
Biochar!

OUTLINE

A BIT ABOUT ME

A BIT ABOUT BIOCHAR

A BIT ABOUT BIOCHAR IN SOIL

Photo's courtesy: pxhere.com, and me!

Farm Program
Tilth Alliance

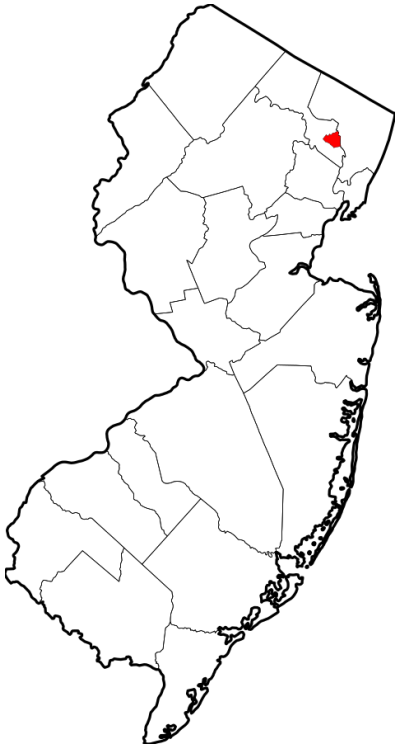
Support farmers in the adoption, implementation and management of organic, regenerative, and sustainable farming practices in Washington State.

About Me

St. Louis, Missouri

BA Communications

What should I do?



Trade School for Golf Course Management

Ph.D. Soil Science (composted biosolids: soil microbiome, nutrient and tissue analysis)


WASHINGTON STATE
UNIVERSITY
COLLEGE OF AGRICULTURAL, HUMAN, AND NATURAL RESOURCE SCIENCES
CSANR
Center for Sustaining Agriculture and Natural Resources

Organic Amendments

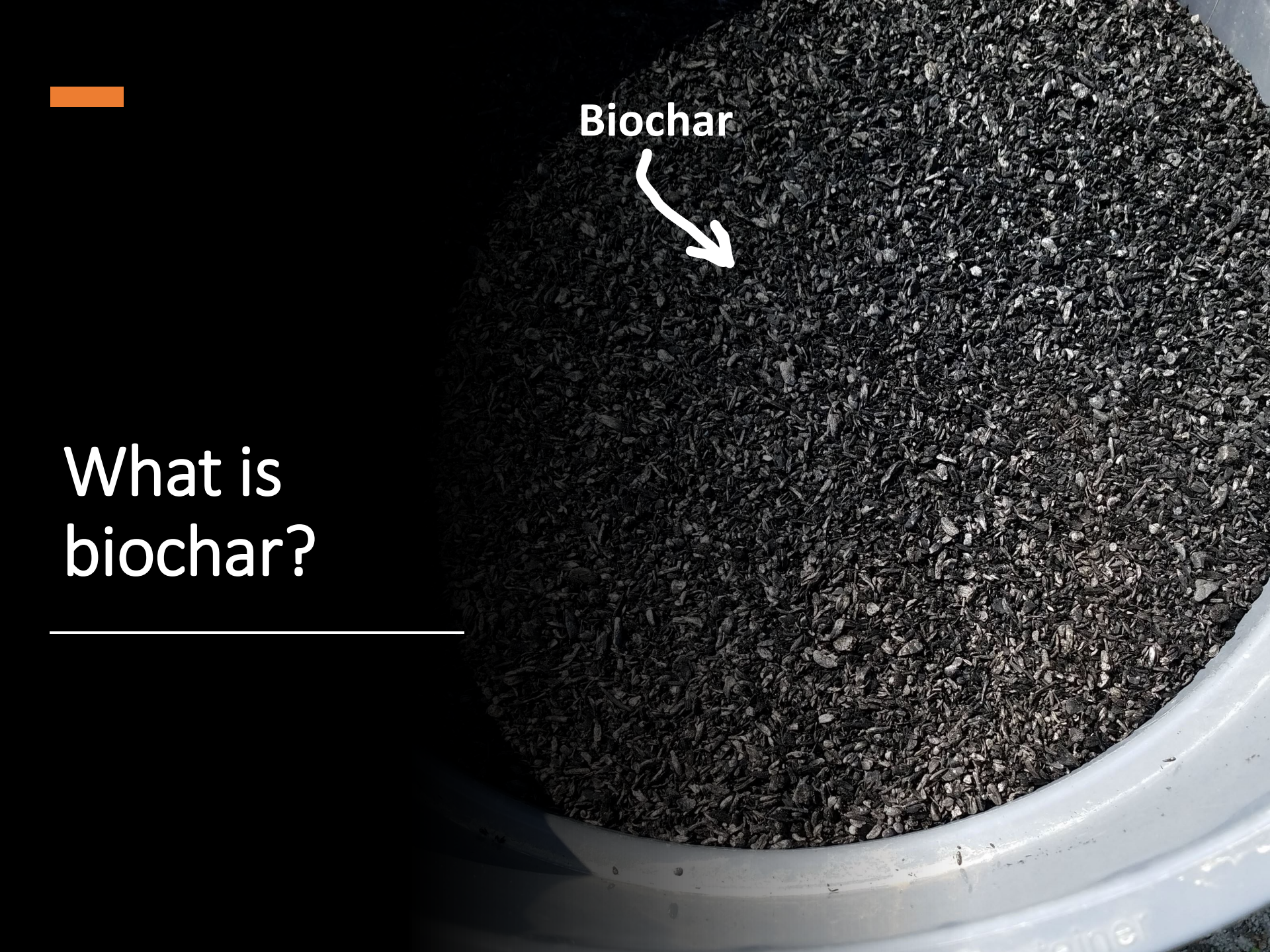
"Investigating the elasticity of biochar"

Composting

"Waste to fuels partnership"

Interlude

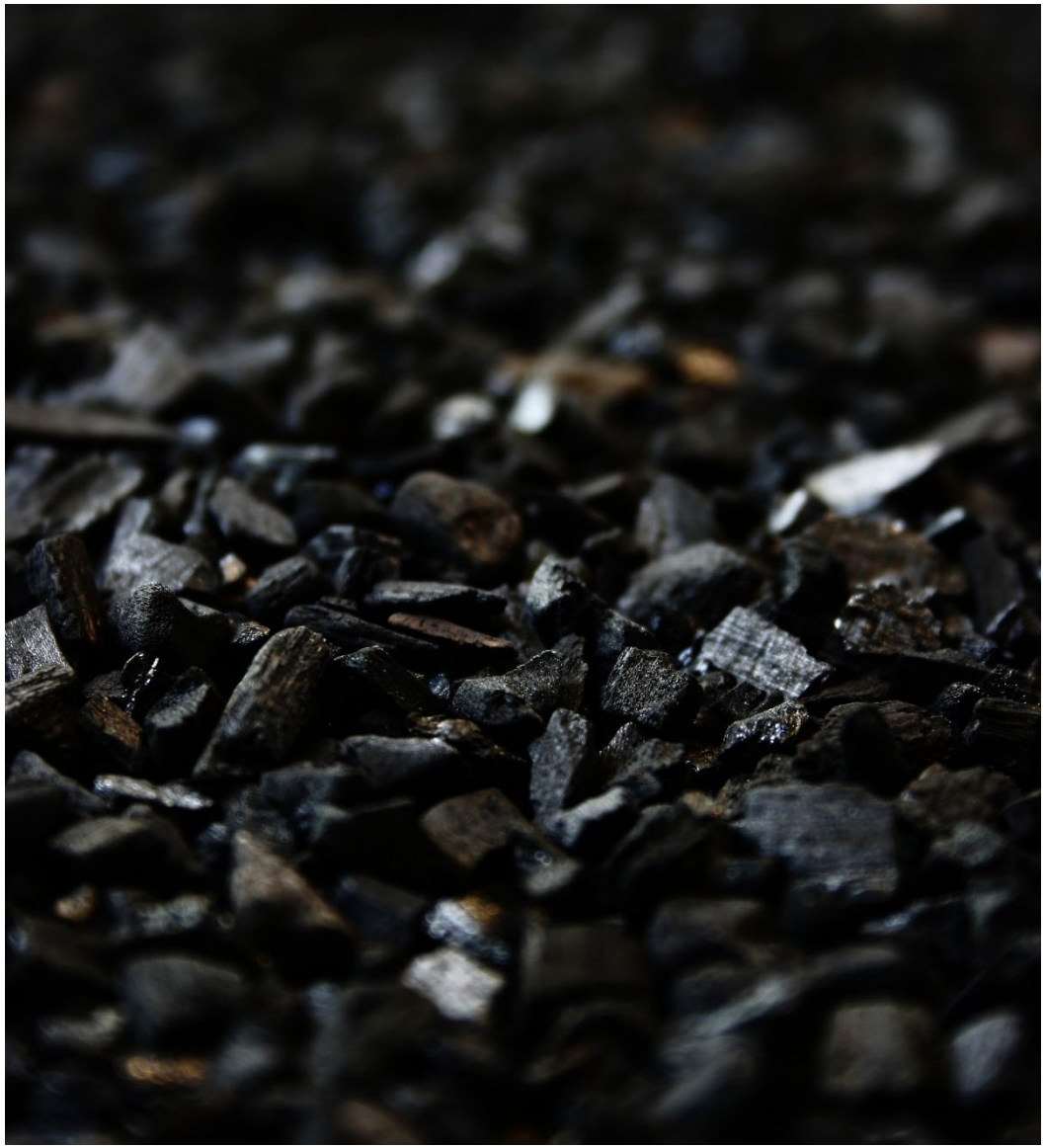
What is biochar?



Calcium
Silicon
Potassium
Aluminum
Magnesium
Iron
Sodium

Biochar is …

- solid, porous, carbon-rich product
- made from biomass such as wood, manure and crop residues
- product of thermochemical conversion under oxygen limited conditions



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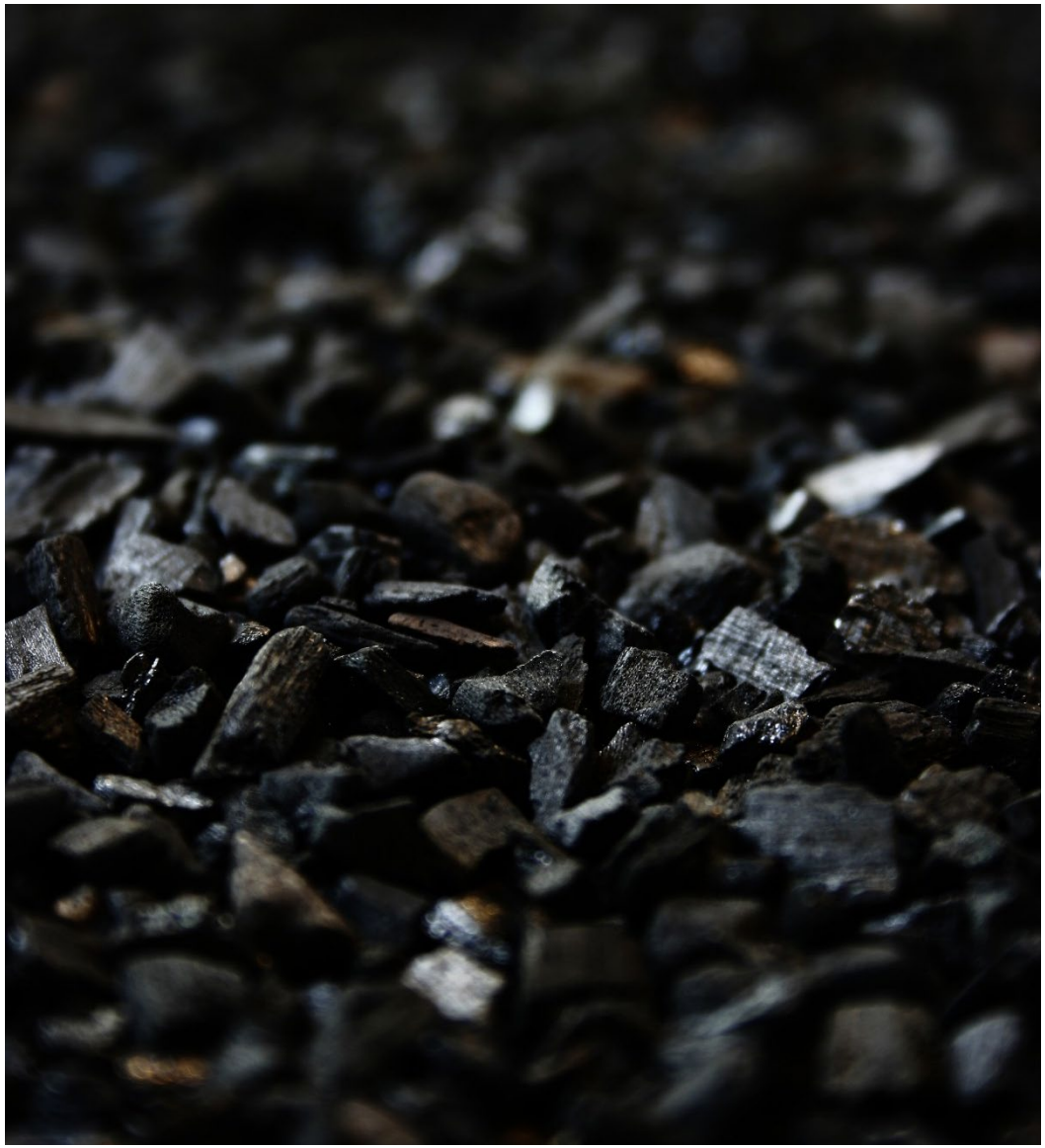


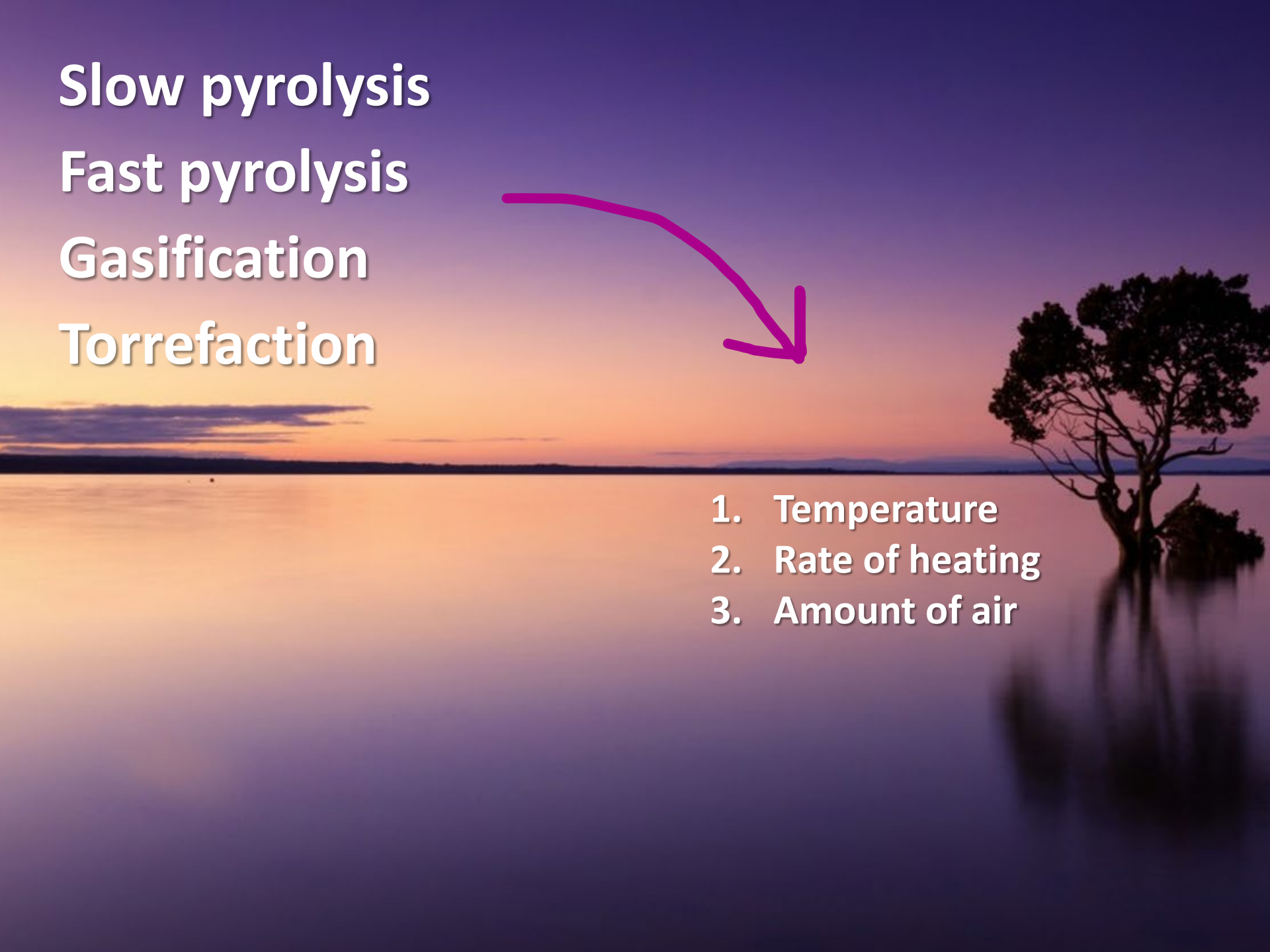
Thermochemical conversion includes:

Slow pyrolysis

Fast pyrolysis

Gasification

Torrefaction


Slow pyrolysis
Fast pyrolysis
Gasification
Torrefaction
1. Temperature
2. Rate of heating
3. Amount of air

Biochar is …

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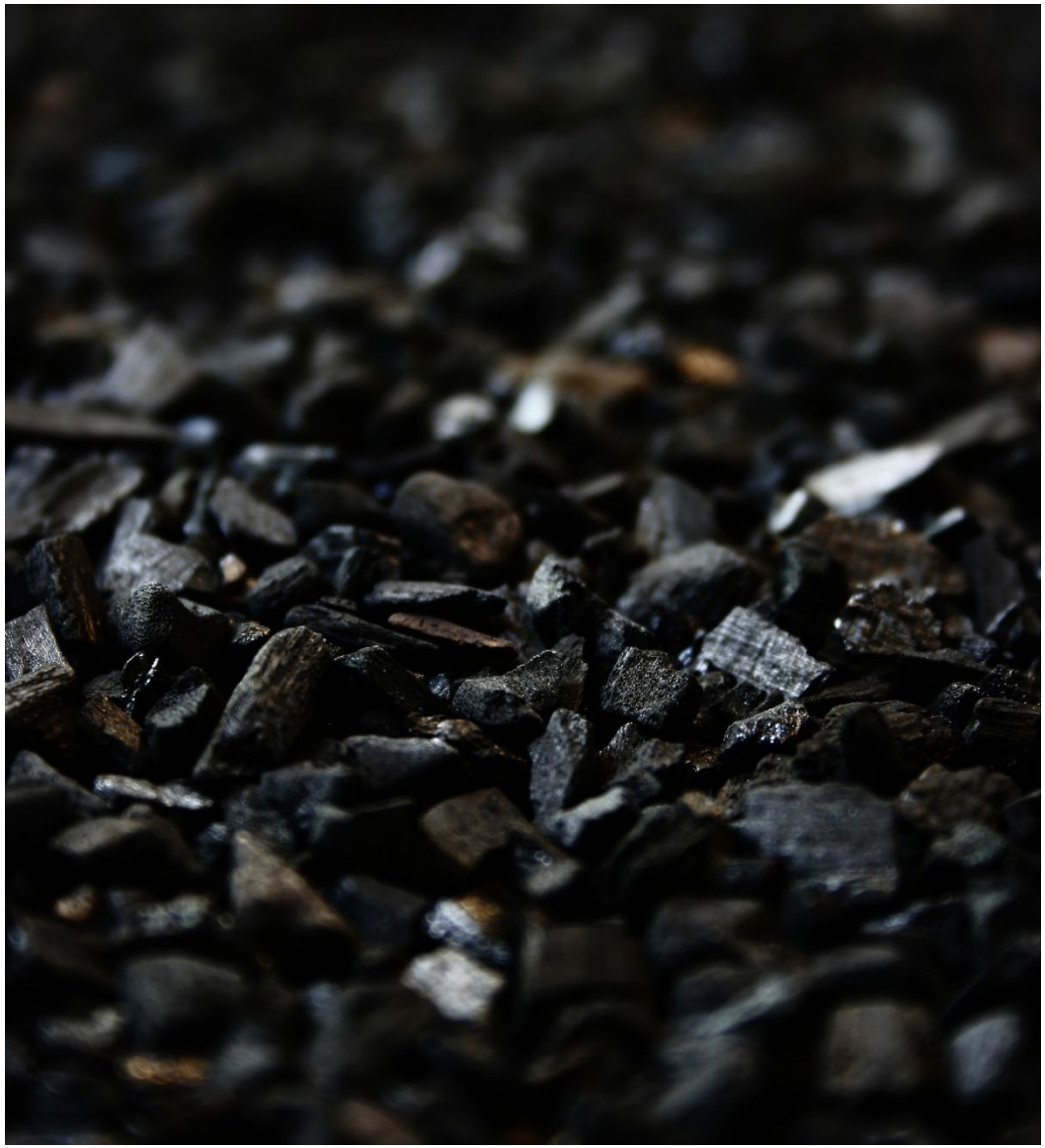


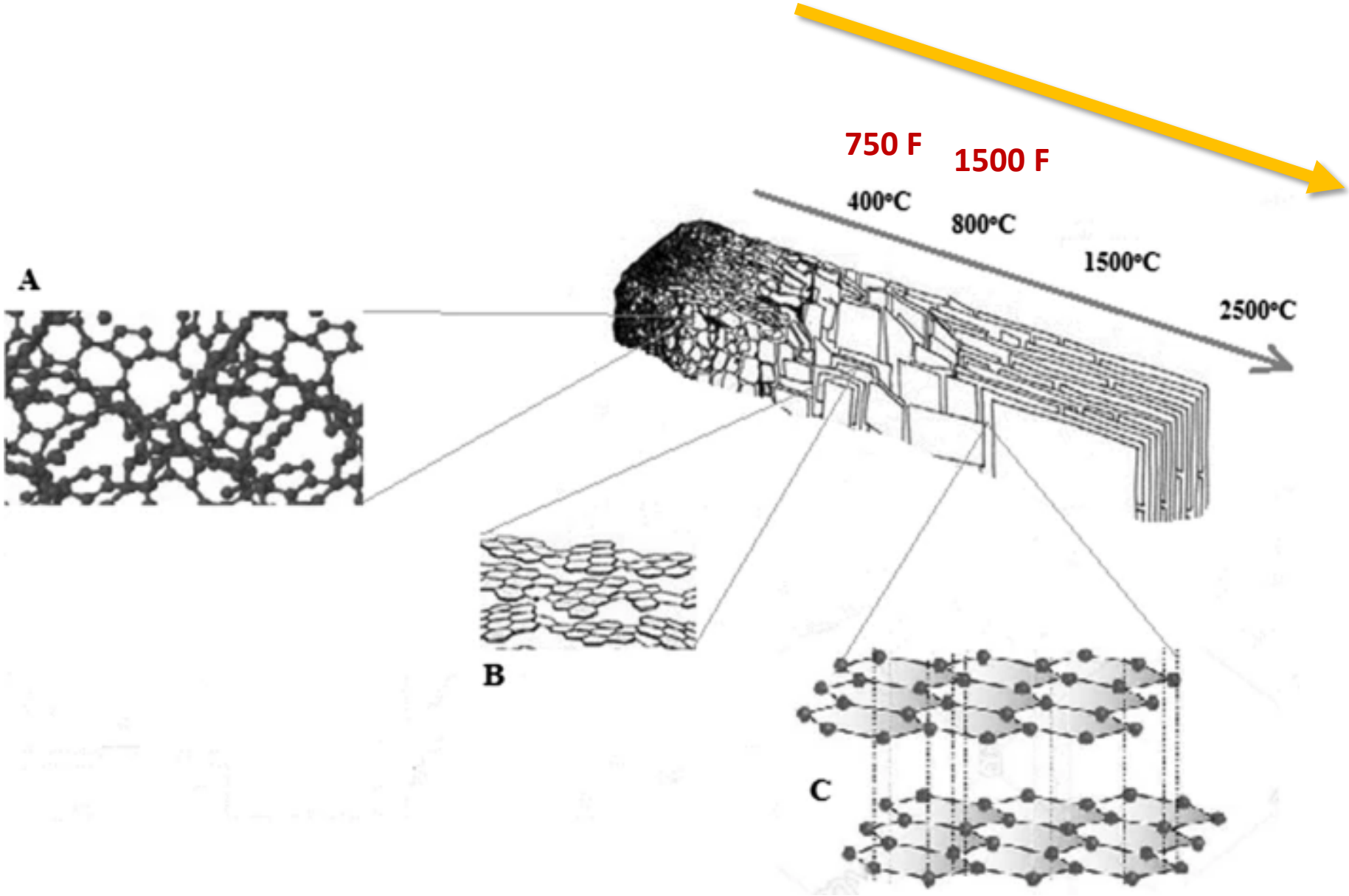


Figure credit: Sokolowska, Zofia, Boguta, Patrycja, Tomczyk, Agnieszka,. *Biochar physicochemical properties: pyrolysis temperature and feedstock kind effects*. Reviews in Environmental Science and Bio/Technology. 2020;19(1):191-215. doi:10.1007/s11157-020-09523-3

Clear as mud?

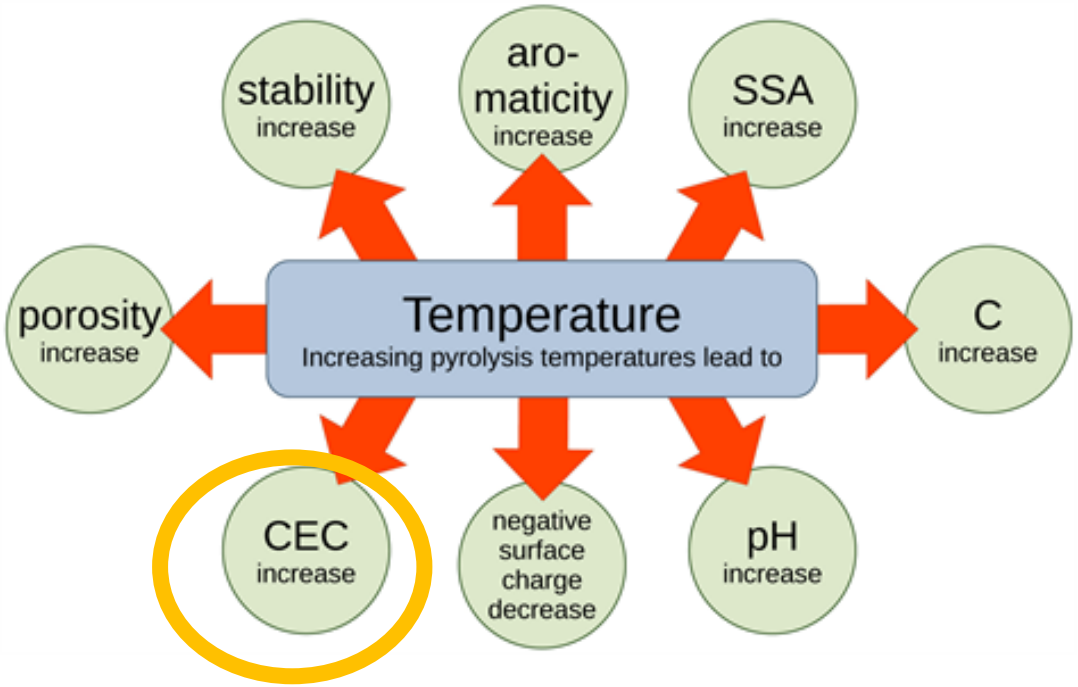
Why are we interested in biochar?

Physical/Chemical Properties Biochar

High C content
pH
Porosity
CEC
Surface Area

But,

PARAMETER	~350 C, 660 F	600-900 C, 1112-1650F
Porosity	Lower	Higher
Surface Area	Lower	Higher
Cation Exchange Cap	Higher	Lower
Oxygen Content	Higher	Lower
Acid-Base Fnxl groups	Higher	Lower
Nutrient Availability	Higher	Lower



Beusch, C. (2021) Biochar as a Soil Ameliorant: How Biochar Properties Benefit Soil Fertility—A Review. *Journal of Geoscience and Environment Protection*, **9**, 28-46. doi: 10.4236/gep.2021.910003.

Biochar in Soil

Benefits

Improve Physical Properties (decrease bulk density, increase water holding capacity)

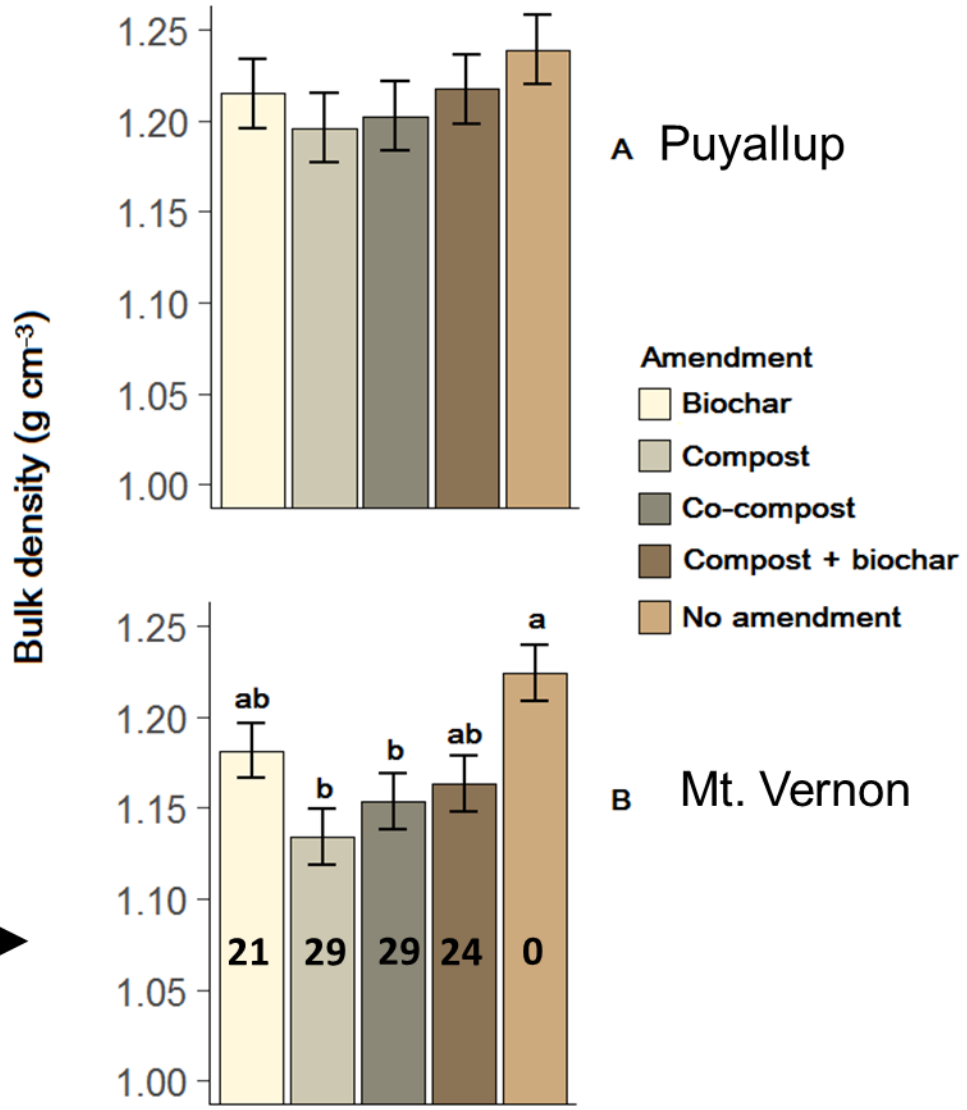
Improve Chemical Properties (increase Soil C, Fertility (Yield), CEC)

Improve Biological Properties (habitat microorganisms)

Decreases Bulk Density – generally more pronounced in sandy vs fine textured soils and is rate specific

Physical Properties

Material applied (yds/a)



Decreases Bulk Density – generally more pronounced in sandy vs fine textured soils and is rate specific

In course textured soils, can reduce water infiltration and saturated conductivity = more storage (also dependent on the size of biochar)

In fine textured or compacted soils, can increase water flow; result of size and increasing aggregation

Less affect in medium textured soils

Increases water storage (rate dependent)

10 Mg ha is cutoff (5 tons per acre)

Physical Properties

Variability in chemical responses are due to the interaction of a particular soil with the type of biochar (feedstock and production method)

Increases in soil pH – more pronounced in sandy soils (also rate dependent)

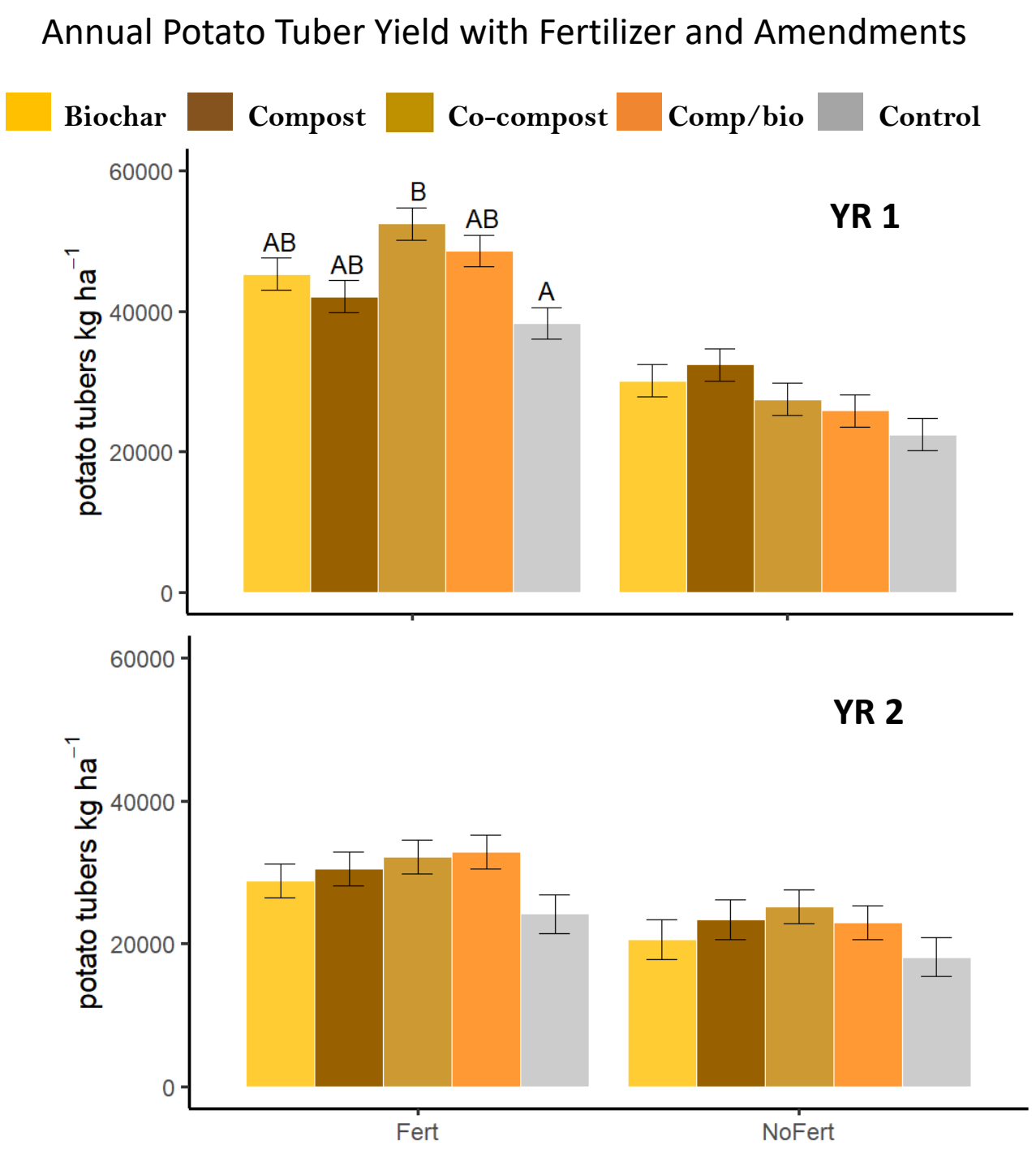
Increases CEC of soils, except those with high amounts of OM

Can increase soil C (rate dependent) (but should be evaluated long-term)

Can improves soil fertility (crop yield), is more pronounced in sandy and degraded soils (when applied alone)

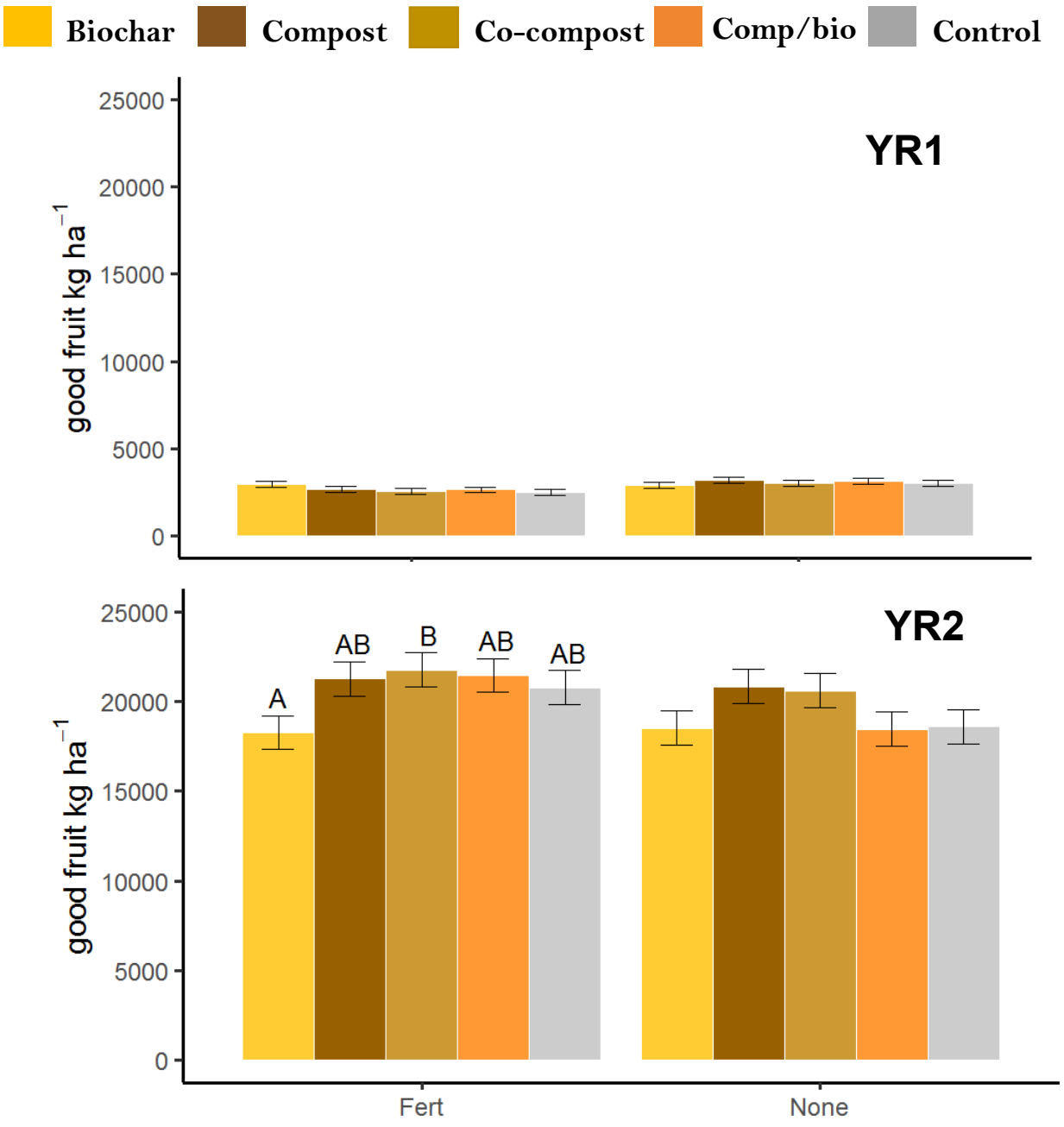
Chemical Properties

Strong fertilizer effect on potatoes; Amendments with compost AND biochar increased yield in fertilized treatments in 2018



No fertilizer or amendment effect on strawberry yield in Yr1.

Biochar alone yielded lower than co-composted biochar amendment



Highly Variable!

Why?
-Depends on the resident population
-Depends on texture/nutrients …
-Microorganisms still need substrate (nutrients, energy, structural …)

Biological Properties

Where does potential risks originate?

Feedstock (sewage sludge)
Process of Pyrolysis (dioxins)

What are the risks?

Salts
Heavy metals
PAH's, dioxins

Considerations

Biochar Standards

International Biochar Initiative

Table 2 (continued). Test Category B Parameters, Maximum Allowed Thresholds and Test Methods.

Parameter	Range of Maximum Allowed Thresholds		Test Method
Polycyclic Aromatic Hydrocarbons (PAHs), total (sum of 16 US EPA PAHs)[7]	6 – 300	mg/kg[8] dry wt	US EPA 8270 (2007) using Soxhlet extraction (US EPA 3540) and 100% toluene as the extracting solvent
Dioxins/Furans (PCDD/Fs)[9]	17	ng/kg WHO-TEQ[10] dry wt	US EPA 8290 (2007)
Polychlorinated Biphenyls (PCBs)[11]	0.2 – 1	mg/kg dry wt	US EPA 8082 (2007) or US EPA 8275 (1996)
Arsenic	13 – 100	mg/kg dry wt	TMECC (2001)
Cadmium	1.4 – 39	mg/kg dry wt	TMECC (2001)
Chromium	93 – 1200	mg/kg dry wt	TMECC (2001)
Cobalt	34 – 100	mg/kg dry wt	TMECC (2001)

Considerations

What is the goal?

Improve infiltration, improve fertility, soil remediation …

Understand …

Material (feedstock) can affect results
Temperature can affect results
Particle size affect results

Best use …

Added as a supplement with organic N
Mixed with compost or used as a feedstock for compost

Recommendations


Thank you!
natestacey@tilthalliance.org