UtahStateUniversity
COOPERATIVE EXTENSION

Reviewed December 2010

Calibrating and Operating Manure Spreaders

Process Improvement for Animal Feeding Operations

AEMS
Agriculture Environmental Management Systems

Rich Koenig, Soil Fertility Specialist
Washington State University

Kerry Goodrich, Conservation Agronomist
USDA Natural Resources Conservation Service

John D. Harrison, Agriculture Waste Management Specialist
2300 Old Main Hill, Logan, UT 84322-2300
Telephone: (435) 797-3396
Coordinates: jdh@cc.usu.edu

Determining the agronomic rate of manure and wastewater application is important for nutrient management planning. However, manure and wastewater application equipment must also be calibrated to insure that nutrients are applied at agronomic rates. The purpose of this guide is to outline simplified methods to calibrate manure spreaders. The methods described in this guide are based on determining the load (or amount of manure in the spreader) and area covered by the load. This guide can be used alone or as a companion guide to the video titled *Calibrating Manure Spreaders*. The video can be viewed or ordered at http://aems.aste.usu.edu.

Solid spreaders

Solid manure spreaders discharge at varying rates depending on ground and PTO speeds, equipment settings and manure moisture content. Solid spreaders should be calibrated during normal manure application times (e.g., spring or fall) and re-calibrated whenever a new source of manure with different moisture content and/or bedding material is used.

BOX 1. Formula for calculating manure volume in solid spreaders

Box spreader (level load):
Volume (cubic ft) = length (ft) x width (ft) x depth (ft)

Box spreader (piled load):
Volume (cubic ft) = length (ft) x width (ft) x depth (ft) + (stacking height (ft) x 0.8)*

*stacking height is the height of any mounded manure above the sides of the spreader

Box spreader (bucket method):
Spreader load (tons) = weight of 5 gallons of manure (lbs) x 1.5 x spreader volume (cubic feet) ÷ 2000

To calibrate solid manure spreaders first determine how much manure is in a load. Fill the unit with a standard load and weigh the contents. Subtract the tare (empty) weight of the spreader from the total loaded weight. Several loads should be weighed to determine an average load weight.

If scales are not available to weigh a spreader, use the following alternative method based on spreader volume and manure density. First, calculate the volume (in cubic feet) of manure in the spreader by using one of the formulas given in Box 1. Second, fill and weigh a 5 gallon bucket of manure. Now, take the weight of manure in the 5 gallon bucket and multiply by 1.5 to estimate manure density in lbs/cubic foot. Finally, multiply density in lbs/cubic

foot by the manure volume in cubic feet to determine the total pounds in the load. Divide the pounds in the load by 2000 to convert to tons in the load.

Next, estimate the distance in feet required to spread the entire load. Distance can be measured or estimated based on known field lengths or by counting fence posts along the length of the spread and multiplying by the average distance between posts. Also estimate the width of spread in feet, allowing 10 to 20% overlap between passes to insure uniform coverage. Multiply the length by the width and divide by 43,560 to convert to acres.

Finally, divide the weight of manure in the spreader by the area covered to determine the application rate at this setting. If necessary re-adjust spreader settings and calibrate again for different application rates.

Worksheet 1 summarizes the procedure for calibrating solid manure spreaders. Enter information on the appropriate lines to calculate the application rate. Retain copies of this worksheet for your records and for future reference on spreader application rates.

Spreader: _____ **Date:** _____

1. Load weight (tons) _____

2. Distance traveled to spread one load (ft) _____

3. Width of spread (ft) _____

4. Area of spread (ft^2) (multiply line 2 by line 3) _____ sq ft

5. Acres covered (divide line 4 by 43,560) _____ acres

6. Application rate (divide line 1 by line 5) _____ tons/acre

Notes on spreader settings:

Worksheet 1. Solid manure spreader calibration worksheet.

Slurry/liquid spreaders

Slurry and liquid spreaders also discharge at varying rates depending on ground and PTO speeds, equipment settings, and manure solids content. Slurry and liquid spreaders should be calibrated during normal manure application times (e.g., spring or fall) and re-calibrated whenever a new source of manure with a different solid content is used. Agitating slurries and liquids before spreading ensures a more uniform material for each spreading event.

To calibrate liquid/slurry spreaders, first determine the volume of material in gallons from manufacturer specifications, or use one of the formulas given in Box 2. If necessary, convert from cubic feet to gallons by multiplying volume by 7.5.

BOX 2. Formula for calculating manure volume in slurry/liquid spreaders

Flail spreader (level load):
Volume (cubic feet) = length (ft) x depth (ft) x depth (ft) x 1.6

Volume (gallons) = length (ft) x depth (ft) x depth (ft) x 1.6 x 7.5

Round tank spreader:
Volume (cubic feet) = length (ft) x tank diameter (ft) x tank diameter (ft) x 0.8

Volume (gallons) = length (ft) x tank diameter (ft) x tank diameter (ft) x 0.8 x 7.5

Next, estimate the distance in feet required to spread the entire load. Distance can be measured or estimated based on known field length or by counting fence posts along the length of the spread and multiplying by the average distance between posts.

Also estimate the width of spread in feet, allowing 10 to 20% overlap between passes to insure uniform coverage. Multiply the length by the width and divide by 43,560 to convert to acres. Finally, divide the volume of manure in the spreader by the area covered to determine the application rate at this setting. If necessary re-adjust spreader settings and calibrate for different rates.

Worksheet 2 summarizes the procedure for calibrating slurry and liquid manure spreaders. Enter information on the appropriate lines to calculate the application rate. Retain copies of this worksheet for your records and for future reference on spreader application rates.

Spreader: _____ Date: _____

1. Load amount (gallons) _____

2. Distance traveled to spread one load (ft) _____

3. Width of spread (ft) _____

4. Area of spread (ft^2) (multiply line 2 by line 3) _____ sq ft

5. Acres covered (divide line 4 by 43,560) _____ acres

6. Application rate (divide line 1 by line 5) _____ gallons/acre

Notes on spreader settings:

Worksheet 2. Liquid/slurry manure spreader calibration worksheet.

Sprinkler systems

Design specifications for the sprinkler system may be used to estimate liquid application rates. An alternative method is to place straight-sided catch cans at various locations under the sprinkler system. Measure the depth of liquid in inches accumulated in the cans over a period of time (e.g., 1 hour). Calculate the average depth of liquid in the cans and divide by the time interval to determine application rates in inches per hour. Multiply by the total hours the system is run to get total inches applied.

Operation of manure spreaders

Proper operation of spreaders is as important as calibration to insure accurate application rates. Uniform spreading is essential to obtain uniform rates of nutrients for crop growth. Recent research has shown that variations in manure spreading can be substantial, but that relatively simple changes in spreading practices can significantly improve nutrient distribution. Consider the following points when applying manure through spreaders:

- Operate spreaders at the PTO speed specified by the manufacturer. The correct PTO speed optimizes manure output and the uniformity of spreading.
- Maintain spreaders by removing twine and other materials from beater paddles, cleaning the floor and lubricating where necessary.
- Load spreaders uniformly.
- Annually alternate spreading patterns in fields. Enter the field and begin spreading from a different gate each year or vary the angle of spreading 45 or 90 degrees each year.
- Spread in one direction and till the field in a direction 90 degrees from the direction of spreading.
- Reduce ground speed as the spreader nears the end of its load to insure more uniform application.

Adapted from the following source materials

Koelsch, R. 1995. Manure applicator calibration. University of Nebraska Cooperative Extension NebGuide G95-1267-A.

Koenig, R., K. Goodrich, and Harrison, J. D. 2002. Comprehensive Nutrient Management Planning: A 12 Step Guide. Utah State CAFO Committee, Utah State University Extension, 20pp.

Sheffield, R. 2001. Livestock and Poultry Environmental Stewardship Curriculum, Lesson 36. MidWest Plan Service, Iowa State University, Ames, Iowa. 48pp.

This publication and the companion video titled Calibrating Manure Spreaders were made possible with a grant from the United States Environmental Protection Agency.