Fertilizer Calculation and Calibration

• **Calculation:** Determine the correct amount of fertilizer needed.

• **Calibration:** The process by which one determines the application rate (gallons per acre or gallons per 1,000 square feet, or lbs per acre or lbs per 1,000 square feet, ) of equipment under a given set of conditions.
Pictures Can Say a ______ Words
Nitrogen & Phosphorus Runoff

- The primary danger of nitrogen and phosphorus runoff from turfgrass fertilization is the application of fertilizer to impervious services
Determine The Correct Amount of Fertilizer Needed

% Analysis $\times$ Wt. Of Fertilizer $=$ Wt. Of Nutrient

Express as a decimal

How much N is in a 40 lb bag of 18-2-18?

$$(.18) \times (40) = x \quad x = 7.2 \text{ lbs of nitrogen}$$

How much of the 18-2-18 will be needed if you want to apply .7 lb of N/M?

$$(.18) \times (X) = .7 \quad \text{Solve for } X \quad x = .7/.18 \quad 3.9 \text{ lbs of fertilizer/M}$$

How much of this fertilizer would be needed to treat a 6,800 sq. ft.?

$$\frac{3.9 \text{ lbs}}{1,000 \text{ sq ft}} = \frac{x}{6,800 \text{ sq ft}} \quad 3.9 \text{ lbs} \times 6.8 = 26.5 \text{ lbs of fertilizer needed}$$
How to Measure Your Yard

To apply the correct amount of fertilizer to your lawn, you need to know its surface area.

First, determine the total area of your property. Second, subtract the areas not to be fertilized. The remaining square footage is the number needed to determine how much fertilizer is needed. (See Figure 1)

Total lot: 125' x 100' = 12,500 sq. ft.

Subtract:
- House: 44' x 26' = 1,144 sq. ft.
- Drive: 40' x 10' = 400 sq. ft.
- Garden: 25' x 15' = 375 sq. ft.
- Walk: 4' x 20' = 80 sq. ft.

Total to subtract: 2,143 sq. ft.
Remaining: 10,357 sq. ft.

How to determine the square footage of some familiar shapes:

- Squares, rectangles:
  - Area = Length x width
  - Example: 30' x 20' = 600 sq. ft.

- Triangles:
  - Area = ½ base x height
  - Example: 50' x 20' = 500 sq. ft.

- Circles:
  - Area = π r²
  - Example: r = 20'; Area = 3.14 x (20' x 20') = 1,256 sq. ft.
Calibration Tools
Dry Application Methods
Drop Spreader

• Provides Uniform Application Across the Width of the Spreader

• Greater Control of Fertilizer Placement

• Minimal Impact of Wind and Fertilizer Particle Size on Distribution Uniformity
Drop Spreader

- Applications Take Longer
- Greater Potential for Striping / Skipping
- Fertilizer Particles May Not Pass Through Spreader When Applying Fertilizer at Low Rates
Drop Spreader Application Tips

For Rectangular Lawns:
Apply two header strips across each end for a turning area. Then apply back and forth in the longest direction.

For Irregular-Shaped Lawns:
Apply one header strip around the entire lawn for a turning area, then apply back and forth.

Spreader Overlap:
To avoid streaks or misses, overlap spreader patterns approximately 1-1/2 feet (50cm). Do not leave spreader open when making turns.
Broadcast Spreader

- Does **Not** Provide a Uniform Application Across the Width of the Spread Pattern
- **Less Control of Fertilizer Placement Without A Deflector Attachment or Other Devices**
- **Wind and Fertilizer Particle Size Will Decrease Distribution Uniformity of Spreader**
Broadcast Spreader Swath Width and Effective Swath Width

Spreader Swath Width: 18 ft

Effective Swath Width: 10 ft (96% of all material)

Left of Center (-) Distance (ft) Right of Center (+)
## Rotary Spreader Spacing For Different Products

Table 1. Recommended spacing during rotary spreader operation

<table>
<thead>
<tr>
<th>Material</th>
<th>Effective Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizers</td>
<td>8 to 10 ft</td>
</tr>
<tr>
<td>Impregnated carriers: vermiculite, corn cob</td>
<td>4.5 to 5 ft</td>
</tr>
<tr>
<td>Seed</td>
<td>3.5 to 4.5 ft</td>
</tr>
</tbody>
</table>
Rotary Spreader Improvements

- Helical Cone
- Edge Guard or Deflector
- 3rd Port Adjustment
Wheel Track to Wheel Track
Points To Remember

- **Rotary Spreader Operation**
  - Walk at normal speed (5 ft per sec); a faster pace will result in a lighter application rate.
  - Overlap to obtain a uniform application; effective overlap changes with each product.
  - Use tighter pattern spacing for seed (3.5 to 4.5 ft) and pesticides (4.5 to 5 ft) than fertilizer materials (8 to 10 ft).
  - Spread wheel track to wheel track (or footprint to footprint); space pattern so that the farthest thrown granules are hitting the wheel marks of the previous pass.
  - Dry materials with different granule sizes and weights do not spread uniformly.
  - Check for clogs and obstructions of the drop holes or ports in the hopper.
  - Check and monitor spreader calibration accuracy during spreader operation.
CALIBRATION

• Measure off an area and determine amount of fertilizer needed

• Attach a catchment pan and adjust the spreader setting

• Treat area and weigh fertilizer

• Set up an equality to solve for your application rate
Calculations

• Assume 1 lb of fertilizer was applied to a 200 sq. ft. area at a setting of K

\[
\frac{1 \text{ lb}}{200 \text{ sq. ft.}} = \frac{x}{1,000 \text{ sq. ft.}}
\]

cross multiply

\[200x = 1000; \quad x = \frac{1000}{200} = 5 \text{ lbs applied}\]

• Apply in 2 directions to increase uniformity for a broadcast spreader
Spray Application

• Various types and formulations of fertilizers will allow for spray applications based on their water solubility. For example, urea nitrogen is water soluble (6.5 lbs of urea will go into solution in 1 gallon of water).
Liquid Application Calibration and Equipment Use

Handheld Spray Gun Selection and Application Technique

Select the proper spray volume.
For example:

- 1.5 gallons
- 2.0 gallons
- 3.0 gallons
- 4.0 gallons

Nozzles are typically used to apply a swath width of 8 feet.

Spray Swath
A spray swath is created as the operator holds the spray-gun at a 45° angle to the body and swings the spray-gun back and forth across his/her body. The applicator’s arm should swing fast enough to hit an area within the swath three times with the spray.

Overlap
The stop and return motion of the operator’s arm swing creates a spray distribution that requires a 100% overlap between successive passes so that application has an even distribution. Thus, an applicator should overlap 4 feet between each parallel pass (8 foot swath).

A typical walking speed is 20.5 feet in 5 seconds (2.8 mph) for handheld sprayer applications.
CALIBRATION

• Measure off known area

• Fill sprayer with water to known volume

• Spray and determine volume used

• Set up an equality to solve for your application rate
Assume area measured off is 10 feet by 25 feet

\[ 10 \times 25 = 250 \text{ sq ft.} \]

The volume used was .5 gallons then the equality is as follows …

\[
\frac{.5 \text{ gallons}}{250 \text{ sq. ft}} = \frac{x \text{ gallons}}{1000 \text{ sq. ft}}
\]

\[ X = 2 \text{ gallons per 1,000 sq. ft.} \]
CALIBRATION

- If you do not have a sight tube or volume marking on a sprayer then another way to determine the spray volume is to collect the spray “Bucket Check” and determine the nozzle output in gallons per minute.
SAMPLE PROBLEM

What is the application rate (gallons/ 1,000 ft$^2$) of a hand held sprayer if it applies 2 gallon per minute? The calibration area was 400 square feet and it took 20 seconds to treat the area.

A. Set up an equality to determine the time it would take to treat a 1,000 square ft area.

\[
\frac{400 \text{ sq. ft}}{20 \text{ seconds}} = \frac{1,000 \text{ sq. ft}}{x}
\]

\[
(400) (x) = (20) (1000)
\]

\[
X = \frac{(20)(1000)}{400}
\]

\[
X = 50 \text{ seconds to treat 1,000 sq. ft.}
\]

B. Set up this equality to solve for the application rate.

\[
\frac{2 \text{ gallon}}{60 \text{ seconds}} = \frac{x}{50 \text{ seconds}}
\]

Solve for x

\[
(60) (x) = (2) (50)
\]

\[
X = \frac{(1)(100)}{60}
\]

\[
X = 1.67 \text{ gallons per 1,000 sq. ft.}
\]
Boom Sprayer Calibration

• There are numerous methods used in calibrating sprayers. Several different techniques and formulas will be discussed.
Table Interpretation: For nozzle model 650067-SS it has the following characteristics: It is a 65 degree nozzle and can be used between 30 and 60 psi. If used at 50 psi its output would be .07 gallons per minute (GPM). Also at a 20 inch spacing and traveling at 5 MPH the application rate would be 4.5 gallons per acre (GPA).

<table>
<thead>
<tr>
<th>Tip No. (Strainer Screen Size)</th>
<th>Liquid Pressure in PSI</th>
<th>Capacity 1 Nozzle in GPM</th>
<th>Capacity 1 Nozzle in oz./min.</th>
<th>Gallons Per Acre — 20” Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>65°, 80°, and 110° Series</td>
<td></td>
<td></td>
<td></td>
<td>4 MPH</td>
</tr>
<tr>
<td>650067-SS</td>
<td>30</td>
<td>.06</td>
<td>7.7</td>
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<tr>
<td></td>
<td>40</td>
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<tr>
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<td>11.5</td>
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<td></td>
<td>40</td>
<td>.10</td>
<td>12.8</td>
<td>7.4</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>.11</td>
<td>14.1</td>
<td>6.3</td>
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<td></td>
<td>60</td>
<td>.12</td>
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<td>30</td>
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<tr>
<td>11001-SS 100 Mesh</td>
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<td>.09</td>
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<td>6.4</td>
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<td>.10</td>
<td>12.8</td>
<td>7.4</td>
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<td>110015-SS (100 Mesh)</td>
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<td>14.1</td>
<td>6.3</td>
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<td>15.4</td>
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<td></td>
<td>60</td>
<td>.12</td>
<td>15.4</td>
<td>9.1</td>
</tr>
</tbody>
</table>
CALIBRATION: Method 1

- Measure off known area
- Fill sprayer with water to set level
- Spray known area noting pressure and speed settings
- Determine volume used
- Set up an equality to solve for your application rate
CALIBRATION
FORMULAS : Method 2

GPA = \( \frac{5940 \times \text{GPM}}{\text{MPH} \times \text{NW}} \) (of nozzle)

GPA = \( \frac{495 \times \text{GPM}}{\text{MPH} \times \text{BW}} \) (of sprayer)

\text{NW} \) (nozzle spacing in inches)
\text{BW} \) (boom width in feet)
SPEED (MPH)

- Inverse relationship between speed and application rate
- As speed increases application rate decreases
- To determine mph use the following formula:
  \[ MPH = \frac{\text{Distance Traveled (ft)} \times 60}{\text{Time (seconds)} \times 88} \]
- Determine the mph if a sprayer travels 130 ft. in 40 seconds.
  \[ MPH = \frac{130 \times 60}{40 \times 88} \]
  \[ MPH = \frac{7800}{3520} = 2.2 \text{ mph} \]
Gallon/ Minute Calculation

- While the sprayer is running, determine the nozzle output or boom output by collecting the spray and measuring the volume.
SAMPLE PROBLEM

Determine the GPA of a sprayer if given the following information. The nozzle averages .8 GPM and they are spaced at 20 inches. The sprayer will travel at 6 MPH.

Using this formula one can solve for GPA:

\[
GPA = \frac{5940 \times \text{GPM}}{\text{MPH} \times \text{NW}}
\]

\[
GPA = \frac{5940 \times .8}{6 \times 20}
\]

GPA = 39.6
SAMPLE PROBLEM

Determine the GPA of a sprayer given the following information:

The sprayer has 8 nozzles and each nozzle averages .5 GPM. The boom width is 12 feet and will be traveling at 4 MPH.

\[
\text{GPA} = \frac{495 \times \text{GPM}}{\text{MPH} \times \text{BW}}
\]

GPM is for the entire sprayer (8 nozzles). Therefore multiply 8 times .5 to get the sprayer output of 4 GPM.

\[
\text{GPA} = \frac{495 \times 4}{4 \times 12}
\]

GPA = 41.3 or round off to 41
COMPUTERIZATION

• Sprayer Control Systems
• Adjust Pressure and Speed to Deliver Desirable GPA Rates

Pictures From Teejet Web Page