Potential Applications of Biochar in Regional Agriculture

And progress in Designing Specialty Biochars

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Overview

• Reasons for using biochar in growing applications
• Examples of applications
• Results of Langara College research
Reasons for using biochar in growing applications

Long term carbon sequestration!
Active properties

• High surface area:
  • Water holding capacity
  • Gas absorption (CH$_4$, NO$_x$)

• Micro-porous structure:
  • Microbial habitat

• Surface charge:
  • Nutrient retention (CEC)
  • pH buffer

• Ash content
  • Macro- and micro- nutrients
Potential Applications

• Open field soil amendment
• Compost builder
• Hydroponic growing media
• Livestock feed additive
Open field soil amendment
Open field soil amendment

• 2012 report on a study that investigated the multiyear impact of biochar on crop performance and soil quality over a 3 y period.
• Biochar was added to an agricultural field (Wales) at 0, 25 and 50 t ha$^{-1}$ and planted with maize (year 1) and grass (years 2 and 3).
• Plant growth, C and N dynamics, microbial communities, alkalinity measured
Open field soil amendment

• No change in maize crop
• No effect on soil chemistry dynamics
• No long term liming effect
• Some effect on microbial communities
• Significant increase in grass crop biomass and foliar uptake of N
Open field soil amendment

• Conclusion: “the addition of biochar to highly productive agricultural land has no negative consequences in terms of crop growth, crop nutrition or soil quality and may even provide small agronomic benefits.”

• D.L. Jones et al, Soil Biology an Biochemistry, Vol 45, Feb 2012, 113-124
Hydroponic media for greenhouses
Hydroponic media for greenhouses

• Preliminary results from Kwantlen Polytechnic University - Institute for Sustainable Horticulture experiments are “very encouraging!”
Compost builder
Compost builder

- Better water retention
- Less nutrient leaching
- Odor control
- Peat substitute
- Improved tilth
Livestock feed additive

- Cattle fed biochar amended feed (0.6%)
- Growth monitored
- Enteric gas production monitored
Livestock feed additive

• Significant reduction in methane gas production
• Significant increase in live weight gain

Livestock feed additive

• “Double green chickens produce carbon-smart poo”
  Central Queensland University news, Jan 8, 2013
• Feeding the chickens biochar amended feed:
  – Increased chicken weight gain -up to 11%
  – Decreased ammonia release from the litter to atmosphere
Langara College Biochar research program

- Dedicated reactor for making experimental biochar batches (1kg)
- Temperature control and measurement
- Off-gas flare and condensate collection
Langara College Biochar research program

• Laboratory facilities with technician and students
• A range of biochar-relevant parameter determinations
Biochar Yield and Proximate Analysis
(produced at 710 °C)

- Fixed C
- Volatile C
- Ash

percent yield

percent by mass dry basis

Fir
Hemlock
Waste Wood
Alder
Cedar
Pulp Sludge
Cow manure
Poultry Litter
Spent Mushroom Substrate

yield of biochar
Experimental approach

• Produce batches of biochar using various blends of Fir and spent mushroom substrate (SMS) at different temperatures.
• Analyze the biochar for physical and chemical characteristics.
• Model the relationships
• Suggest optimal formulations and operating conditions
Plot relating biochar % ash to treatment temperature, and amount of spent mushroom substrate relative to Fir in the feedstock.
Surface plot relating pH to treatment temperature and amount of spent mushroom substrate relative to Fir in the feedstock
Short term vision

Given **local** biochar ideal target properties AND **locally available** biomass samples, be able to provide feedstock formulations that will produce the desired biochar while minimizing cost.
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Thank you