HORT325: Soils & Fertilizers

Soil Composition
Soil Texture/Structure & Water Capacity
Soil pH & Nutrient Availability
Fertilizers
Soil Testing

<table>
<thead>
<tr>
<th>Soil Fraction</th>
<th>Size Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Coarse Sand</td>
<td>2.0 to 1.0 mm</td>
</tr>
<tr>
<td>Coarse Sand</td>
<td>1.0 to 0.5 mm</td>
</tr>
<tr>
<td>Medium Sand</td>
<td>0.5 to 0.25 mm</td>
</tr>
<tr>
<td>Fine Sand</td>
<td>0.25 to 0.10 mm</td>
</tr>
<tr>
<td>Very Fine Sand</td>
<td>0.10 to 0.05 mm</td>
</tr>
<tr>
<td>Silt</td>
<td>0.05 to 0.002 mm</td>
</tr>
<tr>
<td>Clay</td>
<td>&lt;0.002 mm</td>
</tr>
</tbody>
</table>

Definitions in Handbook

- Soil Structure
- Soil Porosity
- Pore Space
- Soil Air
- Soil Air Movement
- Soil Water
- Drainage
- Soil Organic Matter
- Soil Temperature
- Soil Crusts

What is Soil?

- Sand
  - 0.05 mm to 2.00 mm
- Silt
  - 0.002 mm to 0.05 mm
- Clay
  - Less than 0.002 mm
- Organic Matter
  - Dynamic; the “glue” that cements soil particles into aggregates

See you in Lab!
Why is Soil Texture Important?

- Water (& Nutrient) holding capacity
- Soil Texture & Organic Matter determine Soil Structure

Exam Question

- What is the percent sand, silt & clay of your bare soil vegetable plot?
- Describe the texture of this soil using the Soil Texture Triangle.

Adjusting Soil pH

- Too low
  - Ground agricultural limestone
  - The finer the grind, the more rapid response
- Too high
  - Elemental sulfur; Sulfuric acid; Aluminum sulfate
  - Chelated iron (for iron deficiency)

Soil pH

- Measure of hydrogen ion activity of soil solution (acidity)
- Logarithmic scale
- Most plants do best in slightly acidic soils (~6.5 covers most vegetables)
- pH determines nutrient availability

Fertilizers

- Commercial Fertilizers are Labeled with the Percentage of Nitrogen (N), Available Phosphate (as P$_2$O$_5$) and Soluble Potash (as K$_2$O)
- These numbers are often referred to as N-P-K
- So, a 100 bag of 10-10-10 fertilizer contains 10 pounds of N, P and K right?
- Wrong! It’s 10 pounds of N, 10 pounds of P$_2$O$_5$ and 10 pounds of K$_2$O
- Multiply P$_2$O$_5$ by 0.44 = 4.4 lbs
- Multiply K$_2$O by 0.83 = 8.3 lbs
Complete vs. Incomplete Fertilizers
• Complete fertilizer
  – Contains N, P & K
• Incomplete fertilizer
  – Missing one or more of the major elements
• Complete fertilizer can be made by adding multiple incomplete fertilizers

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>%N</th>
<th>%P₂O₅</th>
<th>%K₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium nitrate</td>
<td>34</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ammonium sulfate</td>
<td>21</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Monoammonium phosphate</td>
<td>11</td>
<td>48</td>
<td>0</td>
</tr>
<tr>
<td>Muriate of potash (precious choline)</td>
<td>0</td>
<td>0</td>
<td>66</td>
</tr>
<tr>
<td>Potassium sulfate</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Super phosphate</td>
<td>0</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Triple super phosphate</td>
<td>0</td>
<td>45</td>
<td>0</td>
</tr>
<tr>
<td>Urea</td>
<td>46</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Urea-ammonium nitrate (tan)</td>
<td>32</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Fertilizer Burn
• Fertilizers are salts and salts pull moisture away from the plant and even from plant roots
• Two rules when applying fertilizer during hot weather when soil moisture is limited:
  – Do not over apply nitrogen fertilizers
  – Make sure adequate moisture is present after applying fertilizers high in salts

Specialty Fertilizers
• Slow release fertilizers
  – Coated with resin or sulfur to control the rate of release
  – Can be applied less frequently and at higher rates without risk of “burning”
• Water soluble fertilizers
  – Highly available since already in solution
  – Uniform application
  – Very efficient especially when combined with drip system

Organic Fertilizers
• Nutrients derived solely from the remains or a byproduct of a once-living organism
• Most are slow release (rely on microbes to mineralize the nutrients) and often contain micronutrients
• Act as soil conditioners, increase organic matter, improve physical structure
• Cottonseed meal, Blood meal, Fish emulsion, Sewage sludge and manures (should be composted)
• Usually very low in major nutrients, so require high levels:

<table>
<thead>
<tr>
<th>Material</th>
<th>%N</th>
<th>%P₂O₅</th>
<th>%K₂O</th>
<th>Suggested amounts of material (lbs. per 1000 sq.ft./A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium nitrate</td>
<td>53</td>
<td>3</td>
<td>0</td>
<td>104.7</td>
</tr>
<tr>
<td>Ammonium sulfate</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>89.0</td>
</tr>
<tr>
<td>Potassium nitrate</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>75.6</td>
</tr>
<tr>
<td>Urea</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>75.4</td>
</tr>
<tr>
<td>Conc Super Phosphate</td>
<td>45</td>
<td>0</td>
<td>0</td>
<td>10.1</td>
</tr>
<tr>
<td>Superphosphate</td>
<td>20</td>
<td>Phosphorus (P₂O₅)</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>0</td>
<td>Potash (K₂O)</td>
<td>118.3</td>
<td></td>
</tr>
<tr>
<td>Potassium sulfate</td>
<td>54</td>
<td>Potash (K₂O)</td>
<td>46.1</td>
<td></td>
</tr>
<tr>
<td>Gypsum</td>
<td>33</td>
<td>Calcium oxide</td>
<td>8.1</td>
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<tr>
<td>Epsom salts</td>
<td>18</td>
<td>Magnesium oxide</td>
<td>44.0</td>
<td></td>
</tr>
</tbody>
</table>

A list of commonly used fertilizers
and salt index or burn potential

Fertilizer Application
• Frequency determined by soil type, crop, irrigation frequency (runoff), type of fertilizer
• General rule of thumb:
  – Nitrogen is for leafy top growth
  – Phosphorus is for root and fruit production
  – Potassium is for cold hardiness, disease resistance and general durability
Application Methods

- **Broadcast**
  - Spread over the growing area and mechanically incorporated into the soil
- **Band**
  - Narrow bands applied in furrows to the side and below the seeds or plants
- **Sidedress**
  - Banding applied to the side of growing plants
- **Fertigation**
  - Water soluble fertilizers applied with irrigation water
- **Starter Solutions**
  - Water soluble fertilizers applied with water used to set transplants
- **Foliar Feed**
  - Used for a quick response or micronutrients are unavailable or soil is too cold for plants to extract

Soil Testing

- Measures nutrient availability of the soil, prior to any amendments that are made
- You should always amend soil based on a soil test:
  - Nutrients can only come from the soil + amendments
  - The soil test will show you how much is available in the soil, so you can estimate how much is needed
  - Estimates are based on how much the crop will remove
  - Applying too much fertilizer = waste money & pollute the environment
  - Applying not enough fertilizer = crop will suffer