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Soil Fertility Guide

MARYLAND DEPARTMENT OF AGRICULTURE

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EC-5

CALIBRATION OF A MANURE SPREADER USING THE LOAD-AREA METHOD (WITH ESTIMATION OF DENSITY AND LOAD WEIGHT)

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 box spreaders, the swath width is the width of the spreader. For spinner spreaders and spreaders with vertical beaters, 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:

- 5-gallon bucket
- tape measure and/or measuring wheel
- scale (with a capacity of 50 pounds and accuracy to a tenth of a pound)
- equipment manual or University of Maryland Extension (UME) Fact Sheet 176, "Determining the Amount of Manure in a Pile or a Pool"

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. Calculate the density of the manure in pounds per cubic feet.

a) Weigh an empty 5-gallon bucket. Record the weight in pounds on line **A1** of the worksheet.
b) Fill a 5-gallon bucket with manure, level to the top. Pack the manure to the same density as in the spreader. Weigh the bucket filled with manure and record the weight in pounds on line **A2** of the worksheet under bucket 1.
c) Repeat Step 2(b) two more times and record the weights of the manure-filled buckets in pounds on line **A2** of the worksheet under bucket 2 and bucket 3.
d) Calculate the total weight of manure for each bucket in pounds. Enter the values on line **A3** of the worksheet under bucket 1, bucket 2, and bucket 3.
e) Calculate the average weight of manure in pounds. Enter the value on line **A4** of the worksheet.
f) Calculate the average density of manure in pounds per cubic feet. Enter the value on line **A5** of the worksheet.

Step 3. Calculate the volume of the manure spreader in cubic feet.

To determine the volume of the manure spreader, consult the equipment manual or refer to University of Maryland Extension Fact Sheet 176, "Determining the Amount of Manure in a Pile or a Pool," for an explanation of how to determine manure spreader volume. Record any volume calculations and keep with your calibration worksheets. Enter the value on line **B1** of the worksheet.

Step 4. Calculate the weight of the manure in the spreader in pounds. Enter the value on line **C1** of the worksheet.

Step 5. 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 6. Measure the length and width of the application area in feet and enter the values on lines **D1** and **D2**, respectively, of the worksheet.

Step 7. Calculate the application area in square feet. Enter the value on line **D3** of the worksheet.

Step 8. Calculate the application rate in pounds per square feet. Enter the value on line **E1** of the worksheet.

Step 9. Convert the application rate to tons per acre. Enter the value on line **E2** of the worksheet.

Step 10. Repeat Steps 5 through 9 for two more loads of manure.

Step 11. Calculate the average application rate in tons per acre. Enter the value on line **E3** 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.

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.

References

Brodie, H. L. 1990. *Determining the Amount of Manure in a Pile or a Pool*. Fact Sheet 176. University of Maryland Extension, Department of Biological Resources Engineering, College Park, MD 20742.

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-5, "Calibration of a Manure Spreader Using the Load-area Method (with Estimation of Density and Load Weight)"

Tractor_____ Spreader model_____ Ground speed_____

Gear_____ Gate setting_____ PTO_____

Apron chain setting_____ Other_____Date of spreader calibration_____

(**A**) calculation of manure density (lbs/cu ft)

A1) weight of 5-gallon bucket (lbs)			
	bucket 1	bucket 2	bucket 3
A2) weight of manure and bucket (lbs)			
A3) total weight of manure (lbs) (**A2** - **A1** = **A3**)	**(a)**	**(b)**	**(c)**
A4) average weight of manure (lbs) (see line **A3**) ([(**a**) + (**b**) + (**c**)] / **3** = **A4**) where 3 = number of buckets			
A5) manure density (lbs/cu ft) (**A4** / **0.667** = **A5**) where volume of a 5-gallon bucket = 0.667 cubic feet			

(**B**) calculation of spreader volume (cu ft)

B1) spreader volume (cu ft) (Refer to equipment manual or UME Fact Sheet 176 for guidance.)	

(**C**) calculation of manure weight in spreader (lbs)

C1) manure weight in spreader (lbs) (**A5** x **B1** = **C1**)	

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

	application area 1	application area 2	application area 3
D1) length of application area (ft)			
D2) width of application area (ft)			
D3) application area (sq ft) (**D1** x **D2** = **D3**)			

(**E**) calculation of average application rate (t/ac)

E1) application rate (lbs/sq ft) (**C1** / **D3** = **E1**)			
E2) application rate (t/ac) ([**E1** x **43,560**] / **2,000** = **E2**) where 1 acre = 43,560 square feet and 1 ton = 2,000 pounds	**(d)**	**(e)**	**(f)**
E3) average application rate (t/ac) (see line **E2**) ([(**d**) + (**e**) + (**f**)] / **3** = **E3**) where 3 = number of loads			

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