Enhancement of Potting Soil Performance with Biochar Amendments

Christoph Steiner, Keith Harris, Julia Gaskin, and K.C. Das
Department of Biological and Agricultural Engineering, Faculty of Engineering, University of Georgia, Athens GA 30602, USA

Introduction
Many potting soils contain biochar or activated carbons and biochar-based potting soil amendments are commercially available. Biochar is supposed to improve aeration and drainage, and to adsorb excess moisture. Some potting soils are highly priced and this facilitates the use of valuable amendments such as charcoal. Even Terra Preta is mined and sold as potting soil in the vicinity of its occurrence.

Results
The charcoal product 1 (CP1) increased flower size (Table 1) and quantity (sunflowers, small pot, Table 3) and could prevent Boron (B) deficiency in sunflower plants (Table 3).

Materials and Methods
We tested 3 commercially available potting soils and 4 soil amendments like worm casings (WC), biochar (charcoal product, CP1, CP2, CP3. Conventional potting soils (Soil1, Soil2 and Soil3) were amended with the commercially available biochar based additive and compared with potting soils without biochar additions. The 7 products were assessed in two different pot sizes (1 liter and 2.4 liter) and 3 different ornamental plant species (Zinnia, pepper and sunflower). Our main interest was focused on CP1 which is enriched with beneficial microbes.

We assessed the costs and measured plant size, number of flowers/fruits, and aboveground biomass 3 months after planting. Chlorophyll was measured optically (Minolta SPAD-502). Leaf samples were analyzed for their nutrient contents to determine deficiencies.

Table 1. Zinnia: Flowers, green biomass, and chlorophyll and price (3 months after planting).

<table>
<thead>
<tr>
<th>Amendment</th>
<th>Soil 1</th>
<th>Soil 2</th>
<th>Soil3</th>
</tr>
</thead>
<tbody>
<tr>
<td># Buds (at harvest)</td>
<td>1.3</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Flowers (F) DW (g)</td>
<td>13.9</td>
<td>17.2</td>
<td>6.8</td>
</tr>
<tr>
<td>Green Biom. DW (g)</td>
<td>14.5</td>
<td>13.3</td>
<td>6.0</td>
</tr>
<tr>
<td>Chlorophyll index</td>
<td>32.7</td>
<td>31.4</td>
<td>32.2</td>
</tr>
<tr>
<td>Price index</td>
<td>1.5</td>
<td>2.6</td>
<td>5.9</td>
</tr>
</tbody>
</table>

CP1=Charcoal product, WC= worm castings, MF = mineral fertilization, DW = dry weight

Table 2. Ornamental pepper: Flowers, green biomass, and chlorophyll and price (3 months after planting).

<table>
<thead>
<tr>
<th>Amendment</th>
<th>Soil 1</th>
<th>Soil 2</th>
<th>Soil3</th>
</tr>
</thead>
<tbody>
<tr>
<td># Buds (at harvest)</td>
<td>1.3</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Flowers (F) DW (g)</td>
<td>13.9</td>
<td>17.2</td>
<td>6.8</td>
</tr>
<tr>
<td>Green Biom. DW (g)</td>
<td>14.5</td>
<td>13.3</td>
<td>6.0</td>
</tr>
<tr>
<td>Chlorophyll index</td>
<td>32.7</td>
<td>31.4</td>
<td>32.2</td>
</tr>
<tr>
<td>Price index</td>
<td>1.5</td>
<td>2.6</td>
<td>5.9</td>
</tr>
</tbody>
</table>

CP1=Charcoal product, WC= worm castings, MF = mineral fertilization, DW = dry weight

Table 3. Sunflower: Flowers (F), green biomass (gb), foliar micro nutrient content (B, Mn and Zn) and chlorophyll (chloro.) (3 months after planting).

<table>
<thead>
<tr>
<th>Treatment</th>
<th># F</th>
<th>DW F (g)</th>
<th>DW gb (g)</th>
<th>Chloro. bottom</th>
<th>Chloro. top leaf</th>
<th>F Mn mg kg⁻¹</th>
<th>Zn mg kg⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pot</td>
<td>10</td>
<td>9.4</td>
<td>8.9</td>
<td>28.4</td>
<td>22.1</td>
<td>1.2</td>
<td>3.0</td>
</tr>
<tr>
<td>Soil 1 + CP1</td>
<td>13.6</td>
<td>13.7</td>
<td>1.0</td>
<td>20.8</td>
<td>27.1</td>
<td>13.7</td>
<td></td>
</tr>
<tr>
<td>Soil 2</td>
<td>5.3</td>
<td>13.6</td>
<td>13.7</td>
<td>1.0</td>
<td>20.8</td>
<td>27.1</td>
<td>13.7</td>
</tr>
<tr>
<td>Soil 3</td>
<td>6.7</td>
<td>14.9</td>
<td>10.3</td>
<td>1.5</td>
<td>21.0</td>
<td>27.3</td>
<td></td>
</tr>
</tbody>
</table>

CP1=Charcoal product, WC= worm castings, MF = mineral fertilization, DW = dry weight

Charcoal product one (CP1) increased (n=3, p<0.05, LSD):
- Number of flowers
- Flower to biomass ratio
- And micro-nutrient supply

Biorefining and Carbon Cycling Program
www.biorefinery.uga.edu