The Effects of Biochar Applications on Soil Fertility & Crop Production for a Small Farm in the Northeast US

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Northeast Biochar Symposium

November 13, 2009

Sponsored by Northeast SARE Farmer Grant Program in cooperation with MOFGA
Downeast Maine is 'biochar country'

- Unusual geology
- Extensive Low bush blueberry cultivation
- Long tradition of burning (charring) fields
Research Design

- 24 separate plots, (16 test plots, 8 controls),
- 2 amounts of biochar applied – 0.5lbs/sq ft & 1.5lbs/sq ft
- 3 different types of char used
- 2 crops grown – soybeans & corn
- Confounding factors
Biochar Production

Bruce's Char - # 1

Prototype - horizontal afterburner design, produces biochar, process heat and electricity
Biochar Production (cont'd)

George's Char - # 2
simple two barrel (home oil storage tank + 55 gal drum) burner
Biochar Production (cont'd)

Chip Energy Char # 3

- biomass furnace produces char & heat through pyrolysis, gasification & combustion of the gases
## Characteristics of Three Biochars Utilized

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<th>Biochar #1 Bruce’s char</th>
<th>Biochar #2 George’s char</th>
<th>Biochar #3 Chip Energy char</th>
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<tbody>
<tr>
<td><strong>Characteristics</strong></td>
<td>Low (400°C) temperature, multi-purpose, backyard energy &amp; char production process</td>
<td>Moderate (500°C) temperature, double barrel, backyard production process</td>
<td>High temperature, byproduct of industrial energy production project</td>
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<td><strong>Feedstock</strong></td>
<td>70 – 80% hardwood shavings &amp; sawdust</td>
<td>Hardwood pallets charred &amp; chipped</td>
<td>Commercial hardwood pellets</td>
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<tr>
<td><strong>Adsorption Capacity</strong></td>
<td>1.50%</td>
<td>1.30%</td>
<td>2.18%</td>
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### Adsorption Capacity of various commercial lump cooking charcoals

| Comparison            | High (5 - 8%) (ex. Montana & Cowboy charcoal) | moderate (1.5 – 2.0%) (ex. Average commercial charcoal) | low (1.0 - 2.0%) (ex. Low cost charcoal with fuel starting additives) |
Weight of soybeans harvested - comparison with no char plots: percent difference

Test plots with the highest amount of char added, produced the highest average weight of soybeans harvested.
Weight of corn plants harvested - comparison with no char plots: percent difference

Char # 1 increased corn yields while Char # 2 and # 3 of any type or amount negatively affected crop yields.
Soybean leaf brix readings

Brix readings taken in August were highest in the 1.5 char # 3, 1.5 char # 1 and the no char control plots
Selected soil characteristics

Soil changes were most affected by initial fertilization (fishmeal, bonemeal, azimite) less so by the biochar.
Conclusions

- In soils that already have a high organic matter content biochar will show little if any crop yield improvements in the first year.

- Biochar applied to cold climate soils takes longer to work.

- Biochar performs best in soils that are inefficient in retaining nutrients.

- Size of biochar particles, and how it is produced, affect performance when first applied.

- Adsorption capacity of biochar is an important factor in determining how biochar will perform.