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Rotary Spreader Calibration

A rotary spreader applies product by dropping a dry granule from a hopper onto a spinning impeller, which distributes granules by centrifugal force. Rotary spreaders distribute granules in a band or swath that is greater than the spreader's width. Rotary spreaders are also known as centrifugal, spinner, cyclone, or broadcast spreaders.

Figure 1: *Image from Penn State University*

When calibrating spreaders, each spreader should be calibrated separately. The spreader should be calibrated for each product being applied by the person making the application. Accuracy is extremely important when applying granular fertilizer or pesticide products. Variables that affect accurate product delivery include:

- Spreaders – Even if spreaders are from the same manufacturer and appear identical, they may have slightly different product delivery settings.
- Product label – Product labels often provide recommendations for spreader settings. Although the recommendation provides a useful starting point for testing spreader settings, it should not be relied upon.
- Granular particles - Granular products vary in density, size, active ingredient, and nutrient content. A granular product with a larger particle size analysis will be distributed a greater distance than a granular product with a smaller particle size analysis.
- Operator ground speed – The speed operators walk varies between individuals and affects delivery of product. Although the rate of material being applied remains consistent, walking speed determines the distance granules are thrown. For example, faster walking speeds increase the distance granules are thrown while slow walking speeds decrease the distance granules are thrown.

Before applying any granular product, each spreader should be calibrated separately by the operator to ensure accurate and consistent distribution of product.

Calibration Process

A worksheet has been provided at the end of the document to help you move through each step and calculation to successfully calibrate your spreader.

Rotary Spreader Calibration

Collect materials needed to calibrate the spreader:

1) Product being applied
2) Spreader
3) Collection bag or calibration pan if available
4) 11-13 collection pans or boxes (1 foot x 1 foot x 3 inches high) – all pans should be the same size
5) Tape measure
6) Scale (needs to be able to weigh small amounts of product accurately, preferably in ounces)
7) Container or bucket
8) Chalk or flags
9) Calculator
10) Pencil and paper

Figure 2: *Image from Dr. Michael Goatley*

Step 1: Determine the size of the area to which product is being applied.

Calculating the square footage of various shapes found in turf and landscape management situations can be determined using the following mathematical formulas:

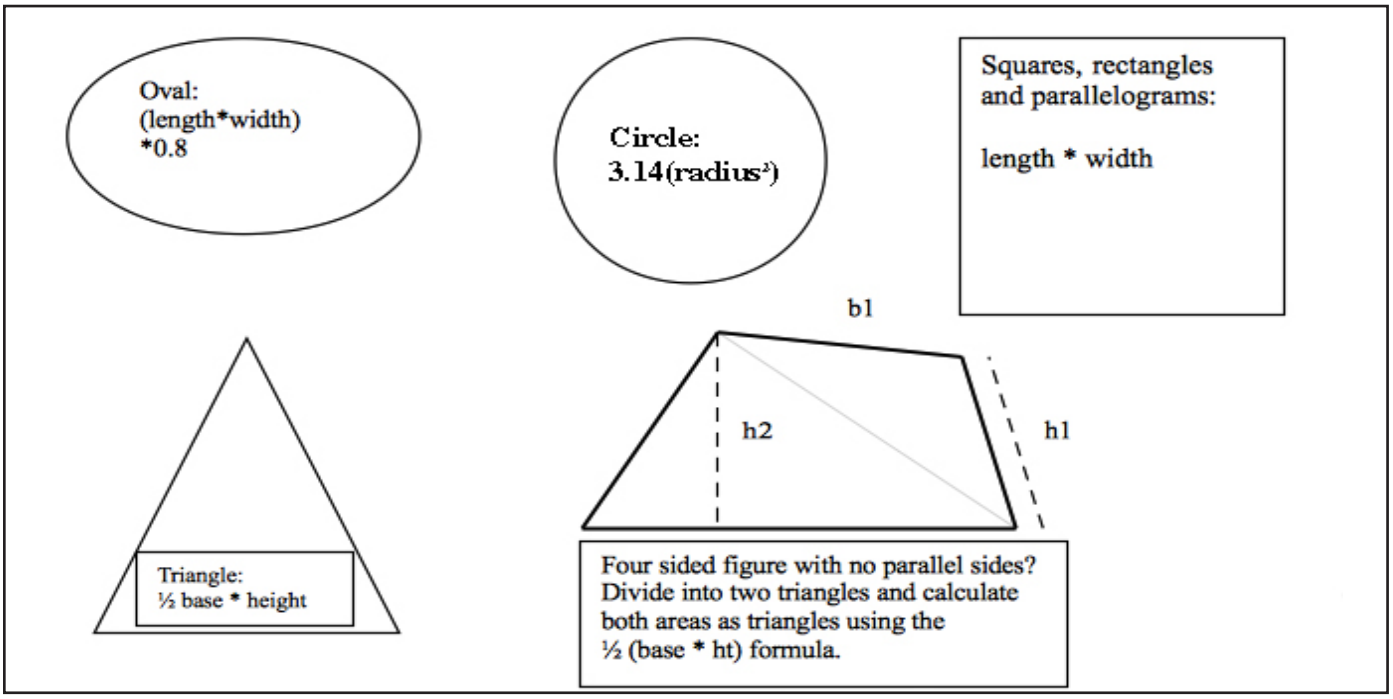


Figure 3: *Figure from Urban Nutrient Management Handbook*

Rotary Spreader Calibration

Step 2: Measure the spreader's effective swath.

Rotary spreaders distribute granules in a band or swath greater than the spreader's width. The product is not uniformly distributed over the entire swath, and fewer granules reach the outer margins of the swath than the area immediately around the spreader. To account for the lack of uniformity associated with spreader distribution, adjacent passes must overlap by 30-50%. The recommended spacing between adjacent passes changes with the density and particle size of the material and the spreader. Calculating effective swath width provides accurate spacing between passes. The effective swath width is the measured distance from the center that is associated with the majority of the released material distributed from the spreader.

Figure 4 is a representation of the swath width of a rotary spreader. The center point, 0, represents the spreader path. Figure 5 displays the decrease in product distribution as distance from the spreader increases.

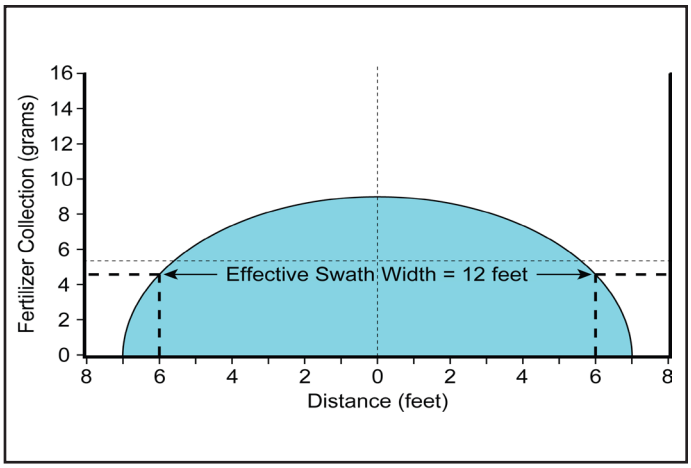


Figure 4: Rotary Spreader Swath Width *Figure adapted from Penn State University*

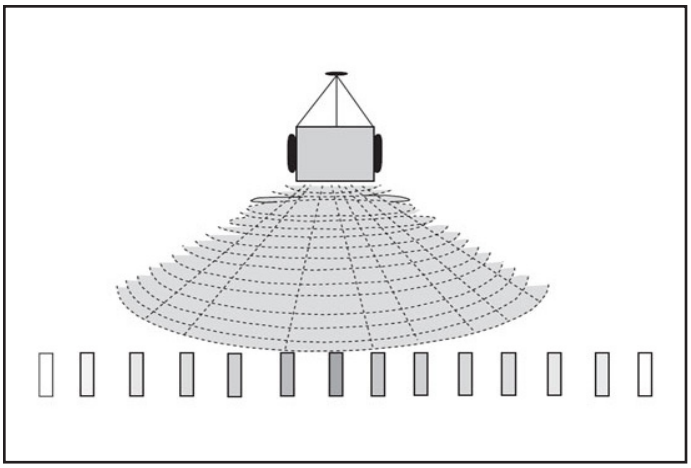


Figure 5: Amount of product distributed decreases as distance from the spreader increases. *Figure from University of Massachusetts*

The figures represent perfectly even product distribution. In reality, distribution patterns are rarely even. Depending on the spreader, more granules may be distributed to one side. This will need to be determined prior to the application so the spreader can be adjusted.

Figure 6: Set out catch pans to equal distances from the center point to catch fertilizer at the edge of the throw pattern. *Image from Texas A&M University*

To measure the effective swath width of the spreader, use catch pans to measure the amount of distributed material. Space the pans 1 foot apart, and make sure the row is at least 1.5-2 times the width of the anticipated effective spacing.

To conduct the test, fill the spreader at least half full, set it at the manufacturer's suggested spreader setting, and make three passes in the same direction over the boxes using a normal walking speed.

Rotary Spreader Calibration

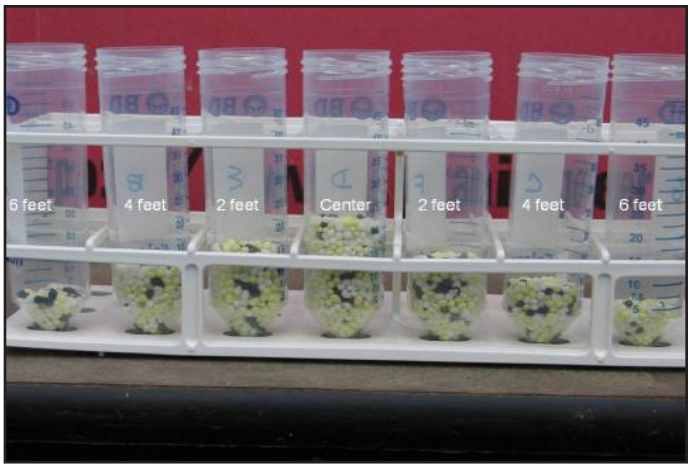


Figure 7: The material collected in the pans set 6 feet from the center collected about 50% of material when compared to the center pan. *Image from Dr. Michael Goatley*

In our example, the effective swath width is 12 ft (6 feet left and right of the spreader centerline).

Distance between spreader passes should be 12 ft to uniformly achieve 100% coverage for effective application.

Put the material from each box into a test tube or small narrow bottle. When the bottles are placed side by side in order, a plot of the distribution pattern is visible.

The material collected in each box can also be weighed. When the weights of the collected material from each box are plotted with distance, the distribution pattern is revealed. The effective swath width is twice the distance out from the center of the spreader to the point where the rate is one half the average rate at the center.

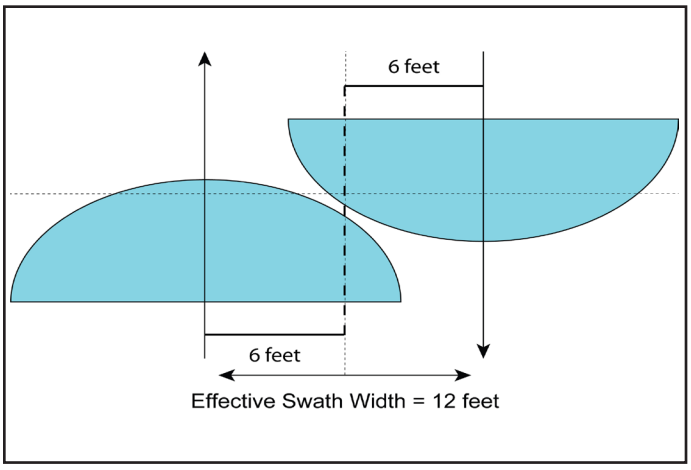


Figure 8: *Figure adapted from Penn State University*

Step 3: Measure calibration run length.

Nutrients are often calculated for application to 1000 sq ft. To make it easy, you can use a calibration run length that results in 1000 sq ft of coverage. Note: You may calibrate the spreader to a shorter distance. Calibrating to 1000 sq ft is only a suggestion. Use the following equation to determine calibration run length:

$$\frac{\text{1000 sq ft}}{\text{\_\_\_\_\_ ft effective swath width}} = \text{\_\_\_\_ ft calibration run length}$$

Example: The effective swath width in Step 2 was 12 ft.

$$\frac{\text{1000 sq ft}}{\text{12 ft effective swath width}} = \text{83.3 ft calibration run length}$$

Rotary Spreader Calibration

Measure your calibration run length and mark the starting and ending points.

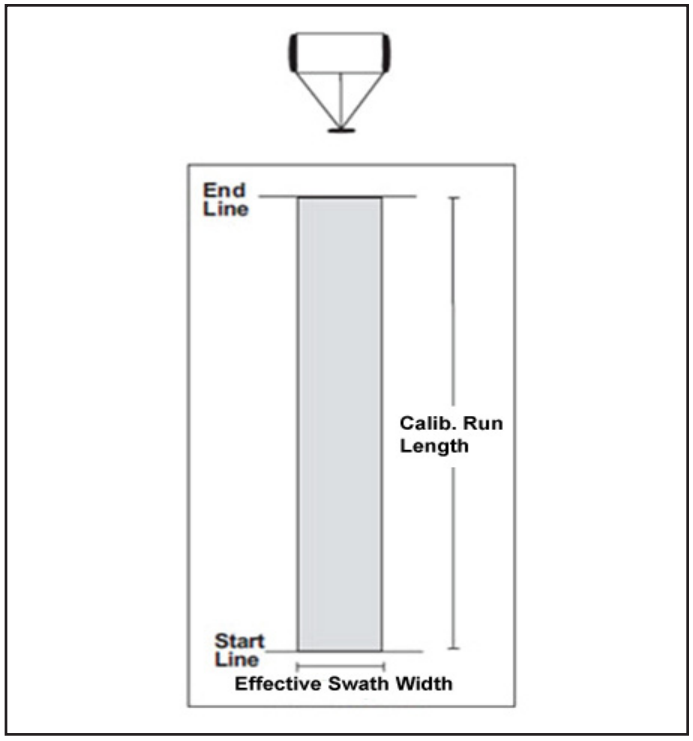


Figure 9: *Image from University of Massachusetts*

Step 4: Determine the amount of product needed to deliver the desired amount of nutrient.

The fertilizer grade is displayed on the product label and represents nutrient content by weight.

Example:

Specialty Turf Fertilizer
16-4-8

Total Nitrogen……..……16%
Total Phosphate……..……...…4%
Total Potash……...……8%

If you have a 100 pound bag of 16-4-8 Specialty Turf Fertilizer, 16% of the weight (or 16 lbs) is nitrogen, 4% of the weight (or 4 lbs) is phosphate (P2O5), and 8% of the weight (or 8 lbs) is potash (K2O).

Rotary Spreader Calibration

Nitrogen is most commonly used when determining amount of product to apply. First determine how much nitrogen you wish to apply, and then determine the amount of nitrogen needed for a given area using the following formula:

$$\text{Pounds fertilizer per area} = \frac{\text{lbs N needed per area}}{\text{N from fertilizer formula as a decimal (i.e. the number divided by 100)}}$$

Example: Using a 16-4-8 fertilizer to supply 1 pound of N per 1000 square feet gives:

$$\text{Pounds fertilizer per area} = \frac{\text{1.0 lb N per 1000 sq ft}}{0.16}$$

$$= 6.25 \text{ lbs of fertilizer per 1000 sq ft}$$

In order to determine product application to a larger area, use the following equation:

$$\frac{\text{\_\_\_\_\_ lbs fertilizer}}{\text{1000 sq ft}} \text{ X } \frac{\text{? lbs fertilizer}}{\text{\_\_\_\_\_ sq ft}}$$

Example: The goal is to fertilize 10,000 sq ft. You want to apply 1 lb of N per 1000 sq ft using a 16-4-8 fertilizer.

$$\frac{\text{6.25 lbs fertilizer (16-4-8)}}{\text{1000 sq ft}} \text{ X } \frac{\text{? lbs fertilizer (16-4-8)}}{\text{10,000 sq ft}}$$

$$62{,}500 = ?1000$$

$$? = 62.5 \text{ lbs of fertilizer (16-4-8) to be delivered over 10,000 sq ft}$$

This number gives you an indication for total amount of material you will need to treat the entire turf area.

Rotary Spreader Calibration

Step 5: Determine the appropriate spreader setting to deliver the desired amount of material.

In order to apply the correct amount of nutrient, spreader output must be determined and spreader setting must be adjusted. We already know how much total fertilizer we want to apply to 1000 sq ft. Therefore, over the course of the calibration run length, we need to collect that amount.

Example: We want to apply 6.25 lbs fertilizer per 1000 sq ft. Our calibration run length has been set to cover 1000 sq ft. Therefore, over the course of the calibration run length (83.3 ft), we need to collect 6.25 lbs of the fertilizer product.

There are two methods to determine spreader output: through use of a collection bag/calibration pan, or without a collection bag/calibration pan.

Collection bag or calibration pan - Collection bags and calibration pans enclose the impeller and capture product being delivered. Once the product is discharged, the material can be collected from these devices and weighed.

Figure 10: Collection bag on rotary spreader. *Image from Dr. Michael Goatley*

Figure 11: *Image from Dr. Michael Goatley*

1) Set the spreader setting to a low to medium range. Often a product label will provide a recommended setting to use as a starting point for the calibration process. Do not rely on recommended settings as spreaders and operator speeds vary and contribute to differing applications.
2) Pour the product into the hopper.
3) Start walking at a brisk, comfortable pace with the spreader several feet in front of the starting line. When you reach the starting line, open the hopper holes and keep walking at the same pace without varying speed. Close the hopper holes as you pass over the finishing or end point. In this example, your hopper should have been open for 83.3 feet.
4) Weigh the material collected in the collection bag/calibration pan (make sure you are not including the weight of the container holding the fertilizer on the scale).
5) Adjust the spreader setting up or down depending on the amount collected. Repeat the process until the desired amount of fertilizer (in our example 6.25 lbs) is collected.

Your spreader will be correctly calibrated to apply the desired amount of nutrient to your turfgrass area once the desired amount of fertilizer is collected and accurately weighed. The spreader is properly calibrated when the calibration rate is within ± 5% of the goal amount. (In this example, when the calibration rate falls between 5.94 to 6.56 lbs. of fertilizer per 1,000 sq. ft.).

Rotary Spreader Calibration

No collection bag or calibration pan - In the absence of a collection bag or calibration pan, measure the weight of the product before placing it in the hopper, then measure the amount of product remaining in the hopper after the calibration run. The difference between weights before and after the calibration run reflects the amount being applied to the turf area.

If using this method, be sure that granules are being discharged in a safe area. Safe areas may include utility turf areas where fertilizer burns will not be a problem. If conducting the calibration run on a paved area, be sure to sweep the area of granules following calibration to prevent fertilizer from entering water sources.

Figure 12: *Image from Penn State University*

Figure 13: *Image from Dr. Michael Goatley*

1) Set the spreader setting to a low to medium range. Often a product label will provide a recommended setting to use as a starting point for the calibration process. Do not rely on recommended settings as spreaders and operator speeds vary and contribute to differing applications.
2) Measure product and write down the exact weight. (Be sure not to include the weight of the container holding the fertilizer on the scale.) Pour the weighed product into the hopper.
3) Start walking at a brisk, comfortable pace with the spreader several feet in front of the starting line. When you reach the starting line, open the hopper holes and keep walking at the same pace without varying speed. Close the hopper holes as you pass over the finishing or end point.
4) Pour the product remaining in the hopper into a bucket and weigh the product. (Be sure not to include the weight of the container holding the fertilizer on the scale.) Subtract the remaining amount of product from the original weight of product. The difference in weight between the original amount and the product left in the hopper after the calibration test run is the amount that was distributed.
5) Adjust the spreader setting up or down depending on the amount collected, and repeat the process until the desired amount (in this example, 6.25 lbs) of fertilizer is distributed.

Your spreader will be correctly calibrated to apply the desired amount of nutrient to your turfgrass area once the desired amount of fertilizer is distributed. The spreader is properly calibrated when the calibration rate is within ± 5% of the goal amount. (In this example, when the calibration rate falls between 5.94 to 6.56 lbs. of fertilizer per 1,000 sq. ft.).

Rotary Spreader Calibration

Figure 14

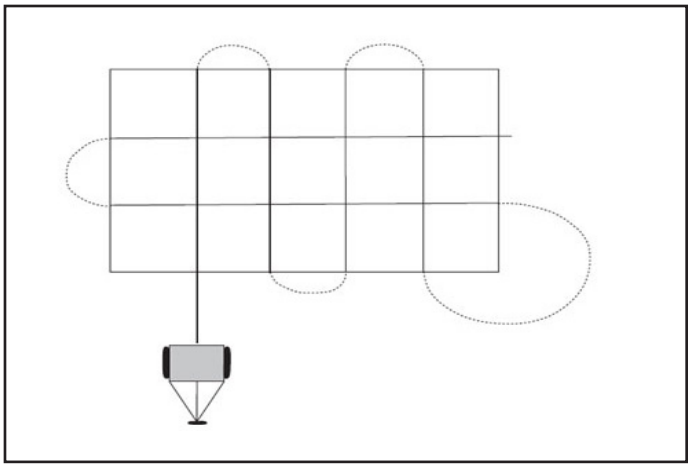


Figure 15: *Figure from University of Massachusetts*

(Optional) Step 6: Split applications

Determine if split applications are more desirable. The spread pattern of a rotary spreader is not completely uniform due to wind, operator speed, equipment, and size and weights of granular particles. As a result, inconsistent application can create alternating light and dark green stripes, poor pest control, or foliar burn.

While more labor intensive, a desirable method to increase uniformity of application is to deliver half the desired rate of product and apply the product in two passes at right angles to each other. The grid pattern can mask skips and overlaps.

If this method is used, the spreader needs to be calibrated to deliver HALF the desired rate of fertilizer. In our example we wanted to apply 6.25 lbs of Specialty Turf Fertilizer per 1000 sq ft in one application. If we were to split the application in order to apply fertilizer in 2 different directions, we need to calibrate the spreader to distribute 3.13 lbs of Specialty Turf Fertilizer per 1000 sq ft. Thus, when the product is applied in two directions, the area is receiving a total of 6.25 lbs of fertilizer per 1000 sq ft.

Tips for Product Application

Correct and accurate application of any granular product to a turfgrass area is essential to prevent damage to the turfgrass and prevent pollution of water sources. Use the following tips for accurate and safe granular applications with your rotary spreader.

- Make sure the spreader is in good operating condition. For example, make sure the tires are inflated and material does not run out of the spreader when in the off position.
- Always stay a safe distance from water sources due to the rotary spreaders wide distribution pattern.
- If granular materials land on an impervious surface, be sure to blow or sweep the material back into the turf.
- Use granules that have similar sizes and weights. Otherwise, poor coverage can result.
- If running low on product in the hopper, do not bounce or rock the spreader during application.
- Always begin walking before opening the hopper holes. Always close hopper holes at the end of a pass while still walking and before turning to begin another pass.
- If granules stick together in clumps, make sure you break them apart, or don't use the product.
- Don't apply light weight materials on windy days.
- Be sure to clean your spreader thoroughly after applying granular products to prevent build up of fertilizer or pesticide particles and corrosion on spreader parts. Also, lubricate gears and other moving spreader parts before storing.

Rotary Spreader Calibration Worksheet

Color-coded squares are meant to help in entering repeated numbers.

Key for Color Coding:

: total square footage of the turf area

: effective swath width

: percentage of nitrogen in the fertilizer

: desired amount of nitrogen to apply (lbs. N / 1000 sq ft)

: amount of fertilizer needed to cover 1000 sq ft and provide desired amount of N

: amount of fertilizer needed for a split application (to cover 1000 sq ft)

Step 1: Determine square footage of the area to which you would like to make a granular application.

Formula:

Area = _____ sq ft

Step 2: Measure the effective swath width.

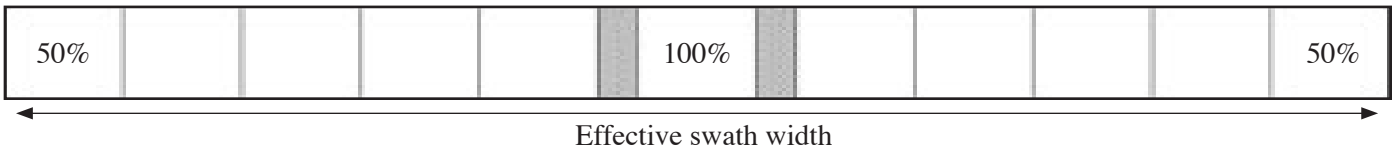
Set the catch pans 1 ft apart and make sure the row is at least 1.5-2 times the width of the anticipated effective spacing. Distribute product into the catch pans using the spreader. Weigh the material from each box or put the material from each box into a test tube or small narrow bottle. Record the amount collected from each catch pan below.

Total weight or percentage of product in each catch pan:

Determine which catch pan collected about 50% of the total material compared to the center catch pan. The effective swath width is twice the distance out from the center of the spreader to the point where the rate is one half the average rate at the center. The catch pans containing 50% of material represent the distance needed between passes for overlap to achieve 100% coverage.

Rotary Spreader Calibration Worksheet

Example:



Effective swath width represents the distance between spreader passes.
Effective swath width = _____ ft

Step 3: Measure calibration run length.

Measure a calibration run length that results in 1000 sq ft of coverage:

$$\frac{\text{1000 sq ft}}{\text{\_\_\_\_\_ ft effective swath width}} = \text{\_\_\_\_ ft calibration run length}$$

Step 4: Measure amount of product needed to deliver the desired amount of nutrient.

Measure and mark the beginning and end points for the calibration run length.

Fertilizer Grade: _____ % N _____ % P2O5 _____ % K2O

Desired amount of Nitrogen to apply: _____ lbs N / 1000 sq ft

Amount of total fertilizer needed to apply desired amount of nitrogen to 1000 sq ft:

$$\frac{\text{\_\_\_\_\_ lbs N per 1000 sq ft}}{\text{\_\_\_\_\_ \% N (fertilizer grade) } \div 100} = \text{\_\_\_\_\_ lbs of fertilizer per 1000 sq ft}$$

Amount of total fertilizer needed to cover entire turf area and deliver desired amount of nutrient:

Cross multiply:

$$\frac{\text{\_\_\_\_\_ lbs fertilizer}}{\text{1000 sq ft}} \times \frac{\text{? lbs fertilizer}}{\text{\_\_\_\_\_ 1000 sq ft}}$$

? = _____ lbs of fertilizer

This number gives you an indication for total amount of material you will need to treat the entire turf area.

Rotary Spreader Calibration Worksheet

Step 5: Set the spreader to deliver the desired amount of material..

In order to apply the correct amount of nutrient, spreader output must be determined and spreader setting must be adjusted. We already know how much total fertilizer we want to apply to 1000 sq ft. Our calibration run length has been set to cover 1000 sq ft. Therefore, over the course of the calibration run length, we need to collect _____ lbs of fertilizer.

Determine if you are using a collection bag/calibration pan.

Collection bag or calibration pan

If using a collection system, material collected needs to be weighed after each calibration run. Adjust the spreader setting up or down depending on the amount collected. Repeat the process until ±5% of the goal weight is collected.

Run Number	**Weight of Material Collected** **Goal Weight: _____ lbs**
Run 1	
Run 2	
Run 3	
Run 4	
Run 5	
Run 6	
Run 7	

No Collection bag or calibration pan

If calibrating without a collection system, conduct the calibration on a utility turfgrass area that is out of sight. If conducting on an impervious surface, take care to clean up all of the dispersed fertilizer materiel so it does not runoff into water sources.

If a collection system is not being used, material needs to be weighed **before and after** the calibration run. The difference between weights before and after the calibration run reflects the amount being applied to the turf area. Adjust the spreader setting up or down depending on the amount collected. Repeat the process until ±5% of the goal weight is collected.

Run Number	**Weight of Material Before Calibration Run**	**Weight of Material After Calibration Run**	**Amount Distributed** **Goal weight to be distributed: _____ lbs**
Run 1			
Run 2			
Run 3			
Run 4			
Run 5			
Run 6			
Run 7			

Rotary Spreader Calibration Worksheet

(Optional) Step 6: Calibrating to apply fertilizer 2 directions.

If you prefer to eliminate potential for skips, overlaps, foliar burn, or other undesirables, the application can be split in half and applied in 2 directions.

_____ lbs of fertilizer ÷ 2 = _____ lbs fertilizer

When calibrating the spreader, _____ lbs of fertilizer per 1000 sq ft should be collected to apply the desired amount of nutrient in 2 directions.