Local Inputs to Enhance Soil Fertility and Plant Growth in Agroforestry Systems

Amjad Ahmad, Theodore Radovich, and Nguyen V. Hue
Department of Tropical Plant and Soil Sciences
CTAHR/University of Hawaii at Manoa

Is more always better?

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
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.

Regression analysis between tankage application rate and shoot dry weight of 6 week old eggplant seedlings grown in (A) peat, (B) peat amended with CaCO₃, (C) coconut coir, and (D) thermophilic compost.

Addition of vermicompost improved seedlings growth
**Vermicompost**

*What to feed worms in a worm bin?*

- The smaller the better.
- Equal portion of greens and browns.

**Greens:** Vegetable and fruit scraps, bread, pasta, coffee grounds and filters, teabags.

**Browns:** Paper, junk mail, paper egg cartons, cardboard, dry leaves, and dead plant matter.

**AVOID:** Salty foods, citrus, spicy foods, oily, meat and dairy products, and foods with preservatives.


---

**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.

---

**Compost Tea**

- Positive growth response.

- Effect is consistent across soil and media.

- Response dependent on rate and quality of compost.


---

**Similar results in the field**

- Fresh Weight
- Dry Weight

*Tea* vs. *No Tea*

---

Amjad Ahmad, Theodore Radovich, and Nguyen V. Hue
Invasive Algae

- Western SARE Research project funded.

“Reducing Pacific Island Growers’ reliance on off-island fertilizer sources through improved awareness and efficient use of locally available inputs”

One of the key study area of the project is to “Quantify the independent and interactive effect three algae species collected from multiple sites for their nutrient (K) availability, impact on crop yield and nutrition”

Samples 1st batch %

<table>
<thead>
<tr>
<th>Description</th>
<th>N*</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<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>14.34</td>
</tr>
<tr>
<td>Ogo</td>
<td>1.41</td>
<td>0.11</td>
<td>12.48</td>
</tr>
</tbody>
</table>

Samples 2nd batch %

<table>
<thead>
<tr>
<th>Description</th>
<th>N*</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kappaphycus</td>
<td>0.82</td>
<td>0.06</td>
<td>24.85</td>
</tr>
<tr>
<td>Eucheuma</td>
<td>0.94</td>
<td>0.07</td>
<td>17.2</td>
</tr>
<tr>
<td>Ogo</td>
<td>1.73</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.


The bar diagrams comparing the average Fresh wt. (gms) among the 5 different rates of Algae (K in kgs/ha) provided through 3 invasive species of Algae from the 1st greenhouse trial. Means followed by the same letter are not significantly different (P < 0.05) using Duncan's multiple range test.

Comparing the Dry wt. with fertilizer types

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Average Dry wt. (gms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eucheuma</td>
<td>b</td>
</tr>
<tr>
<td>Synthetic fertilizer</td>
<td>a</td>
</tr>
<tr>
<td>Control</td>
<td>c</td>
</tr>
</tbody>
</table>

The bar diagram displaying the average Dry wt. (gms) of Pak choi plants grown with Eucheuma & synthetic fertilizers and control K from the 2nd GH trial. Means followed by the same letter are not significantly different (P < 0.05) using Duncan's multiple range test.
The scattered line diagram displaying the relative response of Fresh wt. to algae application from 1st and 2nd greenhouse trials.

Tankage
Local rendered meat product. N = 7.5-9.5%, P = ~2.5%, C:N = 5:1

Nitrogen Release pattern from Tankage

Nitrates release from tankage applied at different application rates over 90 days under Waimanalo (Mollisol) and Poamoho (Oxisol) soils.
Meat and bone meal by products (Tankage). High nitrogen content (10%). Also good source of other nutrients.

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.

Liquid fertilizer with high nitrogen from tankage

-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).

Nitrile 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 through out the test; Verm = Vermicompost; B.Soda = Baking Soda.

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</td>
<td>400.0</td>
<td>1400.0</td>
<td>400.0</td>
</tr>
<tr>
<td>Corn/bush bean</td>
<td>1677.5</td>
<td>540.0</td>
<td>1792.5</td>
<td>616.75</td>
</tr>
<tr>
<td>Corn/cowpea</td>
<td>3023.1</td>
<td>677.5</td>
<td>3856.3</td>
<td>867.50</td>
</tr>
<tr>
<td>Corn/soybean</td>
<td>1630.0</td>
<td>528.8</td>
<td>2226.3</td>
<td>764.50</td>
</tr>
</tbody>
</table>

*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.

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.

#### Acknowledgements

- Alton Arakaki
- Glenn Teves
- Jari Sugano
- Jensen Uyeda
- Roger Corrales

- Funding source:
  - WSARE
  - Hatch
  - HDOA

Amjad Ahmad, Theodore Radovich, and Nguyen V. Hue
Thanks for listening

.......... Questions?