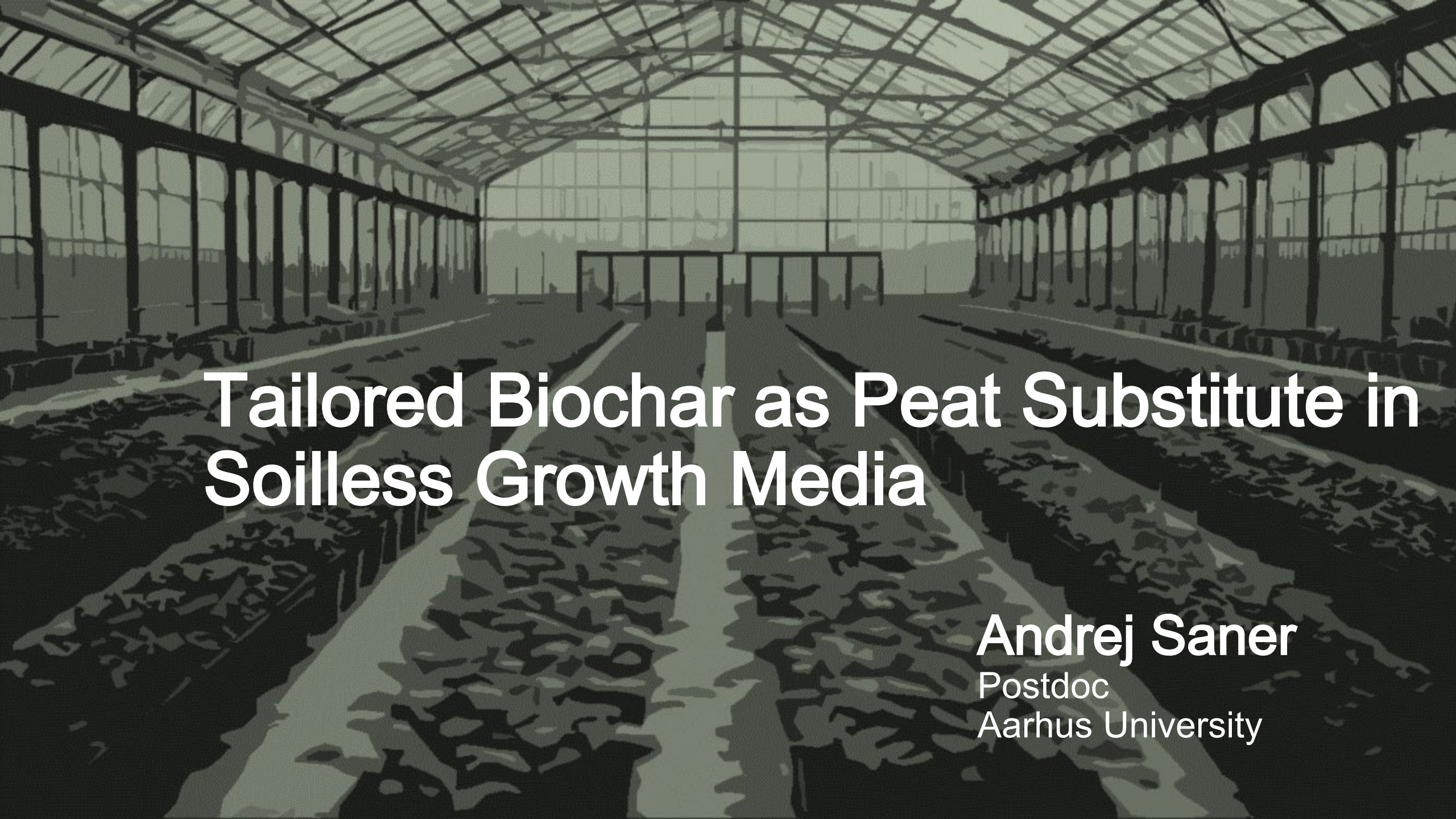

Tailored Biochar as Peat Substitute in Soilless Growth Media

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Overview

- Peat in Growth Media
- Biochar in Growth Media
- Methodology of Research
- Results
- Conclusions

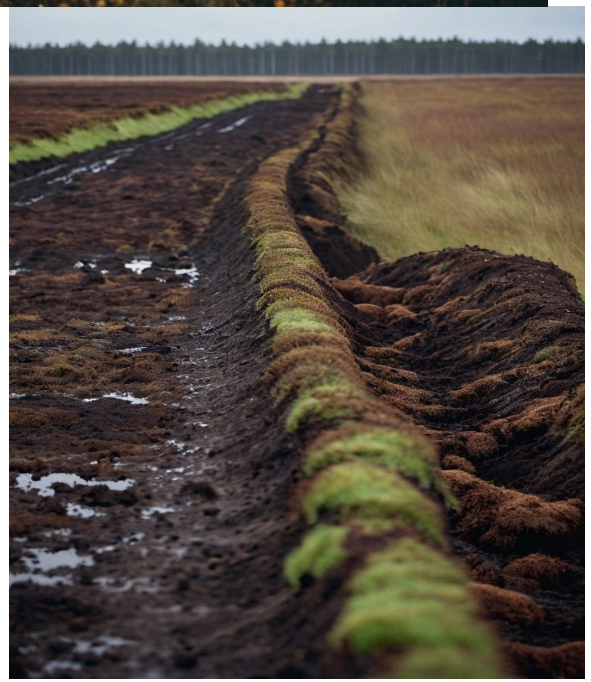
Optimal Growth Media for Plants

- Stability and aeration
- Water and nutrient retention
- Sterility
- Optimal pH (**5.5 – 6.5**) – affects nutrient availability
- Low bulk density

"Images generated by AI using Stable Diffusion"

Peat in Growth Media

- Stable and sterile environment ☑
- Low bulk density and high porosity (aeration) ☑
- Good water and nutrient retention ☑
- pH 3.5 – 5.5 ☒ ⟶ Lime addition (e.g. $CaCO_3$) ☑
- Natural peatlands – Carbon sinks ↓
- Peat mines – GHGs emitters ↑



"Images generated by AI using Stable Diffusion"

Peat Substitutes

- Coconut Coir
- Compost
- Wood

  Fibre / Chips / Bark / Sawdust
- Rice Hulls
- Biochar

"Images generated by AI using Stable Diffusion"

Biochar as Substitute for Peat

- Stable and sterile ☑
- Low bulk density and high porosity (aeration) ☑
- Good water and nutrient retention ☑
- In permanent cultures acting as Carbon sink ☑

- Mostly alkaline (> pH 8) ☒
  - Caused by high inorganics content
  - Post-treatment rather difficult

"Image generated by AI using Stable Diffusion"

Biomass pre-treatment

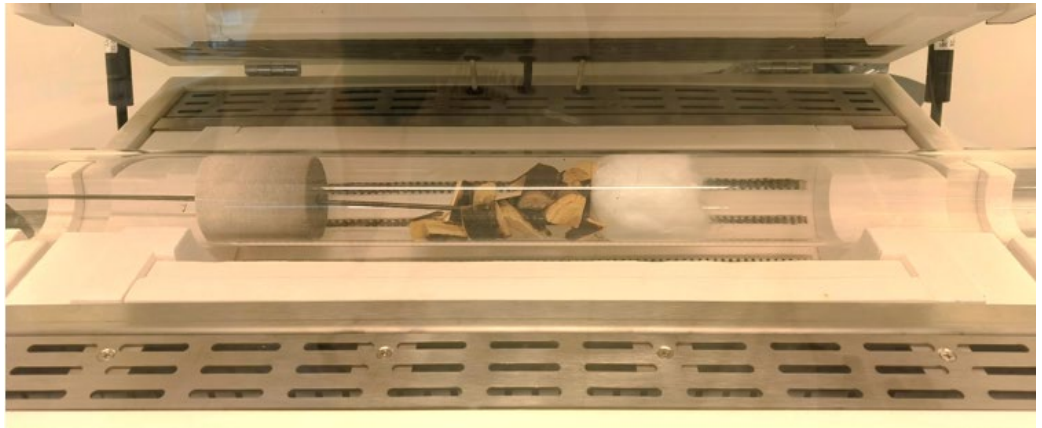
- Inorganics removal prior to pyrolysis via acid washing
- No need to wash the acid out of the feedstock
  - Lower waste-water production
- Residual acids will largely boil off during the pyrolysis
  - Acetic acid boiling point 118 °C
  - Sulfuric acid boiling point 337 °C

"Images generated by AI using Stable Diffusion"

Methodology

- Biomass – Willow branches cut in early spring
  - Coarse (2-3 cm) and Fine (0.5-1 cm) fractions
- Prewashing (soaked for 2-4 hours at 1:10 m:V ratio):
  - Unwashed
  - Water
  - Water -> acetic acid (0.2 M)
  - Water -> sulfuric acid (0.2 M)
- Pyrolysis : 300 – 600 °C with 30 min. residence time

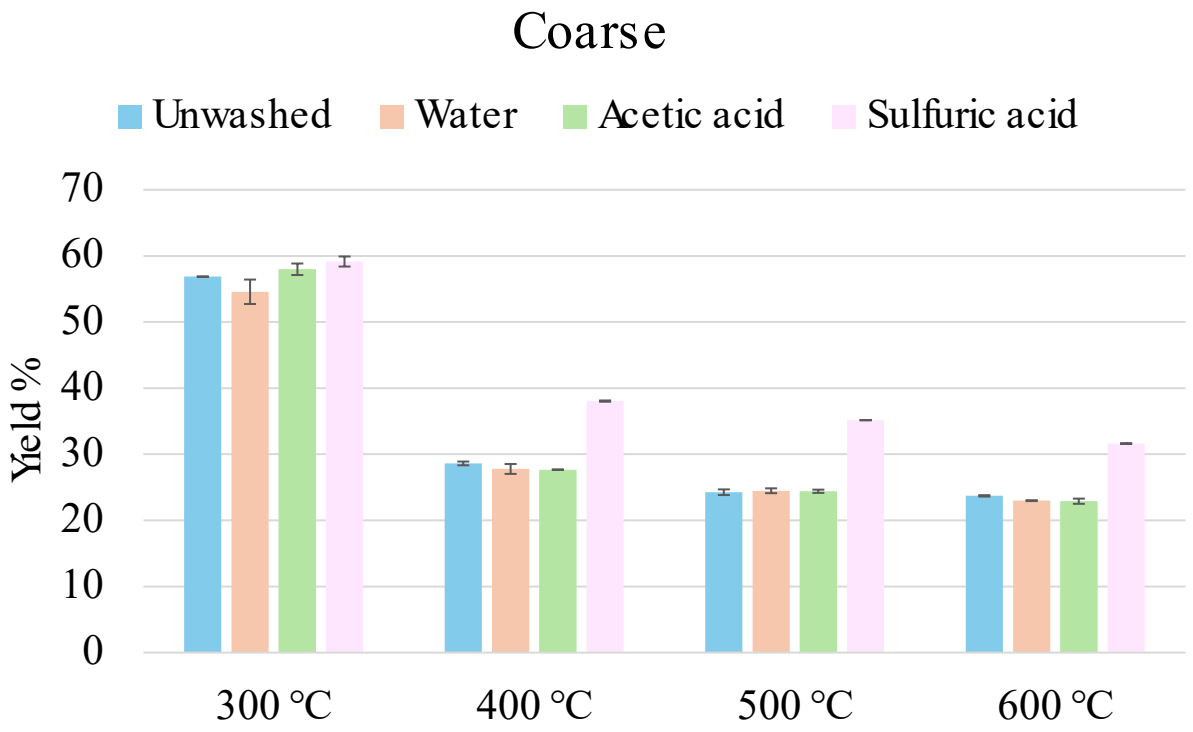
"Image generated by AI using Stable Diffusion"

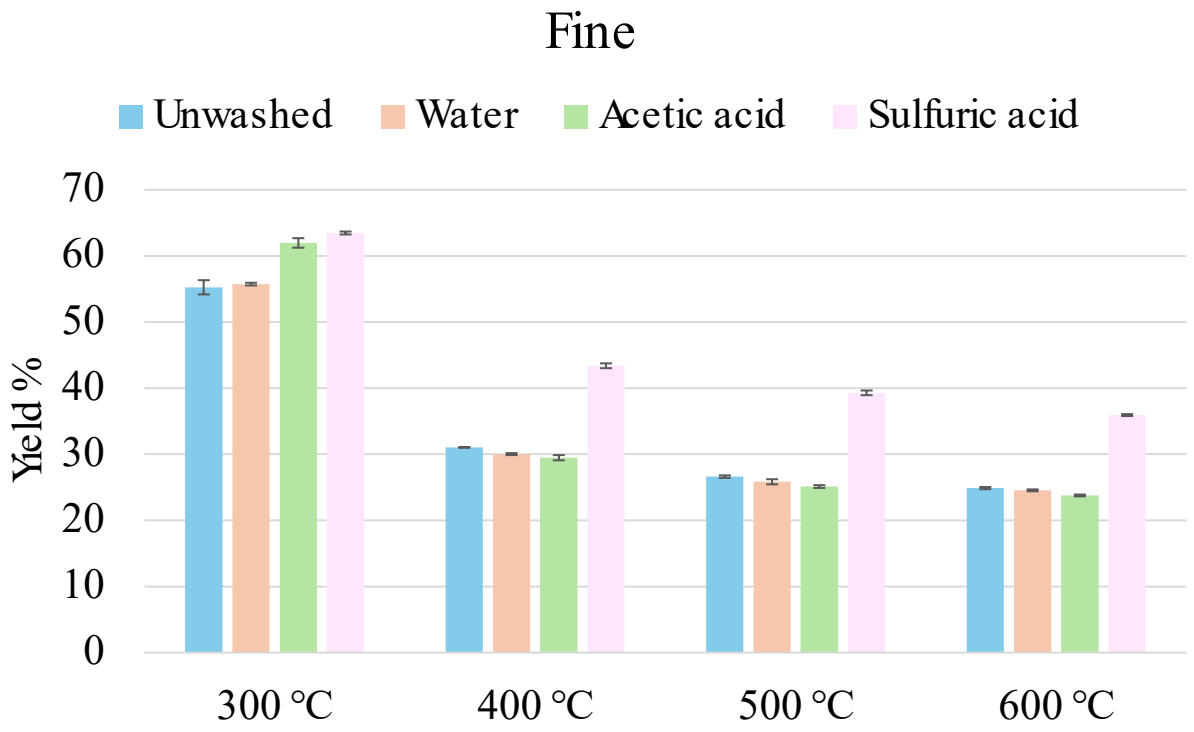


Effect of Sulfuric Acid

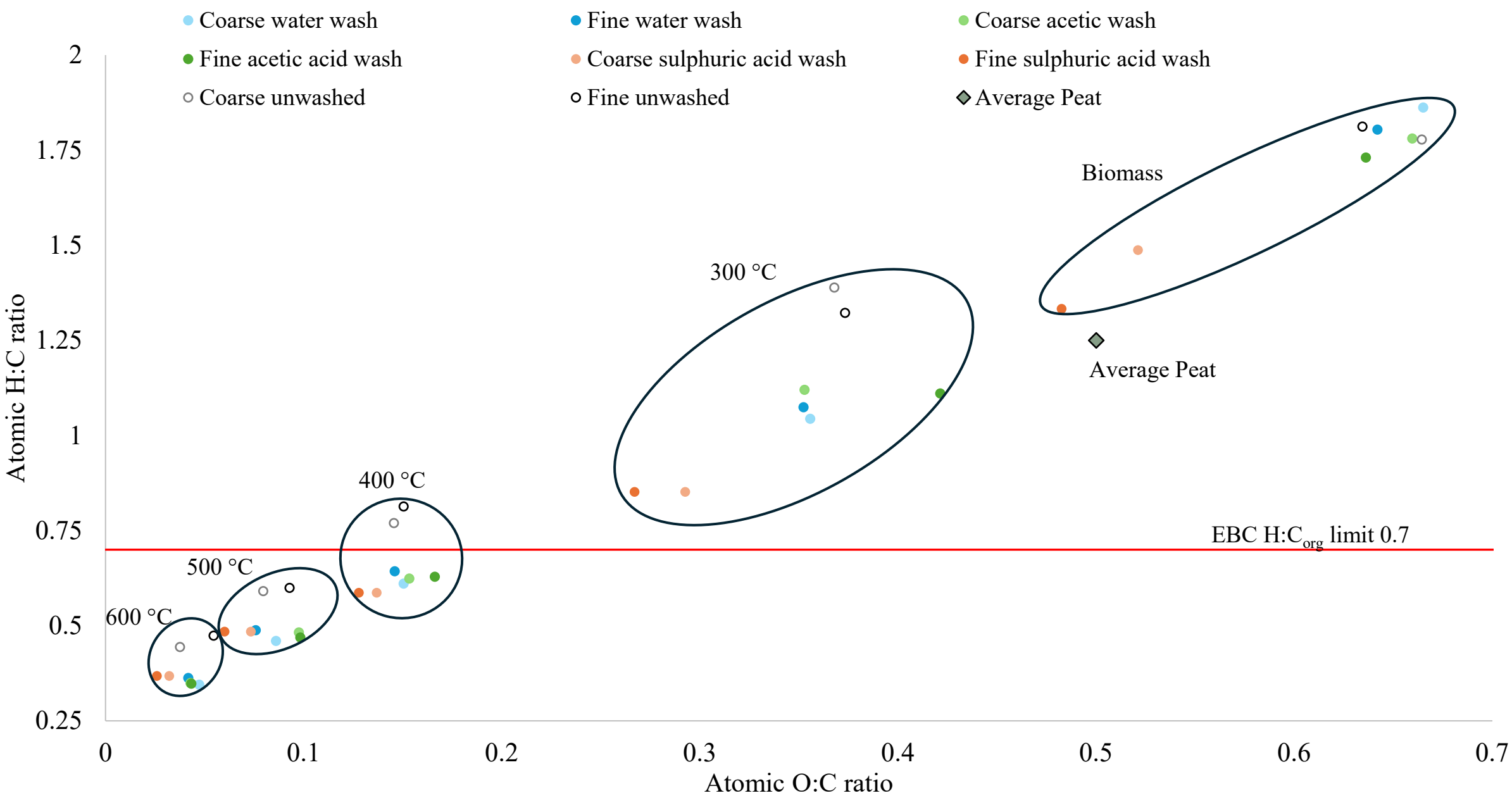
Drying at 105 °C

Biochar Yields

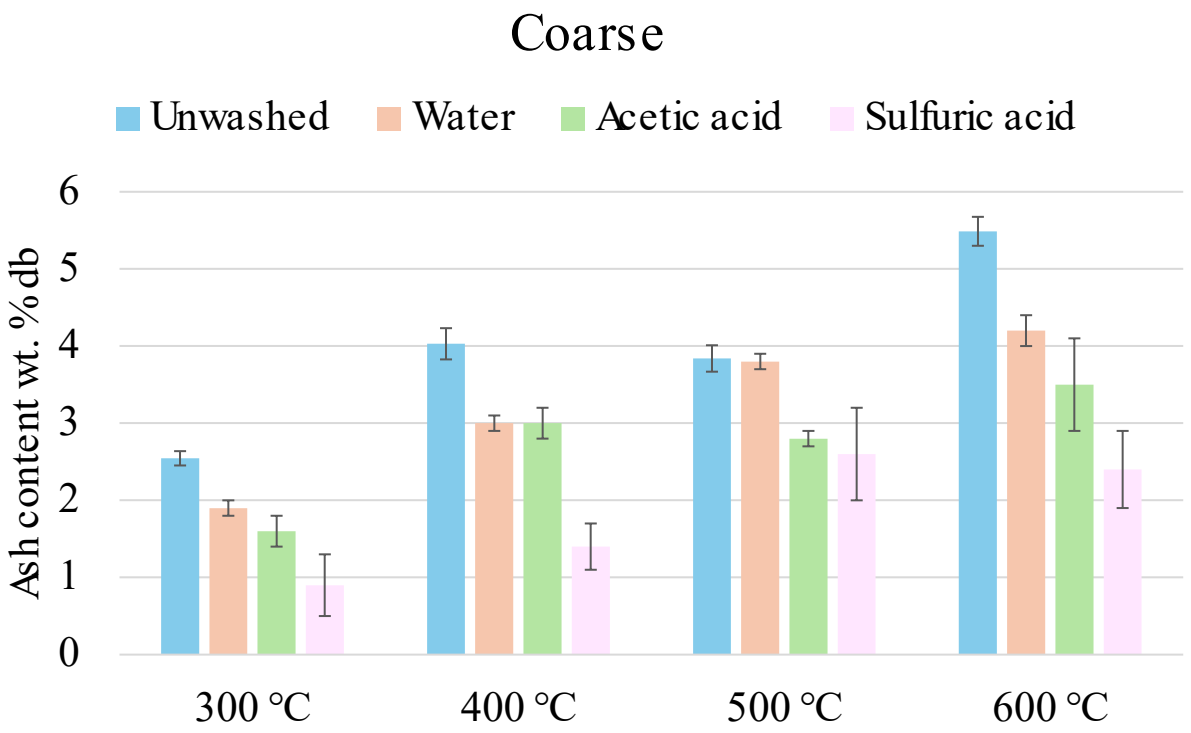


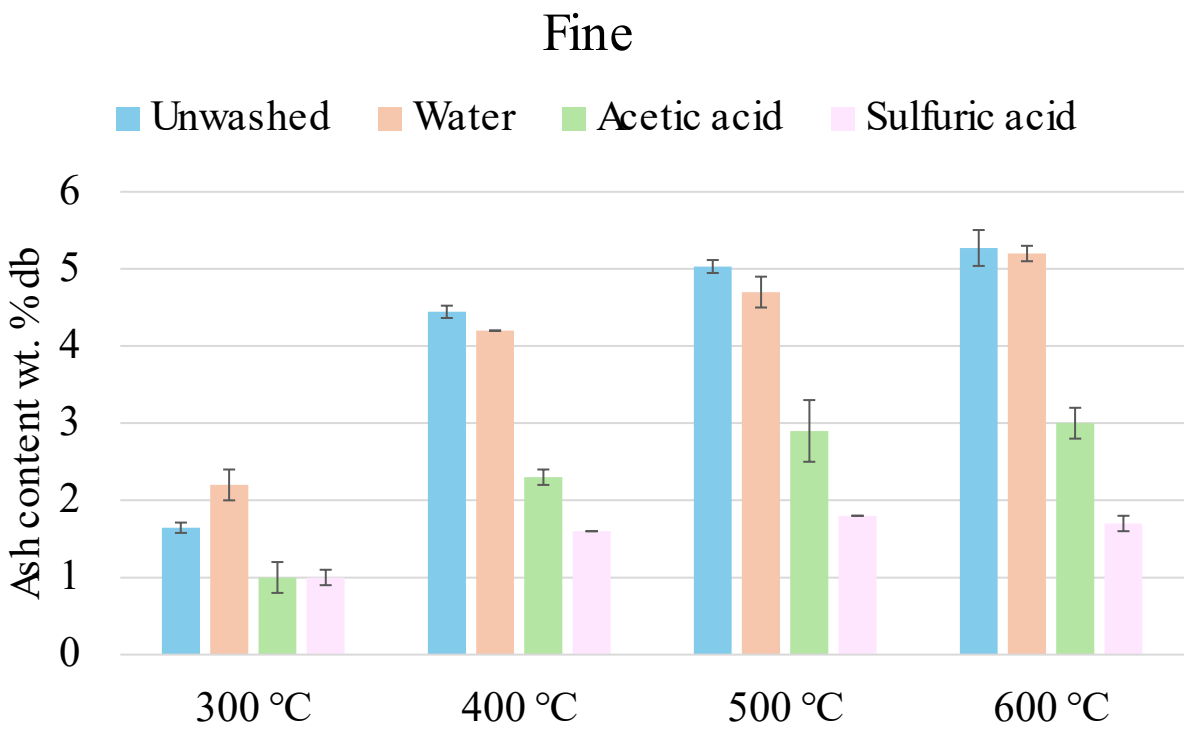


Van Krevelen Diagram

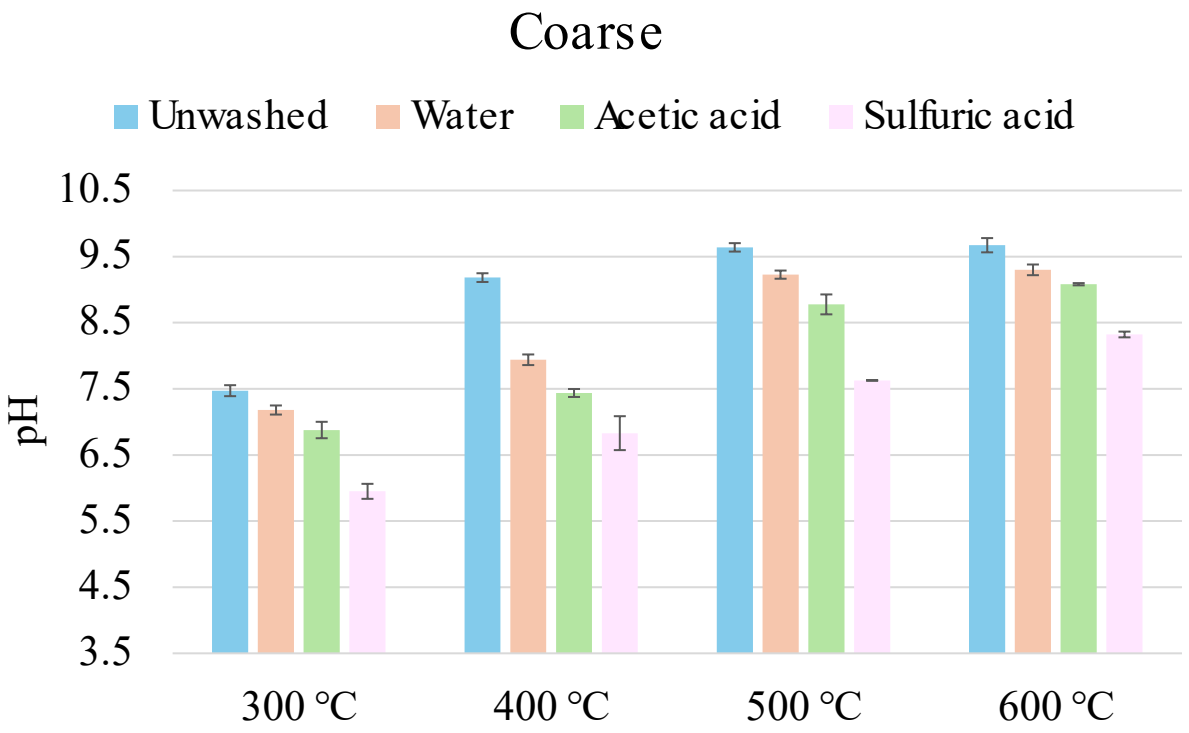


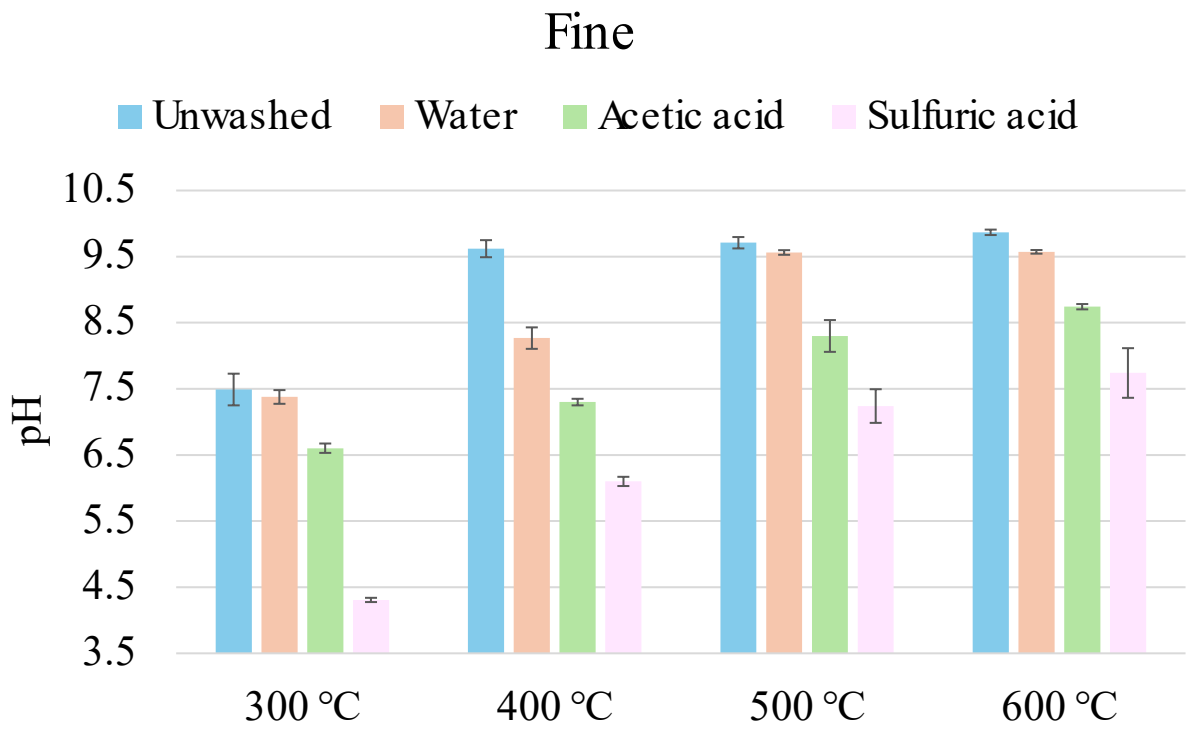
Ash Content


Coarse
Unwashed
Water
Acetic acid
Sulfuric acid
Ash content wt. % db
0
1
2
3
4
5
6
300 °C
400 °C
500 °C
600 °C


Fine
Unwashed
Water
Acetic acid
Sulfuric acid
Ash content wt. % db
0
1
2
3
4
5
6
300 °C
400 °C
500 °C
600 °C

pH


Coarse
Unwashed
Water
Acetic acid
Sulfuric acid
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5
pH
300 °C
400 °C
500 °C
600 °C


Fine
Unwashed
Water
Acetic acid
Sulfuric acid
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5
pH
300 °C
400 °C
500 °C
600 °C

Conclusions

- Biomass pre-treatment was effective.
- Significant removal of inorganics via acid pre-treatment.
- Particle size did influence inorganics removal and the final pH.
- A combination of sulfuric acid pre-wash and 400 °C pyrolysis can produce stable biochar with pH below 6.5.

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GUDP

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