2. Tons or 1,000-gallons per load**

Lbs. of Manure per Load	
Lbs. per ton or Lbs. per 1,000-gal.	/
<b>Tons or 1000-gal. per Load</b>	=



Figure 1. Load cells placed in front of manure spreader tires.



Figure 2. A jack placed on the load cell supports the weight of the spreader.

## Section 2. Calculate Rate Based on Loads Applied per Field

Procedure:

1. Multiply the number of loads applied to a field or area by the tons or 1,000-gallons per load to determine the tons or 1,000-gallons applied to the field.
2. Divide the tons or 1,000-gallons applied to the field by the acres in the field to determine the manure application rate.

Table 3. Application rate based on loads per field

Loads Applied to Field	
Tons or 1,000-gal. per Load	x
Tons or 1,000-gal. Applied to Field =	
Acres in Field	/
Application Rate per Acre =	

## Section 3. Calculate Rate Based on Acres Covered per Load

### Determine Acres Covered by One Spreader Load

Procedure:

1. Multiply the total distance traveled by the spreader by the width of the spread to determine the total area covered.
2. Divide the total area covered by 43,560 to get acres covered per load.

### Determine Manure Application Rate

Procedure:

Divide the tons or 1,000-gallons per load by the acres covered per load to determine the application rate per acre (tons or 1,000-gal./acre).

Table 4. Acres covered per load

Total Distance Traveled (ft)	
Width of Spread (ft)	x
Total Area Covered (ft <sup>2</sup> ) =	
Square Feet per Acre	/
43,560	
Acres Covered per Load =	

Table 5. Application rate based on acres covered

Tons or 1,000-gal. per Load	
Acres Covered per Load	/
Application Rate per Acre =	

## Section 4. Calculate Loads Needed per Field for Target Application Rate

Procedure:

1. Multiply target rate (tons or 1,000-gal.) by acres in field to determine the total manure needed (tons or 1,000-gal.).
2. Divide total manure needed by tons or 1,000-gal. of manure per load to determine the loads needed to meet target rate.

**Table 6. Loads needed for target rate**

Target Rate per Acre			
Acres in Field	x		
Total Manure Needed	=		
Tons or 1,000-gal. per Load	/		
<b>Loads Needed</b>	<b>=</b>		

## Section 5. Calculate the Distance Traveled per Load for Target Application Rate

Procedure:

1. Divide the tons or 1,000-gallons per load by the target application rate per acre. This gives acres covered per load.
2. Take acres per load and multiply by 43,560 to determine the square feet covered per load.
3. Divide square feet per load by the width of spread. The result is the required distance per load that must be traveled to apply at the target rate.

Adjust gate opening or tractor speed (while traveling the determined distance) to adjust spread rate.

**Table 7. Required distance for target rate**

Tons or 1,000-gal. per Load			
Target Application Rate	/		
Acres per Load	=		
Square Feet per Acre	x	43,560	
Square Feet per Load	=		
Width of Spread	/		
<b>Required Distance per Load</b>	<b>=</b>		