

Understanding Feedstock Choice, Pyrolysis Temperature, and Pyrolysis Type When Designing Biochars for Specific Uses

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United States Department of Agriculture
Agricultural Research Service

Factors Influencing Biochar Composition

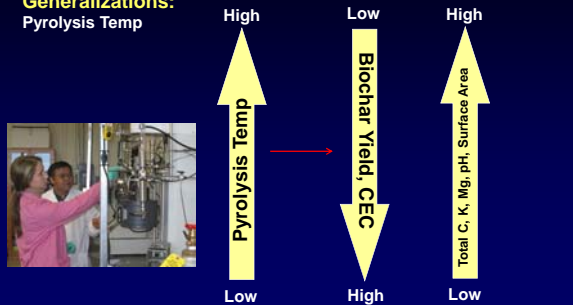
- Feedstock choice:
 - corn, wheat, barley and rice straw, switchgrass, peanut, pecan, and hazelnut shells, sugarcane bagasse, coconut coir, food waste, hardwood and softwood species (ex., PJ), poultry and turkey litter, swine, dairy, and cattle manure, and biosolids
- Pyrolysis Temperature:
 - <300 °C to >800 °C
- Pyrolysis Type:
 - Fast (flash) or slow



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Factors Influencing Biochar Composition

Generalizations:
Pyrolysis Temp



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Factors Influencing Biochar Composition

Generalizations: Pyrolysis Type



Fast
Pyrolysis type
Slow

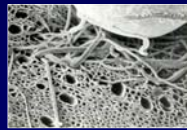
Low
Total N, S, surface area
High

Low
Available P, Ca, Mg, CEC
High

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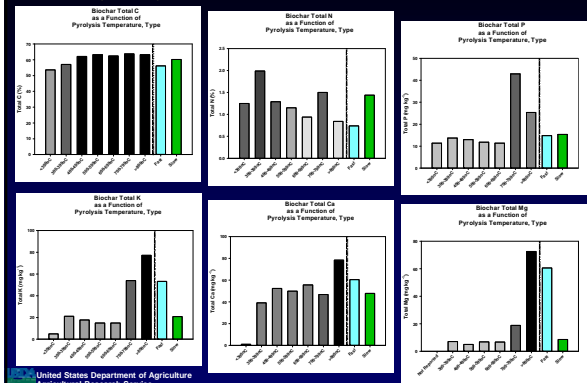
Biochar Type, Pyrolysis Temperature/Type

- Total and available nutrients
- pH
- Potential liming value
- CEC, CCE
- Nutrient sorption and entrapment

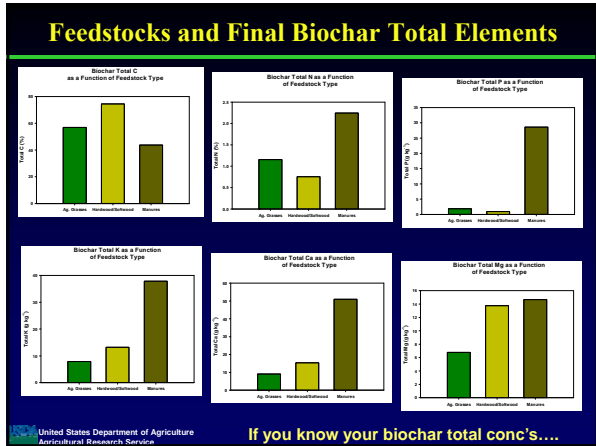


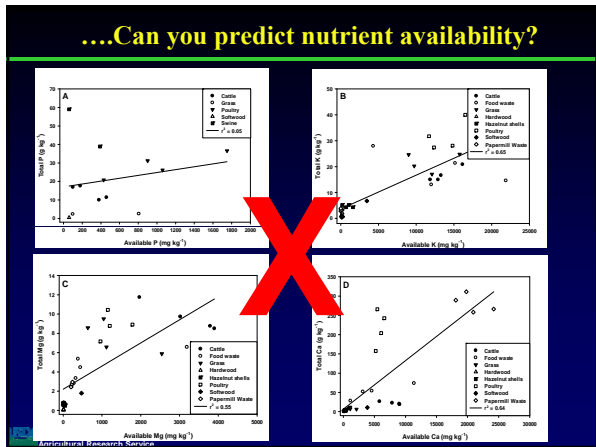
Biochar Total Elements: Pyrolysis Temp and Type

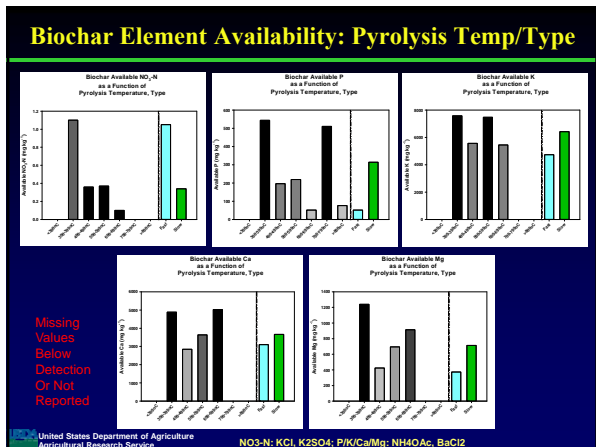
Total C&N: CN Analyzer, Walkley-Black, TKN; Totals: [HNO₃], [HNO₃]+30%H₂O₂, [HNO₃]+[HClO₄], [HClO₄]

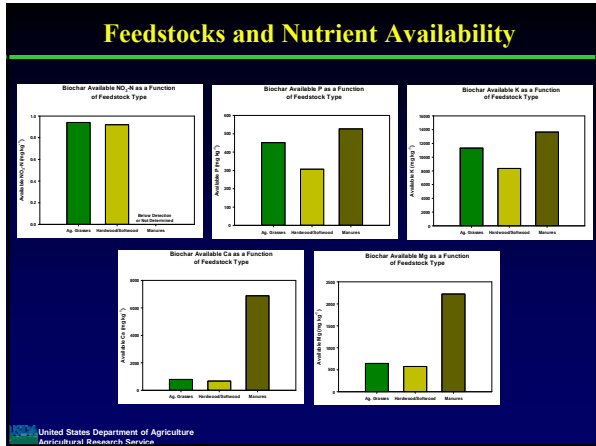


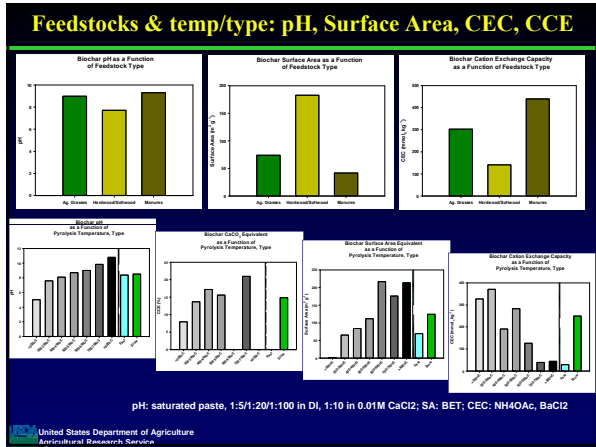
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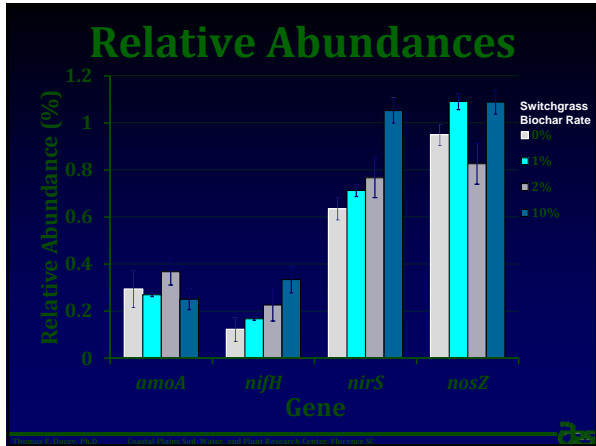








Nutrient Sorption/Entrapment

- Focus has mainly been on NO₃-N
 - Entrapment:
 - Mass flow moving NO₃-N into pores
 - Anion Exchange:
 - Pyrolysis temperatures exceeding 700°C
 - Base functional group formation



Future Research Paths

- Value-added biochar products
 - e.g., co-composting with manure
- Develop designer biochars & biochar-based fertilizers
 - enhance soil fertility, improve soil moisture retention, and reduce soil GHG emissions
- In-field trials
 - Specialty/cash crops, mine land reclamation
- Joint ARS-European research group











Control
(26 bu/ac)

Biochar Treated
(67 bu/ac)

Thank You

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