Offset method

3rd – Measure the length of each offset line

Chapter 8: Turfgrass Calibrations

B = 0  E = 20 yds  H = 20 yds  K = 25 yds
C = 25 yds  F = 15 yds  I = 25 yds
Sprayer/Spreader Calibration

Introduction

• In this chapter you will learn about important topics such as:
  – The importance of accurate calculations and sprayer/spreader calibrations
  – Methods for determining area
  – Methods for calibrating spreaders and sprayers
  – Basic spreader and sprayer maintenance
  – How to understand fertilizer labels
  – How to calculate rates for solid and liquid fertilizers
Sprayer/Spreader Calibration
Area Determinations

- Calculations are routinely performed in the application of any material to turfgrass.
- Whether it is seed, fertilizer, lime, or pesticides it is extremely important to know the size of your turfgrass area in order to apply the right rate.
Sprayer/Spreader Calibration
Area Determinations

- Turfgrass areas can be measured in many different ways including:
  - Linear measurements
    - Pacing
    - Using a tape measure
  - Shapes
    - Square and Rectangles
    - Triangles
    - Circles
    - Trapezoids
Sprayer/Spreader Calibration
Area Determinations

<table>
<thead>
<tr>
<th>Shape</th>
<th>Formula</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squares and rectangles</td>
<td>$\text{Area} = \text{length} \times \text{width}$</td>
<td>$A = 50 \text{ ft} \times 90 \text{ ft}$</td>
</tr>
<tr>
<td></td>
<td>$L = \text{length}$</td>
<td>$A = 4,500 \text{ ft}^2$</td>
</tr>
<tr>
<td></td>
<td>$W = \text{width}$</td>
<td></td>
</tr>
<tr>
<td>Circles</td>
<td>$\text{Area} = \pi \ r^2$</td>
<td>$A = 3.14 \times 30^2$</td>
</tr>
<tr>
<td></td>
<td>$\pi = 3.14$</td>
<td>$A = 2,826 \text{ ft}^2$</td>
</tr>
<tr>
<td></td>
<td>$r = \text{radius}$</td>
<td></td>
</tr>
<tr>
<td>Triangles</td>
<td>$\text{Area} = \frac{\text{base} \times \text{height}}{2}$</td>
<td>$A = 75 \text{ ft} \times 125 \text{ ft}$</td>
</tr>
<tr>
<td></td>
<td>$b = \text{base}$</td>
<td>$A = 4,687 \text{ ft}^2$</td>
</tr>
<tr>
<td></td>
<td>$h = \text{height}$</td>
<td></td>
</tr>
<tr>
<td>Trapezoids</td>
<td>$\text{Area} = \frac{(a+b) h}{2}$</td>
<td>$A = (50 \text{ ft} \times 70 \text{ ft}) \times 30 \text{ ft}$</td>
</tr>
<tr>
<td></td>
<td>$a = \text{base}$</td>
<td>$A = 1,800 \text{ ft}^2$</td>
</tr>
<tr>
<td></td>
<td>$b = \text{base}$</td>
<td></td>
</tr>
</tbody>
</table>
These equations work great for regular shapes.

Unfortunately, most turfgrass areas are not in regular shapes.

When this is the case, there are two other options.
Sprayer/Spreader Calibration
Area Determinations

Option 1 for irregular shapes

• Try to fit the geometric shapes over your area in a pattern that fits as close as possible.
Option 1 for irregular shapes

Measure the area of each of the regular shapes and add them together to get the total area.
Option 2 for irregular shapes

The offset method

• The offset method uses a series of straight lines to calculate the area of irregular shapes.
Offset method

1\textsuperscript{st} – Establish points A and B and measure the distance between them as in this example.

2\textsuperscript{nd} – Establish your offsets making sure that they are at regular intervals and of an even number (Ex: C to D, =, D to E, =, E to F, and so on)
Offset method

3rd – Measure the length of each offset line

A = 0  D = 25 yds  G = 15 yds  J = 25 yds
B = 0  E = 20 yds  H = 20 yds  K = 25 yds
C = 25 yds  F = 15 yds  I = 25 yds
Sprayer/Spreader Calibration
Area Determinations

**Offset method**

4\textsuperscript{th} - Add up the lengths of all the offset lines.

\[ C + D + E + F + G + H + I + J + K = \text{Total length of offsets} \]

\[ 25 + 25 + 20 + 15 + 15 + 20 + 25 + 25 + 25 = 195 \text{ yds} \]

5\textsuperscript{th} – Multiply the total length of the offset lines by the distance between offsets.

Ex: C to D = 30 yds

\[ 30 \text{ yds} \times 195 \text{ yds} = 5,850 \text{ yds}^2 \]

The total area of the irregular shape is 5,850 yds\(^2\).
Proportions

• Proportions are some of the most commonly performed calculations in turfgrass.
• This is because they can be used as the basis for most calculations involving rates and/or areas.
A proportion is essentially a ratio.
In the example below, if the number in the top part of the fraction is divided by the number in the bottom, the result is 0.5, which explains why each fraction is equal.

\[
\frac{1}{2} = \frac{2}{4} = \frac{4}{8} = \frac{1}{2} = \frac{4}{8}
\]
Sprayer/Spreader Calibration
Area Determinations

• If ‘x’ is your unknown value, then solving a proportion to find ‘x’ is a matter of cross multiplying and dividing.

• Multiply the two numbers that are diagonally across from each number and multiply that number by the 3\textsuperscript{rd} number.
Example

If lime is to be applied at 50 lbs per 1000 ft$^2$. How much lime will be needed to treat 6,700 ft$^2$?

\[
\frac{50 \text{ lbs}}{1000 \text{ ft}^2} = \frac{x}{6,700 \text{ ft}^2}
\]

\[
50 \times 6,700 = 1000 \times x
\]

\[
335,000 = 1000 \times x
\]

\[
\frac{335,000}{1000} = x
\]

\[
x = 335 \text{ lbs lime}
\]

In this case, 335 lbs of lime are needed to treat 6,700 ft$^2$ at the rate of 50 lbs lime per 1000 ft$^2$. 
Sprayer Calibration and Maintenance

Nozzle Calibration

• Proper application of pesticides and fertilizers is only possible with a sprayer or spreader that is properly calibrated.

• Pesticides applied with equipment that has not been calibrated may lead to improper application which can result in damaged plants, excess cost, environmental contamination, and ineffective control.
Sprayer Calibration and Maintenance

Nozzle Calibration

• Sprayers should be calibrated regularly.
• A good guideline is to calibrate after every fourth application.
• Also, the sprayer system and nozzles should be checked for damage or wear before every use.
Sprayer Calibration and Maintenance

Nozzle Calibration

• Each type of nozzle has a specific output rate. This specification includes the spray angle and the output rate of the nozzle in gallons per minute.

8002VS => 80 02 VS

8002VS

Spray angle in degrees
(80°)

Gallons per minute at 40psi
(0.2)

Tip material
(Stainless Steel)
Sprayer Calibration and Maintenance

Nozzle Calibration

Types of nozzles and their characteristics

- Ceramic: Superior wear life; highly resistant to abrasive and corrosive chemicals
- Hardened Stainless Steel: Very good wear life; good durability and chemical resistance
- Stainless Steel: Good wear life; excellent chemical resistance; durable orifice
- Polymer: Good wear life; good chemical resistance; orifice susceptible to damage when cleaned improperly
- Brass: Poor wear life; susceptible to corrosion, especially with fertilizers
This table tells you how many gallons per minute you should collect from a properly working spray nozzle at a given PSI.

<table>
<thead>
<tr>
<th>Nozzle Calibration</th>
<th>PSI</th>
<th>Capacity One Nozzle in GPM</th>
<th>Capacity One Nozzle in OZ./MIN.</th>
<th>GPA</th>
<th>Gallons Per 1000 Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 MPH</td>
<td>5 MPH</td>
<td>6 MPH</td>
<td>8 MPH</td>
<td>10 MPH</td>
</tr>
<tr>
<td>XR8001</td>
<td>15</td>
<td>0.061</td>
<td>7.8</td>
<td>4.5</td>
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<td></td>
<td>20</td>
<td>0.071</td>
<td>9.1</td>
<td>5.3</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>0.087</td>
<td>11</td>
<td>6.5</td>
<td>5.2</td>
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<tr>
<td></td>
<td>40</td>
<td>0.100</td>
<td>13</td>
<td>7.4</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>0.111</td>
<td>14</td>
<td>8.2</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>0.121</td>
<td>15</td>
<td>8.9</td>
<td>7.1</td>
</tr>
<tr>
<td>XR11001 (100)</td>
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<td>0.061</td>
<td>7.8</td>
<td>4.5</td>
<td>3.6</td>
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<td>9.1</td>
<td>5.3</td>
<td>4.2</td>
</tr>
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<td>0.087</td>
<td>11</td>
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<td>8.2</td>
<td>6.5</td>
</tr>
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<td>8.9</td>
<td>7.1</td>
</tr>
<tr>
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<td>0.171</td>
<td>22</td>
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</tr>
<tr>
<td></td>
<td>60</td>
<td>0.181</td>
<td>23</td>
<td>13.4</td>
<td>10.7</td>
</tr>
</tbody>
</table>

Chapter 8: Turfgrass Calibrations
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Sprayer Calibration and Maintenance
Nozzle Calibration

• When checking nozzles it is important to know how much you **should** collect and how much you **actually** collect from each nozzle.
• In order to determine this you need to calibrate the nozzle.
• This can be done in a few steps.
Sprayer Calibration and Maintenance
Nozzle Calibration

Steps for nozzle calibration

1. Set the proper PSI for the given nozzle. 40 PSI is a commonly used pressure, but it is not appropriate for all situations.

2. Using only water, start the spray flow on the boom.

3. Using a measuring cup, collect the water sprayed in one minute from a single nozzle.
Steps for nozzle calibration

4. When collecting this number in ounces, divide by 128 to get gallons. This number gives you the gallons per minute flow rate from the nozzles.

\[
GPM = \frac{\text{ounces collected}}{128}
\]

If the actual GPM is different from the target GPM:

5. Subtract the actual GPM from the target GPM.

6. Divide the difference in step 5 by the target GPM to get the percent error in the nozzle. If the nozzle is more than 10% off it needs to be replaced.
Sprayer Calibration and Maintenance

Nozzle Calibration

Example:

You have 8003VS nozzles on your boom and you just collected 45 ounces in one minute from the first nozzle.

\[
\text{GPM} = \frac{\text{45 oz collected}}{128 \text{ oz per gallon}} = 0.35 \text{ GPM}
\]

\[
0.35 \text{ GPM (actual)} - 0.30 \text{ GPM (target)} = 0.05 \text{ GPM difference}
\]

\[
\frac{0.05 \text{ GPM difference}}{0.30 \text{ target GPM}} \times 100 = 17\% \text{ difference}
\]

This nozzle needs to be replaced.
There are three main calculations used in calibrating a sprayer.

1. Miles per hour
2. Gallons per minute (rate of output)
3. Gallons per acre (amount of output over a given area)
Sprayer Calibration and Maintenance
Sprayer Calibration

Miles per hour (MPH)

1. Mark off a 200 foot course on terrain that is representative of the area you will be spraying.
2. Fill the spray tank with water.
3. Test to determine which gear and RPM will allow the sprayer to maintain your target PSI (40 PSI is typical) while maintaining a constant ground speed of 3 to 5 mph. Drive the sprayer through the course at least three times and record how many seconds each run takes.
4. Average the three times.

   Average time
   for sprayer to \(=\) \(\frac{\text{Time 1} + \text{Time 2} + \text{Time 3}}{3}\)
   cross 200 ft.

5. Fill in the appropriate course distance and average time into the following formula to calculate the miles-per-hour of your sprayer at the selected gear and setting.

   \[
   \text{MPH} = \frac{\text{Distance (ft)} \times 60}{\text{Average time (s)} \times 88}
   \]
**Sprayer Calibration and Maintenance**

**Sprayer Calibration**

**Example:**
You set up your 200 ft course, made three test runs, and logged the following times.

- Time 1 = 31.5 seconds
- Time 2 = 30.3 seconds
- Time 3 = 29.2 seconds

**Average time** = \(\frac{31.5 + 30.3 + 29.2}{3} = 30.3\) mph

**MPH** = \(\frac{200 \text{ ft} (\text{distance}) \times 60}{30.3 \text{ (avg time)} \times 88} = 4.5\)

At the selected gear and RPM setting your sprayer is traveling 4.5 miles per hour.
Sprayer Calibration and Maintenance

Sprayer Calibration

Gallons per acre (GPA)

1. Determine the GPM of each nozzle as described in the ‘nozzle calibration’ section.
2. Determine distance in inches between the nozzles on the boom
3. Calculate gallons per acre (GPA) from the following formula:

\[
GPA = \frac{GPM \times 5940}{\text{MPH} \times \text{width}}
\]
Sprayer Calibration and Maintenance

Sprayer Calibration

Example:
Assume the following information has been gathered from your sprayer:

GPM of nozzle = 0.5
MPH = 4.5
Width = 18 inches

\[
\text{GPA} = \frac{\text{GPM} \times 5940}{\text{MPH} \times \text{width}} = \frac{0.5 \times 5940}{4.5 \times 18} = 36.67\text{ GPA}
\]
Sprayer Calibration and Maintenance

Sprayer Calibration

Gallons per minute (GPM)

- If the GPA calculated does not meet the requirements of a specific application, the rate of output can be adjusted by switching nozzles.
- To determine the nozzle with the correct output, use the following GPM formula.

\[ \text{GPM} = \text{GPA} \times \text{MPH} \times \text{Width} \]

5,940
Example:

You have a pesticide that must be applied in 22 gallons of water per acre, so 36.67 GPA (from the previous calculation) is too much. This can be resolved by switching to a nozzle that has a lower output. Using the same information from the GPA example, but substituting 22 GPA for 36.67 GPA, we calculate for the sprayer:

\[
GPM = \frac{22 \text{ GPA} \times 4.5 \text{ MPH} \times 18}{5,940} = 0.30 \text{ GPM}
\]
Proper maintenance of a sprayer is just as important as proper calibration.

Abiding by the following list of guidelines will help to ensure that your sprayer stays in good working order each time you use it.
Sprayer Calibration and Maintenance

Sprayer Maintenance

Maintenance Guidelines

1. Fill the sprayer tank half full with water to check the tank, hoses, and fittings for leaks before adding pesticides.
2. Fix all leaks before spraying.
3. Remove and clean the main-line filter before spraying.
4. Remove each of the nozzles to clean and replace the screens if necessary.
5. With the nozzles removed, start the pump to flush any particles or debris out of the system.
6. Return the nozzles to their assemblies making sure that the spray pattern is in line with the boom.

7. Check the spray pattern of each nozzle. If a pattern is inconsistent, replace the nozzle with a new one.

8. Make sure the nozzles are at the correct width apart and height above the ground.
Two types of spreaders commonly used in turfgrass and landscapes are *rotary* and *drop* spreaders.

Rotary
- Cover a wider area
- Faster
- More forgiving of error
- Better ground clearance
- Less delicate rate mechanism
Sprayer Calibration and Maintenance

Spreader Calibration Factors

- Drop
  - More uniform and consistent patterns
  - Lower drift potential
  - Precise control around edges (flower beds, driveways, etc.)
  - More room for error
Precise Control

More room for error
Sprayer Calibration and Maintenance

Spreader Calibration Factors

- There are four factors that affect the distribution of rotary and drop spreader calibration.
  - Spreader design
  - Application product
  - Environment
  - Spreader operator
Spreader design

• The impeller (paddle or spinner) characteristics are all determined by the manufacturer. These characteristics include:
  – Diameter
  – Speed (gear ratio)
  – Concavity (flat or concave)
  – Height above the ground
  – Fin shape and angle
The characteristics of the application product will affect distribution as well. These characteristics include:

- Product (fertilizer, herbicide, seed, etc.)
- Particle shape and size
- Particle density and uniformity
- Critical relative humidity

- The humidity at which fertilizer becomes sticky
Sprayer Calibration and Maintenance

Spreader Calibration Factors

Environment

- Environmental conditions that may affect distribution patterns include:
  - Wind speed and direction
  - Temperature
  - Relative humidity
  - Rainfall
Spreader operator

• The spreader operator can affect distribution patterns in the following ways:
  – Walking speed
  – Pattern of travel
  – Rate of product applied
  – Uniformity of coverage
Calibrating a rotary spreader involves collecting and weighing the material being spread and analyzing the pattern of distribution across the application area.

This process takes several steps.
Sprayer Calibration and Maintenance

Rotary Spreader Calibration

1. Place collection pans in a line perpendicular to the travel direction of the spreader. Use at least 10 pans equally spaced to cover the full width of the spreader swath.

   * Note: All collection pans must be identical in size. One square foot by 1-2 inches deep is recommended.

2. Make several passes in the same direction over the pans. Be sure the spreader is open before reaching the pans and remember to walk at a consistent speed.
3. Collect and weigh the material in grams for each pan (for all passes combined) on an accurate scale. This data will be used to determine the distribution pattern and application rate.

4. Empty each collection container into separate identical cylindrical tubes and examine the distribution pattern across the series of tubes. A desirable pattern is one that peaks in the center and descends evenly on each side forming a bell-shaped curve.
5. Determine the width of turf covered by each pass of the spreader. This occurs where the amount of granules by weight collected in the trays on the left and right are equal to one half the amount in the center tray.
Sprayer Calibration and Maintenance

Rotary Spreader Calibration

6. Use the weight of material collected from the pan in the center of the pattern in the equation below:

\[
\text{Grams of material} = 1,000 \times \frac{\text{Grams of material collected in center pan}}{\text{sq.ft. per pan} \times \# \text{ of passes}}
\]

Continue this process until the desired rate is achieved, either by increasing or decreasing the spreader setting.
Sprayer Calibration and Maintenance

Rotary Spreader Calibration

• Drop spreader calibration is similar to rotary spreader calibration in that it involves collecting and weighing the material being spread.

• 3 methods of drop spreader calibration are available including:
  – Pan method
  – Sweep and weigh method
  – Catch pan method
Sprayer Calibration and Maintenance
Drop Spreader Calibration

Pan method

• Push the spreader over a pan and collect and weigh the material in the pan.
• By knowing the area of the pan and the weight of the material, the application rate can be determined by:

\[
\text{Grams of material} = 1,000 \times \frac{\text{Grams of material collected in pan per 1000 ft}^2}{\text{sq ft per pan} \times \# \text{ of pans} \times \# \text{ of passes}}
\]
Sweep and weigh method

- Push the spreader over a clean, smooth surface of a known distance and sweep up and weigh the material. The application rate can then be determined by:

\[ \text{Grams of material} = 1,000 \times \frac{\text{Grams of material collected}}{\text{Spreader width} \times \text{distance traveled}} \]
Sprayer Calibration and Maintenance

Drop Spreader Calibration

Catch pan method

- Attach a catch pan to the bottom of the drop spreader and walk a known distance. After walking the known distance the application rate can be determined by:

\[
\text{Grams of material} = 1,000 \times \frac{\text{Grams of material collected}}{\text{Spreader width} \times \text{distance traveled}}
\]
Sprayer Calibration and Maintenance

Spreader Operation

Here are some general tips on operating a spreader

1. Make sure the distribution lever is closed before filling the hopper.
2. Do not overfill the hopper.
3. Make sure the screen filter is in place to prevent clogging.
4. Do not pull the spreader.
5. Push the spreader at the same speed as it was calibrated.
6. Start walking before opening the lever and close the lever before stopping forward motion.
General tips on operating a spreader (continued)

7. Hold the handle at the same height as used in calibration.
8. Walk in straight lines using reference points such as the spreader wheel marks or footprints.
9. Do not spread material while turning.
10. Do not make sensitive applications if wind speed is greater than 5 mph.
11. Keep material dry to prevent caking or clogging.
Sprayer Calibration and Maintenance

Spreader Maintenance

- Even a properly calibrated spreader will not function properly if not maintained correctly.

Here are some tips on spreader maintenance

1. Wash the spreader after each use to avoid buildup of materials in the ports and on the impeller.
2. Consult the operator’s manual for appropriate lubricant and parts requiring lubrication.
3. Use proper replacement parts.
4. Store spreader in a cool, dry place without anything in the hopper.
Proper fertilization is critical to the success of any turfgrass management program.

While general fertility guidelines can aid in maintaining high quality turfgrass, even the best recommendations are no help if you cannot apply the fertilizer as recommended.
One of the first steps to proper fertilization is understanding the fertilizer label.

There are many different fertilizers available for use on turfgrass.

By law they must all carry a label stating the guaranteed analysis of the material.
Fertilizer label

• All fertilizer labels must include the following:
  – Name, brand, or trademark
  – Guaranteed chemical analysis
  – Potential acidity (CaCO$_3$) equivalent
  – Manufacturer’s name and address
  – Net weight of fertilizer in the container
Sprayer Calibration and Maintenance

Proper Fertilization

Fertilizer label

28-5-12
For use in Rotary Spreaders Only
50 lb COVERS 14,000 sq ft

GUARANTEED ANALYSIS
TOTAL NITROGEN (N) ..................28.00%
1.96% Ammonical Nitrogen
28.00% Urea Nitrogen

AVAILABE PHOSPHATE (P2O5) ........5.00%

SOLUBLE POTASH (K2O) ............12.00%

SULFUR (S) Total ....................4.50%
4.30% Free Sulfur (S)

IRON (Fe) Total ....................3.00%

DERIVED FROM: Poly Coated Sulfur Coated Urea, Urea, Ammonium Phosphates, Muriate of Potash, Iron Oxide

CHLORINE (Cl) Max ................6.20%

12.00% Slowly Available Nitrogen from LESCO Poly Plus® Sulfur Coated Urea.

DIRECTIONS FOR USE: This LESCO product is a profession quality turf fertilizer for use on all lawn areas. The best results with this product are obtained when it is applied to actively growing grass, and watered into the turf after application. Avoid mowing immediately following application.

For best results, wash, brush or blow the fertilizer off walks and planted surfaces following application to avoid discoloration.

Recommended rates of fertilizer are three to five applications per year, at the rate of one pound of nitrogen per 1,000 sq ft. Actual rates and timing of applications will vary with weather, soil, and turf conditions.

For additional product assistance, call LESCO, Inc. in Canton, Ohio at 1-800-321-0325.

COVERAGE: Fifty pounds of this LESCO 28-5-12 application rate of 1 pound of nitrogen (50 pounds of fertilizer in 1,000 sq ft)

ROTARY SPREADER SETTINGS

Apply LESCO Fertilizers and Combination Products only with a rotary spreader. The following rotary spreader settings are approximate for the application rate of 1 pound of nitrogen per 1,000 square feet. You may need to adjust the setting depending on walking speed, spreader condition and product.

ROTARY SPREADER SETTINGS

ROTARY SPREADER

LES CO

SCOTT'S RBA

Cyclone or Spreader

LES CO Pendum

Lesco

Settings

Calibration Gauge #14

1

4.25

19

4.0

F1406

WARRANTY

LES CO warrants that this product conforms to the analysis on its label. When used in accordance with label directions, under normal conditions, this product is reasonably fit for its intended purposes. Since time, method of application, weather, plant, and soil conditions, and other factors affecting the results, mixture with other chemicals, and other factors affecting the use of this product are beyond our control, no warranty is given concerning the use of this product except to label directions of use conditions which are abnormal or not reasonably foreseeable. The user assumes all risk of any such use.

LES CO and Poly Plus are registered trademarks of LESCO Technologies, Inc.
Sprayer Calibration and Maintenance
Brief History behind N-P-K analysis
Sprayer Calibration and Maintenance

Brief History behind N-P-K analysis

Colonel Leonidas Lafayette Polk (1837-1892)

- An orphan from Anson County who grew up to become the 1st Commissioner of Agriculture in NC.
- Founder of Progressive Farmer Magazine
- Founder of The Watauga Club
- Namesake of Polk County
- Namesake of Polk Hall on NCSU’s campus
Colonel Leonidas Lafayette Polk (1837-1892)

- At the time, the only products available as fertilizer were animal by-products such as bone meal and manure.
- When rail cars of these products came in from out of state, the only way to know the nutrient analysis was by taking the word of the person selling it.
Sprayer Calibration and Maintenance

Brief History behind N-P-K analysis

Colonel Leonidas Lafayette Polk (1837-1892)

• So, he came up with the idea of the N-P-K analysis and passed it as state law. No person could sell any fertilizer product without proper documentation of its actual N-P-K analysis.

• The rest of the nation, as well as world, followed suit and the N-P-K analysis you see on fertilizer bags today is a direct result of our state being the 1st to pass this law.
Fertilizer analysis and ratios

- Fertilizer *analysis*, or *grade*, consists of three numbers that represent the guaranteed minimum percentages by weight of:
  - Nitrogen (N)
  - Phosphate (P$_2$O$_5$, the source for Phosphorous)
  - Potash (K$_2$O, the source for Potassium)

Ex: A fertilizer with an analysis of 20-5-10 contains a minimum of 20% N, 5% P$_2$O$_5$, and 10% K$_2$O.
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- Only N is expressed on an elemental basis.
- P and K are expressed on an oxide basis which means they are contained in the phosphate ($P_2O_5$) and potash ($K_2O$) compounds.
  - Phosphate ($P_2O_5$) contains 44% P
  - Potash ($K_2O$) contains 83% K
Example:

- A 50 lb bag of 18-6-12 contains:
  - 9 lbs of N
  - 3 lbs of $\text{P}_2\text{O}_5$ (x 0.44 = 1.3 lbs actual P)
  - 6 lbs of $\text{K}_2\text{O}$ (x 0.83 = 5 lbs actual K)
Ratios are the relative amounts of nutrients in a particular material.

10-10-10 = 1:1:1 ratio of N: P$_2$O$_5$: K$_2$O
20-5-10 = 4:1:2 ratio of N: P$_2$O$_5$: K$_2$O
18-6-12 = 3:1:2 ratio of N: P$_2$O$_5$: K$_2$O

*Divide by the least common denominator*

45-15-30, 36-12-24, and 9-3-6 all have a 3:1:2 ratio.
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Water Soluble and Water Insoluble Nitrogen

• In addition to listing the N, P$_2$O$_5$, and K$_2$O by weight, the fertilizer label also must list how much of the N is water soluble and water insoluble.

  – Water soluble nitrogen (WSN)
    • Nitrogen that is quickly available
  – Water insoluble nitrogen (WIN)
    • Nitrogen that is slowly released over a period of time
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Water Soluble and Water Insoluble Nitrogen

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Salt index

- *Salt index*
  - Salt index refers to the measure of burn potential of a fertilizer.
  - Many fertilizers are available as salts. When they come in contact with leaf tissue, they can cause water to be drawn out of the cells, resulting in plant injury.
  - It is important to know the burn potential of a fertilizer source before it is applied.
Directions for applying fertilizer

- Apply fertilizer when grass leaves are dry.
- Uniformly spread fertilizer using a drop or rotary spreader.
- Apply half the fertilizer in one direction, and the other half in a perpendicular direction.
- Water after application to wash fertilizer off of the turfgrass leaves and into the soil.
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Directions for applying fertilizer

- Be careful of excessive rates or spills.
Calculating fertilizer applications

• In order to determine how much fertilizer to apply you must know the following:
  – Square footage of area to be treated
  – Recommended application rate
  – Analysis of the fertilizer
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Example

- A superintendent wants to apply 0.75 lbs of N/1000 ft\(^2\) to the putting greens. If the fertilizer being used has an analysis of 18-5-9, and there are 55,000 ft\(^2\) of greens, how many lbs of fertilizer will be needed for the job?

- How many bags of fertilizer are needed if 18-5-9 is sold in 50 lb bags?
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• How much fertilizer needs to be bought?

\[
\text{Square Footage} \times \text{Rate of application} \times \text{Analysis of fertilizer needed} = \text{lbs of fertilizer needed}
\]

\[
55,000 \text{ ft}^2 \times 0.75 \text{ lbs N} \times 1 \text{ lb fertilizer} = 41,250 \text{ lbs} = 229 \text{ lbs}
\]

\[
1000 \text{ ft}^2 \times 0.18 \text{ lbs of N} \times 180 \text{ fertilizer}
\]

• How many bags need to be bought?

\[
229 \text{ lbs} = 4.58 \text{ bags}
\]

50 lb bags

So, the superintendent needs to buy five bags.

Chapter 8: Turfgrass Calibrations
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Liquid fertilizers

• Example
  – A golf course superintendent uses a 20-4-10 liquid fertilizer on his putting greens. How much N, P₂O₅, and K₂O are in one gallon?

  – In order to determine the nutrient content of liquid fertilizers you need to follow a few steps.
Liquid fertilizers

1. Weigh one gallon of material
   For this example, assume it weighs 11.5 lbs.

2. Determine the lbs of the nutrient in one gallon.
   \[
   \begin{align*}
   11.5 \text{ lbs} \times 0.20 \text{ N} &= 2.3 \text{ lbs of N per gallon} \\
   11.5 \text{ lbs} \times 0.04 \text{ P}_2\text{O}_5 &= 2.3 \text{ lbs of P}_2\text{O}_5 \text{ per gallon} \\
   11.5 \text{ lbs} \times 0.10 \text{ K}_2\text{O} &= 2.3 \text{ lbs of K}_2\text{O} \text{ per gallon}
   \end{align*}
   \]
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Liquid fertilizers

3. Determine the volume rate of fertilizer.

\[
\text{lbs of nutrient to be applied per 1000 ft}^2 = \frac{\text{gallons of fertilizer}}{\text{lbs of nutrient per gallon}} \times 1000 \text{ ft}^2
\]

If you wanted to apply 0.75 lbs of N/1000 ft\(^2\) with the above fertilizer.

\[
0.75 = 0.3 \text{ gallons per 1000 ft}^2
\]

2.3
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Conclusions

- In this section we have covered many important turfgrass mathematics concepts which include:
  - Area determinations
  - Nozzle and sprayer calibration
  - Rotary and drop spreader calibration
  - Fertilizer and seed calculations
- All of these are important calculations which must be correctly performed before any pesticide, fertilizer, or seed is applied to any turfgrass area.