Local Sources of Soil Fertility

Amjad Ahmad, Theodore Radovich, Hue V. Nguyen, Alton Arakaki, Glenn Teves, Jari Sugano, and Jensen Uyeda

Email: alobady@hawaii.edu

How much fertilizer to apply and when?

For both organic and conventional agriculture, you need to know:

- Crop requirements.
- Soil fertility status.
- Fertilizer characteristics.
- Crop peak uptake stages.

Source: http://www.junglemusic.net/palmadvice/palms-fertilizing-palms.htm

Local Inputs

Composts
Tankage
Biochar
Invasive algae

Seedlings media

Seedlings in 100% compost
Replacement of peat moss based media with local resources

Regression analysis between vermicompost application rate and shoot dry weight of 6 week old eggplant seedlings grown in peat.

Vermicompost and Compost “Tea”
- Uses air and water to extract:
  - Nutrients
  - Organic acids
  - Microbes
- Ratio of water to compost (10:1-100:1)
- Water is not circulated, only air
- 12-24 hrs

No additives needed.

Addition of vermicompost improved seedlings growth

Compost Tea Application
- Positive growth response.
- Effect is consistent across soil and media.
- Response dependent on rate and quality of compost.

**Invasive Algae**

- Algae seaweeds & their extracts are known to improve crop production.
- Majority are plant growth stimulants, not directly as a source of nutrient.

<table>
<thead>
<tr>
<th>Samples 1st batch</th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>N</td>
<td>P</td>
<td>K</td>
</tr>
<tr>
<td>Kappaphycus</td>
<td>0.68</td>
<td>0.04</td>
<td>19.52</td>
</tr>
<tr>
<td>Eucheuma</td>
<td>1.01</td>
<td>0.06</td>
<td>18.38</td>
</tr>
<tr>
<td>Ogo</td>
<td>1.41</td>
<td>0.11</td>
<td>12.48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Samples 2nd batch</th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>N</td>
<td>P</td>
<td>K</td>
</tr>
<tr>
<td>Kappaphycus</td>
<td>0.62</td>
<td>0.06</td>
<td>24.85</td>
</tr>
<tr>
<td>Eucheuma</td>
<td>0.84</td>
<td>0.07</td>
<td>17.6</td>
</tr>
<tr>
<td>Ogo</td>
<td>1.33</td>
<td>0.1</td>
<td>13.9</td>
</tr>
</tbody>
</table>

The tissue samples were analyzed at the Agricultural Diagnostic Service Center of the University of Hawaii.

**Source:** [http://www.hydroponics.eu/plagron-alga-bloom-1l~9487.html](http://www.hydroponics.eu/plagron-alga-bloom-1l~9487.html)

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**Tankage**

Local rendered meat product.

N = ~ 9%, P = ~2.5%, C:N = 5:1

**Eggplant, Waimanalo O'ahu 2009**

**Tankage application rate kg/ha²**
Nitrogen Release pattern from Tankage

Waimanalo Soil

Nitrate release from tankage applied at different application rates over 90 days under Waimanalo (Mollisol) and Poamoho (Oxisol) soils.

Poamoho Soil

Liquid fertilizer with high nitrogen from tankage

The lab experiment setup. Showing 125 ml flask (covered and uncovered) contain 1 gram tankage and 50 ml deionized water. Each treatment was replicated 3 times.

Meat and bone meal by products (Tankage). High nitrogen content (10%). Also good source of other nutrients.

Nitrogen release (%) from tankage applied at different application rates over 90 days under Waimanalo (Mollisol) and Poamoho (Oxisol) soils.

Nitrate release (ppm) from tankage under the effect of: A) Time; B) Lab and oven temperature; C) Different materials; and D) Open or covered conditions.

NOTE: Cover = Parafilm was used to cover each sample throughout the test; Verm = Vermicompost; B. Soda = Baking Soda.
Liquid Fertilizer from Tankage

Application Recipe:
- 1.5 lbs of tankage into 10 gallon water.
- Add about 1 ounce vermicompost
- Air for 12-24 hours
- Strain and apply with drip irrigation (Fertigation).

Collaboration with local farmers:
From: Jared Davis
On: April 29, 2015
"Thanx Ahmad for awesome recipe, my first delivery!! We use no chemicals, no pesticides just Ahmad recipe, now that's organic. Super sweet this year. I'll keep you posted on the tonnage."

Measure BRIX in watermelon from the collaborator on Molokai

<table>
<thead>
<tr>
<th>Sample#</th>
<th>Location along Fruit Center Core</th>
<th>BRIX (°Brix)</th>
<th>1-Fruit Pedicle End</th>
<th>2-Center Pedicle</th>
<th>3-Center</th>
<th>4-Center Blossom Calyx End</th>
<th>5-Fruit Blossom Calyx End</th>
<th>Average</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Fruit Pedicle End</td>
<td>12.1</td>
<td>12.2</td>
<td>12.2</td>
<td>12.3</td>
<td>12.1</td>
<td>12.1.</td>
<td>12.1</td>
</tr>
<tr>
<td>2</td>
<td>Center Pedicle</td>
<td>12.0</td>
<td>12.2</td>
<td>12.2</td>
<td>12.3</td>
<td>12.1</td>
<td>12.1.</td>
<td>12.1</td>
</tr>
<tr>
<td>3</td>
<td>Center</td>
<td>12.1</td>
<td>12.2</td>
<td>12.2</td>
<td>12.3</td>
<td>12.1</td>
<td>12.1.</td>
<td>12.1</td>
</tr>
<tr>
<td>4</td>
<td>Center Blossom Calyx End</td>
<td>12.1</td>
<td>12.2</td>
<td>12.2</td>
<td>12.3</td>
<td>12.1</td>
<td>12.1.</td>
<td>12.1</td>
</tr>
<tr>
<td>5</td>
<td>Fruit Blossom Calyx End</td>
<td>12.1</td>
<td>12.2</td>
<td>12.2</td>
<td>12.3</td>
<td>12.1</td>
<td>12.1.</td>
<td>12.1</td>
</tr>
</tbody>
</table>

Replicated Field Trials
- Poamoho Research Station on Oahu.
- Pak choi, lettuce and daikon crops were/are used.
- Tankage and synthetic 10-30-10 were used.
- Liquid fertilizers were produced based on same nitrate (NO₃-N ppm) content.
- Fertigation applied through drip irrigation.
Results - Lettuce and Pak Choi

Lettuce harvested after 4 weeks of seedlings transplant

Pak choi harvested after 4 weeks of seedlings transplant

Fresh weight (gram) for lettuce and pak choi harvested after 4 weeks of seedlings transplant under organic and synthetic liquid fertilizers application.

INTERCROPPING

- Intercropping is the growing of two or more crops simultaneously on the same field.

- Intercropping can be used by small farmers to increase the diversity of their product and the stability of their annual output.

- Selecting the right legume is essential.

Intercropping sweet corn and cowpea
Means and Duncan’s test letters for biomass of different intercropping treatments in the second growing season. *values in the same column followed by the same letter are not different (p>0.05) according to Duncan multiple test.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fresh total biomass (g)</th>
<th>Dry total biomass (g)</th>
<th>Fresh total biomass +pods (g)</th>
<th>Dry total Biomass +pods (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn alone</td>
<td>1400.0{c}</td>
<td>400.0{c}</td>
<td>1400.0{c}</td>
<td>400.0{c}</td>
</tr>
<tr>
<td>Corn/bush bean</td>
<td>1677.5{b}</td>
<td>540.0{b}</td>
<td>1792.5{bc}</td>
<td>616.75{bc}</td>
</tr>
<tr>
<td>Corn/cowpea</td>
<td>3023.1{a}</td>
<td>677.5{a}</td>
<td>3856.3{a}</td>
<td>867.50{a}</td>
</tr>
<tr>
<td>Corn/soybean</td>
<td>1630.0{b}</td>
<td>528.8{b}</td>
<td>2262.3{b}</td>
<td>764.50{b}</td>
</tr>
</tbody>
</table>

Means and Duncan’s test letters for: A) corn plants fresh weight (g); B) corn plants dry weight (g); C) corn + legume biomass fresh weight (g); and D) corn + legume biomass dry weight (g), in the second growing season under different intercropping treatments. *Bars with different letters are significantly (p > 0.05) different from each other according to Duncan multiple test. Treatments (Bars) are: 1 = corn alone. 2 = corn/soy bean. 3 = corn/cowpea. 4 = corn/bush bean.

Growing Chickpea in Hawaii

Chickpea plantation
Source: http://imgbuddy.com/how-to-grow-chickpea-plant.asp

Chickpea (garbanzo) bean pods and seeds
Source: www.onlyfoods.net/chickpea.html

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• HDOA
• WSARE
• Hatch
Thanks for listening

Questions?