Anatomy of a Biochar Trial

FLB001

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Agenda

Biochar Trials for Cropping Systems

• Food production
  – Grains & pulses
• Perennial Horticulture
  – Viticulture
  – Hops
• Dairy

Getting Char

• Make vs Buy
• Know What You Sow
U.S. Cropping Systems

**Positive**
- Common beans
- Cucumbers (clay)
- Oats
- Maize (2\textsuperscript{nd} year)
- Alfalfa

**Negative**
- Cucumbers (sand)
- Tobacco (1 year)
- Lettuce
- Maize (greenhouse)
- Tomatoes
- Peanuts (1 year)
- Cotton (1 year)

**Variability:**
1. Trial duration
2. Production parameters
3. Feedstock quality
4. Biochar characteristics
5. Edaphic qualities
6. Trial design
7. Yield ecology
biochar & perennial horticulture

advantages
- high revenue/acre = high impact
- significant on farm waste biomass
- Ability to ameliorate a variety of growing constraints
- Aggregate stability, moisture retention, pathogen suppression

disadvantages
- hard to get char to root zone for established plants
- measuring results is challenging:
  - pruning controls yield
  - some effects may take years to measure
Diseased and/or old vines
Vine prunings
Rachis
Pomace

Assess underutilized biomass
• Quantity
• Alternative uses
• Charability
• Char characteristics

biochar & viticulture
Possible benefits & uses in viticulture

1. Reduced seasonal inputs (e.g. carbon additions)
2. Improve yield consistency within a vineyard or block.
3. Improve hydraulic management of water drainage and water holding capacity of soil.
4. Boost YAN.
5. Enhance cation exchange capacity and nutrient retention.
6. Promote beneficial microbial activity in soils and pathogen suppression.
8. Less labor intensive vineyard floor management.

biochar & viticulture
Hop Yard organic waste includes bines and for first year plants, much of the twine that is used to guide plant growth. Both of these can be easily charred and used in the hop yard to build up soil organic material and improve soil tilth. Composting both can be problematic as neither the bines nor twine decompose quickly.
Land preparation for new bines includes the following activities in the fall:

- Plowing rows – up to 6” depth
- Row is tilled 1 – 2 times
- Compost & manure added
- Row is tilled at least 1 more time

IDEAL GROWING CONDITIONS FOR HOPS

- pH: 5.7 – 7.5
- Irrigation needed in most places.
- 16 gallons per plant per week!
- Hops do not thrive in heavy, waterlogged soil.
- Annual removal per acre:
  - N: 100 lbs
  - P: 20 – 30 lbs
  - K: 80 – 150 lbs
<table>
<thead>
<tr>
<th>Map Unit Symbol</th>
<th>Map Unit Name</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>48B</td>
<td>Arkport fine sandy loam, 3 to 8 percent slopes</td>
<td>26.5</td>
<td>11.2%</td>
</tr>
<tr>
<td>128B</td>
<td>Palmyra gravelly sandy loam, 3 to 8 percent slopes</td>
<td>42.2</td>
<td>17.7%</td>
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</tbody>
</table>

Find out as much as you can about the location!

http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
Benefits & Uses for Dairy Operations

1. 1% biochar addition into feed as binding agent
   - Improve feed conversion ratio
   - Reduce methane emissions
   - Reduce odors from manure

2. Combine biochar with manure
   - Retains more nutrients during composting
   - Stable C and enhanced nitrogen cycling
   - Reduces nutrient leaching into eco-system

3. Use in anaerobic digestion to boost methane production

4. Help treat dairy wastewater

5. Neutralize toxins from footbaths (e.g. copper)
Making char

Small scale equipment becoming available but processing and charring is time consuming and not always easy. Community scale equipment becoming available.
### Feedstock Options, Attributes & Considerations

<table>
<thead>
<tr>
<th>Possible Feedstock Options (NY)</th>
<th>Cherry Pits</th>
<th>Grape seeds</th>
<th>Nuts</th>
<th>Forestry Slash</th>
<th>Tree Mulch</th>
<th>Pallets</th>
<th>Pomace</th>
<th>Vine &amp; Orchard Trimmings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>med</td>
<td>low</td>
<td>low</td>
<td>med</td>
<td>med</td>
<td>low</td>
<td>high</td>
<td>med</td>
</tr>
<tr>
<td>Particle Size</td>
<td>small</td>
<td>small</td>
<td>s - m</td>
<td>m - l</td>
<td>med</td>
<td>large</td>
<td>varies</td>
<td>varies</td>
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<tr>
<td>Density/BTU</td>
<td>high</td>
<td>high</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Shape</td>
<td>uniform</td>
<td>varies</td>
<td>varies</td>
<td>varies</td>
<td>varies</td>
<td>varies</td>
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<td></td>
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<tr>
<td>Quantity</td>
<td>2T/wk</td>
<td>plentiful</td>
<td>small</td>
<td>plentiful</td>
<td>plentiful</td>
<td>plentiful</td>
<td>plentiful</td>
<td></td>
</tr>
<tr>
<td>Alternate Uses</td>
<td>craft, heating</td>
<td>nutri-</td>
<td>biofuel</td>
<td>biofuel</td>
<td>grape seed oil</td>
<td>org matter for soils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drying</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>maybe</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>prob no</td>
</tr>
<tr>
<td>Chipping</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Acquisition Cost</td>
<td>high</td>
<td>?</td>
<td>free</td>
<td>free</td>
<td>free</td>
<td>free</td>
<td>free</td>
<td></td>
</tr>
<tr>
<td>Seasonality</td>
<td>Jul</td>
<td>S - O</td>
<td>J - O</td>
<td>all year</td>
<td>all year</td>
<td>all year</td>
<td>seasonal</td>
<td>seasonal</td>
</tr>
</tbody>
</table>

*making char*
buying char

More biochar coming on the market each month BUT

- Still expensive compared to other inputs
- CBA is hard to justify
- Hard to know what you are getting sometimes
- Not local (generally)
**know what you sow**

<table>
<thead>
<tr>
<th></th>
<th>Black wattle</th>
<th>Vineyard Prunings</th>
<th>Sugar cane bagasse</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MACRONUTRIENTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>397±4</td>
<td>1,989±102</td>
<td>451±32</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>13,783±120</td>
<td>17,177±1367</td>
<td>2,181±128</td>
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<tr>
<td>Magnesium (Mg)</td>
<td>1,349±73</td>
<td>3,908±255</td>
<td>1,158±71</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>5,670±42</td>
<td>15,746±982</td>
<td>3,463±271</td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>2,205±15</td>
<td>672±18</td>
<td>289±9</td>
</tr>
<tr>
<td><strong>MICRONUTRIENTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>24±2</td>
<td>102±7</td>
<td>3,953±192</td>
</tr>
<tr>
<td>Aluminum (Al)</td>
<td>82±3.5</td>
<td>83±11</td>
<td>2,955±102</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>10±0.3</td>
<td>78±8</td>
<td>162±8</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>7±0.3</td>
<td>179±20</td>
<td>42±4</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>b/d</td>
<td>1.37±0.3</td>
<td>9±0.2</td>
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<tr>
<td>Cobalt (Co)</td>
<td>0.02±0.004</td>
<td>0.06±0.01</td>
<td>1.9±0.1</td>
</tr>
<tr>
<td>Molybdenum (Mo)</td>
<td>0.1±0.003</td>
<td>0.02±0.01</td>
<td>0.01</td>
</tr>
</tbody>
</table>

If possible, map growing constraints to char characteristics

**Importance to Viticulture Management**

- Very important
- Somewhat important
- Not too important

questions?

Biochar Can Do It!

Dig The Change