Organic Agriculture: An Introduction

NRCS Training
Kahului, Maui
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Today:

What is organic?

Farming practices

How do they make money?
What’s Organic?

Certification

Certification agency

Inspect farm

Record keeping

Farming practices to help natural cycles

Organic matter and soil biology

Beneficial insects

College of Tropical Agriculture and Human Resources
University of Hawai‘i at Mānoa
Not used:

- Synthetic fertilizers and pesticides
- Genetically engineered plants and seeds
- Human manure & urine
- Post-harvest radiation
Organic: Hawaii

• ~200 certified farms
• 1900 acres fruits and vegetables
• Different type of operations
Organic: Hawaii

Organic Greens - Kauai

Organic Greens - Big Island

Conventional Greens - O’ahu
Organic: U.S. Mainland

- >10,000 certified farms
- Almost 200,000 acres fruits and vegetables
- 60% in California
- Small to very large

http://barfblog.foodsafety.ksu.edu/Spinatmark.jpg
Soil Testing

University laboratory

http://static.howstuffworks.com/

Private laboratory

http://static.howstuffworks.com/
Soil Testing

### Soil Plant Analysis Report

**Sample Information**
- **Job Control No.:** 08-239880-046
- **Sample Label:** SEC B
- **Date Received:** 9/2/1999
- **Send Copy To:** Elevation (ft.):

**Test Results and Interpretation**

<table>
<thead>
<tr>
<th>Soil Analysis</th>
<th>Results</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.6</td>
<td>Very Low</td>
</tr>
<tr>
<td>P (ppm)</td>
<td>561</td>
<td>35</td>
</tr>
<tr>
<td>K (ppm)</td>
<td>2544</td>
<td>256</td>
</tr>
<tr>
<td>Ca (ppm)</td>
<td>6502</td>
<td>1750</td>
</tr>
<tr>
<td>Mg (ppm)</td>
<td>839</td>
<td>350</td>
</tr>
<tr>
<td>OC (%)</td>
<td>3.1</td>
<td>No criteria found</td>
</tr>
<tr>
<td>Total N (%)</td>
<td>8.31</td>
<td>No criteria found</td>
</tr>
<tr>
<td>Salinity (%)</td>
<td>1.23</td>
<td></td>
</tr>
<tr>
<td>S (ppm)</td>
<td>68</td>
<td>No criteria found</td>
</tr>
<tr>
<td>Fe (ppm)</td>
<td>23</td>
<td>No criteria found</td>
</tr>
<tr>
<td>Mn (ppm)</td>
<td>6.3</td>
<td>No criteria found</td>
</tr>
<tr>
<td>Cu (ppm)</td>
<td>19</td>
<td>No criteria found</td>
</tr>
<tr>
<td>B (ppm)</td>
<td>9.13</td>
<td>No criteria found</td>
</tr>
<tr>
<td>Al (ppm)</td>
<td>465</td>
<td>No criteria found</td>
</tr>
</tbody>
</table>

**Fertilizer and Lime Recommendations**

<table>
<thead>
<tr>
<th>Total Nutrient Requirement (lbs/Acre):</th>
<th>Nitrogen: 150</th>
<th>Phosphorus: 0</th>
<th>Potassium: 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer / Lime Material</td>
<td>Total Amount (lbs/Acre)</td>
<td>Applications</td>
<td>Cost Estimate ($/Acre)</td>
</tr>
<tr>
<td>Blood</td>
<td>1154</td>
<td>split into 2 applns.</td>
<td>762</td>
</tr>
</tbody>
</table>

**Comments**

--- GENERAL INFORMATION ---
- Knowing levels of sulfur and micronutrients in plants is also important. For proper diagnosis, tissue analysis is needed.
- Split the fertilizer into several applications, at planting and thereafter every 3-4 weeks until the total amount has been applied.
- We recommend that you adopt a nutrient monitoring approach by retaining this sample report for comparison with future samples.

**NOTE:**
The interpretations are based on Fact Sheet No. 3 “Adequate Nutrient Levels in Soils and Plants in Hawaii.” To help improve future recommendations, please answer the following questions, photocopy this form and return it to above address.
1. Did you need to modify the recommendation? If so, how?
2. Did your plants improve? Please give yield before and after the recommendations were applied.
Adjust pH

Acid soils

Adjust pH to 5.5-6.5

Powdered Shells

Spreading dolomite on Molokai

Photo: courtesy Alton Arakaki
Building Soil Organic Matter

Figure 3.1 Soil organisms and their role in decomposing residues. Modified from D.L. Dindal, 1978.
Building Soil Organic Matter

- Reduced disease +
- Improved water availability +
- Improved soil structure +
- Nutrients released =

Better plant growth

http://www.turfformula.com
Building Soil Organic Matter

Cover crops

Compost
Covercrops

- Protects soil
- Suppress weeds
- Suppress nematodes
- Fix nitrogen
- Takes up space
- Needs water
- Seed Costs $$
- Can host plant pests
**Sunnhemp**

- Supresses nematodes & weeds
- Fixes nitrogen
- Seed produced in Hawaii

**Poor growth in winter**

- Gets stuck in tiller when old

*Tilling in sunnhemp on organic Farm - Kauai*
Sorghum x Sudangrass

- Produces a lot of organic matter
- Suppresses nematodes & weeds
- Good windbreak

Poor growth in winter

Nitrogen requirement

Windbreak in organic papaya Molokai

Biomass production- O'ahu
Buckwheat

Early weed suppression

Flowers attract good insects

Dies early

Nitrogen requirement
Japanese Millet

- Good biomass production
- Suppresses weeds
- Few pests
- Limited to higher elevations?
- Nitrogen requirement

Japanese millet on organic farm - Maui
A Few Other Cover Crops

Cowpea

Perennial Peanut

Oats

Vetch

http://www.cilr.uq.edu.au
Cover Crops

- Cover crops suppress weeds, protect topsoil and provide other benefits.
- Cover crops take up cash crop space and farmers lose $$ in short term.
- Cover crop seed can be expensive
- UH cover crop database: http://www.ctahr.hawaii.edu/SustainAg/index.html
Compost

Good source of organic matter

Good source of micronutrients and organic acids

Transportation costs $$

Takes time and effort

Low nitrogen

Can be woody and steal nitrogen from plants

Commercial Compost Operation, Oahu
Compost

Keep moist

On-farm compost pile, Maui

Thermometer
Compost

Commercial worm composting operation, O‘ahu

Spreading compost, Molokai
Courtesy: Alton Arakaki
Soil food pyramid

- Compost and covers for long-term health
- Fertilizers for short term nutrition

Cover crops  Compost  Organic Fertilizers
Important Organic N Sources

- Poultry manure, Feather meal
- Fish and meat waste, Blood
- Nitrogen fixation

http://farm1.static.flickr.com/
N fixation by bean plants

1. Carbon dioxide, water, and solar energy fuel plant photosynthesis

2. Products of photosynthesis from the plant fuel N₂ fixation by rhizobia in root nodules

3. N₂ gas in the air is “fixed” by rhizobia

4. Fixed N in the form of ammonia produced by rhizobia is used by the plant

Organic N Sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Total N, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poultry manure</td>
<td>1.5–3.0</td>
</tr>
<tr>
<td>Pig, horse, cow manure</td>
<td>0.3–0.6</td>
</tr>
<tr>
<td>Green manure</td>
<td>1.5–5.0</td>
</tr>
<tr>
<td>Compost</td>
<td>0.5–2.0</td>
</tr>
<tr>
<td>Seaweed meal</td>
<td>2.0–3.0</td>
</tr>
<tr>
<td>Sewage sludge</td>
<td>1.0–5.0</td>
</tr>
<tr>
<td>Fish waste</td>
<td>4.0–10.0</td>
</tr>
<tr>
<td>Blood (slaughter house)</td>
<td>10.0–12.0</td>
</tr>
<tr>
<td>Human urine/night soil</td>
<td>1.0–1.5</td>
</tr>
</tbody>
</table>

Apply 90-120 days before harvest, unless composted.
Phosphorus

Manure and Compost add P

Covercrops and Mycorhizae may improve availability

http://dnr.wi.gov/org/

Courtesy Mitiku Habte

http://www.greenmanconservation.co.uk
## Phosphorus Sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Total P, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock phosphate</td>
<td>17–26</td>
</tr>
<tr>
<td>Bone meal</td>
<td>20–30</td>
</tr>
<tr>
<td>Fish meal</td>
<td>5–10</td>
</tr>
<tr>
<td>Wood ash</td>
<td>2–5</td>
</tr>
<tr>
<td>Poultry manure</td>
<td>0.5–1.5</td>
</tr>
<tr>
<td>Green manure</td>
<td>0.2–0.5</td>
</tr>
<tr>
<td>Compost</td>
<td>0.2–0.5</td>
</tr>
<tr>
<td>Sewage sludge</td>
<td>0.4–2.5</td>
</tr>
</tbody>
</table>

(Adapted from Nick and Bradley, 1994; and Hue, 1995)
Potassium Sources

Mined potassium sulfate

Gorilla Ogo

http://i.treehugger.com/
## Organic Nutrient Sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Total K, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sul-Po-Mag [Mg, K, S04]</td>
<td>22.0</td>
</tr>
<tr>
<td>Polyhalite [Ca, K, S04]</td>
<td>10–15</td>
</tr>
<tr>
<td>Wood ash</td>
<td>5–10</td>
</tr>
<tr>
<td>Green sand</td>
<td>5–7</td>
</tr>
<tr>
<td>Green manure</td>
<td>2–5</td>
</tr>
<tr>
<td>Seaweed meal</td>
<td>2–3</td>
</tr>
<tr>
<td>Compost</td>
<td>0.5–2.0</td>
</tr>
</tbody>
</table>
Locally Available Fertilizers

<table>
<thead>
<tr>
<th>Description</th>
<th>%</th>
<th>ug/g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>C</td>
</tr>
<tr>
<td>UH Vermicompost</td>
<td>1.81</td>
<td>25.67</td>
</tr>
<tr>
<td>Menhune Magic Compost</td>
<td>0.70</td>
<td>19.36</td>
</tr>
<tr>
<td>Kup'a'a Compost</td>
<td>1.71</td>
<td>24.96</td>
</tr>
<tr>
<td>Chicken manure &amp; mortalities</td>
<td>2.91</td>
<td>21.10</td>
</tr>
<tr>
<td>Bioflor®</td>
<td>5.47</td>
<td>27.35</td>
</tr>
<tr>
<td>Island Commodities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bone &amp; Blood</td>
<td>9.38</td>
<td>45.52</td>
</tr>
<tr>
<td>Gorilla Ogo (Gracilaria)</td>
<td>0.41</td>
<td>20.40</td>
</tr>
</tbody>
</table>
Estimated Material Costs

Cover crop seed = $100-200/acre
10-80 pounds per acre @ $3-$15 a pound.

Compost = $450- $1800/acre
10-40 tons per acre @ $45 a ton.

Manure = Free or $300-$1000/acre
3-10 tons per acre @ $100 a ton.

Bone & blood meal $300-$900/acre
1-3 tons per acre @ $300 a ton.

Commercial Organic Fertilizer $120-300/acre
200-500 lbs per acre @ $0.60 a pound.
Organic Seed

Purchased commercially

Produced on-farm
Seedling production

Kauai

Soil blocks
No plastic
Some local materials
Higher labor costs

Hawaii Island

Plastic trays
Less labor
Easy sterilization
All imported materials
Pest control
Focus on plant health

- Improve soil organic matter
- Enough (but not too much) fertilizer and water
- Resistant, well adapted varieties
- Correct plant spacing
Insects

Not all insects are bad
• Pollination
• Organic matter decomposition
• Natural enemies

Save good (beneficial) insects
• Limit pesticide sprays
• Provide flowering plants
“Mummified” aphid, parasitized by wasp
Commonly Used Pesticides

- Sulfur
- Neem extracts
- Spinosad
- Pyrethrins
- Soap
Pesticides

• Organic pesticides are available, but can be expensive.

Examples:
  – Soap = $90 per acre
  – Neem extract = $30-$100 per acre
  – Spinosad = as much as $120 per acre

• Use organic pesticides according to the label. Follow all safety precautions.
Weed control

• One of organic farmers’ biggest problems.
• Labor costs can be very high.
• Some labor saving practices include:
  - Do not let weeds go to seed
  - Space plants closely
  - Use transplants, if possible
  - Use good seed
Primary Strategies

Cultivation

Plastic mulch

Covercrops
Other Strategies

Organic Mulch

Flaming

Photo courtesy Jari Sugano

Organic Herbicides
How Growers try to be profitable

• Go Big
• Cooperatives
• Grants & programs
• High $$ Crops
• Direct marketing
• Distributing other growers produce
• Food Safety Certified