Solid Manure Spreader Calibration

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Animal manure contains nutrients required for plant growth and has been utilized as a fertilizer source for millennia. Efficient utilization of animal manure requires both a manure nutrient analysis to determine the nutrient levels in the manure and application at the correct rate based on this information to provide the nutrients required by the crop. Simply estimating the amount of manure applied and the area the manure is applied to can easily result in under-application of necessary nutrients, resulting in poor crop yields, or over-application of the same, resulting in waste of nutrients, possible surface or ground water quality impacts, and in some cases nutrient imbalances that may also negatively impact crop yields.

Manure Analysis

A manure nutrient analysis may be obtained from the Clemson Agricultural Service Laboratory. The laboratory will analyze any manure sample for primary and secondary nutrients as well as many micronutrients. Manure samples should be refrigerated until they are shipped to the laboratory to help prevent degradation due to microbial activity. One quart of manure placed in a sealed household freezer bag is required to complete the analysis, which currently costs $33.00.

The manure analysis results should be used to determine how much manure should be applied. This is done in conjunction with a soil sample of the field to be planted, which will provide the current nutrient levels in the field and the recommended amounts of nutrients to be added to the field based on the crop to be grown. More information on this procedure may be found in the factsheet “Land Application of Animal Manure” (1), and in Chapters 5 and 6 of the Confined Animal Manure Manager (CAMM) manuals (2).

There are two commonly used methods of solid manure spreader calibration – the Container Method and the Sheet Method. Both methods use similar procedures and are presented in this factsheet.

Solid Manure Spreader Calibration - The Container Method

The container method requires five to seven equally-sized containers (shoebox-sized plastic containers work well), a tape measure, and a postal scale. The scale must be an accurate scale, such as a postal scale, since the collected manure must be weighed to the nearest tenth of a pound (or ounce) for an accurate measurement. A worksheet that may be used for the Container Method is attached to this factsheet. An example calibration calculation is included in the steps below for better understanding.

Step 1. Weigh the Containers
Weigh all of the containers to be used while empty, before they are used, with the postal scale. The containers do not need to be weighed individually, but may be weighed together if the combined weight does not exceed the scale capacity – a total empty container weight is the number needed. If the weight is provided in pounds and ounces by the scale, divide the ounces by 16 to get a decimal number. Record this weight.

Example: 7 containers were used, with a total weight of 5 pounds, 4.8 ounces. Divide 4.8 ounces by 16 to get (4.8/16=) 0.3 pounds, so the total weight is 5.3 pounds.
Step 2. Determine the Spreading Width
Determine the normal spreading width of the manure spreader. This will vary depending on the moisture content of the manure to be spread, the type of spreader used, and the gate and spinner settings of the spreader.

Step 3. Place Containers
Place the containers in a line across the pathway of the planned track of the spreader (Figure 2). These containers should not be placed at the extreme edges of the spread pattern, but in the center and placed equally to approximately 70% of the total spread pattern. Placing containers at the extreme edge of the spread pattern will provide a lower calculated application rate than the actual rate applied. Be sure to place the containers out of the path of the spreader tires.

Step 4. Select a Speed
Select a gear and engine speed to be used during the calibration. These settings should be the same ones used during normal spreading operation. Also select the floor chain speed setting and gate setting. Mark these settings down for reference.

Step 5. Apply Manure
Start the manure spreader some distance from the containers to allow it to reach the speed desired and a normal spreading pattern. Drive the spreader over the containers, continuing past until the manure from the spreader is no longer reaching the containers.

Step 6. Weigh the Containers
Collect the containers. Weigh the containers with the collected manure in them. If the weight of all of the containers exceeds the capacity of the scale, weigh two or three groups of containers, then add the weights together to obtain the total weight of the containers and manure. If the weight is provided in pounds and ounces by the scale, divide the ounces by 16 to get a decimal number.

Step 7. Find the Manure Weight
Subtract the weight found in Step 6 from the weight found in Step 1 to find the weight of the collected manure. Record this number.

Example: 6.2 pounds – 5.3 pounds = 0.9 pounds of manure collected.

Step 8. Measure the Containers
Measure the inside length and inside width of one of the containers used at the top of the container with the tape measure. Multiply these two numbers together to get the open area (in square inches) of the container top. Multiply this number by the number of containers to get the total square inches of container opening area that collected manure. Record that number.

Example: Each container measured 6 inches by 12 inches inside wall to inside wall. 6 inches x 12 inches = 72 square inches per container; 72 square inches x 7 containers = 504 square inches.

Step 9. Calculate Square Feet
Divide the number found in Step 8 by 144 to get square feet. Record that number.

Example: 504 square inches / 144 = 3.5 square feet.

Step 10. Find Pounds per Square Foot
Divide the pounds found in Step 7 by the square feet found in Step 9. Record that number.

Example: 0.9 pounds of manure / 3.5 square feet = 0.257 pounds per square foot

Step 11. Find Pounds per Acre
Multiply the number found in Step 10 by 43,560 to get pounds per acre. Record that number.

Example: 0.257 pounds per square foot x 43,560 = 11,194 pounds per acre.

Step 12. Find Tons per Acre
If desired, divide the number found in Step 11 by 2,000 to obtain tons per acre.

Example: 11,194 pounds per acre / 2,000 = 5.60 tons per acre.
If the amount of manure applied per acre determined by this process is the amount desired, the spreader is calibrated and ready to spread the manure used in the calibration. If the amount is less than desired, the grower may decrease the spreader ground speed, increase the floor chain speed, increase the gate opening, or any combination of these to increase the application rate. Then Steps 1 through 12 must be completed again.

If the amount of manure applied per acre determined by this process is more than desired, the grower may increase the spreader ground speed, decrease the floor chain speed, decrease the gate opening, or any combination of these to decrease the application rate. Then Steps 1 through 12 must be completed again.

The spreader settings, including gate opening, floor chain speed, spreader gear, and spreader engine speed should be recorded for each calibration attempt. This will take 5 to perhaps 10 minutes per pass, but the grower will create several combinations in this time that may be kept on file to provide starting points for several different application rates.

The sheet method uses the same steps as the container method and requires a plastic sheet, a tape measure, and a postal scale. The scale must be an accurate scale, such as a postal scale, since the collected manure must be weighed to the nearest tenth of a pound (or ounce) for an accurate measurement. A worksheet that may be used for the Sheet Method is attached to this factsheet. An example calibration is included in the steps for better understanding.

**Step 1. Weigh the Sheet**
Cut a plastic sheet to desired size (6 feet x 4 feet is a good size; a larger sheet will be more accurate, but any sheet sized 2 feet x 3 feet or larger should work). Weigh the plastic sheet to be used while empty, before it is used, with the postal scale. If the weight is provided in pounds and ounces by the scale, divide the ounces by 16 to get a decimal number. Record this weight.

*Example: The sheet selected weighs 2 pounds, 9.6 ounces. Divide 9.6 ounces by 16 to get (9.6/16=) 0.6 pounds, so the total weight is 2.6 pounds.*

**Step 2. Place the Sheet**
Place the sheet across the pathway of the planned track of the spreader (Figure 4). This sheet should not be placed at the extreme edge of the spread pattern, but in or near the center. Tire travel across the sheet is allowable, but any mud or dirt deposited on the sheet by the tires will alter the calibration weight.

**Step 3. Measure the Sheet**
After placing the sheet on the ground, measure the length and width of the sheet with the tape measure. Multiply these two numbers together to get the open area (in square inches) of the sheet. Record that number.

*Example: The sheet measured 72 inches by 48 inches. 72 inches x 48 inches = 3,456 square inches.*
Step 4. Calculate Square Feet
Divide the number found in Step 3 by 144 to get square feet. Record that number.

Example: 3,456 square inches / 144 = 24 square feet.

Step 5. Select a Speed
Select a gear and engine speed to be used during the calibration. These settings should be the same ones used during normal spreading operation. Also select the floor chain speed setting and gate setting. Mark these settings down for reference.

Step 6. Apply Manure
Start the manure spreader some distance from the sheet to allow it to reach the speed desired and a normal spreading pattern. Drive the spreader over the sheet, continuing past until the manure from the spreader is no longer reaching the sheet.

Step 7. Weigh the Sheet
Collect the sheet, carefully rolling or folding it inward to retain the manure. Weigh the sheet with the collected manure on it. If the weight is provided in pounds and ounces by the scale, divide the ounces by 16 to get a decimal number.

Example: The total weight of the sheet with manure was 6 pounds, 3.2 ounces. Divide 3.2 ounces by 16 to get (3.2/16=) 0.2 pounds, so the total weight with manure is 6.2 pounds.

Step 8. Find the Manure Weight
Subtract the weight found in Step 7 from the weight found in Step 1 to find the weight of the collected manure. Record this number.

Example: 6.2 pounds – 2.6 pounds = 3.6 pounds of manure collected.

Step 9. Find Pounds per Square Foot
Divide the pounds found in Step 8 by the square feet found in Step 4. Record that number.

Example: 3.6 pounds of manure / 24 square feet = 0.15 pounds per square foot.

Step 10. Find Pounds per Acre
Multiply the number found in Step 9 by 43,560 to get pounds per acre. Record that number.

Example: 0.15 pounds per square foot x 43,560 = 6,534 pounds per acre.

Step 11. Find Tons per Acre
If desired, divide the number found in Step 10 by 2,000 to obtain tons per acre.

Example: 6,534 pounds per acre / 2,000 = 3.27 tons per acre.

Notes
1. The amount of manure applied per acre will vary with the moisture content and type of manure. A spreader calibrated for a low moisture content poultry litter will apply a different rate of a high moisture content litter than planned if the settings are not adjusted. A spreader calibrated to apply scraped dairy manure solids will also apply a different rate of poultry manure at the same settings. Spreader calibration should be done for each type of manure to be spread, and also if the moisture content varies much between different sources of the same type manure.

2. South Carolina Regulation R.61-43 requires manure spreaders to be calibrated at least once each year. The calibration from year to year may not change much if the moisture content in the manure is the same and the same type of manure is spread, but normal wear on the spreader equipment will cause application rate changes over several years. Calibrate each year to best utilize the manure to be spread.
3. The containers or the sheet may be placed between two passes of the spreader if desired, rather than directly in the path of the spreader (Figure 5). If this is done, the spreader must be driven with a normal spacing between runs that will be used during manure application. Both passes should be made in the same direction so manure spread from the left side and the right side of the spreader is captured, since some spreaders apply manure more heavily to one side than the other. Making two “dry runs” with the spreader may help the grower determine where to place the containers or sheet before actually applying manure. The operator may then follow the previous sets of tire tracks during calibration.

References


Contact Information
Contact information for the Clemson University Agricultural Service Laboratory:

Clemson University Agricultural Service Laboratory
171 Old Cherry Road
Clemson, SC 29634
864-656-2068
agsrvlb@clemson.edu

Local Clemson Extension Offices will accept manure samples and soil samples to be sent to the Laboratory. There is a Clemson Extension Office in every county in South Carolina - local office locations may be found at http://www.clemson.edu/extension/co/index.html

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# Solid Manure Calibration Worksheet
## Container Method

<table>
<thead>
<tr>
<th>Description</th>
<th>Example Problem</th>
<th>Units</th>
<th>Your Numbers</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Number of containers</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2  Weight of all containers (empty)</td>
<td>5.3</td>
<td>pounds</td>
<td></td>
<td>pounds</td>
</tr>
<tr>
<td>3  Weight of all containers with manure</td>
<td>6.2</td>
<td>pounds</td>
<td></td>
<td>pounds</td>
</tr>
<tr>
<td>4  Weight of manure (Step 3 - Step 2)</td>
<td>0.9</td>
<td>pounds</td>
<td></td>
<td>pounds</td>
</tr>
<tr>
<td>5  Measure the inside width of a container</td>
<td>6</td>
<td>inches</td>
<td></td>
<td>inches</td>
</tr>
<tr>
<td>6  Measure the inside length of a container</td>
<td>12</td>
<td>inches</td>
<td></td>
<td>inches</td>
</tr>
<tr>
<td>7  Area of one container (Step 5 x Step 6)</td>
<td>72</td>
<td>square inches</td>
<td></td>
<td>square inches</td>
</tr>
<tr>
<td>8  Area of all containers (Step 1 x Step 7)</td>
<td>504</td>
<td>square inches</td>
<td></td>
<td>square inches</td>
</tr>
<tr>
<td>9  Convert container area to square feet (Step 8 / 144)</td>
<td>3.5</td>
<td>square feet</td>
<td></td>
<td>square feet</td>
</tr>
<tr>
<td>10 Find pounds per square foot applied (Step 4 / Step 9)</td>
<td>0.257</td>
<td>pounds per square foot</td>
<td></td>
<td>pounds per square foot</td>
</tr>
<tr>
<td>11 Find pounds per acre applied (Step 10 x 43,560)</td>
<td>11,194</td>
<td>pounds per acre</td>
<td></td>
<td>pounds per acre</td>
</tr>
<tr>
<td>12 Find tons per acre applied (Step 11 / 2,000)</td>
<td>5.6</td>
<td>tons per acre</td>
<td></td>
<td>tons per acre</td>
</tr>
</tbody>
</table>
## Solid Manure Calibration Worksheet
### Sheet Method

<table>
<thead>
<tr>
<th>Farm Name:</th>
<th>Person(s) Calibrating:</th>
<th>Date:</th>
<th>Manure Type:</th>
</tr>
</thead>
</table>

**Description of Equipment:**

**Gear Used and Engine Speed:**

**Floor Chain Setting:**

**Ground Speed:**

**Gate Setting:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Example Problem</th>
<th>Units</th>
<th>Your Numbers</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Measure the width the sheet</td>
<td>48</td>
<td>inches</td>
<td>inches</td>
<td></td>
</tr>
<tr>
<td>2 Measure the length the sheet</td>
<td>72</td>
<td>inches</td>
<td>inches</td>
<td></td>
</tr>
<tr>
<td>3 Area of the sheet (Step 1 x Step 2)</td>
<td>3,456</td>
<td>square inches</td>
<td>square inches</td>
<td></td>
</tr>
<tr>
<td>4 Convert sheet area to square feet (Step 3 / 144)</td>
<td>24</td>
<td>square feet</td>
<td>square feet</td>
<td></td>
</tr>
<tr>
<td>5 Weight of sheet (empty)</td>
<td>2.6</td>
<td>pounds</td>
<td>pounds</td>
<td></td>
</tr>
<tr>
<td>6 Weight of sheet with manure</td>
<td>6.2</td>
<td>pounds</td>
<td>pounds</td>
<td></td>
</tr>
<tr>
<td>7 Weight of manure (Step 6 - Step 5)</td>
<td>3.6</td>
<td>pounds</td>
<td>pounds</td>
<td></td>
</tr>
<tr>
<td>8 Find pounds per square foot applied (Step 7 / Step 4)</td>
<td>0.15</td>
<td>pounds per square foot</td>
<td>pounds per square foot</td>
<td></td>
</tr>
<tr>
<td>9 Find pounds per acre applied (Step 8 x 43,560)</td>
<td>6,534</td>
<td>pounds per acre</td>
<td>pounds per acre</td>
<td></td>
</tr>
<tr>
<td>10 Find tons per acre applied (Step 9 / 2,000)</td>
<td>3.27</td>
<td>tons per acre</td>
<td>tons per acre</td>
<td></td>
</tr>
</tbody>
</table>