SOIL MANAGEMENT

Strategies for Effective Crop Production
Summary

- Introduction
- Diversity of Soils
- Identifying Your Soil
- Best Management Practices
Know Your Soil!

Soil Controls:

- Water storage and movement
- Nutrient availability
- Trafficability
Nitrogen and Potassium deficient Dracaena plants growing on a Histosol
On the Big Island
Healthy sugarcane growing on an Oxisol from Kauai amended with calcium silicate

Poorly growing sugarcane growing on the Same Oxisol without calcium silicate
Diversity of Soils

http://gohawaii.about.com/cs/photogalleries/l/blgallery553.htm
### Diversity of Soils

<table>
<thead>
<tr>
<th>Soil Forming Factors:</th>
<th>Soil Forming Processes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Parent Material</td>
<td>- Weathering</td>
</tr>
<tr>
<td>• Age</td>
<td>- Physical</td>
</tr>
<tr>
<td>• Climate</td>
<td>- Chemical</td>
</tr>
<tr>
<td>• Biota</td>
<td></td>
</tr>
<tr>
<td>• Topography</td>
<td></td>
</tr>
</tbody>
</table>
Soils Differ:

- Chemical composition
- Mineral composition
- Microbial composition
- Temperature and moisture regime
Lualualei
- Neutral pH
- 2:1 clay minerals
- High CEC

Molokai
- Acidic pH
- 1:1 clay minerals
- Low CEC

Hilo
- Acidic pH
- Amorphous clays
- High P fixation

Vertisol

Oxisol

Andisol
Identifying Your Soil
Best Management Practices

Management Practices Vary with Soil
- Andisols (Big Island, Maui)
- Oxisols (Molokai, Lanai, Oahu, Kauai)
- Vertisols (Oahu)
- Histosols (Big Island)
Best Management Practices

Andisols

1. *Eutrustands* – Kula and Waimea
   - neutral, fertile (high CEC)
   - Phosphorus fixation capacity
   - Irrigation

2. *Hydrudands* – Hamakua
   - acid, infertile (low CEC)
   - High phosphorus fixation
   - High water content
Best Management Practices

Highly Weathered Soils

1. *Acrudox* – Kapaa
   - acid, infertile
   - High Phosphorus fixation capacity
   - Low bases

2. *Eutrustox* – Wahiawa
   - acid, infertile
   - High phosphorus fixation
   - Mn toxicity
Best Management Practices

Limited Weathering

*Ustert* - Lualualei
- Neutral, fertile
- Low Phosphorus fixation capacity
- Shrink/swell
- Poor aggregation
Organic soils

*Ustifolists* – Puna

- Formed on forested A`a/pahoehoe Lava lands
- Organic layer lying on lava
- Organic matter key to production
- High leaching capacity
Best Management Practices

1. Identify your soil
2. Choose your crop(s)
3. Soil test
4. Nutrient management program
   - liming(?)
   - fertilization
# Soil Testing

## Phosphorus Management

### Table 1. Levels of P in plant tissue and soil solution associated with 80–95% of maximum yield of some crops grown in Hawaii.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Plant P (%)</th>
<th>Soil-solution P (mg/liter)</th>
<th>Soil series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabbage (<em>Brassica oleracea</em>)</td>
<td>0.4 – 0.8</td>
<td>0.02 – 0.04</td>
<td>Kula</td>
</tr>
<tr>
<td>Corn (<em>Zea mays</em>)</td>
<td>0.3 – 0.5</td>
<td>0.03 – 0.05</td>
<td>Halii, Wahiawa</td>
</tr>
<tr>
<td>Head lettuce (<em>Lactuca sativa</em>)</td>
<td>0.4 – 1.0</td>
<td>0.20 – 0.40</td>
<td>Kula, Lualualei</td>
</tr>
<tr>
<td>Macadamia (<em>Macadamia integrifolia</em>)</td>
<td>0.08 – 0.10</td>
<td>0.02 – 0.04</td>
<td>Kapaa, Puna, Wahiawa</td>
</tr>
<tr>
<td>Sorghum (<em>Sorghum bicolor</em>)</td>
<td>0.2 – 0.6</td>
<td>0.02 – 0.06</td>
<td>Honokaa</td>
</tr>
<tr>
<td>Soybean (<em>Glycine max</em>)</td>
<td>0.25 – 0.50</td>
<td>0.10 – 0.20</td>
<td>Halii, Wahiawa</td>
</tr>
<tr>
<td>Sugarcane (<em>Saccharum officinarum</em>)</td>
<td>0.18 – 0.30</td>
<td>0.02 – 0.04</td>
<td>Wahiawa</td>
</tr>
<tr>
<td>Tomato (<em>Lycopersicon esculentum</em>)</td>
<td>0.4 – 1.0</td>
<td>0.10 – 0.20</td>
<td>Kula, Waimanalo</td>
</tr>
</tbody>
</table>

*Plant P concentration may vary considerably with plant age and part. *Soils of Hawaii used for establishing critical concentrations of soil-solution P.

*Macadamia is an exception to the general rule that tissue levels of P should be in the range 0.2 to 0.5%; iron chlorosis may occur when P is above 0.15%.

Hue et al., 2000
Soil Testing

Phosphorus Management

Need to apply 2000 lbs P per acre

Figure 3. Relationship between soil-solution P and modified Truong P for soils of Hawaii.

Hue et al., 2000
Nutrient Management

Choosing Nutrient Source

1. Conventional
   - blends: 16-16-16, 10-30-10
   - Slow release: osmocote, nutracote
   - Single: urea, muriate of potash (KCl), treble superphosphate (TSP)

2. Organic
   - manures: chicken, steer, swine
   - Biosolids
   - Green manures
Nutrient Management

Fertilizer Rates:

1. **Conventional**
   - 16-16-16
   - Need 150 lb N/acre per crop
   - $150 / 0.16 = 938$ lb/acre

2. **Organic**
   - Composted chicken manure (2.5% N)
   - Assume 50% available
   - $150 / 0.0125 = 12,000$ lb/acre (6T/acre)
Nutrient Management Program

1. Initial soil test to guide fertilization
2. Measurement of crop yields
3. Tissue and soil test at end of cropping cycle
4. Monitoring soil and tissue allow for more efficient fertilization increasing profits and reducing harm to the environment.