Welcome to
Florida Small Farms and Alternative Enterprises
CONFERENCE

From Concepts to Practice:
How to develop and implement a fertility plan in certified organic and sustainable vegetable production systems.
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For more information on Small Farms, visit our website at: http://smallfarms.ifas.ufl.edu/ or contact your local County Extension Agent.

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The correct application of nutrients in vegetable production systems requires growers to handle concepts that range from taking a soil sample to correctly applying the appropriate amounts of organic, granular or liquid fertilizers. Growers often wonder: how do I correctly implement a fertilizer recommendation? What do they mean by the “four R’s of fertilization”?

By working on real-life examples of fertility plans, participants in this hands-on session will (1) learn how to take a soil sample and request an analysis, (2) recognize the parts of the soil test recommendation, (3) choose the correct type of fertilizer, (4) learn how to determine the contribution of organic amendments and cover crops, and (5) correctly calibrate their equipment.
From Concepts to Practice: How to develop and implement a fertility plan in certified organic and sustainable vegetable production systems.

Eric H. Simonne and Aparna Gazula
Horticultural Sciences Department
Kissimmee, FL – Aug. 2, 2014
Deficiencies
Toxicities
Poor fertilizer and water management has consequences on the crop and off the farm.
Learning Objectives Today

(1) Learn how to take a soil sample and request an analysis
(2) Recognize the parts of the soil test recommendation
(3) Choose the correct type of fertilizer
(4) Learn how to determine the contribution of organic amendments and cover crops
(5) Correctly calibrate spreading equipment
DON'T BE AFRAID TO ASK DUMB QUESTIONS, THEY'RE EASIER TO HANDLE THAN DUMB MISTAKES!
Concept 1
The Four Pillars of Vegetable Production
Concept 1
The Four Pillars of Vegetable Production

- Marketing plan
- Fertilization schedule
- Irrigation schedule
- Pest management plan
Concept 1
The Four Pillars of Vegetable Production

- Marketing plan
- Fertilization schedule
- Irrigation schedule
- Pest management plan
Pillar #1 - Irrigation schedule

1. Have a target irrigation volume based on weather demand and crop stage of growth.
   Target:
   - small plants: 2 x 30 min/day (20-25 gal/100ft/day)
   - large plants: 3 x 1hr/day (70-80 gal/100ft/day)

2. Fine tune schedule and monitor soil moisture (SWT or VWC)

3. Know the contribution of rainfall

4. Have a rule for splitting irrigation (highest volume before leaching is expected)

5. Keep irrigation records
Pillar #2

Fertilizer schedule

1. Soil test and understand the recommendation
2. Lime if necessary
3. Apply organic amendments (cover crop, compost, manure)
4. Incorporate the preplant fertilizer; sidedress; or develop a weekly fertigation schedule (drip)
5. (Use foliar fertilization)
6. Assess the efficacy of the fertilizer program through leaf or petiole analysis
7. (Trap residual nutrients at the end of the season with a cover crop)
Definitions

• A **cover crop** is a crop planted primarily to manage soil fertility, soil quality, water, weeds, pests, diseases, biodiversity and wildlife in an agroecosystem.

• **Compost** is organic matter that has been decomposed and recycled as a fertilizer and soil amendment.

• **Fertilizer** is any organic or inorganic material of natural or synthetic origin (other than liming materials) that supplies one or more plant essential nutrients.
A poor irrigation management plan WILL negate all the efforts and the benefits of a good fertility plan.

It is not one or the other. It has to be BOTH!
Concept 2: The Four “R”s of fertilization

• Right Source  What material?
• Right Rate  How much?
• Right Time  When?
• Right Place  Where?
Concept 2: The Four “R”s of fertilization for record keeping:

• Date
• What material?
• How much?
• When?
• Where?
• Tractor operator
• Tractor speed
• Weather
Concept 3: Fertilizer placement

- Broadcast (lime, compost, cover crop)
- Modified broadcast (preplant, compost)
- Band (fertilizer, compost)
- Fertigation injection (drip)
Modified Broadcast

targeted surface = bed width x lbf

Fertilizer is applied only where the beds will be formed

30 lbs N /A
Modified Broadcast

targeted surface = bed width x lbf

No fertilizer is applied in the alleys

30 lbs N /A
Modified Broadcast

targeted surface = bed width x lbf

No fertilizer is applied in the alleys

30 lbs N /A
Concept 4:

OK: a rate is in “pounds per acre”.

But, what is an acre?
What is an acre?

1. Real estate definition: 1 acre = 43,560 sq-ft
2. Linear bed foot definition (fertilizer, irrigation):
   Drip irrigation: 1 acre = 43,560/bed spacing = X lbf
   Example 1: 1 acre of watermelon on 8ft centers is 5,445 lbf (43,560/8)
   Example 2: 1 acre of sweet corn with rows 28 inches apart is 18,930 linear feet of row (43,560/2.3)
3. Treated acre (pesticide): area that is the target of the application (real estate, area under plastic, lbf)
Concept 5: Standard row spacing for Hills or Flat Ground Cultivation
(1 acre = 43,560 sq-ft)

<table>
<thead>
<tr>
<th>Row Spacing</th>
<th>1.5 feet (18 inches)</th>
<th>2 feet (24 inches)</th>
<th>2.5 feet (28 inches)</th>
<th>3 feet (36 inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop</td>
<td>Bean</td>
<td>Cabbage</td>
<td>Sweet corn</td>
<td>Bean, Potato, Sweetpotato</td>
</tr>
<tr>
<td>Linear ft of row/acre</td>
<td>29,040</td>
<td>21,780</td>
<td>17,424</td>
<td>14,520</td>
</tr>
</tbody>
</table>
Concept 5
Standard bed spacing for Raised Bed Cultivation
(1 acre = 43,560 sq-ft)

<table>
<thead>
<tr>
<th>Bed Spacing</th>
<th>4 feet</th>
<th>5 feet</th>
<th>6 feet</th>
<th>8 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strawberry</td>
<td>10,890</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>8,712</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomato</td>
<td></td>
<td></td>
<td>7,260</td>
<td></td>
</tr>
<tr>
<td>Pepper</td>
<td></td>
<td></td>
<td>Eggplant</td>
<td>5,445</td>
</tr>
<tr>
<td>Watermelon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Linear ft of bed /acre

10,890
8,712
7,260
5,445
Concept 6: Selection of fertilizer materials

• X-Y-Z: N-P$_2$O$_5$-K$_2$O means that there are X, Y and Z lbs of N, P$_2$O$_5$ and K$_2$O, respectively, in 100 lbs of fertilizer material

• Importance of 0:
  If “high P” soil test, use X-0-Z

• Importance of ratios:
  if N and K$_2$O are needed in equal quantities, use X:0:X ratio
The 6 Concepts: Summary

1. The four pillars of vegetable production
2. Manage water and nutrients together
3. The 4 Rs: Right source, place, time and rate
4. What is an acre?
5. Standard row and bed spacings
6. Know the fertilizer grade
How do we use all this to come up with a fertility and irrigation plan?
Nutrient Management Plan: Overview

Crop needs

Contributions

Fertilization

What is often left out
Overall Approach to Nutrient Management (I)

1. Identify Homogenous Growing zones
2. Take a Representative soil sample
3. Use soil-test results to identify recommendation
4. Estimate dry matter of cover crop
5. Estimate nutrient content of cover crop
6. Estimate nutrient release from cover crop
7. Prior season cover crop
8. Identify local sources of compost or manure
9. Estimate total nutrient content of compost or manure
Overall Approach to Nutrient Management (II)

- Estimate nutrient release from comp/manure
- Estimate nutrient release from organic matter
- Add up nutrients from organic sources
- Do the right math
- Nutrients needed
- Recommendation minus organic sources
- Calibrate equipment
- Keep records
- Are we done?
Overall Approach to Nutrient Management (III)

Are we done?

Keep records

No!

No!

No!
Nutrient and Irrigation Management: Overview

Crop nutritional requirement

Contributions

Fertilization
Nutrient and Irrigation Management: Overview

- **Crop nutritional requirement**
- **Contributions**
- **Fertilization**
- **Monitoring crop nutrient status**
- **Irrigation system maintenance**
- **Irrigation scheduling**
The Crop Nutritional Requirement: Source of nutrients needed to grow a crop

CNR

Soil  Fertilization  Other

Compost  Cover crop
# Fertilization worksheet

<table>
<thead>
<tr>
<th>Nutrient source</th>
<th>N (lbs/acre)</th>
<th>P2O5 (lbs/acre)</th>
<th>K2O (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test recommendation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Compost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cover crop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Organic matter decomposition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= Fertilizer need</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preplant application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidedress/Injection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Soil Testing

We need to test the soil to determine what part of the CNR will be supplied by the soil, and which part needs to be supplied through compost application, cover crop and fertilizer application.
Approach for soil testing

or how to take the guessing part out of fertilization…

• Take a representative soil sample and send to the lab http://www.youtube.com/watch?v=f77MtMX45XQ

The lab will:
• Extract the nutrient fraction that represents what the plan can take up
• Analyze extractant content
• Interpret the analytical result (this requires a previous determination of plant response to extractable nutrient content)
• Propose a fertilizer recommendation

• You implement the recommendation
Taking a soil sample

- Sample results are no better than the sample itself (the GIGO principle applies)
- Soil sample: representative, large enough, recent
Divide fields into similar management zones, typically less than 20 acres

Avoid sampling near feeding areas and trees

Avoid sampling near limestone roads

Take at least 15-20 cores at random points along a zig-zag pattern in the field.
Get a Useful Sample

15-20 cores

Right Depth (plow layer or 6 inches)

Clean Bucket

Soil Probe
No plastic bags for soil samples (yes for nematode samples)

- Use paper bags
- Label completely
- Limit moisture
- Ship promptly
Extractions: General Principle

- Each method aims at displacing into solution a representative fraction of plant-available nutrients.

- Soil tests for cations typically estimate the quantity of water-soluble and exchangeable forms of the cations by replacing the cations on the soil’s exchange sites with a counter ion such as Na$^+$ (Olsen and Morgan), NH$_4^+$ (neutral ammonium acetate and Mehlich 3), or H$^+$ (Mehlich 1 and Mehlich 3).
<table>
<thead>
<tr>
<th>Method</th>
<th>Soil type</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morgan</td>
<td>All acid soils</td>
<td>P, K, Ca, Mg, Cu, Fe, Mn, Zn, NO₃, NH₄SO₄, Al, As, Hg, Pb</td>
</tr>
<tr>
<td></td>
<td>Soilless mixes</td>
<td></td>
</tr>
<tr>
<td>Morgan-Wolf</td>
<td>All acid soils</td>
<td>P, K, Ca, Mg, B, Cu, Fe, Mn, Zn, NO₃, NH₄, Al</td>
</tr>
<tr>
<td></td>
<td>Organic soils</td>
<td></td>
</tr>
<tr>
<td>Mehlich 1</td>
<td>Acid sandy soils</td>
<td>P, K, Ca, Mg, B, Cu, Mn, Zn</td>
</tr>
<tr>
<td></td>
<td>(CEC&lt;10 meq/100g)</td>
<td></td>
</tr>
<tr>
<td>Mehlich 3</td>
<td>All acid soils</td>
<td>P, K, Ca, Mg, Na, B, Cu, Fe, Mn, Zn</td>
</tr>
<tr>
<td></td>
<td>Soilless mixes</td>
<td></td>
</tr>
<tr>
<td>AB-DTPA</td>
<td>Alkaline soils (pH&gt;7.4)</td>
<td>P, K, Na, Fe, Mn, Zn, As, Cd, NO₃</td>
</tr>
<tr>
<td>Olsen</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Soil test results interpretation

<table>
<thead>
<tr>
<th>Rating</th>
<th>Probability of response to nutrient application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low (VL)</td>
<td>Very high probability</td>
</tr>
<tr>
<td>Low (L)</td>
<td>High probability</td>
</tr>
<tr>
<td>Medium (M)</td>
<td>Moderate probability</td>
</tr>
<tr>
<td>High (H; optimum)</td>
<td>Low probability</td>
</tr>
<tr>
<td>Very high (VH)</td>
<td>Very low (or adverse)</td>
</tr>
</tbody>
</table>
**Soil Analysis**

- **Grower:** [Redacted]
- **Farm ID:** [Redacted]
- **Received:** 04/07/2014
- **Processed:** 04/09/2014
- **Sample ID:** [Redacted]
- **Account #:** [Redacted]

**Lab Results**

<table>
<thead>
<tr>
<th></th>
<th>Phosphorous</th>
<th>Potassium</th>
<th>Magnesium</th>
<th>Calcium</th>
<th>Soil pH</th>
<th>Buffer pH</th>
<th>Sulfur</th>
<th>Boron</th>
<th>Zinc</th>
<th>Manganese</th>
<th>Iron</th>
<th>Copper</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>44 M</td>
<td>65 L</td>
<td>214 VH</td>
<td>1080 H</td>
<td>6.5</td>
<td>7.80</td>
<td>3 L</td>
<td>0.3 L</td>
<td>3.0 L</td>
<td>21 M</td>
<td>23 A</td>
<td>0.3 L</td>
</tr>
<tr>
<td>Aluminum</td>
<td>Sodium</td>
<td>Nitrate N</td>
<td>Soluble Salts</td>
<td>Organic Matter</td>
<td>Molybdenum</td>
<td>NH4</td>
<td>Nickel</td>
<td>BiCarbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Target pH:** 6.5

**Test Method:** Mehlich III

**Soil Analysis Ratings**

- **Crop:** SOYBEANS
- **Yield:** 50 BUSHELS
- **Fertility Recommendations**

<table>
<thead>
<tr>
<th>Lime</th>
<th>gypsum</th>
<th>N (Nitrogen)</th>
<th>P2O5</th>
<th>K2O</th>
<th>Mg</th>
<th>Ca</th>
<th>Sulfur</th>
<th>P</th>
<th>K</th>
<th>Mg</th>
<th>Ca</th>
<th>S</th>
<th>B</th>
<th>Zn</th>
<th>Mn</th>
<th>Fe</th>
<th>Cu</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>70</td>
<td>100</td>
<td>27</td>
<td>0.7</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

**Comments:**

NITROGEN SHOULD BE EXCLUDED IF FERTILIZER APPLICATION IS MADE MORE THAN 4 WEEKS PRIOR TO PLANTING AS NITROGEN EFFICIENCY WILL BE DIMINISHED.
Mailing Address (please print)
Name __________________________ Date __________________________
Address __________________________ FL, Zip ________ Phone ________

Email* __________________________
*Please provide an email address to receive your results faster.

Signature __________________________
(signature only required for UF personnel for approval of chartered charge)

Fill in all requested information, using one line per sample. Use additional forms for more than 11 samples.

<table>
<thead>
<tr>
<th>Lab Use Only</th>
<th>Sample ID</th>
<th>County</th>
<th>Estimated Acreage*</th>
<th>Crop Code(s)</th>
<th>Test Code</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

* This information is used to compute the total acreage served by the UF/IFAS Soil Testing Program.

Check ☐ Money Order ☐ Cash ☐ Total ☐

Please enclose payment and this sheet in the same package as sample(s).
Please make checks and money orders payable to UNIVERSITY OF FLORIDA.
Samples will not be processed without payment. Do not send cash through the mail.

Important Information for Soil Sample Collection and Submission

**Before Sampling**
1. Develop a soil sampling plan of your field. Samples should represent the area being tested, so collect samples from areas of the same soil type, appearance, or cropping history. Sample problem areas separately if needed. From this plan, count the number of samples you will collect.
2. Soil sample bags, addressed shipping boxes, and test forms are available for free from your county UF/IFAS Extension office. Obtain the materials you need before completing your sampling plan.

**Collecting Samples**
1. Collect soil from 20 or more spots in each area, mixing these samples in a clean plastic bucket.
2. Sample from soil surface to depth of tillage, usually 0-6 inches. For pastures, sample from 0 to 4 inches depth.
3. Spread the composted material on clean paper or other suitable material to air-dry. Do not send wet samples.
4. Mix the dry soil, and place about 1 pint of soil in a labeled sample bag.

**Sending Samples to the Extension Soil Testing Laboratory**
1. Enter each sample ID on its sample bag and in the Sample ID column.
2. List each sample separately.
3. Lime and fertilizer recommendations are provided only if the Crop Code(s) is listed.
4. Include the Test Code for each desired test.
5. Enter costs from the Test Cost List found on page 2 of this form.
6. Add the costs of all samples and tests. Make check or money order payable to University of Florida. Checks written to other names will NOT be honored and will be returned, causing a delay in processing the samples.
7. Include the completed Producer Soil Test Form and the check or money order in the shipping box with the sample(s).

**Test Results**
A soil test report will be emailed to you in 3-6 days after your sample arrives at the Extension Soil Testing Laboratory. Contact your county UF/IFAS Extension office if you have questions about the soil test report.
Crop and Test Codes for Producer Soil Test Form

Standard fertilizer and lime recommendations based on the soil test results will be supplied with the test results if you indicate a Crop Code. Please write the appropriate Crop Codes on page 1 of this form. If your cropping situation is not in the list of codes below, routine soil tests may not be appropriate. In such instances, consult your local county UF/IFAS Extension agent before sending soil samples for testing.

AGRONOMIC CROPS
Please use the Landscape and Vegetable Garden Test Form (SL136) for home gardens. Codes for particular vegetables will result in fertilizer recommendations for commercial vegetable production that are not appropriate for home vegetable gardens.

**Crop Code** | **Field Crops** | **Pasture and Forage Crops**
--- | --- | ---
2 | Corn, non-irrigated | Alfalfa
5 | Corn, irrigated | Cold-season annual grasses (small grains and ryegrass)
9 | Cotton | Cool-season legumes or legume-grass mixtures (legumes, sweetclover, vetches, and all true clovers, white, red, arroldale, crimson, subterranean)
7 | Grain sorghum | Hay or silage (perennial grass)
8 | Oats for grain | Improved perennial grasses other than bahiagrass (bermuda, digit, ands (sod grass)
10 | Peanuts | Leptospartos (Hemarthria)
8 | Soybeans | Perennial grasses
11 | Sugarcane for syrup | Summer forages (e.g., millet or sorghum)
12 | Tobacco (fine cut) | Warm-season legumes or legume-grass mixtures (acanthesisomenes, alveckes, danoenius, hairy indigia, and other tropical legumes)
27 | Wheat for grain **FRUIT CROPS**

Except for pH and lime requirement, and in some cases P, soil tests are not used as a basis for fertilization of perennial fruit and nut crops in Florida. Program fertilization is practiced, and plant tissue testing is helpful in certain crops. Tissue testing is available from commercial labs. Consult with your county UF/IFAS Extension agent about interpretation before taking samples.

**Crop Code** | **Crop Description**
--- | ---
67 | Blueberry (bearing)

**VEGETABLE CROPS**

Use special forms for requesting other tests, including the Landscape and Vegetable Garden Test Form (SL136), the Container Media Test Form (SL134), or the Pine Nursery Soil Test (SL132).

**Crop Code** | **Crop Description**
--- | ---
217 | Beet, beet, pole or snap | Okra
228 | Beet, beet, pole or snap | Onion, bulb
212 | Broccoli | Onion, bunching
212 | Brussels sprouts | Parsley
207 | Cabbage, head or Chinese | Pea, English, snow or southern
226 | Carrot | Pepper, bell or specialty
212 | Cauliflower | Potato, Irish
214 | Celery | Potato, sweet
207 | Collard | Pumpkin squash
200 | Corn, sweet | Radish
211 | Cucumber | Spinach
203 | Eggplant | Squash, summer or winter
225 | Kale | Strawberry
229 | Leek | Tomato, cherry or slicing
209 | Lettuce, crisphead endive, escarole, or romaine | Turnip
205 | Mekmetta | Watermelon
225 | Mustard | **ORNAMENTAL HORTICULTURE**

Do not use this form for potting media used in containers. Use the Container Media Test Form (SL134). For fertilization of plants in the landscape, use the Landscape and Vegetable Garden Test Form (SL136).

**Crop Code** | **Crop Description**
--- | ---
604 | Commercial nursery growing azaleas, camellias, gardenias, hibiscus, or trees in the ground | Athletic field, golf green, tee, or fairway
600 | Commercial woody ornamental nursery growing plants other than azaleas, camellias, gardenias, hibiscus, or trees in the ground |

**Test Code** | **Test Name** | **Determinations Made** | **Test Cost**
--- | --- | --- | ---
1 | Standard Soil Fertility Test | pH, lime requirement, P, K, Ca, and Mg | $7
2* | Soil pH and Lime Requirement | pH and lime requirement | $3
3 | Soil Micronutrients | Ca, Mn, Zn, and pH | $5
4 | Organic Matter | percent organic matter | $10
5 | Electrical Conductivity (soluble salts) | conductivity in 1:2 soil/water | $2

**Other**

*Additional Tests*

* Included in standard soil fertility test. Do not request both codes 1 and 2 for the same soil sample.
SOIL TEST RESULTS AND THEIR INTERPRETATIONS

Target pH: 6.5  
P (1:2 Sample:Water) pH: 6.6  
A-E Buffer Value: N/A

<table>
<thead>
<tr>
<th>MEHLICH-3 EXTRACTABLE</th>
<th>V LOW</th>
<th>LOW</th>
<th>MED</th>
<th>HIGH</th>
<th>V HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHOSPHORUS (ppm P)</td>
<td>&gt; 236</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POTASSIUM (ppm K)</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAGNESIUM (ppm Mg)</td>
<td>59</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CALCIUM (ppm Ca)</td>
<td>795</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LIME AND FERTILIZER RECOMMENDATIONS

Crop: Tomato - Cherry or Slicing
Lime: 0.0 lbs per acre (1 Ton = 2000 Lbs)
Nitrogen: 200 lbs per acrebed ft.
Phosphorus (P₂O₅): 0 lbs per acrebed ft.
Potassium: (K₂O): 150 lbs per acrebed ft.
Magnesium: (Mg): 0 lbs per acrebed ft.
Note #  | Description
--- | ---
1 | Soil test values noted with a “+” sign exceed the normal working range of our extraction method and are interpreted as high or very high for P, K, or Mg. No positive plant response to addition of the nutrient is likely. In some circumstances, addition of this nutrient to the soil could be detrimental to plant performance or to the environment.

250 | Indicated fertilizer amounts, and the nutrients already in the soil, will satisfy the crop nutrient requirement for this cropping season. Fertilizer and water management are linked. Maximum fertilizer efficiency is achieved only with close attention to water management. Supply only enough irrigation water to satisfy crop requirements. Excess irrigation may result in leaching of N and K creating possible plant deficiencies. Overfertilization has been shown to reduce vegetable quality.

For subsurface irrigation, maintain a constant water table between 18 (at planting) and 24 inches (near harvest) below the top of the bed. Monitor water table depth and do not fluctuate, else N can be "scrubbed" from the root zone.

On soils that have not been in vegetable production within the past 2 years, or where micronutrients are known to be deficient, apply 5 lb Mn, 3 lb Zn, 4 lb Fe, 3 lb Cu, and 1.5 lb B/A. Use soil testing to monitor micronutrient status every 2 years. When deciding about micronutrient applications, consider micronutrients added to the crop via fungicides. Some micronutrients can build up in the soil -- avoid micronutrient toxicity.

Up to 40 lb/acre Mg might be needed when soil test is medium or lower in Mg. Mg can be supplied in fertilizer or from dolomitic limestone, when liming is recommended.

Calcium concentrations are typically adequate in most soils used continuously for vegetable production or where the Mehlich-1 Ca index is >300 ppm. Calcium is added during liming activities and from calcium carbonate present in irrigation water drawn from aquifers in Florida. These sources should be considered in the determination of Ca fertilizer needs.

251 | For unamended crops, fertilizer should be applied in split applications to reduce leaching losses and lessen danger of fertilizer burn. Broadcast all P2O5 and micronutrients, if any, and 25 to 30% of the N and K2O in the bed at planting. Apply remaining N and K2O in sidedress bands during the early part of the growing season.

Additional, supplemental sidedress applications of 30 lb N/A and 20 lb K2O/A should be applied only if rainfall/irrigation amounts exceed 3 inches within a 3-day period or exceeds 4 inches within a 7-day period. Avoid mechanical damage to plants when applying fertilizers.

Use this rate of fertilizer per 100 linear bed feet even if you are using different bed spacing. For more information on fertilizer management and the use of Linear Bed Feet, see the following UF/IFAS publications SSP177 and H0740. These publications are available on the web at http://edis.ifas.ufl.edu/CV001 and http://edis.ifas.ufl.edu/WQ112, or from county...
Table 2. Soil test results and fertilizer recommendations for strawberry on 4-foot bed centers on mineral soils.\(^1\)

<table>
<thead>
<tr>
<th>Target pH</th>
<th>N lb/A</th>
<th>(lb/A/crop season)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5</td>
<td>150</td>
<td>150 120 100 0 0 150 100 80 0 0</td>
</tr>
</tbody>
</table>

\(^1\) See Chapter 2 section on supplemental fertilizer application and best management practices, pg 11.

Table 3. Fertilization recommendations for strawberry grown in central Florida on sandy soils testing very low in Mehlich-1 potassium (K\(_2\)O)

<table>
<thead>
<tr>
<th>Production system</th>
<th>Nutrient</th>
<th>Total (lbs/A)</th>
<th>Preplant (lbs/A)</th>
<th>First 2 weeks</th>
<th>Sept. to Jan.</th>
<th>Feb. and Mar.</th>
<th>April</th>
<th>Injected (lbs/A/day)</th>
<th>Measured &quot;low&quot; plant nutrient content</th>
<th>Recommended Supplemental fertilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drip irrigation, raised beds, and polyethylene mulch</td>
<td>N</td>
<td>150</td>
<td>0-40</td>
<td>0.3</td>
<td>0.6</td>
<td>0.75</td>
<td>0.6</td>
<td>0.6 to 0.75 lbs/A/day for 7 days</td>
<td>0.6 to .75 lbs/A/day for 7 days</td>
<td>0.6 to .75 lbs/A/day for 7 days</td>
</tr>
<tr>
<td></td>
<td>K(_2)O</td>
<td>150</td>
<td>0-40</td>
<td>0.3</td>
<td>0.6</td>
<td>0.75</td>
<td>0.6</td>
<td>0.6 to 0.75 lbs/A/day for 7 days</td>
<td>0.6 to .75 lbs/A/day for 7 days</td>
<td>0.6 to .75 lbs/A/day for 7 days</td>
</tr>
</tbody>
</table>
### Table 2. Soil test and fertilizer recommendations for mineral soils for tomato on 6-foot centers.¹

<table>
<thead>
<tr>
<th>Target pH</th>
<th>N lb/A</th>
<th>VL</th>
<th>L</th>
<th>M</th>
<th>H</th>
<th>VH</th>
<th>VL</th>
<th>L</th>
<th>M</th>
<th>H</th>
<th>VH</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5</td>
<td>200</td>
<td>150</td>
<td>120</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>225</td>
<td>150</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

¹ See Chapter 2 section on supplemental fertilizer application and best management practices, pg 11.

### Table 3. Fertilization recommendations for tomato grown in Florida on sandy soils testing very low in Mehlich-1 potassium (K₂O)

<table>
<thead>
<tr>
<th>Production system</th>
<th>Nutrient</th>
<th>Recommended-Base fertilization²</th>
<th>Recommended-Supplemental fertilization²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drip irrigation, raised beds, and polyethylene mulch (on deep sands or on soils with shallow Impermeable layer)</td>
<td>N</td>
<td>200</td>
<td>Injected² (lbs/A/day) Weeks after transplanting³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total (lbs/A)</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preplant (lbs/A)</td>
<td>0-70</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>K₂O</td>
<td>220</td>
<td>Injected² (lbs/A/day) Weeks after transplanting³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total (lbs/A)</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preplant (lbs/A)</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leaching rain⁴,⁵</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measured &quot;low&quot; plant nutrient content⁶,⁷</td>
<td>1.5 to 2 lbs/A/day for 7 days¹</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extended harvest season⁹,¹⁰</td>
<td>1.5 to 2 lbs/A/day⁸</td>
</tr>
<tr>
<td>Seepage irrigation, raised beds, and polyethylene mulch (on soils with shallow Impermeable layer)</td>
<td>N</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>K₂O</td>
<td>220</td>
<td>0</td>
</tr>
</tbody>
</table>

¹ See Chapter 2 section on supplemental fertilizer application and best management practices, pg 11.
Broadcast

1 acre = 1 real-estate acre = 43,560 sq ft
Broadcast lime application

- 2 ton/acre = 4,000 lbs/43,560 sq-ft
- We will apply 0.10 lb /sq-ft of lime, uniformly over the entire field, then incorporate it.
For example, our soil test results show:

- Need an application on 2 ton/acre of lime to adjust pH to 6.0-6.5
Now, let’s plough under our cover crop

- A sorghum sudangrass was planted as a cover crop with nutrient content of:
  - 1.5% N
  - 0.2% P, and
  - 2% K
- Mineralization rates/Availability:
  - N of 23%
  - 70% of P
  - 80% of K
- A biomass yield of 9.800 lbs/acre
- 10% moisture content.
Sorghum Sudangrass

- Tall (18 to 197 in) warm-season annual grass
- Frost sensitive
- Multiple usages
- Biomass 15,000-20,000 lb/a with multiple cuttings
- N content about 1.5%
- May be used in mixes with sesbania, sunn hemp, cowpea, and buckwheat
What is the nutrition content (total) and contribution (available) of the cover crop?

- **Dry matter production:**
  \[ DM = 9,800 \times (1-0.1) = 8,820 \text{ lbs/acre DM} \]

- **Nutrient content of 1.5% N, 0.2% P and 2% K**

- **N content:**
  \[ 8,820 \times \frac{1.5}{100} = 132 \text{ lbs} \]

- **P content:**
  \[ 8,820 \times \frac{0.2}{100} = 18 \text{ lbs} (\times 2.29) \]

- **K content:**
  \[ 8,820 \times \frac{2}{100} = 176 \text{ lbs} (\times 1.2) \]
<table>
<thead>
<tr>
<th>Nutrient source</th>
<th>N (lbs/acre)</th>
<th>P2O5 (lbs/acre)</th>
<th>K2O (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test recommendation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Compost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cover crop: total</td>
<td>132</td>
<td>41</td>
<td>212</td>
</tr>
<tr>
<td>- Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Organic matter decomposition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= Fertilizer need</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preplant application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidedress/Injection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What is the nutrition content (total) and contribution (available) of the cover crop?

- A N mineralization rate of 23%, an availability of 70% P and 80% K,
- N content: $8,820 \times 1.5 / 100 = 132$ lbs
- N available: $132 \times 0.23 = 54$ lbs N/acre
- P content: $8,820 \times 0.2 / 100 = 18$ lbs
- P$_2$O$_5$ available: $18 \times 0.70 \times 2.29 = 29$ lbs P$_2$O$_5$/acre
- K content: $8,820 \times 2 / 100 = 176$ lbs
- K$_2$O available: $176 \times 0.80 \times 1.2 = 169$ lbs K$_2$O/acre
### Fertilization worksheet

<table>
<thead>
<tr>
<th>Nutrient source</th>
<th>N (lbs/acre)</th>
<th>P2O5 (lbs/acre)</th>
<th>K2O (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test recommendation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Compost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cover crop: total Available</td>
<td>132</td>
<td>41</td>
<td>212</td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>29</td>
<td>169</td>
</tr>
<tr>
<td>- Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Organic matter decomposition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= Fertilizer need</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preplant application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidedress/Injection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Remember,

• In this example, total means “total in any form”, and “available” means “will be released in a form that the plant can take up”.

• Based on row spacings or raised bed spacing and width, a smaller fraction will actually be accessible by the plant.

• What will happen to nutrients released between the planted rows?
Overall Approach to Nutrient Management (I)

1. Identify Homogenous Growing zones
2. Take a Representative soil sample
3. Use soil-test results to identify recommendation
4. Estimate dry matter of cover crop
5. Estimate nutrient content of cover crop
6. Estimate nutrient release from cover crop
7. Prior season cover crop
8. Identify local sources of compost or manure
9. Estimate total nutrient content of compost or manure
Our soil test results show:

- Need an application on 2 ton/acre of lime to adjust pH to 6.0-6.5
- We want to apply 5 ton/acre of compost:
  - $40/ton + $10 ton/acre for spreading and transportation
  - fertilizer analysis N 2%, P 1% and K 1% (dry weight basis)
  - moisture content: 30%
  - depth of incorporation root zone (12 inches)
Broadcast compost application

- 5 ton/acre = 10,000 lbs/43,560 sq-ft
- We will apply 0.25 lb /sq-ft of compost, uniformly over the entire field, then incorporate it.
Broadcast compost application

• 5 ton/acre = 10,000 lbs/43,560 sq-ft
• We will apply 0.25 lb/sq-ft of compost, uniformly over the entire field, then incorporate it.
• How much does this application cost?
• 5 tons x ($40/ton + $10/ton application and transport) = $250/acre
Broadcast compost application

- How much N-P2O5 and K2O does this compost application provide?
- Fertilizer analysis N 2%, P 1% and K 1% (dry weight basis) and moisture content: 30%
- Dry weight applied: 5 x 2,000 x 0.70 = 7,000lbs (or 70 x 100lbs)
- Nutrient contribution:
  - 70 x 2 = 140 lbs of N
  - 70 x 1 = 70 lbs of P = 70 x 2.2910 = 154 lbs P2O5
  - 70 x 1 = 70 lbs of K = 70 x 1.2047 = 84 lbs K2O
## Broadcast compost application

<table>
<thead>
<tr>
<th>Nutrient source</th>
<th>N (lbs/acre)</th>
<th>P2O5 (lbsa/acre)</th>
<th>K2O (lbsa/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test recommendation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Compost: broad.</td>
<td>140</td>
<td>154</td>
<td>84</td>
</tr>
<tr>
<td>- Cover crop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Organic matter decomposition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= Fertilizer need</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preplant application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidedress/Injection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
We made a broadcast application of compost. Good!
We made a broadcast application of compost. Good!

Are the crop roots having access to all the compost? What will happen to the nutrients from the compost that fell between the rows? Are all the nutrients available to the first crop?
If we grow cantaloupes on 28-inch wide beds and rows spaced 5-ft apart, only $\frac{2.3}{5} = 50\%$ of the compost will be under the plastic, how much nutrients would be accessible?
## Cantaloupes - The soil test results are in:

<table>
<thead>
<tr>
<th>Nutrient source</th>
<th>N (lbs/acre)</th>
<th>P2O5 (lbs/acre)</th>
<th>K2O (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test</td>
<td>150</td>
<td>0 (VH)</td>
<td>100 (M)</td>
</tr>
<tr>
<td>recommendation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Compost:</td>
<td>140</td>
<td>154</td>
<td>84</td>
</tr>
<tr>
<td>broad.</td>
<td>70</td>
<td>77</td>
<td>42</td>
</tr>
<tr>
<td>accessible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cover crop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Organic matter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>decomposition</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

= Fertilizer need

Preplant application

Sidedress/Injection
Typically, 50% of nutrients from compost are available for the first crop;

How much nutrient will be available?
Cantaloupes - The soil test results are in:

<table>
<thead>
<tr>
<th>Nutrient source</th>
<th>N (lbs/acre)</th>
<th>P2O5 (lbs/acre)</th>
<th>K2O (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test recommendation</td>
<td>150</td>
<td>0 (VH)</td>
<td>100 (M)</td>
</tr>
<tr>
<td>- Compost: broad. accessible available (1st crop)</td>
<td>140</td>
<td>154</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>77</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>36</td>
<td>21</td>
</tr>
<tr>
<td>- Cover crop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Organic matter decomposition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= Fertilizer need</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preplant application</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
If we grow snap beans on 18-inch row spacing and the roots grow 6-inch on each side of the plant, \(1/1.5 = 66\%\) of the compost will be accessible by the roots.

how much nutrients would be accessible?
## Snap beans - The soil test results are in:

<table>
<thead>
<tr>
<th>Nutrient source</th>
<th>N (lbs/acre)</th>
<th>P2O5 (lbs/acre)</th>
<th>K2O (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test recommendation</td>
<td>100</td>
<td>0 (H)</td>
<td>120 (VL)</td>
</tr>
<tr>
<td>- Compost: broad. accessible</td>
<td>140</td>
<td>154</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>92</td>
<td>102</td>
<td>55</td>
</tr>
<tr>
<td>- Cover crop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Organic matter decomposition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= Fertilizer need</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preplant application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidedress/Injection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Typically, 50% of nutrients from compost are available for the first crop.

How much nutrient will be available?
### Snap beans - The soil test results are in:

<table>
<thead>
<tr>
<th>Nutrient source</th>
<th>N (lbs/acre)</th>
<th>P2O5 (lbs/acre)</th>
<th>K2O (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test recommendation</td>
<td>100</td>
<td>0 (H)</td>
<td>120 (VL)</td>
</tr>
<tr>
<td>- Compost: broad. accessible available (1\textsuperscript{st} crop)</td>
<td>140</td>
<td>154</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>92</td>
<td>102</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>46</td>
<td>51</td>
<td>27</td>
</tr>
<tr>
<td>- Cover crop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Organic matter decomposition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= Fertilizer need</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preplant application</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lessons: compost application

• Broadcast application is easier, but a portion of the compost will be in the alleys
• Only 50% of the nutrients are available to the first crop.
• Based on compost mineralization, about 50% of what is left will be available to the second crop (50% of 50% = 25% of the initial amount)
Estimated N availability from compost (50% per crop)

- Crop 1
  - Available: 46
  - Total N = 92 lbs / A

- Crop 2
  - 23
  - 23 lbs / A

- Crop 3
  - 12
  - 12
Another example: Pine bark for blueberries
Pine bark for blueberries

- Rows are 3 ft wide and 8-ft apart. We want to apply a 6-inch thick, 18-inch wide layer of bark on each side.
- In 1 acre of these blueberry, there are 43,560/8 = 5,445 linear feet of row.
- Volume of bark needed in 1 acre:
  $$V = 5,445 \times 0.5 \times (1.5+1.5) = 8,168 \text{ cu-ft}$$
  $$= 303 \text{ cu-yd}$$
- Volume delivered per foot (2 passes; 1 each side):
  $$v = 0.5 \times (1.5 + 1.5) = 1.5 \text{ cu-ft of bark / ft of row}$$
What is the point in soil testing and doing the correct maths if the spreader is not properly calibrated???
everybody chill out

I got this!
Steps for manure/granular spreader calibration

1. Measure width of application
2. Spread at steady speed for 20 ft
3. Weigh the material spread:
   \[ \text{Rate} = \frac{\text{material}}{\text{(width x length)}} \]
4. Adjust opening/setting/speed as needed and re-run
Tomato chicken litter

What should we weigh?

- We want to apply 50 lbs N/A using chicken litter (50 lbs N/ton @ 50% N available to first crop) to tomato on 6-ft centers.
- \( \frac{43,560}{6} = 7,260 \) lbf/A on 6-ft centers
- 1 ton = 2,000 lbs
- So, we need 2t/A or 4,000 lbs / 7,260 lbf

- If we make a 20-ft long run, we should collect
  \( \frac{4,000 \times 20}{7,260} = 11 \) lbs of chicken litter
Tomato chicken litter
What should we weigh?

- We make 3 passes and collect: 7, 9 and 8 lbs
- What do we do??????
Tomato chicken litter
What should we weigh?

• Make sure the tractor speed is constant over the tarp
• Check for uniformity of material (clumps?)
• Check for holes in the soil (uneven discharge)
Tomato chicken litter
What should we weigh?

• Make sure the tractor speed is constant over the tarp
• Check for uniformity of material (clumps?)
• Check for holes in the soil (uneven discharge)
• Run 1 : (7+8+ 9) / 3 =  8 lbs (target: 11 lbs)
• Error: (8-11) / 11 =  -27%
• We under-applied at a rate of 27%
Tomato chicken litter

What should we weigh?

- Make sure the tractor speed is constant over the tarp
- Check for uniformity of material (clumps?)
- Check for holes in the soil (uneven discharge)

Run 1: \( (8 + 7 + 9) / 3 = 8 \text{ lbs} \) (target: 11 lbs)

Error: \( (8-11) / 11 = -27\% \)

- We under-applied at a rate of 27% 
- WE NEED TO DO BETTER!!

- Increase speed or open boards or change settings
Tomato chicken litter
What should we weigh?

• We changed our setting.
• We make 3 more passes and collect: 10, 11 and 11 lbs each time.
• Run 2 : \( \frac{10 + 11 + 11}{3} = 10.7 \text{ lbs} \) (target: 11 lbs)
• Error: \( \frac{10.7 - 11}{11} = -0.03 \geq -1\% \)
• THIS IS VERY ACCEPTABLE!

• Let’s get to work!
Why are you looking at me like that?
By correctly calibrating our spreading equipment, we are applying what we calculated we need to apply.
Overall Approach to Nutrient Management (I)

1. Identify Homogenous Growing zones
2. Take a Representative soil sample
3. Use soil-test results to identify recommendation
4. Estimate dry matter of cover crop
5. Estimate nutrient content of cover crop
6. Estimate nutrient release from cover crop
7. Identify local sources of compost or manure
8. Estimate total nutrient content of compost or manure
Overall Approach to Nutrient Management (II)

1. Estimate nutrient release from comp/ manure
2. Estimate nutrient release from organic matter
3. Add up nutrients from organic sources
4. Do the right math
5. Recommendation minus organic sources
6. Nutrients needed
7. Calibrate equipment
8. Keep records
9. Are we done?
What is the N contribution of the mineralization of the organic matter?

- Field contains 1% OM; OM contains 1% N; OM decomposes at a 10% rate.
- OM in field: \(2,000,000 \times 0.01 = 20,000\) lbs OM/acre
- N in OM: \(20,000 \times 0.01 = 200\) lbs of N/acre
- Released N: \(200 \times 0.10 = 20\) lbs N released/acre

- If the beds cover 3/5 of the field, plants will have access to \(20 \times \frac{3}{5} = 12\) lbs of N from mineralization over the entire field.
# Fertilization worksheet

<table>
<thead>
<tr>
<th>Nutrient source</th>
<th>N (lbs/acre)</th>
<th>P2O5 (lbs/acre)</th>
<th>K2O (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test recommendation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Compost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cover crop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Organic matter decomposition</td>
<td>12</td>
<td>small</td>
<td>small</td>
</tr>
<tr>
<td>= Fertilizer need</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preplant application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidedress/Injection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Another example: strawberry

- We are growing strawberries of 4-ft centers conventionally.
- The recommendation is 150-0-150 N-P2O5-K2O for our strawberry crop (H P, VL K).
Table 2. Soil test results and fertilizer recommendations for strawberry on 4-foot bed centers on mineral soils.\(^1\)

<table>
<thead>
<tr>
<th>Target pH</th>
<th>N lb/A</th>
<th>(lb/A/crop season)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5</td>
<td>150</td>
<td>150 120 100 0</td>
</tr>
</tbody>
</table>

\(^1\) See Chapter 2 section on supplemental fertilizer application and best management practices, pg 11.

Table 3. Fertilization recommendations for strawberry grown in central Florida on sandy soils testing very low in Mehlich-1 potassium (K\(_2\)O).

<table>
<thead>
<tr>
<th>Production system</th>
<th>Recommended-Base fertilization(^2)</th>
<th>Injected(^6) (lbs/A/day)</th>
<th>Recommended-Supplemental fertilization(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drip irrigation, raised beds, and</td>
<td>N</td>
<td>0.3 0.6 0.75 0.6</td>
<td>0.6 to 0.75 lbs/A/day for 7 days(^7)</td>
</tr>
<tr>
<td>polyethylene mulch</td>
<td></td>
<td></td>
<td>0.6 to 0.75 lbs/A/day for 7 days(^7)</td>
</tr>
<tr>
<td></td>
<td>K(_2)O</td>
<td>0.3 0.6 0.75 0.6</td>
<td>0.6 to .75 lbs/A/day(^8)</td>
</tr>
</tbody>
</table>

\(^6\) Measured "low" plant nutrient content\(^4\,\(^5\) |
\(^7\) Extended harvest season\(^8\)
## Strawberry production

<table>
<thead>
<tr>
<th>Nutrient source</th>
<th>N (lbs/acre)</th>
<th>P2O5 (lbs/acre)</th>
<th>K2O (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil test recommendation</td>
<td>150</td>
<td>0 (H)</td>
<td>150 (VL)</td>
</tr>
<tr>
<td>- Compost</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>- Cover crop</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>- Manure</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>- Organic matter decomposition</td>
<td>Small</td>
<td>Small</td>
<td>Small</td>
</tr>
<tr>
<td>= Fertilizer need</td>
<td>150</td>
<td>0</td>
<td>150</td>
</tr>
<tr>
<td>Preplant application (15-0-15)</td>
<td>30</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Sidedress/Injection</td>
<td>120</td>
<td>0</td>
<td>120</td>
</tr>
</tbody>
</table>
Preplant application

• We need to apply 30-0-30 N-P2O5-K2O (1:0:1)
• We will use a 15-0-15 fertilizer (1:0:1 also!)
• On 4-ft centers, there are 43,560 / 4 = 10,890 lbf /A
• Method: Modified broadcast (in the bed only)
• How much fertilizer do we need to apply?
• 100 lbs of 15-0-15 fertilizer contains 15 lbs of N. We will need 200lbs of fertilizer applied to 10,8990 lbf of bed (or 200 / 10,890 = 0.02 lbs/ft) to apply 30 lbs of N /A.
Fertilizer for strawberry
What happens if we use 13-4-13? (in stead of 15-0-15)

• Preplant: we are using 13-4-13 at a rate of 30 lbs N/A incorporated in the bed
• How much fertilizer do we need to apply?
Fertilizer for strawberry (w/13-4-13)

• Preplant: we are using 13-4-13 at a rate of 30 lbs N/A incorporated in the bed

• How much fertilizer do we need to apply?
• Based on the label, 100 lbs of fertilizer contains 13 lbs of N. For 30 lbs of N, we need $100 \times 30 / 13 = 231$ lbs/A of 13-4-13

• How many lbs of fertilizer / ft of row is that?
Fertilizer for strawberry (w/13-4-3)

• For 30 lbs of N, we need 231 lbs/A of 13-4-13
• How many lbs of fertilizer / ft of row is that?
• Strawberries are planted on 4-ft centers.
  \[ \frac{43,560}{4} = 10,890 \text{ lb/ft of row/A} \]
• 231 lbs of 15-4-15 / 10,890 = 0.02 lbs/ft
• How much P and K did we apply?
Fertilizer for strawberry (w/ 13-4-13)

- For 30 lbs of N, we need 231 lbs/A of 13-4-13
- **How much P and K did we apply?**
- The math show $4 \times \frac{231}{100} = 13$ lbs/A of P2O5
- And as much N as K2O
<table>
<thead>
<tr>
<th>Nutrient source</th>
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<td>0</td>
</tr>
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<td>Small</td>
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<td>150</td>
<td>0</td>
<td>150</td>
</tr>
<tr>
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<td>13</td>
<td>30</td>
</tr>
<tr>
<td>Sidedress/Injection</td>
<td>120</td>
<td>0</td>
<td>120</td>
</tr>
</tbody>
</table>
Fertilizer for strawberry
What happens if we use 13-4-13? (in lieu of 15-0-15)

• We apply nutrients (here P) that are not needed in the recommendation.

• Hence, the choice of fertilizer matters!
So, what have we covered so far?

1. Identify Homogenous Growing zones
2. Take a Representative soil sample
3. Use soil-test results to identify recommendation
4. Estimate nutrient release from manure
5. Estimate total nutrient content of compost or manure
6. Identify local sources of compost or manure
7. Estimate nutrient content of cover crop
8. Estimate dry matter of cover crop
9. (Select a) cover crop
Overall Approach to Nutrient Management (II)

1. Estimate nutrient release from cover crop
2. Estimate nutrient release from organic matter
3. Estimate atmospheric depositions
4. Add up nutrients from organic sources
5. Recommendation minus organic sources
6. Nutrients needed
7. Do the right math
8. Calibrate equipment
9. Keep records
Nutrient and Irrigation Management: Overview

- Crop nutritional requirement
- Contributions
- Fertilization

Monitoring crop nutrient status

Irrigation system maintenance

Irrigation scheduling
## Strawberry production

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<td>Small</td>
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<tr>
<td>= Fertilizer need</td>
<td>150</td>
<td>0</td>
<td>150</td>
</tr>
</tbody>
</table>

Preplant application (15-0-15): 30

Sidedress/Injection: 120
Table 2. Soil test results and fertilizer recommendations for strawberry on 4-foot bed centers on mineral soils.¹

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<th>Target pH</th>
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<td>150</td>
<td>150 120 100 0 0 150</td>
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</tbody>
</table>

¹ See Chapter 2 section on supplemental fertilizer application and best management practices, pg 11.

Table 3. Fertilization recommendations for strawberry grown in central Florida on sandy soils testing very low in Mehlich-1 potassium (K₂O)

<table>
<thead>
<tr>
<th>Production system</th>
<th>Nutrient</th>
<th>Total (lbs/A)</th>
<th>Preplant² (lbs/A)</th>
<th>Injected³ (lbs/A/day)</th>
<th>Growth period⁴</th>
<th>Recommended-Supplemental fertilization²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drip irrigation,</td>
<td>N</td>
<td>150</td>
<td>0-40</td>
<td>0.3 0.6 0.75 0.6</td>
<td></td>
<td>Measured &quot;low&quot; plant nutrient content⁶</td>
</tr>
<tr>
<td>raised beds, and</td>
<td>K₂O</td>
<td>150</td>
<td>0-40</td>
<td>0.3 0.6 0.75 0.6</td>
<td></td>
<td>0.6 to 0.75 lbs/A/day for 7 days⁸</td>
</tr>
<tr>
<td>polyethylene</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mulch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
We now need to figure out the injections

• We need to apply 0.75 lbs/A/day of N and K2O (1:0:1) through the drip using liquid 8-0-8 (1:0:1 also!)

• How much liquid fertilizer is needed for a daily injection?

• How much liquid fertilizer is needed for a weekly injection?

• How much liquid fertilizer do we need to order for the whole season?
Calculating liquid fertilizer rate for drip

- We need to apply 0.75 lbs/A/day through the drip using liquid 8-0-8
- Liquid 8-0-8 @ 0.8 lb N/gal
- Use information from label or assume 1 gal = 10 lbs
- A daily rate of 0.75 lb N is also 5.25 lbs N/week (7 x 0.75 = 5.25)
- Gallons needed: 5.25 / 0.8 = 6.5 gal/A
- So, a weekly injection of 6.6 gal of 8-0-8 to a 1-acre field provides 5.25 lbs of N and 5.25 lbs of K₂O.
- For a 23-week season, we will need 6.5 x 23 = 150 gal/acre/season.
We now need to figure out the injections

- How much liquid fertilizer is needed for a daily injection? 1 gallons of 8-0-8
- How much liquid fertilizer is needed for a weekly injection? 6.5 gallons of 8-0-8
- How much liquid fertilizer do we need to order for the whole season? For a 23-week growing season, 6.5 x 23 = 150 gallons/acre/season.
Other application

- Injection of compost tea
- You need to know the grade (composition of N-P2O5-K2O) of your tea.
What happens when a non-standard bed spacing is used?

This occurs when existing beds are used for a second or third crop (double or triple cropping)
Strawberry beds on 4-ft centers:

1 A = \frac{43,560}{4} = 10,890 \text{ lbf}
Tomato beds on 6-ft centers:

1 A = 43,560 / 6 = 7,260 lbf
How many acres of tomato will “fit” in 1 acre of strawberry?

1 acre on 4-ft center = 10,890 lbf

1 acre on 6-ft center = 7,260 lbf

3,630 lbf or 0.5 A on 6-ft center
In this case, 1.5 acre of tomato will fit into 1 acre of strawberry.

The important point is the total number of linear bed feet, not the field surface.

For each crop, the fertilizer rate expressed in lbs/100lbf remains constant whatever the bed spacing.
Show me the math!

• 200 lbs of N/A on 6-ft centers = $200/72.6 = 2.75$ lbs of N /100lbf

• If 4-ft center is used, there will be $43,560/4 = 10,890$ lbf/acre. The same “200lbs/A rate” will require $2.75 \times 108.9 = 300$ lbs in 1 acre.

• So, 200 lbs on 6-ft centers and 300 lbs on 4-ft centers achieve the same rate.
What Should be Your Nutrient Management Strategy?

- Level 0 – Guessing …
- Level 1 – Soil testing and (still) guessing
- Level 2 – Soil testing and implementing “a” recommendation
- Level 3 – Soil testing, understanding the recommendation, and implementing it correctly
- Level 4 – Soil testing, understanding the recommendation, implementing it AND monitoring crop nutritional status
- Level 5 -- Soil testing, understanding the recommendation, implementing it, monitoring crop nutritional status, AND planting a cover crop at the end of the season.
Practices - Summary

• Only 6 types of maths!
• Broadcast rate
• Modified broadcast rate
• Banded rate
• Spreader calibration
• Liquid fertilizer rate
• Rates when non-standard bed spacing is used
There is a lot of (incorrect) information out there....

Can you pick WHAT from what NOT to do?

http://www.youtube.com/watch?v=2swDMjTlEVY
Questions?

Thank you!
### Common Soil Extraction Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Extractant components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morgan</td>
<td>Sodium acetate, adjusted to pH = 4</td>
</tr>
<tr>
<td>Morgan-Wolf</td>
<td>Sodium acetate, glacial acetic acid, DTPA, adjusted to pH = 4</td>
</tr>
<tr>
<td>Mehlich 1</td>
<td>HCl and H&lt;sub&gt;2&lt;/sub&gt;SO&lt; sub&gt;4&lt;/sub&gt; (double acid)</td>
</tr>
<tr>
<td>Mehlich 3</td>
<td>Acetic acid (buffer at pH=2.5), ammonium nitrate (bases), nitric acid (Ca-P, micros), ammonium fluoride (Fe, Al-P), EDTA (micros, Cu, prevents CaF&lt;sub&gt;2&lt;/sub&gt; precipitation)</td>
</tr>
<tr>
<td>AB-DTPA</td>
<td>NH&lt;sub&gt;4&lt;/sub&gt;HCO&lt;sub&gt;3&lt;/sub&gt;, DTPA, adjusted to pH=7.6</td>
</tr>
<tr>
<td>Olsen</td>
<td>Sodium bicarbonate (NaHCO&lt;sub&gt;3&lt;/sub&gt;)</td>
</tr>
</tbody>
</table>
Soil test calibration:
Relative yield vs. Soil test value

Soil test value, mg/kg (ppm)

Relative yield, %

- V. LOW
- LOW
- MEDIUM
- HIGH
# Soil Test Report

**Serving N.C. Residents for Over 60 Years**

**Received:** 11/10/2011  **Completed:** 11/23/2011

**Grover:** Buggeln, Richard  
1719 Verrazano Dr  
Wilmington, NC 28405

**Farms:** New Hanover County

## Agronomist Comments

### Field Information

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Last Crop</th>
<th>Mo</th>
<th>Yr</th>
<th>T/A</th>
<th>Crop or Year</th>
<th>Lime</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>Mg</th>
<th>S</th>
<th>Cu</th>
<th>Zn</th>
<th>B</th>
<th>Mn</th>
<th>See Note</th>
</tr>
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<tbody>
<tr>
<td>FE1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1st Crop: Azalea / Camellia</td>
<td>45M (17 lbs 6-6-18 or EQUIV PER 1000 SQ FT)</td>
<td>0</td>
<td>.0</td>
<td></td>
<td>0</td>
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<td>2nd Crop:</td>
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<td>.0</td>
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### Test Results

<table>
<thead>
<tr>
<th>Soil Class</th>
<th>HM%</th>
<th>W/V</th>
<th>CEC</th>
<th>BS%</th>
<th>Ac</th>
<th>pH</th>
<th>P-I</th>
<th>K-I</th>
<th>Ca%</th>
<th>Mg%</th>
<th>Mn-I</th>
<th>Mn-Al(1)</th>
<th>Mn-Al(2)</th>
<th>Zn-I</th>
<th>Zn-Al</th>
<th>Cu-I</th>
<th>S-I</th>
<th>SS-I</th>
<th>NO₃-N</th>
<th>NH₄-N</th>
<th>Na</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN</td>
<td>0.92</td>
<td>1.00</td>
<td>5.6</td>
<td>45.0</td>
<td>3.1</td>
<td>4.3</td>
<td>55</td>
<td>17</td>
<td>34.0</td>
<td>9.0</td>
<td>27</td>
<td>220</td>
<td>220</td>
<td>195</td>
<td>44</td>
<td>0.1</td>
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<th>Zn</th>
<th>B</th>
<th>Mn</th>
<th>See Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1st Crop: Azalea / Camellia</td>
<td>0</td>
<td>.0</td>
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### Test Results

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<th>CEC</th>
<th>BS%</th>
<th>Ac</th>
<th>pH</th>
<th>P-I</th>
<th>K-I</th>
<th>Ca%</th>
<th>Mg%</th>
<th>Mn-I</th>
<th>Mn-Al(1)</th>
<th>Mn-Al(2)</th>
<th>Zn-I</th>
<th>Zn-Al</th>
<th>Cu-I</th>
<th>S-I</th>
<th>SS-I</th>
<th>NO₃-N</th>
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### Field Information

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<th>Yr</th>
<th>T/A</th>
<th>Crop or Year</th>
<th>Lime</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>Mg</th>
<th>S</th>
<th>Cu</th>
<th>Zn</th>
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<tbody>
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<th>Zn-Al</th>
<th>Cu-I</th>
<th>S-I</th>
<th>SS-I</th>
<th>NO₃-N</th>
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<th>Crop or Year</th>
<th>Lime</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>Mg</th>
<th>S</th>
<th>Cu</th>
<th>Zn</th>
<th>B</th>
<th>Mn</th>
<th>See Note</th>
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<tbody>
<tr>
<td>BOE</td>
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<td>1st Crop: Azalea / Camellia</td>
<td>50M (12.5 lbs 8-0-24 or EQUIV PER 1000 SQ FT)</td>
<td>0</td>
<td>.0</td>
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<th>Mn-Al(2)</th>
<th>Zn-I</th>
<th>Zn-Al</th>
<th>Cu-I</th>
<th>S-I</th>
<th>SS-I</th>
<th>NO₃-N</th>
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<th>Na</th>
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<tbody>
<tr>
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**Report No:** 14526

**Copies To:**
SOIL TEST REPORT
UNIVERSITY OF DELAWARE — SOIL TESTING LABORATORY
NEWARK, DELAWARE 19717-1303

BACKGROUND INFORMATION:
GROWER copy

<table>
<thead>
<tr>
<th>FIELD NAME OR NO.</th>
<th>YIELD NAME OR NO.</th>
<th>ACRES</th>
<th>COUNTY</th>
<th>DATE SAMPLED</th>
<th>DATE RECEIVED</th>
<th>DATE COMPLETE</th>
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<th>BAG NO.</th>
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<td>FRONT YARD</td>
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<td>NEW CASTLE</td>
<td>7/06/11</td>
<td>03/28/12</td>
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SOIL TEST FOR: GROWER
ADDITIONAL COPY TO:
COUNTY AGENT

HOMEOWNER
123 MAIN STREET
ANYTOWN DE 19716

LANDSCAPER
LANDSCAPING COMPANY
123 MAIN ROAD
NEWARK, DE 19716

GARDEN HELPLINE
NEW CASTLE CO. EXT.
461 WYOMING RD.
NEWARK, DE 19716-1303
302-831-2506

SOIL NAME
SOIL DRAINAGE
SOIL COLOR
SOIL TEXTURE
SAMPLE DEPTH
TILLAGE
PRESENT COVER
IRRIGATION
INJ. PUMP

<table>
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<tr>
<th>LAST CROP</th>
<th>YIELD OF LAST CROP</th>
<th>TYPE</th>
<th>T/A WHEN MANURE</th>
<th>N</th>
<th>P2O5</th>
<th>K2O</th>
<th>MOS.AGO</th>
<th>T/A LAST LIME</th>
<th>TYPE</th>
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SOIL TEST RESULTS:

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<tr>
<td>POTASSIUM</td>
<td>K</td>
<td>43</td>
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<tr>
<td>MAGNESIUM</td>
<td>Mg</td>
<td>120</td>
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<tr>
<td>CALCIUM</td>
<td>Ca</td>
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</table>

0.8 55.6 2.8 27.7 1.8
7.69 13.0 6.7 63.2 1.9

SUGGESTED FERTILIZER PROGRAM:

CROP: BLUEGRASS/FESCUE LAWN MAINTENANCE
YIELD GOAL: N/A

THIS FALL - AUGUST 15 TO OCTOBER 1
1. Apply 25 lbs ground limestone per 1000 square feet. Lime is best applied to
     lawns between AUGUST 15 and NOVEMBER 1.
2. Apply 5.5 lbs 18-24-12 (or equivalent turf type fertilizer as described in Soil
   Test Note 9, enclosed) per 1000 square feet.

THIS FALL - OCTOBER 1 TO NOVEMBER 15
1. Apply 4 lbs 24-0-11 (or equivalent turf type fertilizer as described in Soil
   Test Note 9, enclosed) per 1000 square feet.
2. Re-test in 2 to 3 years to update your fertilizer program and determine if
   additional lime is needed.
Soil Analysis

Lab Results

<table>
<thead>
<tr>
<th>Lab Number:</th>
</tr>
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<table>
<thead>
<tr>
<th>P</th>
<th>K</th>
<th>Mg</th>
<th>Ca</th>
<th>Soil pH</th>
<th>Buffer pH</th>
<th>S</th>
<th>B</th>
<th>Zn</th>
<th>Mn</th>
<th>Fe</th>
<th>Cu</th>
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<tbody>
<tr>
<td>52</td>
<td>31</td>
<td>79</td>
<td>645</td>
<td>6.3</td>
<td>7.80</td>
<td>10</td>
<td>0.2</td>
<td>2.5</td>
<td>11</td>
<td>29</td>
<td>0.6</td>
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Test Method: Mehlich I

Target pH: 6.5

Soil Analysis Ratings

Crop: COASTAL BERMUDA
Yield: HAY 8 TONS

Fertility Recommendations

Lime | Gypsum | N | P2O5 | K2O | Mg | S | B | Zn | Mn | Fe | Cu |
<table>
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<td>0.0</td>
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<td>1</td>
<td>9</td>
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Comments:

FERTILIZER SHOULD BE APPLIED IN SPLIT APPLICATIONS- ESPECIALLY NITROGEN AND POTASSIUM. INITIAL APPLICATION SHOULD BE MADE IN EXTREMELY EARLY SPRING WITH 1/3 OF NITROGEN AND POTASSIUM APPLIED AT THIS TIME. BALANCE OF NITROGEN AND POTASSIUM SHOULD BE APPLIED IN SPLIT APPLICATIONS AFTER EACH CUTTING. PLANT SAMPLES SHOULD BE TAKEN DURING THE GROWING SEASON TO MONITOR NITROGEN AND POTASSIUM LEVELS. ADDITIONAL NITROGEN AND POTASSIUM MAY BE NEEDED. IF DOLomite Lime has been applied recently - Magnesium recommendation can be cut in half.
With drip think “water placement”

- Overhead: the entire field is wet:
  
  1 acre-inch = 27,150 gallons

- Drip: a narrow band is wetted
Drip irrigation

Emitter = controlled leak
The emitter is the device that drops the water pressure from 12 psi (inside the tape) to 0 psi (at the whole) so the water is delivered by gravity.
Install drip tape with emitters facing UP
Emitter = controlled leak
How do I choose a drip tape?

• Emitter spacing: 4, 8, 12 or 18 inches?
  8 to 12 inches preferred
• Flow rate: low, medium or high flow?
  Medium preferred
• Wall thickness? Typically between 4 to 25 mils
  Thin (<10 mil) ok for 1 or 2 season usage
• Other parameters:
  Operating pressure? 10-20 psi
  Uniformity? >90%
  Maximum length of run? 300-400 ft
  Pressure compensation (0% to 100%)
Beyond the soil test report

<table>
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<tr>
<th>Extraction Method</th>
<th>Test Results</th>
<th>Interpretation</th>
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<td>Kjeldhal</td>
<td>PO4</td>
<td>Adequate</td>
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<td>P2O5</td>
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<th>N</th>
<th>P</th>
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**Graphical Representation:**

- **A**: Soil test results with various nutrients.
- **B**: Interpretation of soil test results with color coding.
- **C**: Selection of interpretation methods (ppm, kg/ha, meq/L, mmol/L, meq/100g %).
Let’s calibrate our spreader!
Example 1 – Blueberry bark
What should we weigh?

• Volume delivered per foot (1 pass):
  \[ v = 1 \text{ ft} \times 0.5 \times 1.5 = 0.75 \text{ cu-ft of bark/ft of row} \]

• The bark weighs 18.8 lbs/cu-ft at 40% moisture

• If we make a 20-ft long run, we should collect
  \[ 20 \times 0.75 = 15 \text{ cu-ft} \]
  \[ 20 \times 0.75 \times 18.8 = 282 \text{ lbs} \]
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• We make 3 passes and collect: 250, 235, 260 lbs
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- We make 3 passes and collect: 250, 235, 260 lbs

- What do we do??????
Example 1 – Blueberry bark
What should we weigh?

- Make sure the tractor speed is constant over the tarp
- Check for uniformity of material (clumps?)
- Check for holes in the soil (uneven discharge)
- Run 1: \( \frac{250 + 235 + 260}{3} = 248 \text{ lbs} \) (target: 282)
- Error: \( \frac{248 - 282}{282} = -12\% \)
Example 1 – Blueberry bark
What should we weigh?

- Make sure the tractor speed is constant over the tarp
- Check for uniformity of material (clumps?)
- Check for holes in the soil (uneven discharge)
- Run 1: \( (250 + 235 + 260) / 3 = 248 \text{ lbs (target: 282)} \)
- Error: \( (248-282) / 282 = -12\% \)
- We under-applied at a rate of 12\%
Example 1 – Blueberry bark
What should we weigh?

- Make sure the tractor speed is constant over the tarp
- Check for uniformity of material (clumps?)
- Check for holes in the soil (uneven discharge)
- Run 1: \( \frac{250 + 235 + 260}{3} = 248 \text{ lbs (target: 282)} \)
- Error: \( \frac{248-282}{282} = -12\% \)
- We under-applied at a rate of 12%
- WE NEED TO DO BETTER!!
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- Make sure the tractor speed is constant over the tarp
- Check for uniformity of material (clumps?)
- Check for holes in the soil (uneven discharge)
- Run 1: \( (250 + 235 + 260) / 3 = 248 \) lbs (target: 282)
- Error: \( (248-282) / 282 = -12\% \)
- We under-applied at a rate of 12%
- WE NEED TO DO BETTER!!
- Increase speed or open boards or change settings