Granular Applicator Calibration Handout

Fire Ant In-service Training
Southwest Research and Extension Center
Hope, AR
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Granular Applicators

Homeowners as well as many lawn and ornamental care service applicators use granular products to control insects, weeds, and diseases in the landscape environment. Proper selection, care, calibration, and use of granular applicators can minimize costs and maximize the results obtained. Improper use of granular applicators can reduce product efficiency, result in injury to turf or ornamentals, increase costs, and harm the environment. In addition, improper calibration can result in misapplication that would be a violation of the label and thus a violation of federal law.

Types of Granular Applicators

Drop (gravity) and rotary (centrifugal) spreaders are commonly available for applying granules. **Drop spreaders** are generally more precise and deliver a better pattern. Since the granules drop straight down, there is less pesticide drift and better control. Some drop spreaders will not handle large granules, and ground clearance in ornamental settings can be a problem. Since the edge of the drop -spreader is the limit of pesticide distribution, the applicator must be very careful to align the swaths correctly to provide proper application. It is easy to either overlap or skip areas with drop spreaders, if one is not attuned to the pattern of the spreaders.

Drop spreaders	
	
	

Rotary or centrifugal spreaders cover a wide swath, and, thus, cover a given area faster. However, they are less precise than drop spreaders in terms of uniformity and distribution. Because of pattern feathering, steering errors are less critical. Since they do not have a full width agitator to turn, they require less effort to push. Rotary spreaders normally handle large particles well, but drift is a problem with fine particles when wind is excessive. Ground clearance in ornamental settings is usually a problem for rotary spreaders also. Since rotary patterns vary, more calibration time is needed. A major advantage of rotary spreaders is that they can be made of plastics and fiberglass, and, therefore, are more resistant to corrosion. Rotary spreaders are also more durable in commercial use, and less likely to be knocked out of calibration than some drop spreaders.

Rotary or centrifugal spreaders	
	
	

Air spreaders are popular in the agricultural market but are just now beginning to receive attention from turfgrass managers. Air spreaders meter granules through an orifice, or with a fluted roller, into a venturi cup where they are suspended in an airstream and travel through hoses to deflectors mounted on a boom. At the deflectors, the granules are distributed in a pattern similar to that of a flat fan nozzle. When properly calibrated, air spreaders can uniformly distribute materials over a wide range of application rates.

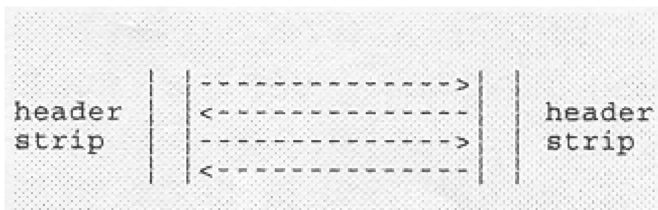
Air spreaders	
	

General Considerations for Using Granular Applicators

Experienced operators are familiar with proper use of granular applicators, but new operators should review the basic operating procedures.

Begin by reading the operator's manual or instruction booklet provided by the manufacturer and follow the manufacturer's instructions. The second obvious recommendation is to follow the instructions on the product label, modifying rate and pattern settings, if necessary, for specific conditions.

Header strips (at least two widths of the spreader pattern) at each end of the application area provide a place to turn around and realign the spreader, and serve to make the border area more uniform. Operators should always get the spreader moving at rated speed (normally three miles per hour) on the header strip or on a driveway, sidewalk, etc., and then open the spreader as the spreader crosses into the area to be treated. At the other end, the spreader should be closed when moving into the header strip and turning. A spreader should be closed when stopped to prevent the product from being over applied to a small area. Likewise, the end turns should be made with the spreader closed, since the application pattern would be very irregular while turning. The header strips should be treated last.



Occasionally, it may be impossible to obtain a completely acceptable pattern with a rotary spreader and striping of the treated area may result. A common approach to this problem is to reduce the setting to a half rate and go over the bed twice at right angles. This is not a valid solution to the problem. This approach will not average out the pattern, but will merely change stripes into a diagonal checkerboard. If pattern problems cannot be corrected, the proper procedure is to reduce the setting to a half rate and reduce the swath width in half, but still go back and forth in parallel swaths.

Normally, a spreader should not be operated backwards. It is obvious with most rotary spreaders that pulling the spreader backwards will deliver an unacceptable pattern. There is a problem also with reversing the direction of a drop spreader. Most drop spreaders will deliver granules at a considerably different rate at the same setting if reversed. In some cases such as in loose soil with new seedings, the spreader may be easier to pull than to push. If it is desired to operate a spreader backwards, a different setting must be determined.

Some rotary spreaders enable you to cut off one side of the pattern. This feature is desirable when edging along driveways, sidewalks, etc.

Fill the spreader on a paved surface rather than in the bed. If a spill occurs, a driveway is much easier to sweep clean than a bed.

There are two important aspects to the precise application of granular products. The first is the product application rate. This term refers to the overall average amount of product applied in pounds per thousand square feet. Over-application is costly, increases the risk of plant injury, and may be illegal if label recommendations are exceeded. Under-application can reduce the product efficacy and cause customer dissatisfaction. The flow rate from granular applicators does not change proportionately with changes in speed. Therefore, uniform ground speed is necessary to maintain a uniform application rate, and constant speed is needed if predeveloped settings are to be accurate.

Equally important is uniform distribution. This aspect is different from the application rate. A pesticide might be labeled for application at four pounds per 1,000 square feet. If a spreader applies 20 pounds to a 5,000 square foot bed, the apparent rate of application is correct, but it is possible some areas of the bed will receive twice as much pesticide per square foot as other areas. It is impossible to achieve absolutely uniform distribution with any granular applicator, but the most uniform distribution possible is particularly important with ornamentals. Under certain conditions, small differences in rate on different areas may result in poor pest control.

With drop spreaders, the distribution pattern, whether good or bad, is normally the same within a fairly broad range, regardless of speed, product physical characteristics, the environment, and other factors. Rotary spreader patterns, on the other hand, are sensitive to these variables, and severe pattern skewing can result if the operator neglects these variables. The pattern applied by a rotary spreader is dependent on impeller characteristics (height, angle, speed, shape, and roughness), ground speed, drop point of the product on the impeller, product physical parameters (density, shape, and roughness of particles), and environmental factors (temperature and humidity). Most of these factors are beyond the control of the spreader operator.

Spreader engineers normally try to design rotary spreaders to give an acceptable distribution pattern for a broad range of products and operating conditions. Small rotaries, particularly homeowner models, usually do not have any pattern adjustment, and are designed to perform well with average products and to work acceptably well with a fairly wide range of products. This is possible because of the limited swath width. The wider pattern of the larger commercial rotary spreaders is more susceptible to skewing; thus, a means of adjustment is usually provided for pattern distribution. This adjustment typically consists of blocking off part of the metering port(s) on smaller units, and moving the metering point or changing the impeller geometry on larger units.

It is essential the operator be aware of the need for pattern adjustments and also be able to make those adjustments. The operator should first follow the manufacturer's recommendation on pattern adjustment. If the skewing cannot be fully corrected, there are other means that can be used, such as varying the speed or tilting the impeller. In extreme cases where a product is so heavy or so light that skewing cannot be eliminated, it may be necessary to use a wider swath width on one side than on the other.

Granular Applicator Calibration

Because of many variables, it is highly recommended all spreaders be calibrated for proper delivery rate with the specific operator and product to be used. Many product suppliers furnish recommended settings and swath widths. These are as precise as the manufacturer can make them, but factors just mentioned can add up to a significant rate variation in some cases. Label settings should be used only as the initial setting for verification runs by the operator prior to large-scale use.

Calibration should be checked and corrected according to the manufacturer's directions at least once a week when the spreader is in regular use and more frequently if the spreader has suffered any abuse or mechanical damage.

The easiest way for an commercial operator to check the delivery rate of a spreader is to spread a weighed amount of product on a measured area, preferably at least 1,000 square feet for a drop spreader and 5,000 for a rotary, and then weigh the product remaining to determine the rate actually delivered.

To avoid contamination of the area during initial calibration, the spreader can be supported above a floor and the drive wheel spun at the correct speed with the spreader remaining stationary. Granules can be collected and reused with this technique. Another method of rate verification that can be used with drop spreaders is to hang a catch pan under the spreader and push the spreader a measured distance at the proper speed. This method can be precise, but it is essential that the pan be hung on the spreader so that there is no interference with the shut-off bar or rate control linkage.

An alternate calibration procedure for drop or rotary spreaders can be accomplished by using the following method:

Step 1. Start with a clean spreader. Mark out an area 100 ft^2. If marked on a clean concrete or asphalt surface, the product can be swept up and reused once calibration is complete.

Step 2. Weigh and record the amount of product you think will cover 100 ft^2 and add it to the hopper. Adjust the spreader to a setting you feel is close to the desired rate. Refer to the applicator manual.

Step 3. Apply granules to the marked area, walking the same rate you plan to use during treatment.

Step 4. Calculate the amount of product discharged by weighing the product left in the hopper. Then use the following equation to determine the amount of product used per 1000 ft^2.

Amount per 100 ft^2 = Initial weight – final weight

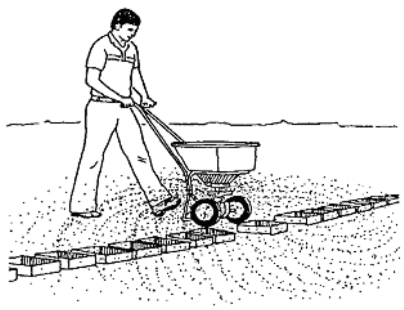
Amount per 1000 ft2 = Amount per 100 ft^2 x 10

Step 5. Adjust and re-calibrate as needed to obtain the desired rate.

With rotary spreaders, it is also necessary to check and correct the distribution pattern. Again, the product label may give a recommended setting and width, but a custom applicator should check the setting and width before using. A quick pattern check can be made by operating the spreader over a paved area and observing the pattern. However, this method is not highly accurate, since even major distribution errors may not be visible because of particle bounce and scatter.

A preferred method is to lay out a row of shallow cardboard boxes on a line perpendicular to the directions of travel. Boxes one to two inches high, with an area of about one square foot, and spaced on one-foot centers are good for commercial push-type rotaries. The row of boxes should cover one and one-half to two times the anticipated effective swath width.

Checking Pattern Distribution of Rotary Spreader



To conduct the test, pour some product into the spreader and set it at the label setting for rate and pattern. Make three passes over the boxes, operating in the same direction each time. The material caught in each box can be weighed and a distribution pattern plotted. However, a simpler procedure is to pour the material from each box into a test tube, vial, or small bottle. With the bottles standing side by side in order, a plot of the pattern is visible.

This method can be used to detect and correct skewing and to determine swath width. The effective swath width is twice the distance out to the point where the rate is one-half the average rate at the center. For example, if the center three to five bottles have material two inches deep, and the bottles from the six-foot positions (six feet left of the spreader center line and six feet right of the spreader center line) have material one inch deep, the effective swath width is 12 feet.

Step 1. Average 3 to 5 center boxes.

Step 2. Find the point out from the center where the quantity in a box is half of the average found in step 1.

Step 3. Measure the distance from the center of these two boxes for the effective swath width.

Granular Pesticide Calibration Problem

Example 1: You are using a centrifugal granular spreader on an area of turfgrass 120.5 feet by 120.5 feet. The recommendation for Amdro Pro is 1.5 pounds of product per acre. You have purchased Amdro Pro Fire Ant Killer (0.73% hydramethylnon). How many pounds of active ingredient will be applied per acre? How many pounds of product will it take to cover this lawn?

Step 1. Convert pounds product per acre to pounds active ingredient per acre.

$$\text{Pounds active ingredient per acre} = \text{Pounds product per acre} \times \frac{\%\text{a.i.}}{100\%}$$

$$\text{Pounds active ingredient per acre} = 1.5 \text{ lbs. product} \times \frac{0.73}{100}$$

Pounds active ingredient per acre = 1.5 x .0073 = **0.01095 lb a.i. per acre**

Step 2. Determine the number of pounds of product required to cover this lawn.

$$\text{Pounds required} = \frac{\text{lb./A} \times \text{area treated (sq. ft.)}}{43{,}560^*}$$

*1 acre = 43,560 sq. ft.

$$\text{Pounds required} = \frac{1.5 \text{ lb./A} \times 14{,}520.25 \text{ sq. ft.}}{43{,}560^*}$$

$$\text{Pounds required} = \frac{21{,}780.375}{43{,}560} = \mathbf{0.5 \text{ lbs. or } 8.0 \text{ oz.}}$$

For treated areas less than 1/3 Acre (14520 sq ft), it is very difficult for the average homeowner to measure, calibrate, and apply a commercial fire ant bait like Amdro Pro correctly. The homeowner would be much better off using a formulation specifically designed for homeowner use.

Example 2: You are using a centrifugal granular spreader on an area of turfgrass 120.5 feet by 120.5 feet. The recommendation for Amdro Yard Treatment is 5.5 pounds of product per 11,000 sq ft (21.78 lbs of product per Acre). You have purchased Amdro Fire Ant Bait Yard Treatment (0.036% hydramethylnon). How many pounds of active ingredient will be applied per acre? How many pounds of product will it take to cover this lawn?

Step 1. Convert pounds product per acre to pounds active ingredient per acre.

$$\text{Pounds active ingredient per acre} = \text{Pounds product per acre} \times \frac{\%\text{a.i.}}{100\%}$$

$$\text{Pounds active ingredient per acre} = 21.78 \text{ lbs. product} \times \frac{0.036}{100}$$

Pounds active ingredient per acre = 21.78 x 0.00036 = **0.00784 lb a.i. per acre**

Step 2. Determine the number of pounds of product required to cover this lawn.

$$\text{Pounds required} = \frac{\text{lb./A} \times \text{area treated (sq. ft.)}}{43{,}560^*}$$

*1 acre = 43,560 sq. ft.

$$\text{Pounds required} = \frac{21.78 \text{ lb./A} \times 14{,}520.25 \text{ sq. ft.}}{43{,}560^*}$$

$$\text{Pounds required} = \frac{316{,}251.04}{43{,}560} = \mathbf{7.26 \text{ lbs.}}$$

Land Area Measurement

How Do I Measure Small Land Areas?

It is essential to know the amount of area you intend to cover when applying pesticides or fertilizer. Small ornamental areas, such as lawns, golf course greens, and fairways, should be measured in square feet or acres, depending on the units needed.

Rectangular Areas

Area = length x width

Example: A flowerbed measures 980 ft. long by 150 ft. wide. What is the area?

Area = 980 ft. x 150 ft. = 147,000 sq. ft.

$$\text{Area in acres} = \frac{147{,}000 \text{ sq. ft.}}{{}^{*}43{,}560 \text{ sq. ft./acre}} = 3.4 \text{ acres}$$

*1 acre = 43,560 sq. ft.

Triangular Areas

$$\text{Area} = \frac{\text{base x height}}{2}$$

Example: An ornamental area in a corner lot has a base of 500 ft. and a height of 100 ft. What is the area?

$$\text{Area} = \frac{500 \text{ ft. x } 100 \text{ ft.}}{2} = 25{,}000 \text{ sq. ft.}$$

$$\text{Area in acres} = \frac{25{,}000 \text{ sq. ft.}}{43{,}560 \text{ sq. ft.}} = 0.6 \text{ acres}$$

Circular Areas

Area = πr^2 where π = 3.14 and r = the radius of the circle OR

$$\text{Area} = \frac{\pi d^2}{4}$$ where π = 3.14 and d = the diameter of the circle

Example: A ground cover underneath a tree has a diameter of 40 ft. What is the area?

$$\text{Area} = \frac{3.14 \times 40^2}{4} = \frac{5{,}024}{4} = 1{,}256 \text{ sq. ft.}$$

$$\text{Areas in acres} = \frac{1{,}256 \text{ sq. ft.}}{43{,}560 \text{ sq. ft.}} = 0.03 \text{ acres}$$

Irregularly Shaped Areas

Any irregularly shaped ornamental area can generally be reduced to one or more of the geometric figures shown previously. The area of each is calculated and added together to obtain the total area.

Example: What is the total area of all ornamental areas mentioned above?

Area 1 is a rectangle = length x width

Area = 980 ft. x 150 ft. = 147,000 sq. ft.

Area 2 is a triangle = $\frac{b \times h}{2}$

$$\text{Area} = \frac{500 \text{ ft.} \times 100 \text{ ft.}}{2} = 25{,}000 \text{ sq. ft.}$$

Area 3 is a circle = $\frac{\pi d^2}{4}$

$$\text{Area} = \frac{3.14 \times 40^2}{4} = \frac{5{,}024}{4} = 1{,}256 \text{ sq. ft.}$$

Total Area = Area 1 + Area 2 + Area 3

Total Area = 147,000 sq. ft.+ 25,000 sq. ft. + 1,256 sq. ft. = 173,256 sq. ft. = 3.977 acres

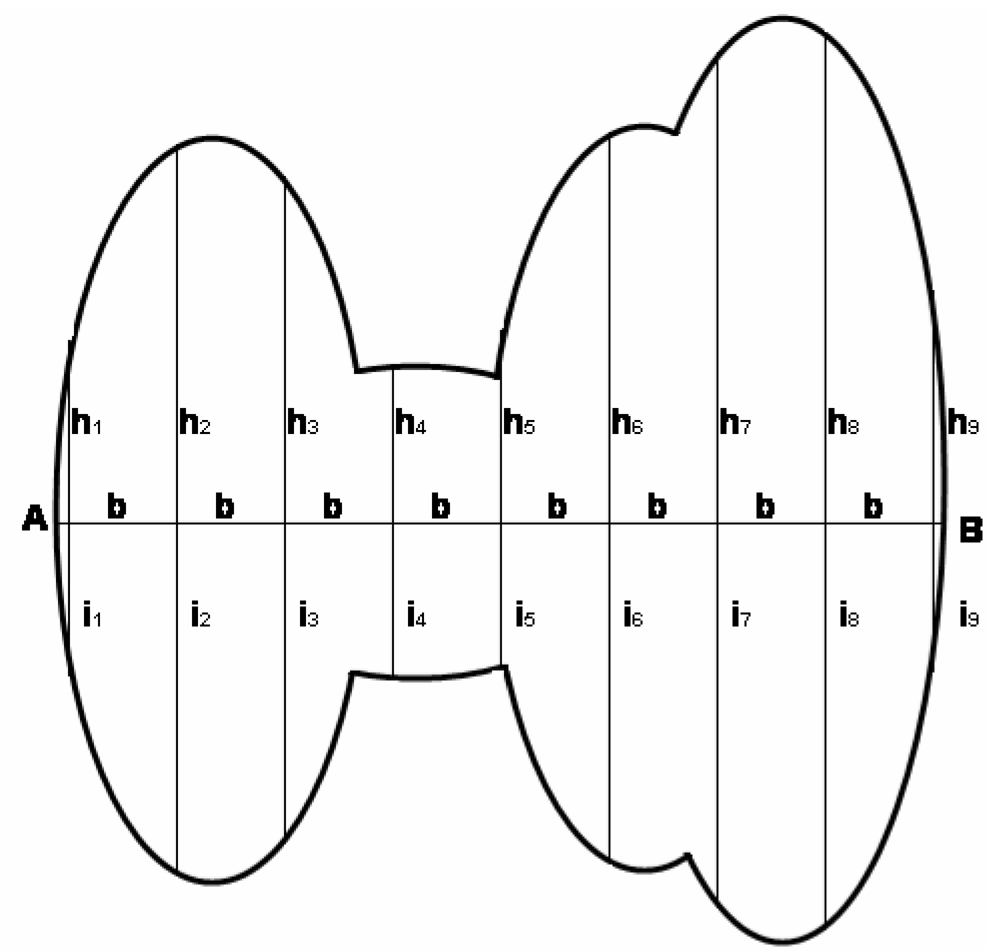
Irregular Boundaries

Irregular areas can be reduced to a series of trapezoids by right-angle offsets from points at regular intervals along a measured line AB. The area of this shape is determined by this formula:

$$\text{Area} = \left(b\left(\frac{h_1 + h_2}{2} + \frac{h_2 + h_3}{2} + \frac{h_3 + h_n}{2}\right)\right) + \left(b\left(\frac{i_1 + i_2}{2} + \frac{i_2 + i_3}{2} + \frac{i_3 + i_n}{2}\right)\right)$$

- b is the length of a common interval between the offsets.
- b must be the same for every interval.
- $h_l, h_2, h_3, \ldots h_n$ are the offsets measured perpendicularly from one side of line AB.
- $i_l, i_2, i_3, \ldots i_n$ are the offsets measured perpendicularly from the other side of line AB.

Example: In this flowerbed, the intervals, or b, are 10 feet. The offsets are measured out from line AB, which is a cord, stretched across the bed and marked in 10-foot intervals (h_l=5 feet, h_2=10, h_3=9, h_4=5, h_5=5, h_6=10, h_7=11, h_8=12, h_9=5, i_1=4 feet, i_2=10, i_3=9, i_4=5, i_5=5, i_6=10, i_7=11, i_8=12, i_9=3). What is the area of this bed?



$$\text{Area} = 10\left(\frac{5+10}{2} + \frac{10+9}{2} + \frac{9+5}{2} + \frac{5+5}{2} + \frac{5+10}{2} + \frac{10+11}{2} + \frac{11+12}{2} + \frac{12+5}{2}\right) +$$

$$10\left(\frac{4+10}{2} + \frac{10+9}{2} + \frac{9+5}{2} + \frac{5+5}{2} + \frac{5+10}{2} + \frac{10+11}{2} + \frac{11+12}{2} + \frac{12+3}{2}\right)$$

Area = (10 (7.5 + 9.5 + 7 + 5 + 7.5 + 10.5 + 11.5 + 8.5)) + (10 (7 + 9.5 + 7 + 5 + 7.5 + 10.5 + 11.5 + 7.5))

Area = 10 (67) + 10 (65.5)

Area = 670 + 655 = 1,325 sq. ft.

Suggestions

- A measuring wheel or device can save time over a tape.
- Once the area has been measured, record the measurements for future reference.
- If the area is new to you and you are relying on the figures of someone else, it would be advisable to check them.

Measurement conversions.			
Square Measure:			
144 square inches			1 square foot
9 square feet			1 square yard
30 1/4 square yards		1 square rod	272 1/4 square feet
43,560 square fee			1 acre
4,840 square yards			1 acre
160 square rods			1 acre
640 acres			1 square mile
Linear measure:			
1 inch		2 1/2 centimeters	25 1/2 millimeters
1 foot			12 inches
1 yard			3 feet
1 rod		5 1/2 yards	16 1/2 feet
1 mile	320 rods	1,760 yards	5,280 feet
Fluid Measure:			
1/6 fluid ounce			1 teaspoon (tsp.)
1/2 fluid ounce		1 tablespoon (Tbs.)	3 teaspoons
1 fluid ounce		2 tablespoons	1/8 cup
8 fluid ounces		1 cup	1/2 pint
16 fluid ounces		2 cups	1 pint
32 fluid ounces		4 cups	1 quart
128 fluid ounces		16 cups	1 gallon
Weights:			
1 ounce			23 1/3 grams
1 pound		16 ounces	453 1/2 grams
2 1/5 pounds		1 kilogram	1,000 grams
1 ton		2,000 pounds	907 kilograms
1 metric ton		1,000 kilograms	2,205 pounds
Approximate Rates of Application Equivalents:			
1 ounce per square foot			2,722.5 pounds per acre
1 ounce per square yard			302.5 pounds per acre
1 ounce per 100 square feet			27.2 pounds per acre
1 pound per 1,000 square feet		43.56 ounces per acre	2.72 pounds per acre
1 pound per acre		1 ounce per 2,733 sq feet	8 1/2 grams per 1,000 sq. feet
100 pounds per acre			2.5 pounds per 1,000 sq. feet
5 gallons per acre			1 pint per 1,000 sq. feet
100 gallons per acre		2.5 gallons per 1,000 sq. feet	1 quart per 100 sq. feet

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