Manure Management Benefits of Poultry Litter Pyrolysis in the Fraser Valley

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Outline

• Fraser Valley Nutrient Surplus
• Pyrolysis Overview
• Poultry Litter Pyrolysis
• Current Research
• Conclusion
Fraser Valley Nutrient Surplus

• High Manure Production in FV

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Manure Production (m³/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy</td>
<td>1,617,070</td>
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<tr>
<td>Poultry</td>
<td>739,670</td>
</tr>
<tr>
<td>Hog</td>
<td>187,870</td>
</tr>
<tr>
<td>Horse</td>
<td>174,750</td>
</tr>
<tr>
<td>Beef</td>
<td>95,364</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,814,724</strong></td>
</tr>
</tbody>
</table>

• Roughly 500,000 m³ of Poultry Litter (PL) is produced per year

• Innovative technologies/strategies can help ensure this resource is utilized as effectively as possible
Fraser Valley Nutrient Surplus

• Decreasing and limited land base
  – Loss of ALR land
  – Cropping changes to crops that use less manure (e.g. blueberries)
Fraser Valley Nutrient Surplus

• FV nutrient excesses estimates
  – ~ 12,309 tonnes of N; 4, 437 tonnes of P; 9161 tonne of K per year

• Estimates for P reflect FV soil nutrient studies
  – 2005, 80% of fields had high to very high P levels
  – 2012, preliminary results indicate Increase

• Municipal organics diversion from landfills will likely increase nutrient loads
Potential Impact of Nutrient Surplus

• Eutrophication of surface waters

• Groundwater contamination

• Air quality (i.e. Ammonia)

• P buildup in soils over time increase the potential for P loss
Reducing Nutrient Surplus

• Innovative policies, technology and on-farm nutrient management

• Pyrolysis is 1 innovative technology that may help reduce surplus
  – Explored for PL in US (Georgia, Pennsylvania, Delaware, Virginia, etc)
What is Pyrolysis?

• Pyrolysis
  – is a thermochemical decomposition of feedstock at elevated temperatures in the absence of oxygen to make char, biooil and syngas
  – results in significant volume and mass reduction
  – can reduce the risks of nutrient overloads on water quality in Fraser Valley
  – can be done at many different scales
Poultry Litter in Fraser Valley

- Direct Land Application in FV (rates based largely on N crop requirements)
- Exported outside FV (~13-30%)²
- Use a substrate in production of mushroom media (~16%)²
- Poultry litter has potential as a pyrolysis feedstock due to high availability and low pre-processing requirements
Biochar

• 10-30% of yield

• High surface area:
  – Strong water holding capacity
  – Gas adsorption or filtering (i.e. Methane)

• Strong surface charge:
  – Strong nutrient retention and high CEC
  – High Ash content (PL biochar ~ 35% ash)
    • Macro and Micro Nutrient

• High Energy Content (~ 18 MJ kg\(^{-1}\) HHV)
Bio-oil

• 40-70 % of yield
• Highly viscous
• High Energy Content (~ 28 MJ kg$^{-1}$ HHV)
• Can be burned in industrial burner or converted into diesel like fuel
• Markets need to be developed
Syngas

• 10-25% of yield

• Low Energy Content (~ 8 MJ kg\(^{-1}\) HHV )

• Contains NH\(_3\), CO, VOC, phenols, particulates

• Can be burnt on site to fuel pyrolysis unit
Pyrolysis Products - Potential Markets

• Biochar
  – Soil or greenhouse growing media amendment
  – Soil remediation
  – Compost additive
  – Storm water management
  – Heating (not as suitable for PL due to high ash)

• Bio-oil
  – Fuel applications
  – Chemical synthesis (i.e. Adhesives, resins, etc)
Our Experiment

- Objectives:
  - Characterize biochar derived from 100% PL sourced locally in the Fraser Valley
  - Perform nursery trials with the biochar to explore its potential as an amendment for greenhouse media
# Preliminary Results

## Biochar Characteristics

<table>
<thead>
<tr>
<th>Source</th>
<th>C (%)</th>
<th>H (%)</th>
<th>N (%)</th>
<th>P (%)</th>
<th>K (%)</th>
<th>S (%)</th>
<th>pH</th>
<th>Ash (%)</th>
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</thead>
<tbody>
<tr>
<td>Broiler 1</td>
<td>53.7</td>
<td>2.0</td>
<td>4.1</td>
<td>4.3</td>
<td>5.0</td>
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<td>0.6</td>
<td>10.0</td>
<td>32.3</td>
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<tr>
<td>Average</td>
<td>54.2</td>
<td>2.1</td>
<td>4.5</td>
<td>3.7</td>
<td>4.7</td>
<td>0.8</td>
<td>10.1</td>
<td>34.3</td>
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## Preliminary Results

- Biochar Characteristics Continued...

<table>
<thead>
<tr>
<th>Source</th>
<th>Ca (%)</th>
<th>Mg (%)</th>
<th>Al (%)</th>
<th>Cu (%)</th>
<th>B (%)</th>
<th>Fe (%)</th>
<th>Mn (%)</th>
<th>Na (%)</th>
<th>Zn (%)</th>
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<tbody>
<tr>
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<tr>
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<tr>
<td>Broiler 3</td>
<td>4.1</td>
<td>1.5</td>
<td>.16</td>
<td>.07</td>
<td>.008</td>
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<td>.13</td>
<td>.68</td>
<td>.09</td>
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<tr>
<td>Broiler 4</td>
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<td>1.3</td>
<td>.12</td>
<td>.06</td>
<td>.005</td>
<td>.18</td>
<td>.11</td>
<td>.68</td>
<td>.09</td>
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<tr>
<td><strong>Average</strong></td>
<td><strong>6.2</strong></td>
<td><strong>1.5</strong></td>
<td><strong>0.19</strong></td>
<td><strong>0.08</strong></td>
<td><strong>0.007</strong></td>
<td><strong>0.20</strong></td>
<td><strong>0.13</strong></td>
<td><strong>0.70</strong></td>
<td><strong>0.10</strong></td>
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</table>
Nursery Trials

• Trials with 2 flower annuals (snapdragon & angelonias)

• 2 treatments: biochar proportion (%) and fertilizer use

• Measure the effect on water holding capacity and plant growth
Conclusion

• PL pyrolysis can significantly reduce nutrient surplus if biochar is diverted off of agricultural fields

• More research is required to evaluate local market value of PL biochar and bio-oil

• Tipping fees for raw poultry litter likely required for pyrolysis to be economically viable
References
