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Soil Fertility Guide

MARYLAND DEPARTMENT OF AGRICULTURE

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EC-4

CALIBRATION OF A MANURE SPREADER USING THE LOAD-AREA METHOD (WITH DRIVE-ON SCALES)

Introduction

Calibration is a way of checking and/or adjusting a manure spreader to ensure that a nutrient source is being applied uniformly and at the desired rate. It is important to properly calibrate a manure spreader to minimize the potential for over- or under-applying nutrients to your crops.

The load-area method is a reliable method of calibrating manure spreaders when using solid and semi-solid manure. This method requires knowledge of the spreader capacity. It involves spreading several loads with the spreader filled to capacity, using the same spreader settings and tractor speed. The area spread (which we will refer to as the ***application area*** for the rest of this publication) is then measured for each load, and the application rate for each application area is calculated. The average application rate for all loads is then projected to a per-acre basis.

Manure application rates across a field for some types of spreaders can be quite variable even at the same ground speed and with identical equipment settings. Multiple measurements of actual application rates are required to ensure that the calculated average rate is truly representative of the average rate across the field.

> **NOTE:** A minimum of three measurements is recommended for the load-area method of calibration.

Before continuing, determine the spread pattern of the spreader. For some spreaders, the swath width is the width of the spreader. For spinner spreaders, spreaders with vertical beaters and many liquid spreaders, material is spread for some distance on each side of the spreader and the ***effective swath width*** must be determined to maximize application uniformity. Consult EC-1, "Calibration of Manure Spreaders: Uniformity, Spread Patterns and Effective Swath Width," in the *Soil Fertility Guide* series for information.

Weather Conditions

It is important to take note of the weather conditions before conducting a calibration. If the weather is windy or rainy, it would be a good idea to reschedule the spreader calibration for a different day as both of these conditions can affect the accuracy of your measurements.

Using the Load-area Method

The following equipment is needed to perform the load-area method of calibration:

- farm or truck scales
- tape measure and/or measuring wheel

The steps for using the load-area method of calibration are as follows:

Step 1. Make note of equipment settings using the information at the top of the worksheet on page 6 as a guide for the kind of information you want to track. Record these settings on the top of the worksheet.

In addition to recording equipment settings, use the worksheet to record calibration data. Calculations used in the load-area method are provided on the worksheet.

Step 2. In order to determine the load weight, the equipment must be weighed when empty and again when fully loaded. **The full weight minus the empty weight equals the load weight.**

NOTE: Manure spreaders should be weighed on a level and hard-packed surface. Weighing on a slope can cause a shift in the center of gravity or cause the load to shift, resulting in weight measurement errors.

1. Place the scales in the weighing position.

2. Zero out each scale.

3. Move the equipment so that the tires are resting on the weighing platforms.

Note 1: Care should be taken to ensure that each tire is positioned correctly on the weighing platforms. Under-inflated tires may cause a portion of the weight to rest on the base of the scale and cause error.
Note 2: Each axle must be weighed separately. For example, a two-axle manure spreader pulled by a tractor would require four axle weight measurements.
Note 3: Only the outside tires need to be weighed on axles having dual sets of tires. However, care should be taken to ensure that the inside tires clear the ground. An under-inflated outside tire might allow an inside tire to touch the ground and cause error.
Note 4: Leveling blocks are required when weighing tandem-axle equipment. Scales are placed under the first axle, leveling blocks under the second axle, and the weight is recorded. The position of the scales and leveling blocks are then reversed and the weight of the second axle is recorded.

4. Weigh each axle separately when the spreader is empty. Record each axle weight in the appropriate Appendix. **Appendix A is for 2-axle spreaders** and **Appendix B is for 3-axle spreaders**.

Add each weight together and record the total empty spreader weight in pounds on line **A1** of the worksheet. Repeat this step for when the spreader is full. Record the total full spreader weight in pounds on line **A2** of the worksheet.

Calculate the total weight of the manure in pounds. Enter the value on line **A3** of the worksheet.

Step 3. Spread a load of manure on the desired field. If possible, spread the manure in a rectangle or square for easier calculation of the area treated. Use the effective swath width that you have previously determined is necessary to maximize application uniformity (refer to EC-1, "Calibration of Manure Spreaders: Uniformity, Spread Patterns and Effective Swath Width").

Step 4. Measure the length and width of the application area in feet and enter the values on lines **B1** and **B2**, respectively, of the worksheet.

Step 5. Calculate the application area in square feet. Enter the value on line **B3** of the worksheet.

Step 6. Calculate the application rate in pounds per square feet. Enter the value on line **C1** of the worksheet.

Step 7. Repeat Steps 1 through 6 for two more loads of manure.

Step 8. Calculate the average application rate in pounds per square feet. Enter the value on line **C2** of the worksheet.

NOTE: If a large difference in application rates between loads is noticed and can be attributed to equipment malfunction, do not include that rate in the average.

Step 9. Convert the average application rate in pounds per square feet to tons per acre. Enter the value on line **C3** of the worksheet.

If the current application rate is different from the recommended application rate, adjust the settings on the manure spreader or change your driving speed to increase or decrease the application rate, as needed. Repeat the calibration procedure until you identify the tractor speed and manure spreader settings that will enable you to approximate the recommended application rate. Maryland Department of Agriculture (MDA) policy requires that the average application rate should be within 10% of the recommended rate.

Two copies of the worksheet are included so all data for each calibration attempt can be recorded.

Recalibrating the Spreader

For manure spreaders handling solid or semi-solid manures, recalibrate whenever the consistency of a manure is different from the manure used for the last calibration. Consistency of manure can vary due to changes in any of the following:

- bedding
- feed components
- manure management practices
- any factor that affects the moisture content of manure

Application rates change over time as equipment gets older and components wear. Periodic recalibration of equipment is encouraged even if all factors appear to be similar.

Record Keeping

Keep calibration worksheets and nutrient application records with your nutrient management plan. This information will be needed in the event that MDA conducts a plan implementation review.

Reference

Brodie, H. L. and G. L. Smith. 1993. *Calibrating Manure Spreaders*. Fact Sheet 419. University of Maryland Extension, Maryland Institute for Agriculture and Natural Resources, College Park, MD 20742.

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WORKSHEET
EC-4, "Calibration of a Manure Spreader Using the Load-area Method (with Drive-on Scales)"

Tractor_____ Spreader model_____ Ground speed_____

Gear_____ Gate setting_____ PTO_____

Other_____ Date of spreader calibration_____

(**A**) calculation of manure weight (lbs)

A1) total empty spreader weight (lbs)			
	load 1	load 2	load 3
A2) total full spreader weight (lbs)			
A3) total manure weight (lbs) (**A2** - **A1** = **A3**)			

(**B**) calculation of application area (sq ft)

	application area 1	application area 2	application area 3
B1) length of application area (ft)			
B2) width of application area (ft)			
B3) application area (sq ft) (**B1** x **B2** = **B3**)			

(**C**) calculation of application rate (t/ac)

	application area 1	application area 2	application area 3
C1) application rate (lbs/sq ft) (**A3** / **B3** = **C1**)	**(a)**	**(b)**	**(c)**
C2) average application rate (lbs/sq ft) (see line **C1)** ([(**a**) + (**b**) + (**c**)] / **3** = **C2**) where 3 = number of application areas			
C3) application rate (t/ac) ([**C2** x **43,560**] / **2,000** = **C3**) where 1 acre = 43,560 square feet and 1 ton = 2,000 pounds			

WORKSHEET
EC-4, "Calibration of a Manure Spreader Using the Load-area Method (with Drive-on Scales)"

Tractor_____ Spreader model_____ Ground speed_____

Gear_____ Gate setting_____ PTO_____

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(**A**) calculation of manure weight (lbs)

A1) total empty spreader weight (lbs)			
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A2) total full spreader weight (lbs)			
A3) total manure weight (lbs) (**A2** - **A1** = **A3**)			

(**B**) calculation of application area (sq ft)

	application area 1	application area 2	application area 3
B1) length of application area (ft)			
B2) width of application area (ft)			
B3) application area (sq ft) (**B1** x **B2** = **B3**)			

(**C**) calculation of application rate (t/ac)

	application area 1	application area 2	application area 3
C1) application rate (lbs/sq ft) (**A3** / **B3** = **C1**)	**(a)**	**(b)**	**(c)**
C2) average application rate (lbs/sq ft) (see line **C1)** ([(**a**) + (**b**) + (**c**)] / **3** = **C2**) where 3 = number of application areas			
C3) application rate (t/ac) ([**C2** x **43,560**] / **2,000** = **C3**) where 1 acre = 43,560 square feet and 1 ton = 2,000 pounds			

APPENDIX A
Recording Weights for Spreaders with 2 Axles (3 Loads)

EMPTY WEIGHT (LBS)

	TRACTOR		SPREADER	
AXLE	FRONT	REAR	FRONT	REAR
RIGHT				
LEFT				
TOTAL WEIGHT				

TOTAL EMPTY WEIGHT (LBS):________________________________

FULL WEIGHT (LBS)

	TRACTOR		SPREADER	
AXLE	FRONT	REAR	FRONT	REAR
RIGHT				
LEFT				
TOTAL WEIGHT				

TOTAL FULL WEIGHT (LBS):________________________________

FULL WEIGHT (LBS)

	TRACTOR		SPREADER	
AXLE	FRONT	REAR	FRONT	REAR
RIGHT				
LEFT				
TOTAL WEIGHT				

TOTAL FULL WEIGHT (LBS):________________________________

FULL WEIGHT (LBS)

	TRACTOR		SPREADER	
AXLE	FRONT	REAR	FRONT	REAR
RIGHT				
LEFT				
TOTAL WEIGHT				

TOTAL FULL WEIGHT (LBS):________________________________

APPENDIX B
Recording Weights for Spreaders with 3 Axles (3 Loads)

EMPTY WEIGHT (LBS)

	TRACTOR		SPREADER		
AXLE	FRONT	REAR	FRONT	REAR	REAR
RIGHT					
LEFT					
TOTAL WEIGHT					

TOTAL EMPTY WEIGHT (LBS):____________________________________

FULL WEIGHT (LBS)

	TRACTOR		SPREADER		
AXLE	FRONT	REAR	FRONT	REAR	REAR
RIGHT					
LEFT					
TOTAL WEIGHT					

TOTAL FULL WEIGHT (LBS):____________________________________

FULL WEIGHT (LBS)

	TRACTOR		SPREADER		
AXLE	FRONT	REAR	FRONT	REAR	REAR
RIGHT					
LEFT					
TOTAL WEIGHT					

TOTAL FULL WEIGHT (LBS):____________________________________

FULL WEIGHT (LBS)

	TRACTOR		SPREADER		
AXLE	FRONT	REAR	FRONT	REAR	REAR
RIGHT					
LEFT					
TOTAL WEIGHT					

TOTAL FULL WEIGHT (LBS):____________________________________