Potential Benefits of Incorporating Biochar, a Soil Amendment, into Wetland Reclamation

By Tyler Nicoll
Ground Level, Inc.
Thank you to...

- Ground Level, Inc.
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Things to Consider…

- What is the problem that needs to be fixed?
- What is biochar?
- What can biochar do for reclamation?
- What is the current research set-up?
The Problem

- Poor Soil Characteristics
  - Sandy, low organic matter, low pH
- Hydrology
  - Sites do not receive sufficient water
  - Drought periods
- Green House Gas Emissions
- Water Quality Degradation
  - Storm water run-off, agricultural
Goal:

- To find cost-effective and sustainable tools to improve current restoration practices.
- Specifically: Increase plant survival and growth to decrease restoration management time and cost.
What is biochar?

- Carbon-based material made from the decomposition of biomass waste at high temperatures
  - This process is called Pyrolysis
- Biochar may be the *bi-product* of energy production

*Lehmann and Joseph 2009*
Biochar production processes utilize cellulosic biomass such as wood chips, corn stover, rice and peanut hulls, tree bark, paper mill sludge, animal manure and most urban, agricultural and forestry biomass residues.

Besides biochar, bioenergy is also produced in the form of either synthetic gas (syngas), or bio-oils, which can be used to produce heat, power or combined heat and power.

Source: The International Biochar Initiative http://www.biochar-international.org/
Green House Gas Emissions Offset

- The carbon stores in biochar are stable for hundreds of years
  - Creates a carbon sink in the soil
- Pyrolysis stabilizes carbon and captures gases that would otherwise be released into the environment through natural decomposition.
  - CO2, Methane, Nitrous Oxide

Lehmann and Joseph 2009
Biochar History

- Biochar is modeled after Terra Preta:
  - Dark, carbon rich, fertile soils uncharacteristic of the Amazon Region in which they were found.
  - The anthropogenic plots are significantly more productive hundreds of years later than in surrounding areas.

*Lehmann and Joseph 2009*
Biochar Characteristics

- Neutral to alkaline pH
  - Raises pH of acidic soils
  - Can eliminate or reduce lime requirement
- Low Bulk Density, reduces soil compaction
- High Surface Area and pore space
- Provides substrate for soil microbes
- High Cation Exchange Capacity
- Increases water retention and decreases nutrient leaching
  - Reduces fertilizer need
  - Can treat storm water run-off

Lehmann and Joseph 2009
Magnified Pore Space
Sand vs. Biochar

Photo Credit: drillingcontractor.org
Dr. Jocelyn & biocharproject.org
Reclamation Research

- Goal of research:
  - To find the biochar application method and rate that will significantly increase tree survival and growth while still being cost-effective.
Application Method

- Broadcast & Disk the Biochar into the Soil
- Hand Fill the planting hole with Biochar
Disking Application

- **Pros**
  - Long term tree growth supported
  - Contributes to establishment of ground cover vegetation
  - Large area covered for run-off treatment

- **Cons**
  - Requires a large amount of biochar
  - Requires heavy equipment
Hand Filling Application

Pros
- Initial tree establishment assistance
- Biochar is concentrated around tree base
- Requires less biochar and no heavy equipment

Cons
- Does not assist in ground cover establishment
- Less run-off filtration
- Less biochar in landscape = less support for long term tree growth
Research Set-up

- Wetland Plot: 9 acres
- Tree Species Planted: Black Gum, Red Maple, Sweet Bay, Sweet Gum
  - Hand Filling- ½ cup on bottom
  - ½ cup on bottom and top
- Disking Application Rates:
  - 0.5 ton/acre
  - 1 ton/acre
  - 1.5 ton/acre
  - 2 ton/acre
  - 2.5 ton/acre
  - 3 ton/acre
Research Set-up

- Upland Plot: 10 acres
- Tree Species: Live Oak, Slash Pine
  - Hand Filling – $\frac{1}{2}$ cup in bottom
  - $\frac{1}{2}$ cup in top and bottom
  - 1 cup in bottom
  - 1 cup in top and bottom

- Disking Application Rates
  - 1 ton/acre
  - 2 ton/acre
  - 3 ton/acre
  - 4 ton/acre
Results

- **Wetland- Hand Filling: Mortality**
  - Control- 51.06%
  - ½ Cup in bottom- 14.54%
  - ½ Cup in bottom & top- 6.90%

- **Upland- Hand Filling: Mortality**
  - Control- 15.26%
  - ½ Cup in bottom- 14.79%
  - ½ Cup in bottom & top- 8.21%
Next Steps in Research

- Monitor plots long term
- Based on results, modify and select applications for future projects
Other Biochar Applications

- Agriculture & Turf Grass
  - Reduce fertilizer and liming needs, Filter run-off
- Water Purification & Soil Remediation
- Urban (Street) Planting
  - Filter storm water run-off
- Carbon Credit Trading
- Green Roof
  - Low Bulk Density
- Produce biofuel or heat as main product
Thank You!

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