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

By Tyler Nicoll

Ground Level, Inc.

Thank you to…

- Ground Level, Inc.
- Mosaic Co.
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- Waste to Energy Solutions, 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:

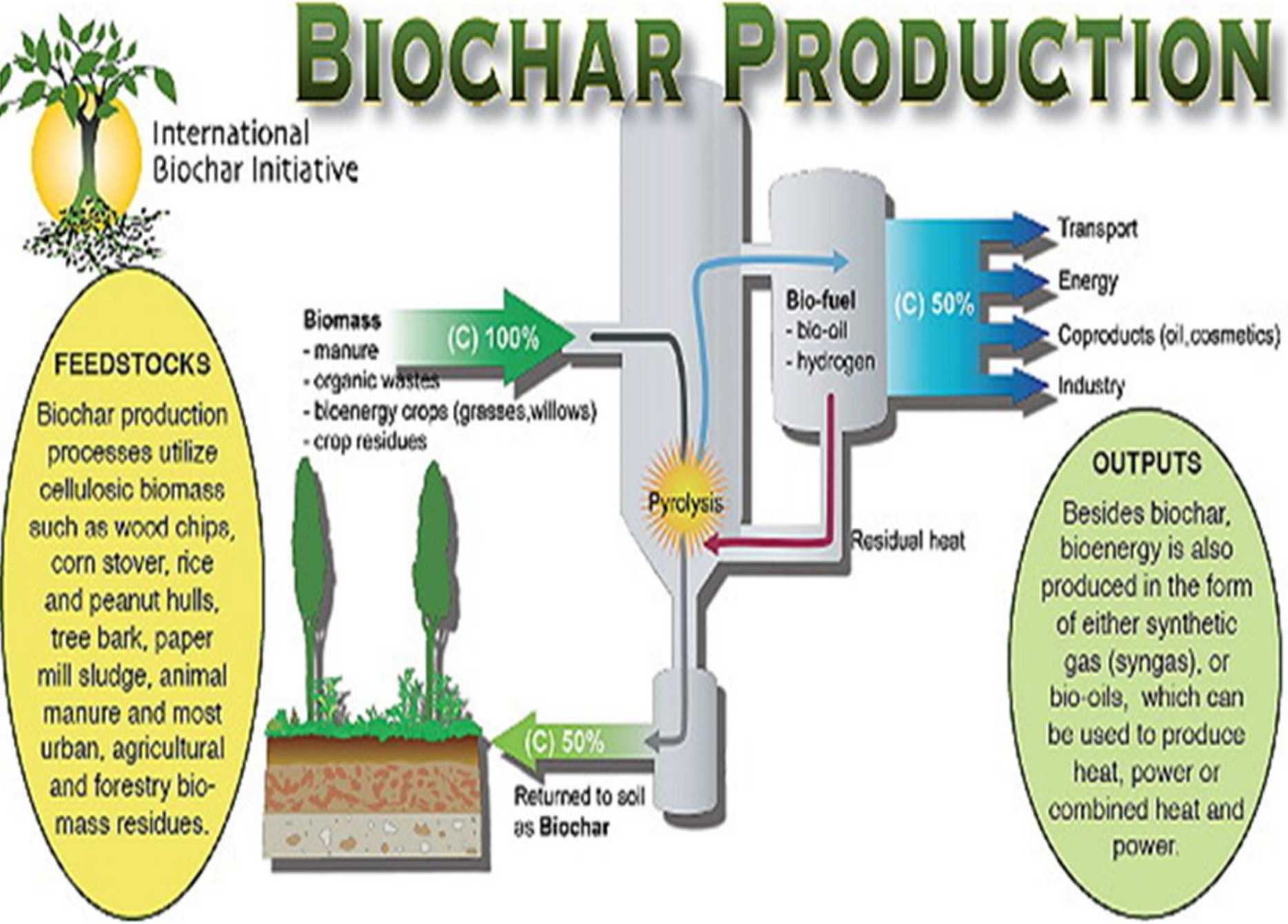
- To find cost-effective and sustainable tools to improve current restoration practices.
  - Specifically: Increase plant survival and growth to decrease restoration management time and cost.

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



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

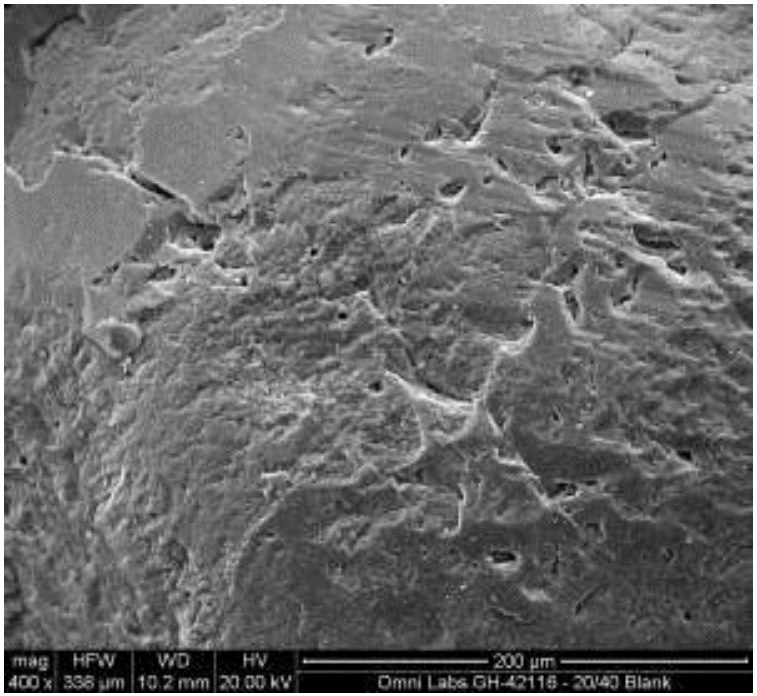


Photo Credit: drillingcontractor.org Dr. Jocelyn & biocharproject.org

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


5045

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 – ½ cup in bottom
    - ½ 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!

Personal Contact Information:

Tyler Nicoll
tnicoll@udel.edu
(203)- 733-3541

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