Biochar – a potential carbon sequestration technology in Alberta

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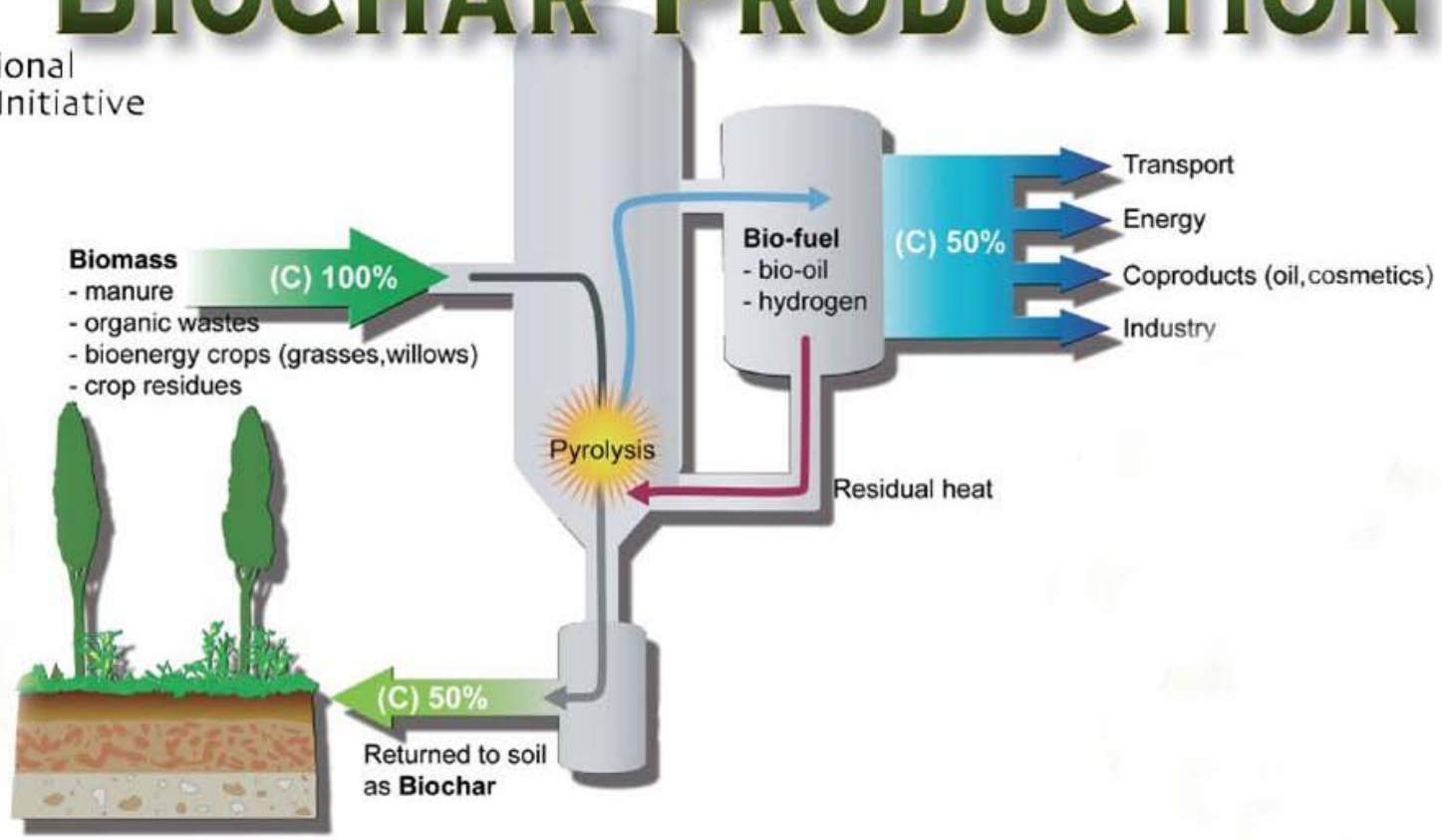
What is Biochar?

- Biochar is the agricultural and environmental use of Char or Charcoal
- It is a Carbon-rich solid produced by low-temperature (400 and 500º C) pyrolysis of biomass under complete or partial exclusion of oxygen.

BIOCHAR PRODUCTION

International Biochar Initiative



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Pyrolysis Reaction Conditions

	Reaction conditions	Liquid	Char	Gas
Slow pyrolysis (Carbonization)	Low temperature (>400°C), very long residence time (hours)	30%	35%	35%
Fast pyrolysis	Moderate temperature (~500°C), short residence time (<2 seconds)	75%	12%	13%
Gasification	High temperature, long residence times (hours)	5%	10%	85%

Source: Bridgwater, A.V. “Thermal Conversion of Biomass and Waste:

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AITF Pyrolyzers

- **AITF is currently the only Biochar facility in the province**
- **Larger capacity is needed**

Why the renewed interest in Biochar?

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Biochar for soils

- Boosts food production and preserves cropland diversity
- High Cation Exchange Capacity (CEC)
- Reduces nutrient leaching (water quality impacts)
- Enhances water retention
- Reduces chemical fertilizer requirements

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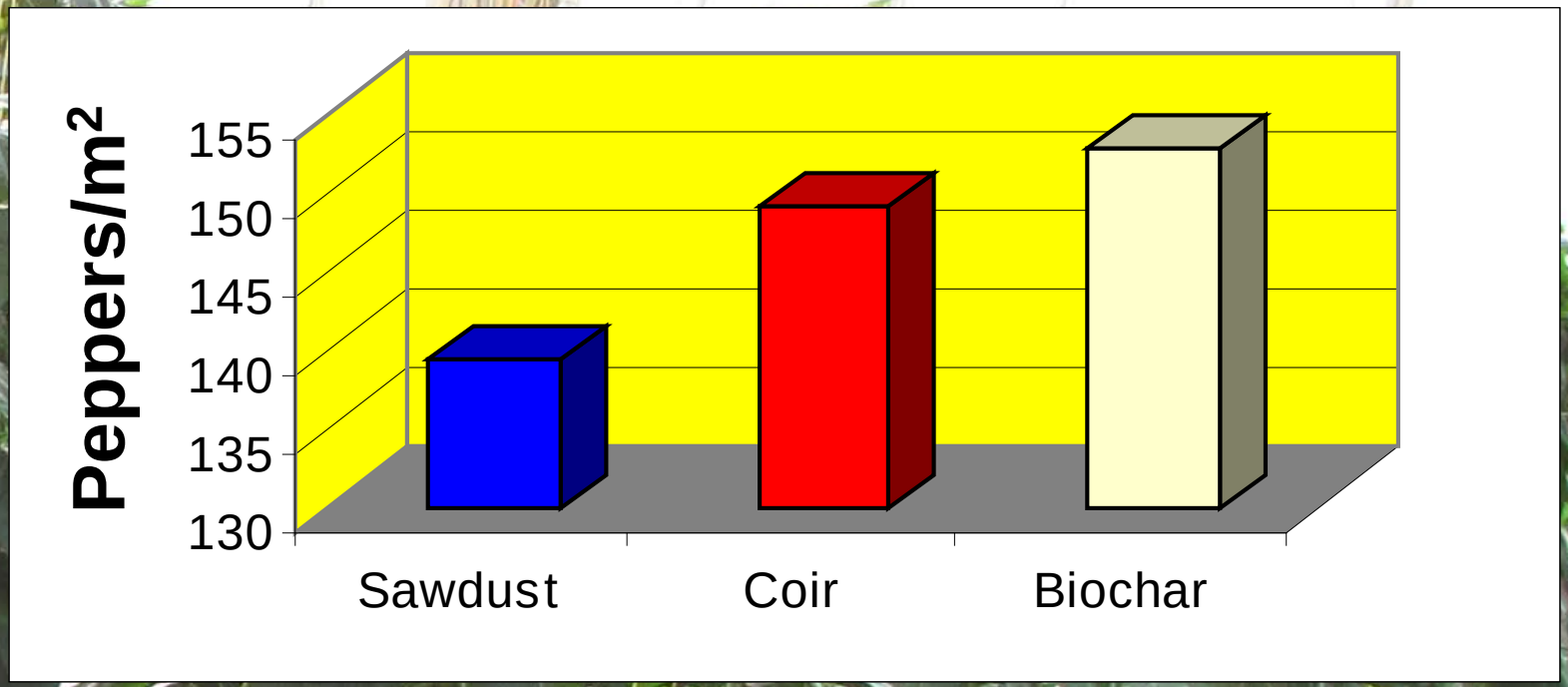
Biochar enhances soil and crop yield

20% - < 200% yield increase depending on soil type and climate

Slides courtesy of IBI

Biochar in Hydroponics



Coir

Biochar

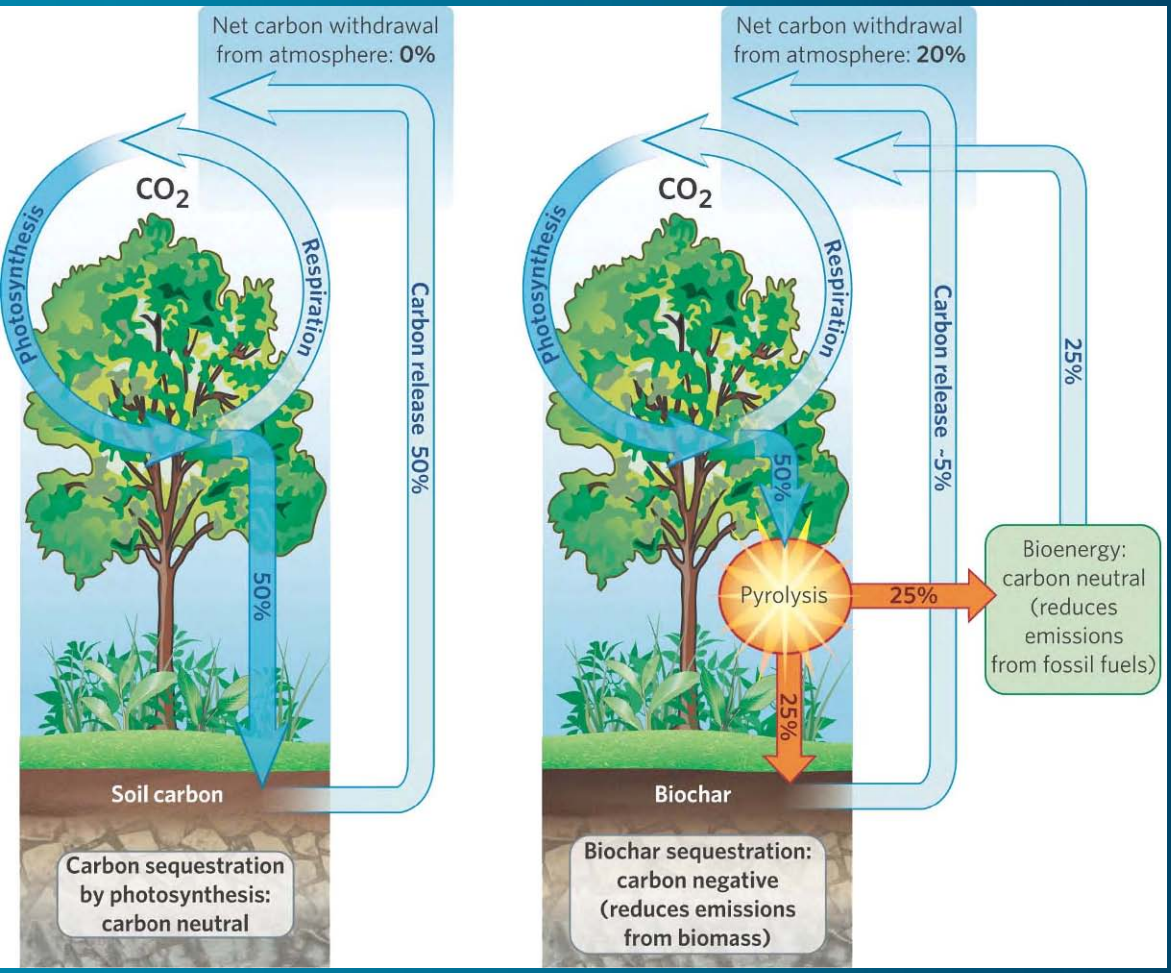
Sawdust

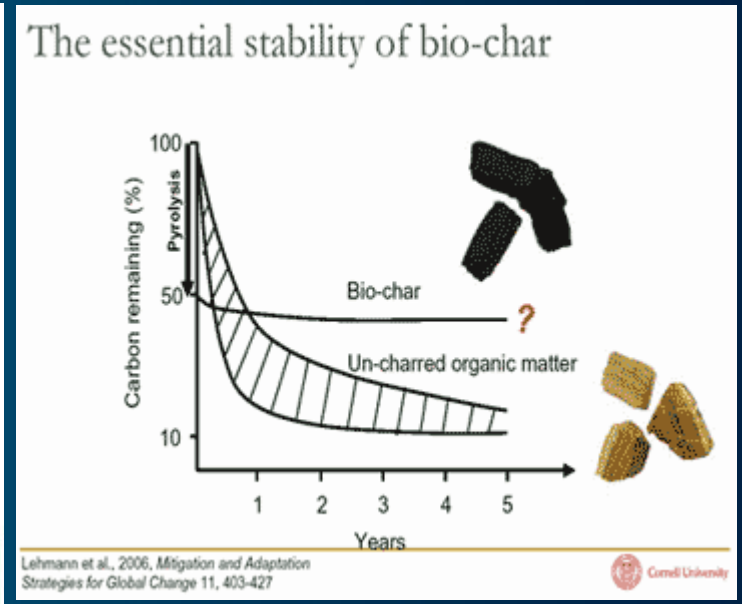
Courtesy – Dr Nick Savidov, ARD

Biochar and Climate Change

- Carbon in biochar resists degradation and can stay sequestered for long periods
- Biochar can reduce methane and NO_x emissions from soils
- Co-products (Bio-oil and Syngas) are potentially valuable sources of green materials
- Biochar is “carbon negative” in contrast to Bio-fuel, which is carbon neutral

Biochar is a powerfully simple tool to Combat Climate Change





Biochar Initiatives

International Biochar Initiative (IBI)

Recognition of biochar as a tool to fight global warming will be driven by:

1. *the post-2012 United Nations Framework Convention on Climate Change (UNFCCC)*
2. *energy and climate legislation and policies being developed and adopted in nations around the world*

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Biochar Initiatives

UK Biochar Research Centre

Mission to "research on the role of biochar as a carbon storage and sustainable energy technology, and to provide an understanding of the agronomic, environmental and socio-economic impacts of biochar."

New Zealand Biochar Research Centre

Aims "to advance the understanding of biochar for mitigating global climate change and to enable its use in New Zealand, particularly by agricultural and forestry sectors."

US Biochar Initiative

"A not-for-profit organization promoting the sustainable production and use of biochar through research, policy, technology and doing it!"

Biochar:

- Gaps in Knowledge
- Potential Negatives
- Other issues

Major Gaps

Quality and Standards definition: *Not all biochar is created equal - how do we separate good biochar from bad biochar?*

Climate and soil type affects response to biochar: *Large scale agronomic field trials needed across climatic zones and soil types*

Biochar application rate: *Soil type specific application rate lacking*

Fate of biochar in soils: *Stability of biochar in different soils and climates?*

Potential negatives

Contaminants (e.g. PAHs, heavy metals, dioxins) *- Careful selection of feedstock and processing conditions*

Removal of crop residues *for biochar production can forego incorporation of the crop residue into the soil.*

Health (e.g. dust exposure) and fire hazards – biochar is flamable -, must be handled with care

Poor biochar production practices *- could lead to greater GHG emissions and pollution.*

Biochar in Alberta

Alberta's 2008 Climate Change Strategy

Responsibility / Leadership / Action

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Alberta's 2008 Climate Change Strategy

Committing to results

By 2010 - - Reduce emissions by 20 megatonnes

RESULT *-- Meet intensity target established in 2002 plan*

By 2020 - - Reduce emissions by 50 megatonnes

RESULT *-- Stabilize greenhouse gas emissions and begin reductions*

By 2050 - - Reduce emissions by 200 megatonnes

RESULT *-- Emissions reduced by 50 per cent below business as usual level and* 14 per cent below 2005 levels while maintaining economic growth

Biochar can help to achieve these targets

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We estimate the following as achievable targets** with Biochar deployment in Alberta:

2010-15 – Development phase -- ***will achieve 5 Mt GHG reductions by applying ~1.4 Mt of biochar to 280 thousand ha of farmland annually***

2020 – Scale-up phase -- ***will achieve 10 Mt GHG reductions by applying ~2.8 Mt of biochar to 560 thousand ha of farmland annually***

2050 and beyond – ***following full scale commercial adoption, biochar will reduce projected GHG emissions by 30 Mt annually (or 15% of the target set in the 2008 GoA plan) by applying ~8.3Mt of biochar over 1.6 million ha each year***

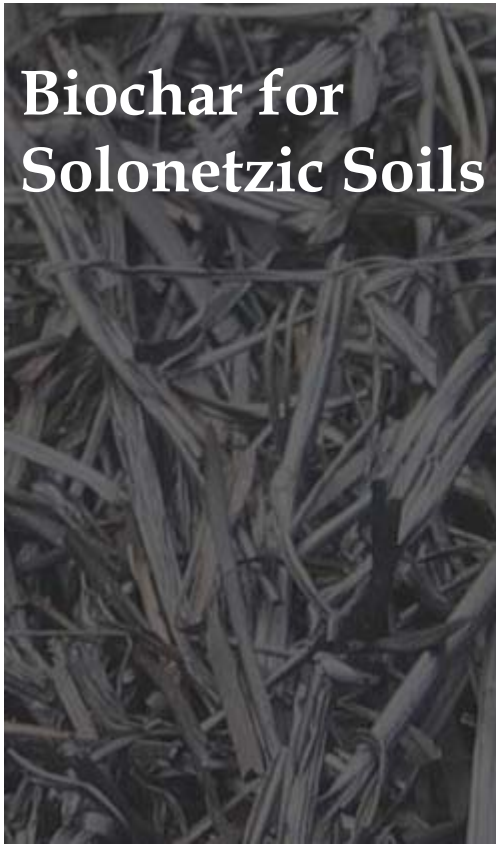
Based on AITF internal estimates

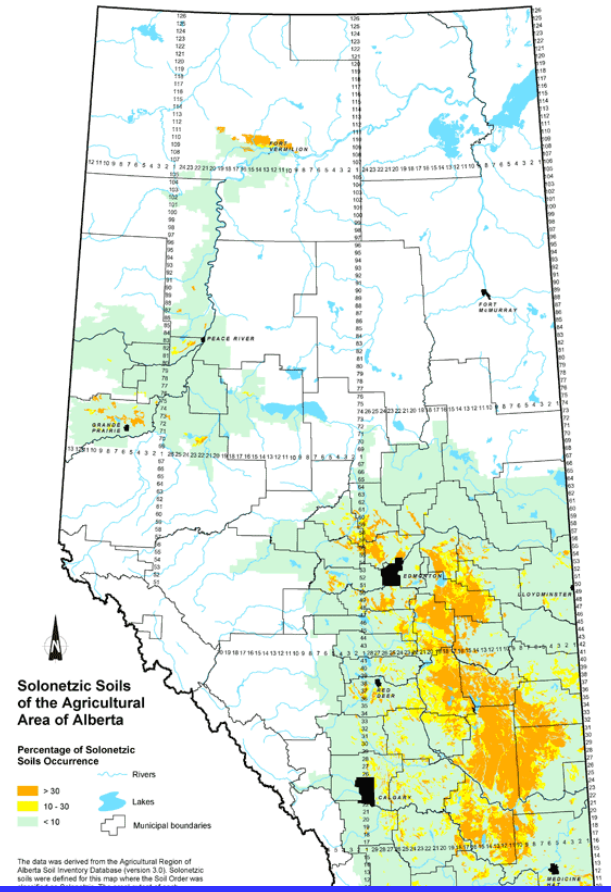
Feedstock for Biochar in Alberta

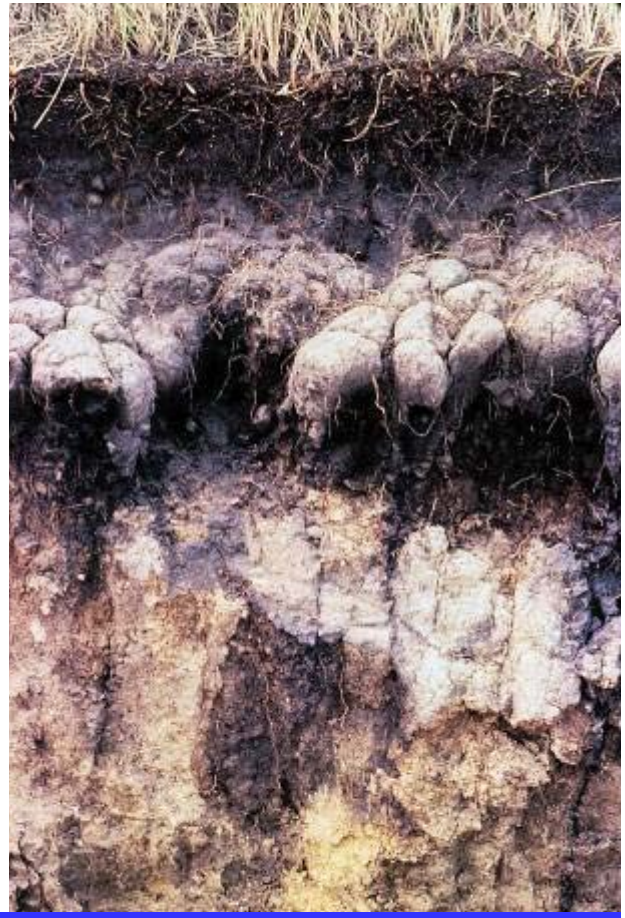
- Crop residues
- Forest and mills residues
- Municipal solid waste
- purpose-grown biomass crops and

- Based on these available feedstock for the biochar production, the CO2 sequestration potential in Alberta is significant

Biochar for soil remediation and carbon storage – *Solonetzic soils*







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4-5 million hectares of solonetzic soils in Alberta (~ 20% of the arable land base)

Ameliorative potential of AITF biochar on solonetzic soils in Alberta

Simulating a subsoiler action with a trencher (4 in. wide 2 ft. deep)

Filling trenches with a mix of Bnt material with AITF biochar

Ameliorative potential of AITF biochar on solonetzic soils in Alberta

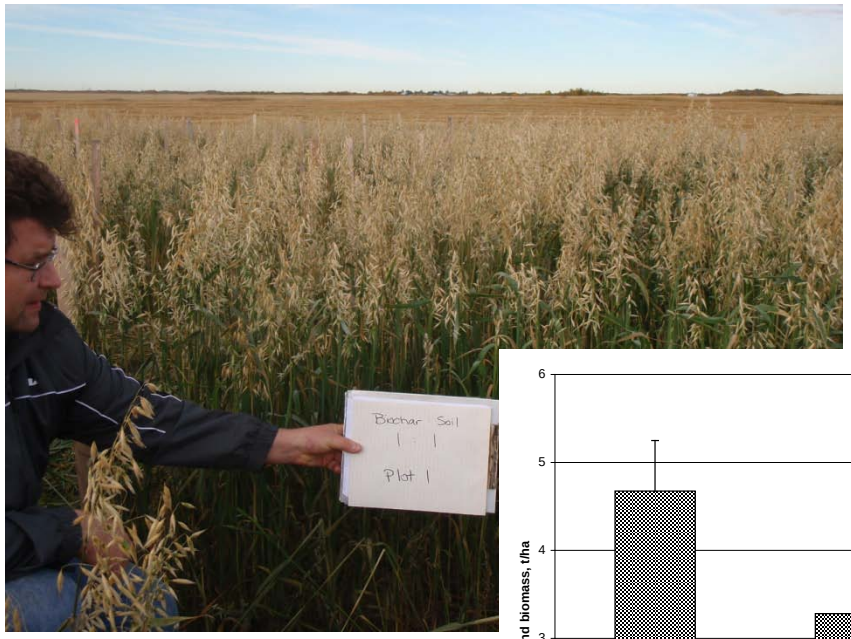
Biochar incorporated at 60 tons/ha

Control (business as usual)

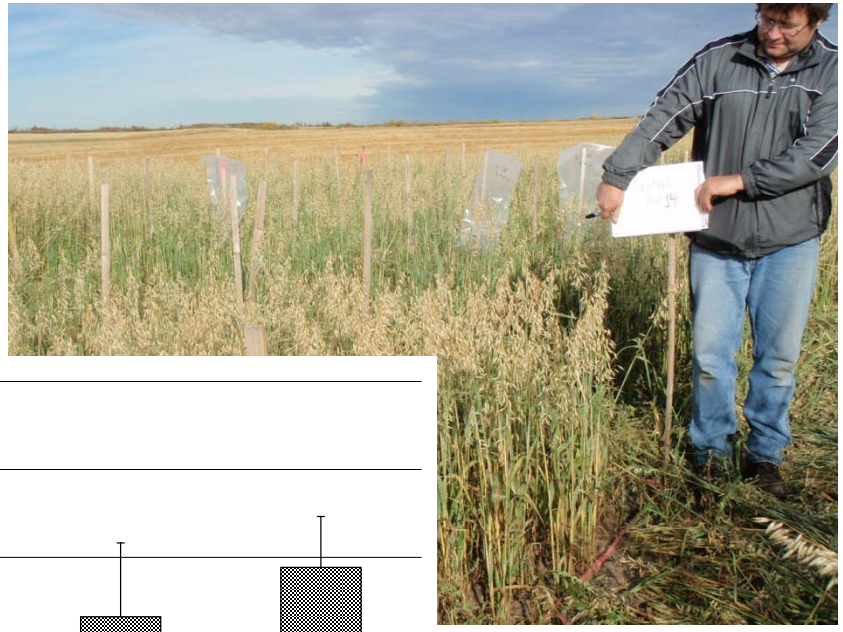
Biochar treatment enhanced oats early vigour despite the unusually wet season in 2010.

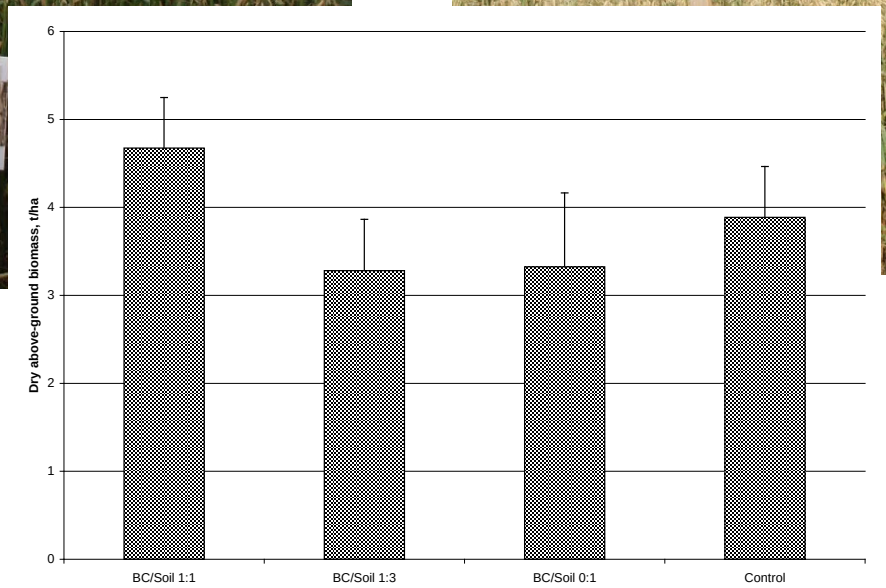
Ameliorative potential of AITF biochar on solonetzic soils in Alberta

Biochar incorporated at 60 tons/ha



Control (business as usual)





Biochar for soil remediation and carbon storage – *Land reclamation*

Biochar for Well site reclamation and remediation

Over 10,000 per year wells (~ 1 Ha/well) have been drilled in Alberta in the past 15 years. These together create an extremely large cumulative area requiring reclamation.

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Biochar - *Other potential areas of use in Alberta*

- **Peatmoss replacement:** *Engineering and blending of biochar as an alternative to peatmoss as a growing medium in horticulture need to investigated*
- **Hydroponics use:** *On-going trials in Alberta?*
- **Landscaping:** *Potential for this needs to be investigated*
- **Green-roofs:** *On-going trials in Alberta?*
- **Golf-turf:** *On-going trials in Alberta?*

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Biochar – Other issues to consider in Alberta

- **Production technology** – scale up, design of mobile, modular pyrolysers for on-farm biochar production.
- **Feedstock delivery and Biochar distribution** - mobile biochar carbonizers essential to minimize transportation of biomass and biochar
- **Biochar application** - modification of farm equipment for soil application of biochar as needed
- **Economics** cost benefits analysis of biochar use
- **Government Policies -** regulations, guidelines and possible incentives are needed to develop and deploy Biochar in AB

Thank you!

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