Soil Health, Carbon Farming: Tools in soil building

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<table>
<thead>
<tr>
<th><strong>Soil Health</strong></th>
<th><strong>Benefits of Compost</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. promotes a resilient population of soil organisms</td>
<td>1. Diversity of microorganisms</td>
</tr>
<tr>
<td>2. has a symbiotic relationship with plant roots</td>
<td>2. Promotes healthy plant growth</td>
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<tr>
<td>3. is in balance with plant pathogens, insect and weed infestations</td>
<td>3. Tool in IPM</td>
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<tr>
<td>4. recycles, conserves and fix nutrients</td>
<td>4. Nutrient management</td>
</tr>
<tr>
<td>5. provides good soil structure to maximize root penetration</td>
<td>5. Improves soil structure</td>
</tr>
<tr>
<td>6. improves soil water management</td>
<td>6. Soil moisture management</td>
</tr>
<tr>
<td>7. ‘maximizes’ crop production</td>
<td></td>
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</tbody>
</table>
What is in the soil?

- Air: 25%
- Water: 25%
- Mineral Particles: 45%
- Organic Matter: 5%
  - Humus: 80%
  - Roots: 10%
  - Organisms: 10%
Soil Structure

Can’t change texture. What does soil structure do?

Affects water infiltration rate and water holding capacity, erodibility. Enhances root penetration, optimizes soil aeration, stimulates microbial diversity.
Soil Aggregation

- Tilth, Friability, Soil Structure
- Aggregation Formation
- Aggregation Destruction
- Soil Aeration
- Root Penetration

90% of roots in top 18” of soil
Nutrient Management

- Increase CEC
- Immobilize Water Soluble Nutrients
- Long Term Nutrient Release
- Nitrogen Fixing Micoorganisms
Soil Water Availability

- Increased Water Holding Capacity (Sandy)
- Increased Water Permeability (Clay)
Water Conservation

• 4 inch layer of mulch can save 130,000 gallons of water/acre in vineyards
• Water holding capacity increased by 40%
• 49% greater water Marin Carbon Project ½ inch compost one time 2600 gallons/acre
Diversity of Soil Microorganisms

- Organic residue
- First level consumers:
  - Snails
  - Bacteria
- Second level consumers:
  - Worms
  - Fungi
- Third level consumers:
  - Woodlice
  - Springtails
  - Roundworms
  - Rotifers
  - Mites
  - Ants
  - Rove beetles
  - Pseudoscorpions

Food web of the compost pile
Diversity of Soil Microorganisms

- A Tool in IPM
  - Turns on plant’s natural disease fighting mechanism
  - Increased Competition for nutrients and energy
  - Predation
  - Site Occupation
  - Nutrient Management
  - Fungal Presence for Aggregation

Diversity and abundance of microbes are indicators of soil health
Compost vs. Mulch

- In/on top of the Soil
- Supplies Nutrients
- Improves Soil Structure
- Affects Soil Water Management
- Improves CEC
- Some Erosion Control

- On Top of the Soil
- Zero Nutrient Input
- Slow Soil Structure Improvement
- Conserves Water
- No CEC Change
- Reduced Erosion Control
Soil erosion is expressed in percent of control. Control has no mulch applied. Mulch 1 and 2 had 3 inches of mulch applied in the fall of 1999. Mulch 2 has received an additional 1.5 inches of mulch in the fall of 2000.

http://cesonoma.ucanr.edu/files/27435.pdf
Biochar in Compost

- Reduces emissions, conserves N
- Strips off available carbon
- Inoculates the biochar
- One application, rather than two
- Most effective in sandy or clay soils
Carbon Farming

Source: Marin Carbon project
Photosynthesis

Source: Squizzes.com
Without Compost With
Carbon Depletion/Restoration

- It is estimated 150 – 200 billion tons of soil organic matter has been lost over the past century.
- In 2012 it was estimated that 9 billion tons of CO₂ are annually released in to the atmosphere from fossil fuel consumption.
- With the implementation of the appropriate management practices, soil organic matter content could be restored to pre-industrial agricultural levels within 50 years.

Source: Future Directions International, August 2016
## Table 1. CO2e Reduction/Sequestration Potential, Cachuma Ranch (8000 acres), Santa Barbara County, CA

<table>
<thead>
<tr>
<th>Practice</th>
<th>Average Annual CO2e Sequestration</th>
<th>20 yr CO2e Sequestration</th>
<th>CO2e Sequestration at Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rangeland Compost</td>
<td>638 Mg</td>
<td>98,847 Mg</td>
<td>162,619 Mg (30 years)</td>
</tr>
<tr>
<td>Cropland Compost (590)</td>
<td>2,060 Mg</td>
<td>23,200 Mg</td>
<td>43,374 Mg at 5% SOM</td>
</tr>
<tr>
<td>Shelterbelts (380)</td>
<td>98 Mg</td>
<td>1,960 Mg</td>
<td>7,840-19,260 Mg at 80 years.</td>
</tr>
<tr>
<td>Hedgerows (422)</td>
<td>6 Mg</td>
<td>120 Mg</td>
<td>120 Mg</td>
</tr>
<tr>
<td>Prescribed Grazing (528)</td>
<td>1,460 Mg</td>
<td>29,200 Mg</td>
<td>29,200 Mg</td>
</tr>
<tr>
<td>Riparian Restoration</td>
<td>410 to 1,535 Mg</td>
<td>6,144-23,035 Mg at 15 years</td>
<td>18,431-69,106 Mg at 45 years.</td>
</tr>
<tr>
<td>No Till (329)</td>
<td>39 Mg</td>
<td>780 Mg</td>
<td>780 Mg</td>
</tr>
<tr>
<td>Minimum-Tillage (345)</td>
<td>100 Mg</td>
<td>2,000 Mg</td>
<td>2,000 Mg</td>
</tr>
<tr>
<td>Silvopasture (381)</td>
<td>660 Mg</td>
<td>13,200 Mg</td>
<td>214,000 Mg</td>
</tr>
<tr>
<td>Nutrient Management (590)</td>
<td>610 Mg</td>
<td>12,200 Mg</td>
<td>48,800 Mg</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>6,081-7,206 Mg</strong></td>
<td><strong>187,651 - 204,542 Mg</strong></td>
<td><strong>527,164 - 589,259 Mg</strong></td>
</tr>
</tbody>
</table>
Guidelines

- Make wisely use of compost and mulch
- Use mature compost
- Have a soil test done for baseline and amendments
- Monitor Soil Organic Matter (SOM) levels
### Quantity and Cost Calculator

#### Mulch/compost calculations. Only fill in the non-shaded, green areas

<table>
<thead>
<tr>
<th>Product</th>
<th>Compost/Mulch depth (In.)</th>
<th>Number of acres you want to put mulch/compost on</th>
<th>Cost per Cubic Yard</th>
<th>Cubic yards per Acre</th>
<th>Cubic Yards for Total Farm</th>
<th>Cost per Acre</th>
<th>Total Cost of Mulch needed for Total Vineyard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonoma Compost</td>
<td>0.2</td>
<td>3</td>
<td>$20.00</td>
<td>26.9</td>
<td>80.7</td>
<td>$537.78</td>
<td>$1,613.33</td>
</tr>
</tbody>
</table>

**Change info in these cells only**

### Mulch/Compost Calculations.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Vine Row Swath (Ft.)</th>
<th>Vine Row Spacing (Ft.)</th>
<th>Percent of one Vineyard Acre that mulch will be applied to</th>
<th>Number of Vineyard Acres that you want to put mulch on</th>
<th>Total number of &quot;treated acres&quot; that mulch will be applied to</th>
<th>Depth of mulch to be Applied (In.)</th>
<th>Cost per Cubic Yard Delivered</th>
<th>Cubic Yards/Acre*</th>
<th>Total Cubic Yards Needed</th>
<th>Mulch Cost/Acre</th>
<th>Total Mulch Cost for Vineyard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your Winery</td>
<td>2</td>
<td>8</td>
<td>25.00%</td>
<td>10</td>
<td>2.5</td>
<td>2</td>
<td>$25.00</td>
<td>67.2</td>
<td>672.2</td>
<td>$1,680.56</td>
<td>$16,805.56</td>
</tr>
</tbody>
</table>

Sonoma Compost Co.
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**Change info in these cells only**
SPREADING THE GOODS
Thank you
Questions?

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