Arguments against biochar: True or false?

by

Suzanne Allaire, Ph.D.

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A threat or a saviour?

- Saves the planet from climate change
- Solves large environmental problems
- Solves all problems related to residues
- Reduces hunger in the world
- Improves soils/water retention
- Improves wealth

Briefly: Black gold for solving food, climate, and environment crisis?

- False hope on climate change
- Long term: bad impact on the environment
- Reduces innovation of new products from residues
- Will increase hunger
- Depletes soil properties
- Not economical

Briefly: Another snake oil?

Note: I’ll be using ‘biochar’ for char and biochar
Climate change: Carbon sequestration

Content in biochar

<table>
<thead>
<tr>
<th>Carbon Content</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total carbon content</td>
<td>50-97%</td>
</tr>
<tr>
<td>Stable carbon content</td>
<td>18-90%</td>
</tr>
<tr>
<td>Content in volatiles</td>
<td>7-50%</td>
</tr>
</tbody>
</table>

Therefore, only a part of the carbon is stable, sometimes very little. Some biochars will do the job while others won’t.
Climate change: GHG emissions

**When applied in soil:**
- Often \( \uparrow \) respiration

**During manufacturing:**
- Always emit \( \text{CO}_2 \)
- emit particles when poorly controlled
- Emit during transport
- emit if grown for biochar

**Feedstock:**
- Emit during transport
- emit if grown for biochar

**Life cycle budget:**
- usually less emissions than if residues let on around, composted, burned

**For decreasing overall emissions:**
- Manufacturing should be efficient, recycle its gases,
- Control particle emissions
- Should use residues rather than crop, not too far from the pyrolysis plant
Transforming into biochar should not be the 1\textsuperscript{st} reflex for residues, but rather to improve life cycle of residues.
Environment: Residue routes

**Pyrolysis**
- Pyrolysis can not transform all residues into biochar

**Organics**
- When contaminated with organics, better transform residues into biochar at high temp. to destroy them (ex: creosote)

**Heavy metals**
- The metals concentrate in the biochar, limiting it uses, but still have interesting markets

**Mixture**
- When several materials are mixed and can’t be separated, they go to landfill, can transform them into biochar for improving life cycle

Pyrolysis transformation may eliminate or concentrate contaminants into the biochar, then, we have to know its properties to use it correctly.
### Environment

**Some biochars may**
- Sorb heavy metals, organics, nutrients to clean the environment
- Serve for water filtration, replacing coal-based products (AC)
- Serve for air filtration, replacing AC and other less renewable products
- Serve for gas interception, replacing less renewable products
- Serve as slow release fertilizer, reducing the needs for fertilizers
- Support good microorganisms for decontamination

**However, some biochars may**
- Contain heavy metals, other contaminants
- Release contaminants into the environment
- Clog filtration systems
- Sorb slower in water and air, than other sorbants at first
- Sorb too much nutrients, resulting in less availability
- Support undesired microorganisms
Environment

Therefore

**Climate change:** Partly help, but not all biochars

**GHG emissions:** Mostly good, but no reduction under certain conditions

**Residues:** Excellent solution
Should not compete for RRR,
Should complement RRR

**Biochars from contaminated feedstock:** Good solution, but
Use with care
Avoid most environmental, ag markets and markets for human consumption
# Soil amendment

**Statements pro**

- Increases water holding capacity
- Improves the structure
- Contains nutrients
- Acts as slow release fertilizer
- Increases pH and has buffer capacity
- Sorbs contaminants

**Statements against**

- Has no effect on soil water
- Organisms improve structure, not the biochar
- Does not contain N
- Too slow to be helpful
- Sometimes too much, burn the soil and not always buffer
- Sorb pesticides, protecting them and decreasing their efficiency
Soil use: Water holding capacity

Water sorption rate under different tensions (0=saturated environment)

Therefore, not all biochars can increase soil water sorption rate!
Soil use: Water sorption and pH buffer capacity

Therefore, not all can increase soil water sorption and change soil pH!
Crop production
Our lab tested various biochars with plants conditions in Canada

<table>
<thead>
<tr>
<th>Species</th>
<th>Conditions</th>
<th>Biochars</th>
<th>Growth</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picea glauca</td>
<td>Greenhouse, field, mine residues</td>
<td>3 biochars, 3 conc</td>
<td>↑ or ↓</td>
<td>Depends upon biochar conc, better resists to wind, high biochar effect</td>
</tr>
<tr>
<td>Alnus rugosa</td>
<td>Greenhouse, field, mine residues</td>
<td>3 biochars, 3 conc</td>
<td>↑ or --</td>
<td>Depends upon soil properties, good with symbiotics</td>
</tr>
<tr>
<td>Alnus viridis</td>
<td>Greenhouse, field, mine residues</td>
<td>2 biochars, 3 conc</td>
<td>↑ or --</td>
<td>Better on fine tailing</td>
</tr>
<tr>
<td>Alnus crispa</td>
<td>Greenhouse, field, mine residues</td>
<td>3 biochars, 3 conc</td>
<td>↑ or --</td>
<td>Depends upon soil properties,</td>
</tr>
<tr>
<td>Populus balsamifera</td>
<td>Greenhouse, field, mine residues</td>
<td>3 biochars, 3 conc</td>
<td>↑ or --</td>
<td>Likes wet conditions</td>
</tr>
<tr>
<td>Populus tremuloides</td>
<td>Field, rich soil</td>
<td>1 biochar, 1 conc</td>
<td>↑ or --</td>
<td>↑ C budget, better in waste rock</td>
</tr>
<tr>
<td>Salix arbusculoides</td>
<td>Greenhouse and field, mine residues</td>
<td>1 biochar, 2 applicat.</td>
<td>↑ or --</td>
<td>↑ contaminant interception, better on waste rock</td>
</tr>
</tbody>
</table>
## Crop production

Our lab tested various biochars with plants conditions in Canada and Africa

<table>
<thead>
<tr>
<th>Species</th>
<th>Conditions</th>
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</thead>
<tbody>
<tr>
<td>Avena sativa</td>
<td>Greenhouse, mine residues</td>
<td>2 biochars, 3 conc</td>
<td>↑ or --</td>
<td>Need fertilizer</td>
</tr>
<tr>
<td>Festuca rubra</td>
<td>Greenhouse, mine residues</td>
<td>3 biochars, 3 conc</td>
<td>↑ or ↓</td>
<td>Depends upon conc, Good winter survival</td>
</tr>
<tr>
<td>Trifolium repens</td>
<td>Field, rich soil and mines residues</td>
<td>1 biochar, 1 conc</td>
<td>↑ or --</td>
<td>↑ C budget</td>
</tr>
<tr>
<td>Spirea</td>
<td>Greenhouse, potting soil</td>
<td>3 biochars, 4 conc</td>
<td>-- or ↓</td>
<td>Needs pH adjustment</td>
</tr>
<tr>
<td>Calamagrostis canadensis</td>
<td>Greenhouse, mine residues</td>
<td>3 biochars, 3 conc</td>
<td>↑ or --</td>
<td>Depends upon mixture</td>
</tr>
<tr>
<td>Calamagrostis overdam</td>
<td>Greenhouse, mine residues</td>
<td>3 biochars, 4 conc</td>
<td>-- or ↓</td>
<td>Needs pH adjustment</td>
</tr>
<tr>
<td>Switchgrass</td>
<td>Field, rich soil</td>
<td>1 biochar, 1 conc</td>
<td>↑ or --</td>
<td>↑ C budget, ↑ Microbial activity</td>
</tr>
<tr>
<td>Corn in Africa</td>
<td>Field, rich soil</td>
<td>1 biochar, 1 conc</td>
<td>↑</td>
<td>2 x the yield!</td>
</tr>
</tbody>
</table>
The impact on crop production depends on:

**Soil**
- Works better on dry, poor or acidic soils

**Plants**
- Works not as good with competitive plants

**Climate**
- Impact more impressive in warm country or with lack of water

**Management**
- Enhanced interactions when managed with microorganisms and N, need to be careful for pH

**Biochar**
- Biochar properties must match the needs of soil/plant/climate/management scenario

Therefore, it does not always work! Need for careful selection and management.
Hunger, wealth, and economy

**Hunger**
- Increase crop production, *not always*
- Does not displace food crop, *unless badly managed*
- May help in reclaiming soils, but be careful on biochar choice

**Wealth**
- Help in decreasing dependency to imports, affects large number of people, *but need to be organized*
- Revenues for biochar and residue producers, salesmen
- Lower needs for fertilizers, pesticides, *but not always true*

**Economy**
- Favour RRR+new markets, *but sometimes displace only*
- Favour local, circular and green economy
- Other industries try to protect themselves from being displaced
- *Does not help economy as long as too expensive, should become commodity for some markets*
What should I believe!

- Arguments against it have a basic and should be considered seriously
- Biochar is not the solution to all problems and is not a snake oil

- Biochars can solve problems, but each one is different
- Some solve only one problem, others several
- The right use of the right biochar at the right place and time is the solution!
- There us no one recipe fits all!
To buy and sell online pyrolytic products and services

Will be available before December 2018
For overview go to:
Offer.pyrolist.com
For consulting on biochar and pyrolysis

Suzanne Allaire, Ph.D.
GECAnvironnement@gmail.com
+1-581-305-3374
Thanks

To the USBI for this event!
To all of you for being here today!