Controlling Biochar Properties for Quality, Beautiful, and Resilient Turf

USBI Biochar 2018 Conference
Chase Center on the Riverfront
Wilmington, DE
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K. Vodrazka
Head of Commercial Strategy
Cool Planet
Biochar - carbon-enriched product from pyrolysis of biomass

Biomass selection, pyrolysis conditions, and other factors impact the quality of biochar.
Biochar – The Promise and Potential

Multiple benefits of biochar have been touted

➢ Improve soil health
➢ Increase crop yields
➢ Protect water quality
➢ Sequester carbon/mitigate climate change
Biochar – Environmental Solution or Snake Oil?

Biochar - The new frontier

The bright prospect of biochar

Biochar is amazing stuff

Can Biochar Help Save the World?

By Ron Dembo

NOT SO FAST WITH THE BIOCHAR, SCIENTISTS SAY

Biochar: Black Gold or Just Another Snake Oil Scheme?

most promising developments in our fight against climate change. At the new website, http://www.newcarboneconomy.info, you can find out about biochar and...
Soil carbon is a key component of soil health.

Soil carbon comes in many forms and each play an important role:

- **Labile**
  - Compost and manure
  - Nutrient rich
  - Highly degradable
  - Short-lived

- **Humic**
  - Humus
  - Humic / fluvic acids
  - Complex organic compounds
  - Degradable

- **Recalcitrant**
  - Mostly pyrogenic
  - Structural
  - Fixed Carbon
  - Long-lasting (100+ years)

These three types of carbon can complement each other.
Recalcitrant fixed carbon has the potential to address a range of soil issues...

Features & Benefits of recalcitrant carbon

1. Adsorptive and Desorptive
   - Holds water
   - Retains nutrients

2. Porous
   - Anchors micro-roots
   - Promotes microbial growth as "habitat"

3. Structure
   - Pathway for water and oxygen
   - Aeration in clay soils
   - Structure in sandy soils

4. Chemically stable
   - Durable, 100+ yr degradation cycle
   - Sequesters carbon

Cool Terra Structure under a scanning electron microscope
Historically, biochar has been inconsistent, due to lack of understanding of key properties and production process.

Key physical and chemical properties:
- High pH levels
- High phytotoxic concentration
- Low pore capacity
- Low process control

Can lead to inconsistent results:
- Degraded elements of soil health
- Decreased crop productivity & plant health
Biomass selection, pyrolysis conditions, and other factors impact the quality and performance of biochar!

All Biochars Are NOT Created Equal!

The key properties of biochar are determined by:

1. Source & quality of feedstock used
2. Pyrolysis type & conditions
3. Post-Pyrolysis treatment, if any

Biomass selection, pyrolysis conditions, and other factors impact the quality and performance of biochar!
Our Differentiator: Cool Terra® is Engineered Biocarbon™ Technology

Pyrolysis expertise and patented ‘Demetra’ process designed to maximize consistency & effectiveness

- **Pyrolysis**
- **Demetra Process** (Patented)
- **Biomass** (e.g., Nutshell, Pine)
- **Raw Biochar**

- **Modify surface chemistry** – Optimizing pH, ion exchange and hydrophilicity
- **Detoxify Raw Biochar** – Micropores cleaned to eliminate toxicity
- **Maximize Capacity** – Improves input holding capacity in pores
- **Sized for soil** – Consistent particle sizes designed for consistent results

https://www.coolplanet.com/cool-terra/how-it-works/
Cool Terra® Engineered Biocarbon™ Technology
*A consistent and durable soil revitalizer*

Engineered Biocarbon™ Technology

- **Consistent**
- **Durable**
- **Granular**

- Made from organic biomass biochar and treated to ensure consistency, quality, and performance.
- Works in a complementary fashion to other soil carbons, but resists breaking down biologically over time.

This means it will stay in your soil and maintain its physical, chemical, and biological properties over many years.
Cool Terra® Engineered Biocarbon™ Technology

*Modern science and engineering applied to biochar*

<table>
<thead>
<tr>
<th>Predictable characteristics and performance</th>
<th>High variability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processed to eliminate compounds which negatively impact plant growth</td>
<td>Potentially contains phytotoxins or other problematic compounds (dioxins)</td>
</tr>
<tr>
<td><strong>Hydrophillic</strong>: Ready-to-use immediately</td>
<td><strong>Hydrophobic</strong>: May need ‘aging’ to utilize</td>
</tr>
<tr>
<td>Low dust, higher crush strength</td>
<td>High dust content, low crush strength</td>
</tr>
<tr>
<td>Designed to flow through most common application equipment</td>
<td>Difficult to apply: flowability issues / large variability in particle sizes</td>
</tr>
<tr>
<td>Low application rates</td>
<td>High application rates</td>
</tr>
</tbody>
</table>

Proprietary process transforms biochar into a consistent, durable, and stable soil revitalizer
## Cool Terra® Engineered Biocarbon™ Technology

**Revitalizes the soil through physical, chemical & biological mechanisms**

### Physical

**Enhance Soil Structure**
- High porosity benefits water and nutrient holding
- Expansive surface area creates free air space in heavy soil and can improve infiltration
- Water holding capacity improves plant available water and reduces evaporative loss in highly evaporative soils

### Chemical

**Enhance Nutrient Efficiency**
- High ion (CEC and AEC) exchange capacity can promote nutrient exchange and availability – holding nutrients in the root zone longer
- Porous structure of recalcitrant carbon can delay leaching – giving plants more time to use nutrients

### Biological

**Enhance Microbial Activity**
- Strong and durable cell walls enhance the structural habitat for microbes
- Neutral pH provides optimal microbial environment
- Pore-size distribution benefits microbial populations
Cool Terra® Engineered Biocarbon™ Technology

100+ independent field trial results have shown consistent yield increases

Trials have shown average yield increase of ~12% with greater than 3:1 grower ROI

Improvement in marketable yield (%) Cool Terra vs. control

Trial result highlights
Results vs. grower standard (typical levels of water and fertilizer)

KS: 8% Increase
Corn bushels / acre
1 year ROI: 4x

OR: 15% Increase
Wheat lbs / acre
1 year ROI: 5x

FL: 9.2% Increase
Tomato lbs / acre
1 year ROI: 5.1x

CA: 42% Increase
Strawberry flats / acre
1 year ROI: 18x

OR: 35% Increase
Potato lbs / acre
1 year ROI: 4.9x

Includes results from 90 field trials that produced data on marketable yield for treated vs. grower standard control in 2016 and 2017
## Cool Terra® Impact on Turf Establishment & Quality

### Impact of Cool Terra on Establishment & Quality of T-1 Creeping Bentgrass

<table>
<thead>
<tr>
<th><strong>Trial Description</strong></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Trialist</strong></td>
<td>Mark Mahady &amp; Associates</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>Carmel Valley Ranch Golf Club, Carmel, CA</td>
</tr>
<tr>
<td><strong>Trial Initiation</strong></td>
<td>September 12, 2016</td>
</tr>
<tr>
<td><strong>Plot Description</strong></td>
<td>9’ X 8’ plots, 4 replications</td>
</tr>
<tr>
<td><strong>Objective</strong></td>
<td>Evaluate Cool Terra for enhancement of speed to cover, rapid establishment and improved surface quality of a newly seeded T-1 creeping bentgrass putting green</td>
</tr>
<tr>
<td><strong>Evaluations</strong></td>
<td>Speed of Establishment (% Cover), Turf Quality (visual rating, 0 to 10 scale)</td>
</tr>
</tbody>
</table>
Cool Terra® Impact on Turf Establishment

Cool Terra 1 cf/1000 ft² (M) exhibited enhanced speed to cover of creeping bentgrass when compared to the untreated fertilized check. Differences were statistically significant on 7 of 9 evaluation dates from 7 DAS to 42 DAS.

Cool Terra 2 cf/M exhibited greatly enhanced speed to cover of creeping bentgrass when compared to the untreated fertilized check. Differences were statistically significant on 9 of 9 evaluation dates from 7 DAS to 42 DAS.
Cool Terra® Impact on Turf Quality

• **Cool Terra 1 cf/1000 ft^2 (M)** exhibited enhanced creeping bentgrass quality when compared to the untreated fertilized check. **Differences were statistically significant on 7 of 9 evaluation dates from 7 DAS to 42 DAS.**

• **Cool Terra 2 cf/M** exhibited greatly enhanced creeping bentgrass quality when compared to the untreated fertilized check. **Differences were statistically significant on 9 of 9 evaluation dates from 7 DAS to 42 DAS.**
Establishment @ 13 Days After Seeding
Mahady & Associates
2016, Carmel Valley Golf Club
Cool Terra® Impact on Turf Establishment

Speed of Establishment - Tall Fescue
Cool Planet R&D Plant Lab
Camarillo, CA

Control 1
(No Fertilizer)

Applied with Seed
(No Fertilizer)

Control 2
+ Fertilizer

Applied with Seed
+ Fertilizer
Cool Terra® Engineered Biocarbon™ Technology

*Can provide increased root development & biomass in turf*

Cool Terra was applied on top of the soil surface without rototilling and before sod installation. Images at 19 weeks after installation.

Control  2 CY/acre  6 CY/acre

*Significant increase in turf root development and biomass*
Cool Terra® Engineered Biocarbon™ Technology

Feeding more people...
Higher crop yields

...with increased grower & user benefits...

...and a healthier planet
Improved soil health | Less fertilizer leaching
Carbon sequestration | Healthier soil, Cleaner water

Optimizes water holding in soil

Increases nutrient efficiency

Nurtures microbial growth

Impacts germination and establishment

Sequesters carbon
1 ton CT = 2.7 tons CO2 removed from atmosphere
Cool Terra is produced with 100% biobased biochar

https://www.coolplanet.com