Proton Power

Hybrid Cottonwood Poplar

&

pro C (6, 12.011)

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Overview

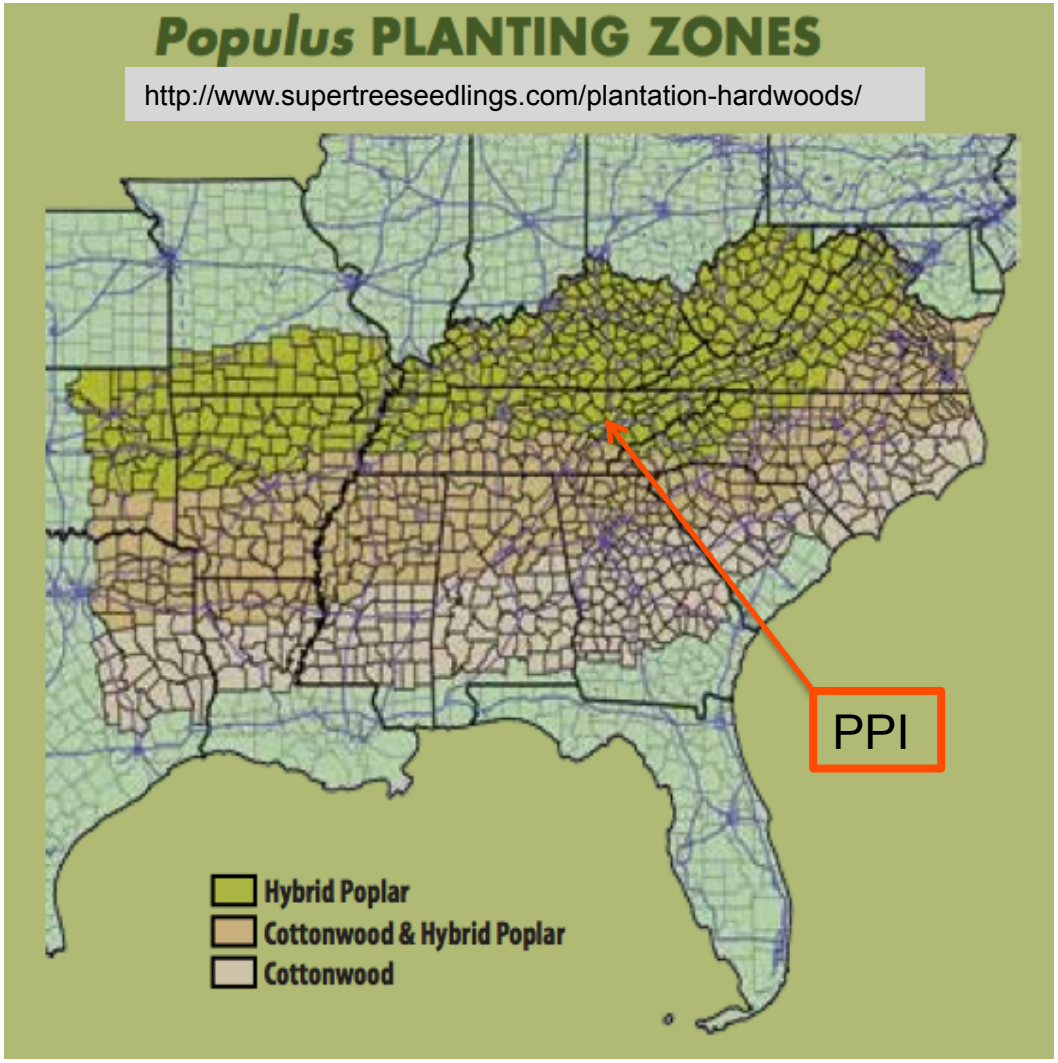
- Mission Statement
- Site Layout
- Species Overview
- Procedure Description
- Initial Results
- Discussion & Cause
- Future Implications

Mission Statement

- To evaluate the efficacy of pro C related to tree plantation operation
- To plant a native species that is recognized as an important woody biomass feedstock by the US Dept. of Energy
- To get hands on experience with land application of pro C
- To compare different application rates of pro C
- To estimate the broader impact of pro C application

Species Selection

- Purpose grown *Populus* plantations are quite common
- The US DOE has recognized *Populus* as an "important woody biomass feedstock."
- *Populus* offers high productivity on short rotations with the ability to coppice.
- Used principally for lumber, veneer, pulpwood, excelsior & fuel
- 3-5 year rotation typically produces 14-18 green tons/acre/year
- **<u>Cottonwood & Hybrid Poplar</u>** selected



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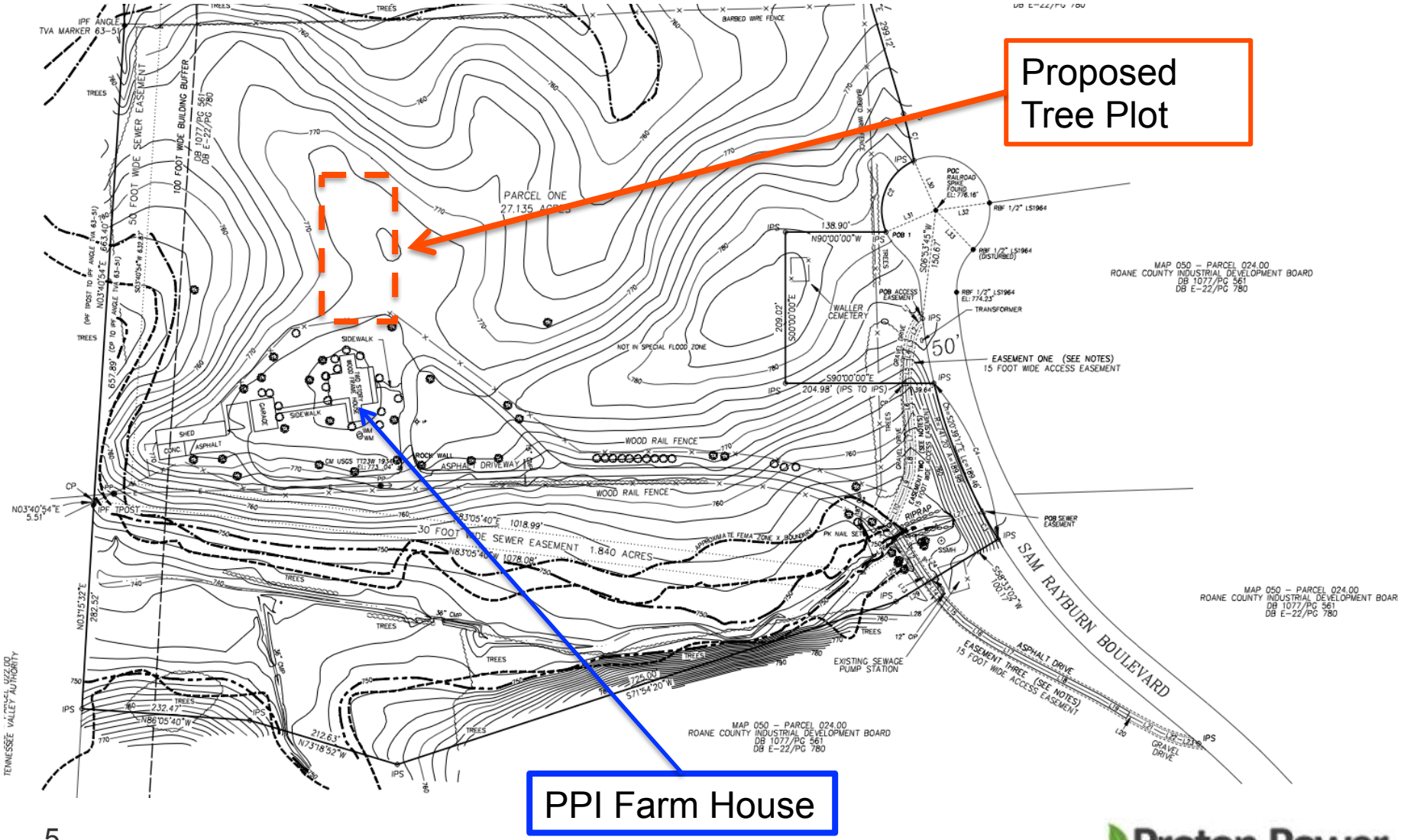
Proton Power "Farm" Site Overview



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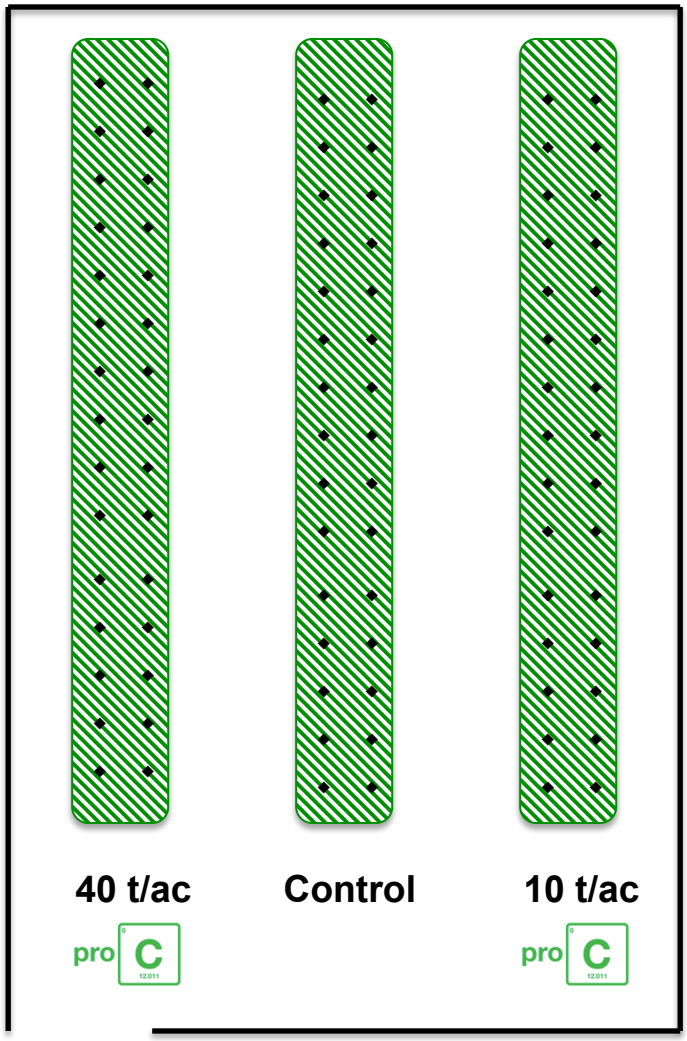
Plot Diagram

- 3 plots planted, 2 with pro C
- Planted 2 rows of 30 trees in each plot (60 trees x 3 plots = 180 total)
- Spacing
  - Trees = 3 ft
  - Rows = 2.5 ft
  - Plots = 8 ft
- Application rates of 40, 10 & 0 tons/ acre
  - i.e. →(40t/ac)(ac/43,560sq.ft)(600sq.ft/plot) (2000lbs/t)=1102lbs/plot of pro C @ 6%Mwb



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Application Method

- We first weighed the appropriate amount of pro C for each plot
- The material was added to the top profile of each plot strip ("top dressed")
- The pro C was incorporated into the soil using a rotary disc tiller to maximum depth of 6 inches
- The control plot was also tilled in the same fashion even though no material was added
- Planted March 7, 2014

July 2014

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August 2014

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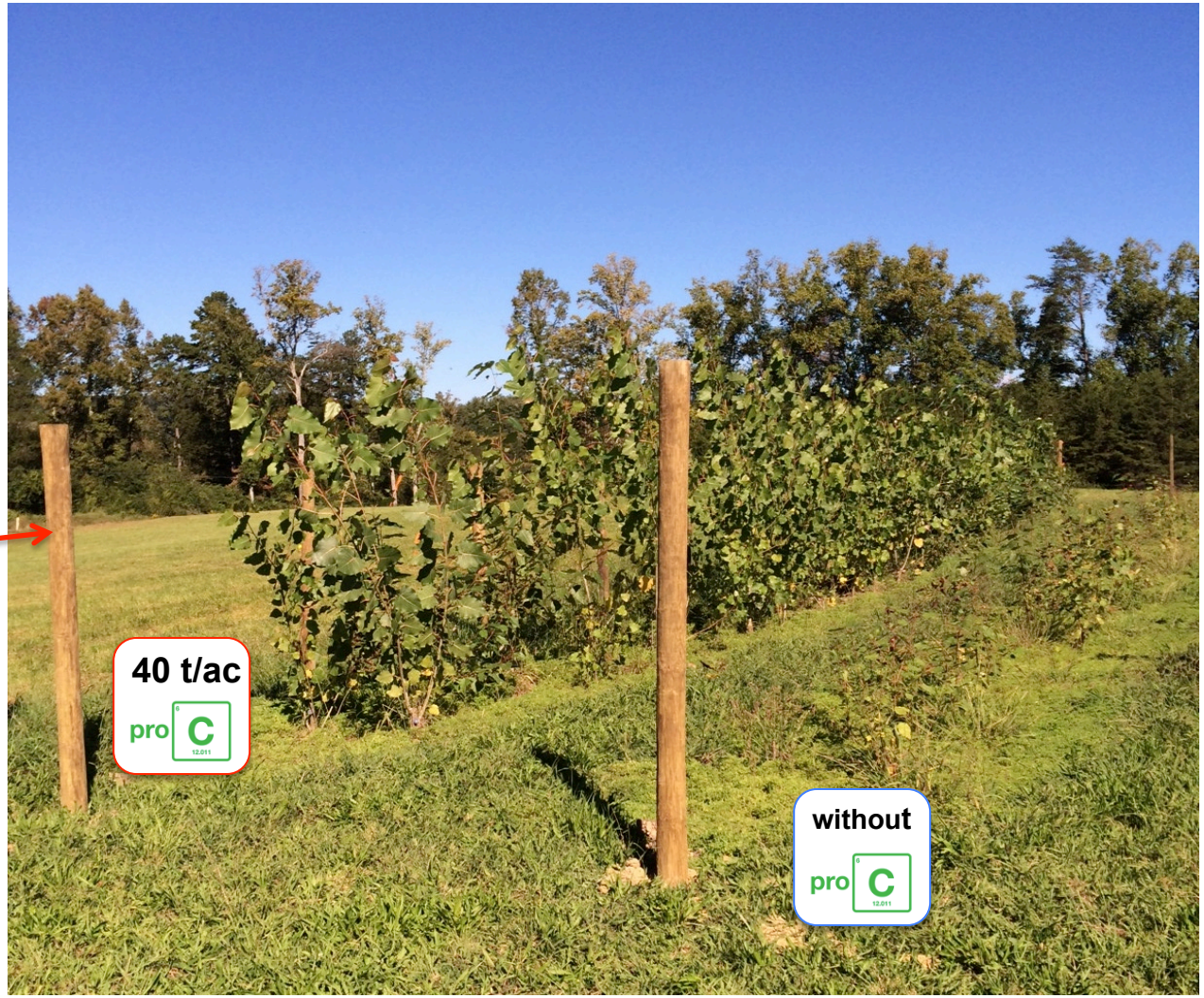
September 2014

These post are 6.5 feet tall



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October 2014

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November 2014

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Tree Growth - Height & Base Diameter

	Cottonwood Average Height					
	w/o Pro-C		10 t/ac		40 t/ac	
	Inches	Feet	Inches	Feet	Inches	Feet
Mean	26.78	2.23	63.42	5.29	76.24	6.35
Stdev	12.45	1.04	23.28	1.94	21.26	1.77

	Cottonwood Average Diameter		
	w/o Pro-C	10 t/ac	40 t/ac
	Inches	Inches	Inches
Mean	0.57	0.80	0.99
Stdev	0.22	0.27	0.28

Cottonwood Mortality		
w/o Pro-C	10 t/ac	40 t/ac
8	**7**	**4**

- 49.5 inches greater height
- 0.42 inches greater diameter
- Half the initial mortality
- Data from *9-5-14

40 t/ac pro C

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How Can we explain these results?

- What we already know
  - pro C is very hydrophilic
  - pro C has a water holding capacity between 175-200 gal/ton
  - pro C has an industry high carbon content
  - pro C has a high pH but is not an effective liming agent
- Auburn University ruled out the possibility of the improved yield being a result of a pH change (soil pH for all three plots between 6.3-7.1)
- Auburn University compared the stem sizes of the three plots & found stem volume of the 10 t/ac & 40 t/ac to be 5 & 9 times the stem volume of the control respectively
  - Differences in stem volume can be used as an indication of relative difference in weight of biomass between the three test plots

Soil Food Web Analysis

Proton Power Cottonwood Poplar Tree Planting - Soil Analysis

pro C	Density	Total Bacteria	Total Fungi	Total Fungi/Total Bacteria	Nematodes	Flagellates	Amoebae	Ciliates	Nitrogen Cycling Potential
Plot	g/cc	µg/g	µg/g	ratio	#/g	#/g	#/g	#/g	(lbs/ac)
Control	0.82	1753	829	0.47	4.78	701	16906	56	75-100
10 t/ac	0.78	1551	651	0.42	2.32	2744	35456	362	100-150
40 t/ac	0.72	442	770	1.74	9.49	3851	38503	38	100-150

- Density improvement was seen on both pro C tree plots
- The **nitrogen cycling potential was increased** by adding pro C
- The 40 t/ac plot has a correctly balanced fungal & bacterial population
- Bacterial feeding Nematodes were doubled within the 40 t/ac plot
- 27% of the bacteria population in the 40 t/ac plot were active bacteria resulting in ***excellent*** bacterial activity
- The response in the 10 t/ac plot was most likely a result of the improved water holding capacity and the improved Nitrogen Cycling potential although it remains bacterially dominated

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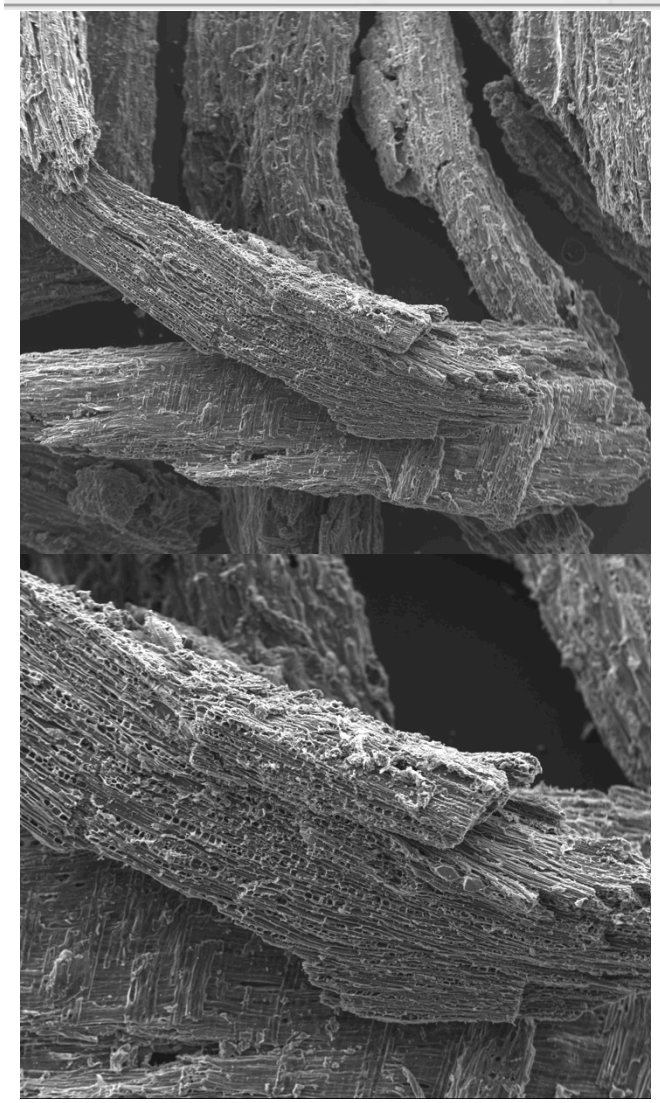
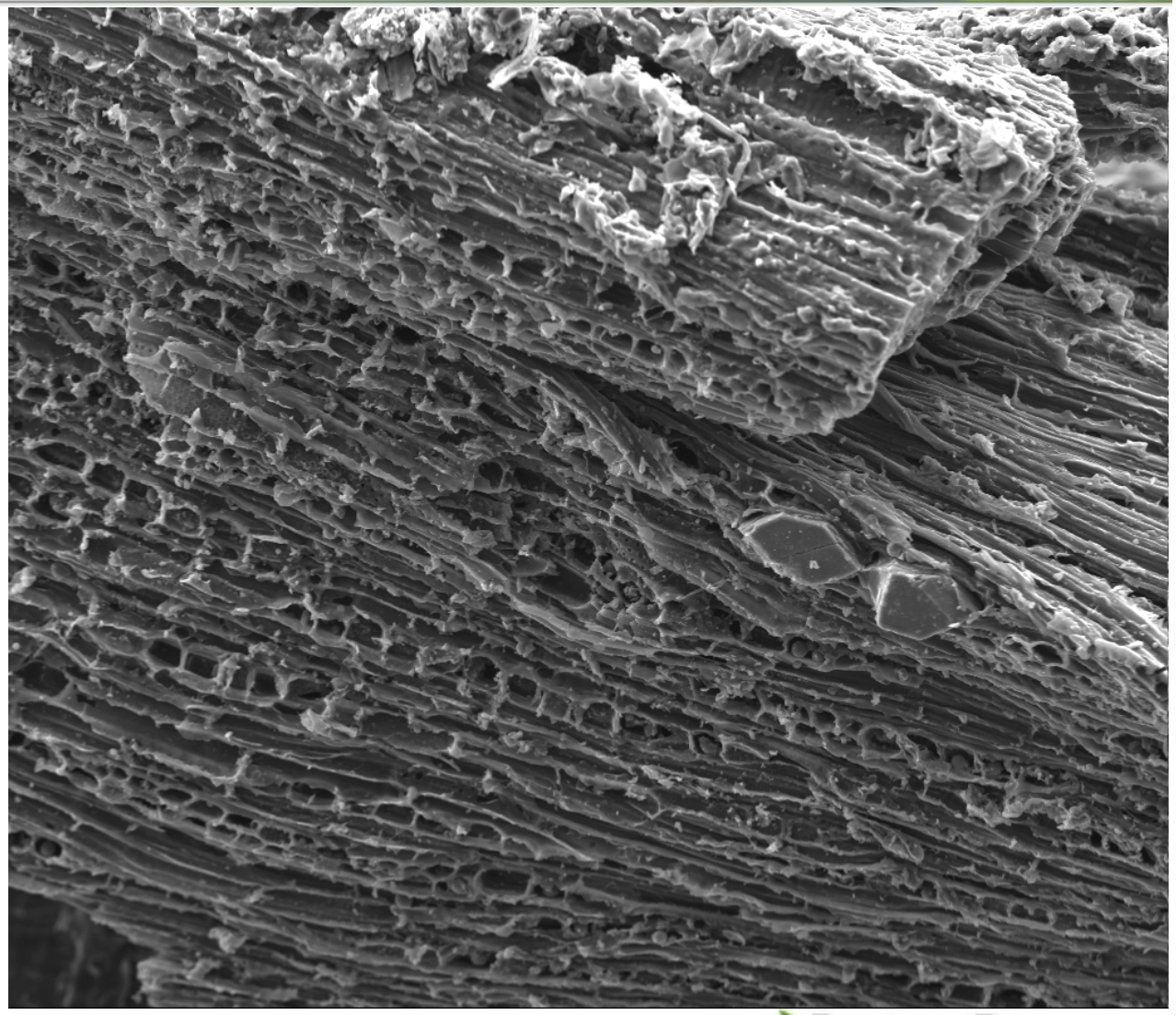
Pro-C Structure – Holds Water & Microbes





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Summary

- pro C can improve the water holding capacity of your soil
- When your soil is lacking microbial diversity pro C can be added to balance your soil food web
- PPI is working to improve the shipping density of pro C which would make large application rates more feasible
- PPI will continue to monitor this tree stand
- We plan for our next research projects to be more scientific/ academic in terms of data collection & plot design
- pro C can sequester carbon, improve yields, reduce greenhouse gases, improve soil function, conserve water & reduce nutrient leaching