Trees and Construction: A Hostile Relationship

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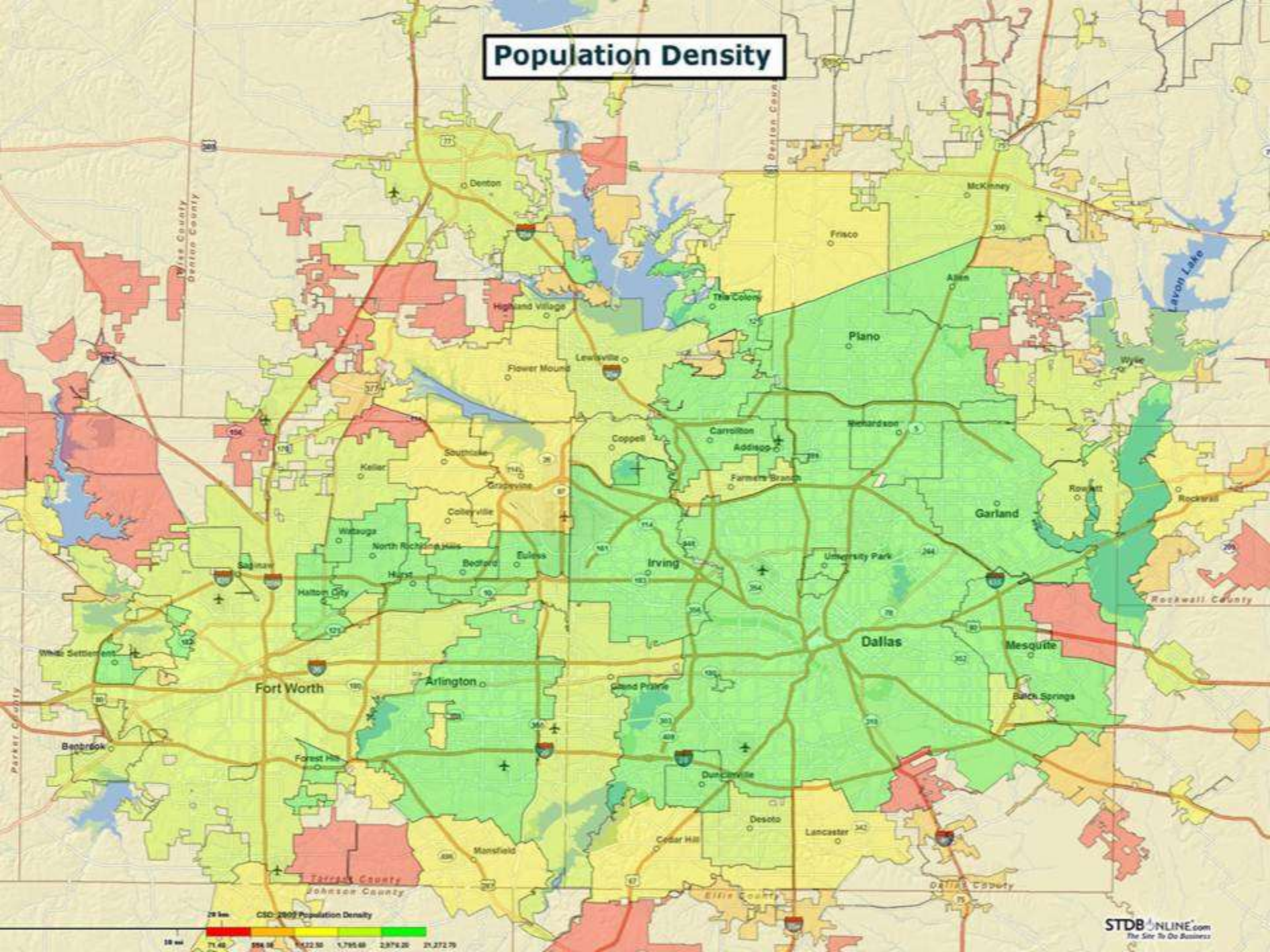
Overview

- Background
- Construction Damage
- Tree Preservation
- Other Solutions
- Post Construction Care

Population Density



Urban Sprawl from Space

- http://www.citylab.com/housing/2013/06/devastating-impact-30-years-sprawl-seen-space/5955/

Native Ecology

Cross Timbers

Riparian Zone

Trinity Blackland/Grand Prairie

Post Oak Savannah

Urban Ecology

Dynamic environment with static materials

Construction is constant

Cycles of renewal interrupted

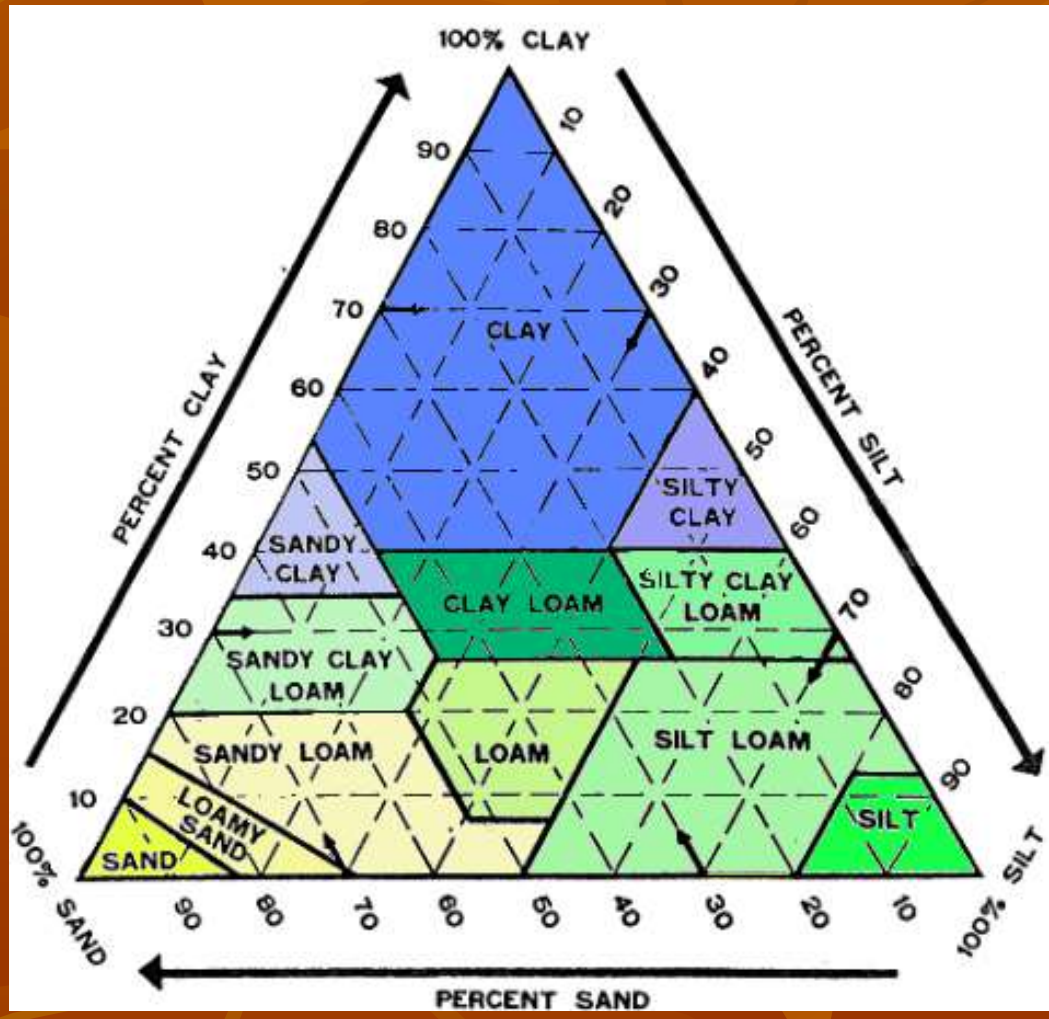
Urban soil is "dirty"

What is Soil

- Soils are complex systems of solid matter, pore spaces filled with water & oxygen, and numerous bacteria, fungi, & other organisms (Harris 1992)
- Soils are dynamic & influenced by environment
- Soil consists of 4 basic components:
  - inorganic materials, organic material, air, & water

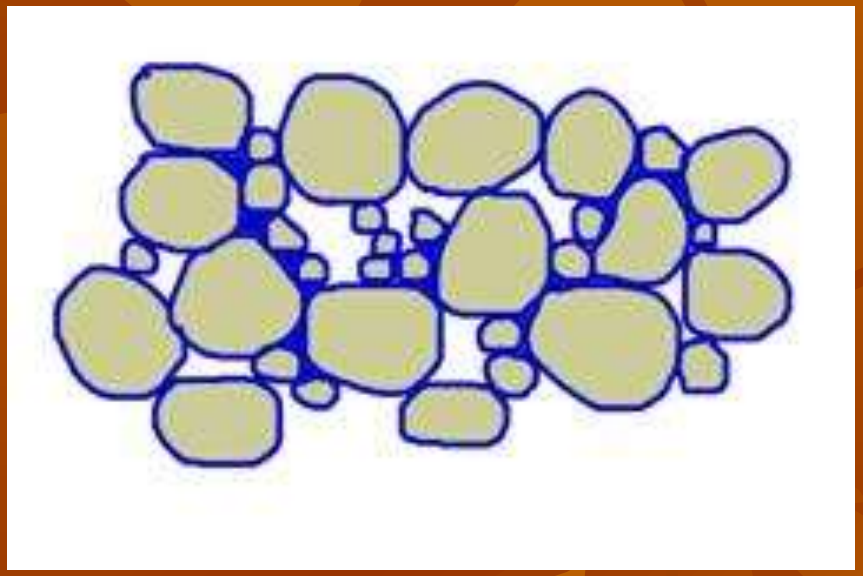
Ideal Soil

- 50% solid; 50% space
  - 45% Inorganic minerals
  - 25% Macropores (air)
  - 25% Micropores (water)
  - 5% Organic Matter (i.e. humus, roots, organisms)
- Clay, Silt, or Sand?
  - 35% - 45% concentration
- Loam is ideal mix of particle properties



Physical Properties of Soil

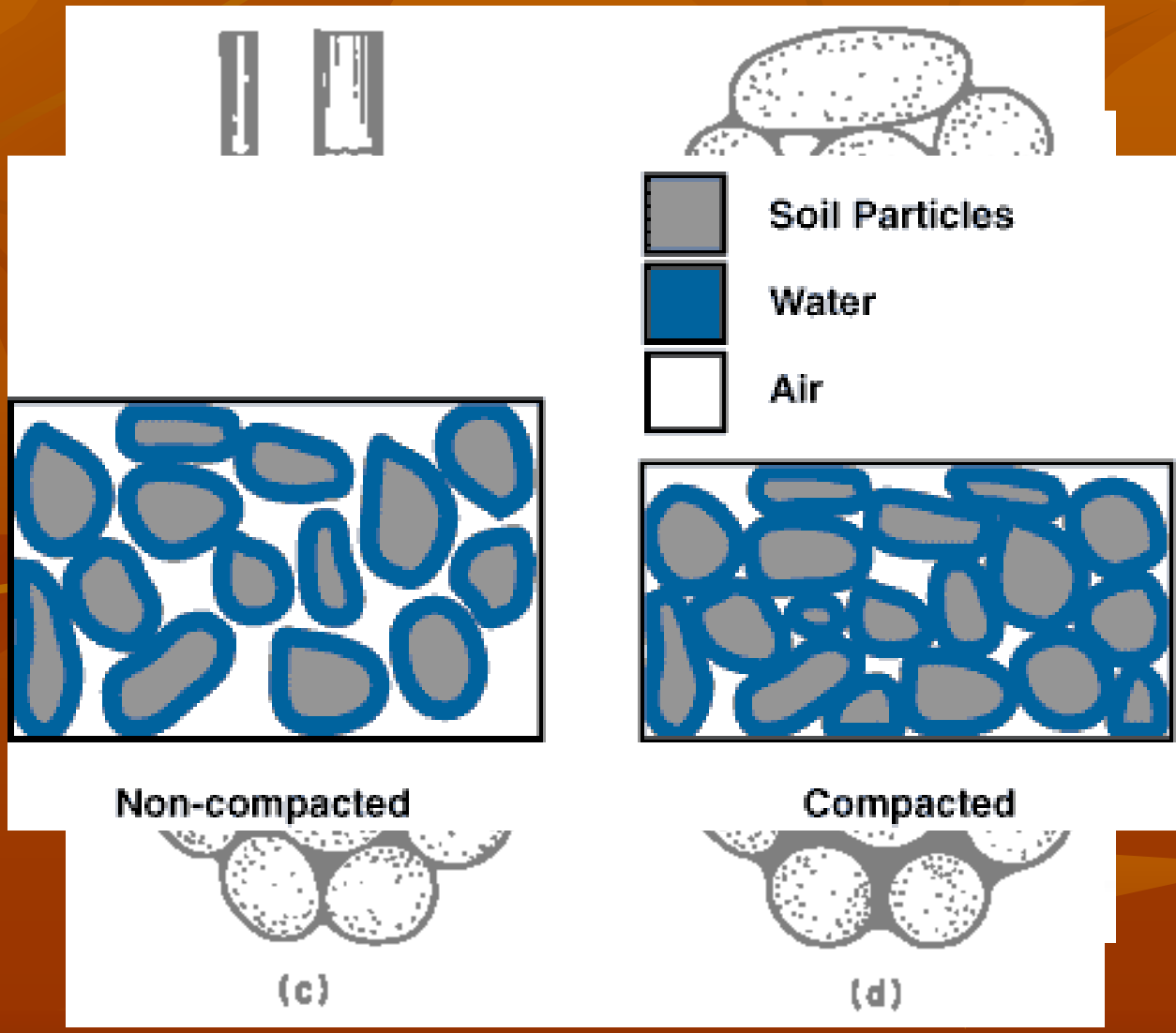
- Pore space
  - Macropores –large spaces between soil particles that are filled with air.
  - Micropores – small spaces that hold water & dissolved nutrients after excess water has moved through or drained from the macropores



Ideal soil at field capacity

Physical Properties of Soil

- Texture
- Structure
- Aeration
- Soil Moisture
- Bulk Density



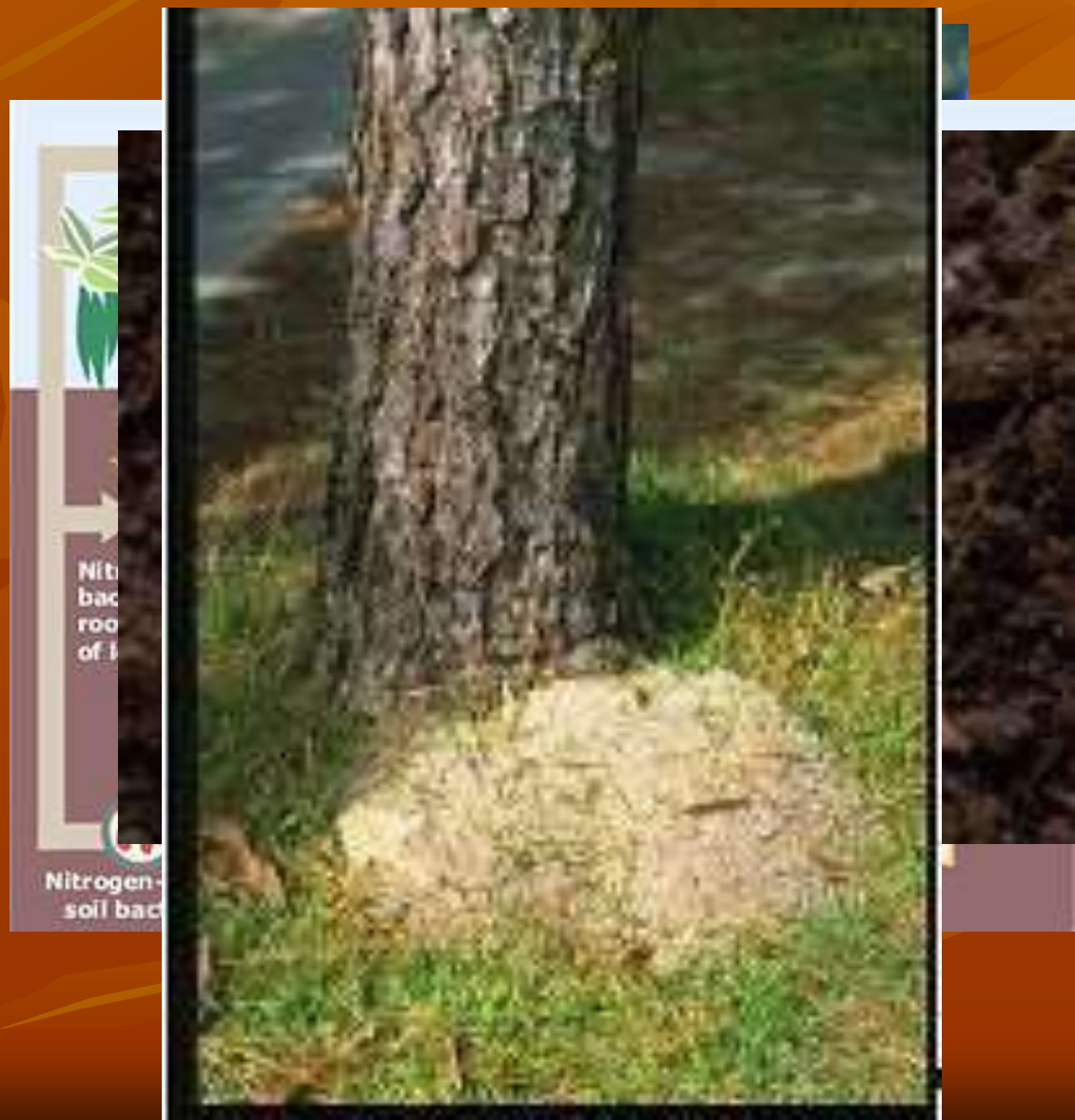
Bulk Density

Soil Bulk Density

Bulk Density g/cc3	Level	Treatment
1.0-1.6	Normal Soils	None-Avoid Disturbances
1.4-1.65	Slight	Mulch
1.50-1.70	Moderate	Core Aeration
1.70-2.2	Severe	Soil Excavation

Biological Properties of Soil

- Beneficial micro-organisms
- Mycorrhizae
  - “fungus root”
  - endo & ecto
- Rhizobium – bacteria
- Macroorganisms
- All elements of Rhizosphere



Construction Damage

- Two types of damage:
  - Above and below ground
- Below ground damage greater issue
  - Greater impact on plant health
  - Longer lasting; irreversible
  - Requires human action
- Prevention is the best remedy

Above Ground Damage

View of the treehouse frame looking East, toward the front of our property. The big blue tarp is covering excess dirt from our septic installation. You can see the neighbor's playhouse on the left.


Genie Z-80/60

Below Ground Damage

Construction:

- Qualities of soil varies widely from site to site (even on same site) before and after years of human interference.
- Construction results in compaction, fills, grading, drainage issues, and contamination that make the soil useless for planting.
- Soil structure is destroyed and interface is negatively impacted.

- Drainage and compaction greatest impact and challenge to correct

Below Ground Damage


2008/01/28


2008/04/15


PRO VIGIL
Construction Security
866-616 1318
021
TX Lic# C14263
2008/04/05

Urban Soil Issues

- Native soil horizons are greatly disturbed & soil interface altered

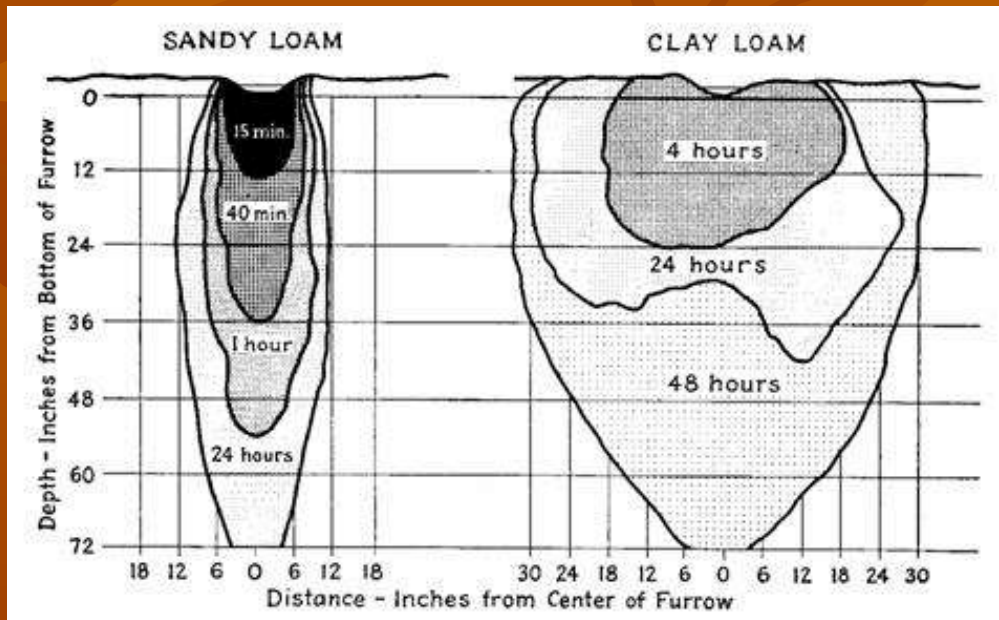
- Topsoil layer completely removed and/or fill soil or sod added on top

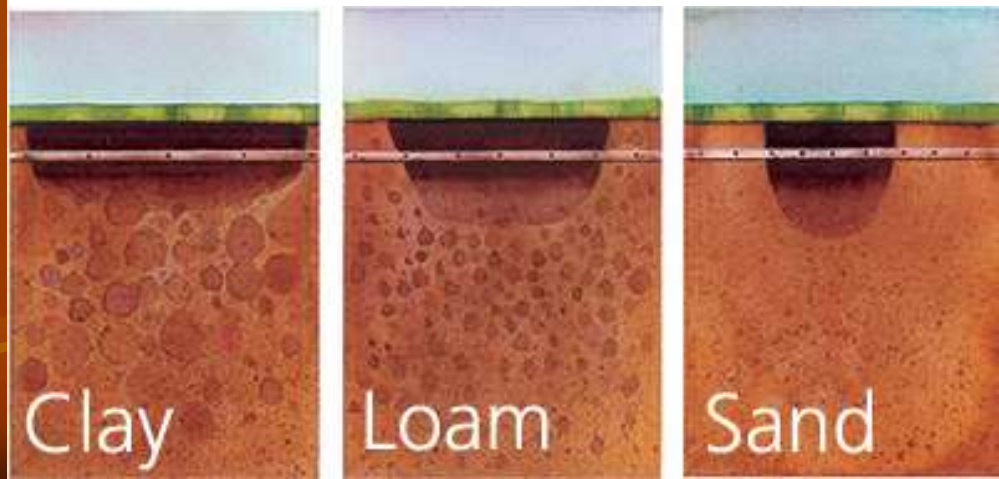
- Chemical contaminants

Urban Soil Issues - Fill Soil

Urban Soil Issues

- Biological activity non-existent
- Soil typically compacted & chemically altered
- Soil hydrology worsened or completely changed
- Virtually all factors are unnatural and work against tree & shrub growth

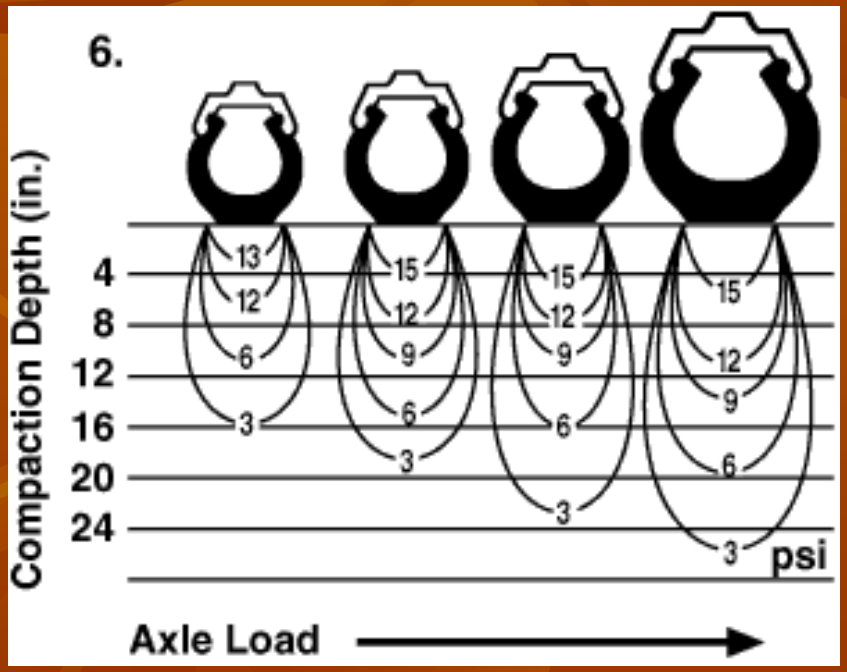


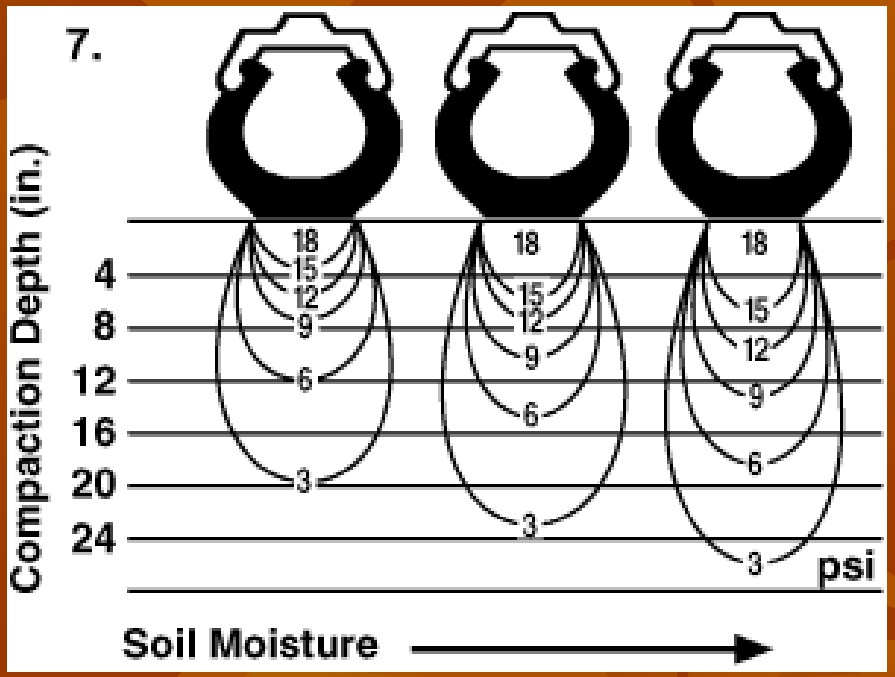


Lack of Irrigation Plan

Effects of Compaction & Soil Moisture

Figures 6 and 7. Depth of compaction as (6) axle load and (7) soil moisture increases
(Adapted from Soehne, 1958).





Soil Compaction Factors

Prevention is the best solution!

Tree Preservation

- Involve certified arborist from beginning
- Do no rely on L.A. or construction company for proper tree preservation
- Install tree preservation before any construction & utilize eco-friendly materials
- Monitor tree stress, pest/disease problems, & irrigation cycles; apply mulch
- MUST LIMIT TREE STRESS!

Improper Tree Preservation

Proper Tree Preservation

Alternative Tree Preservation

Highly effective, but costly!

Bartlett Root Rx® Program

- Developed and patented by scientists at Bartlett Tree Experts Laboratory in N.C.
- Root invigoration technique that cultivates and amends poor soil
- Ideal for heavily compacted or altered soils, and transplanted trees that are stabile

Pecan - Senter Park West, Irving

Senter Park Pecan

- Approx 3 ft. DBH
- Construction staging area 4 year prior
- Drain pipe laid 150’ away
- Dirt piled 10-15’ high for 3 months
- CRZ compacted with equipment & materials
- Root Rx radius of 13 ft.
- Non-irrigated site

Treated November 2007

Check severity of buried root flare!

Senter Park Pecan

Senter Park Pecan

- Removed approx. 9” of fill soil
- Used turf shaper to break up soil
- Found concrete slab
- Removed slab and 55 cubic yards of fill soil from CRZ of tree!

Senter Park Pecan

- Moist soils necessary
- Tried water truck . . . and rock bar
- Well timed heavy soaking rain arrived

Senter Park Pecan

- Proper cultivation possible
- Found some fine feeder roots
- Mixed-in amendments & compost with Air Spade®

- Had to do sections at a time over 4 days

Senter Park Pecan

SMU Root Rx – 9 months later

SMU Root Rx – 9 months later

FWMSH – Feb. 2008


FWMSH – July 2008
2008/07/31

FWMSH – Nov. 2008

FWMSH – Feb. 2009


FWMSH – May 2009

FWMSH – Fall 2010

FWMSH – April 2011

FWMSH – April 2011


2009/03/23


2009/03/23

Newest Innovation: Biochar

What is Biochar?

- Product of pyrolysis of organic matter
  - Source of energy from exothermic heat
  - Oils and gasses collected and used as fuel
- Mimics ancient practices discovered in nutrient poor tropical soils.
  - Terra preta soils (Dark earth), 2,000+ years

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- Mimics ancient practices discovered in nutrient poor tropical soils.
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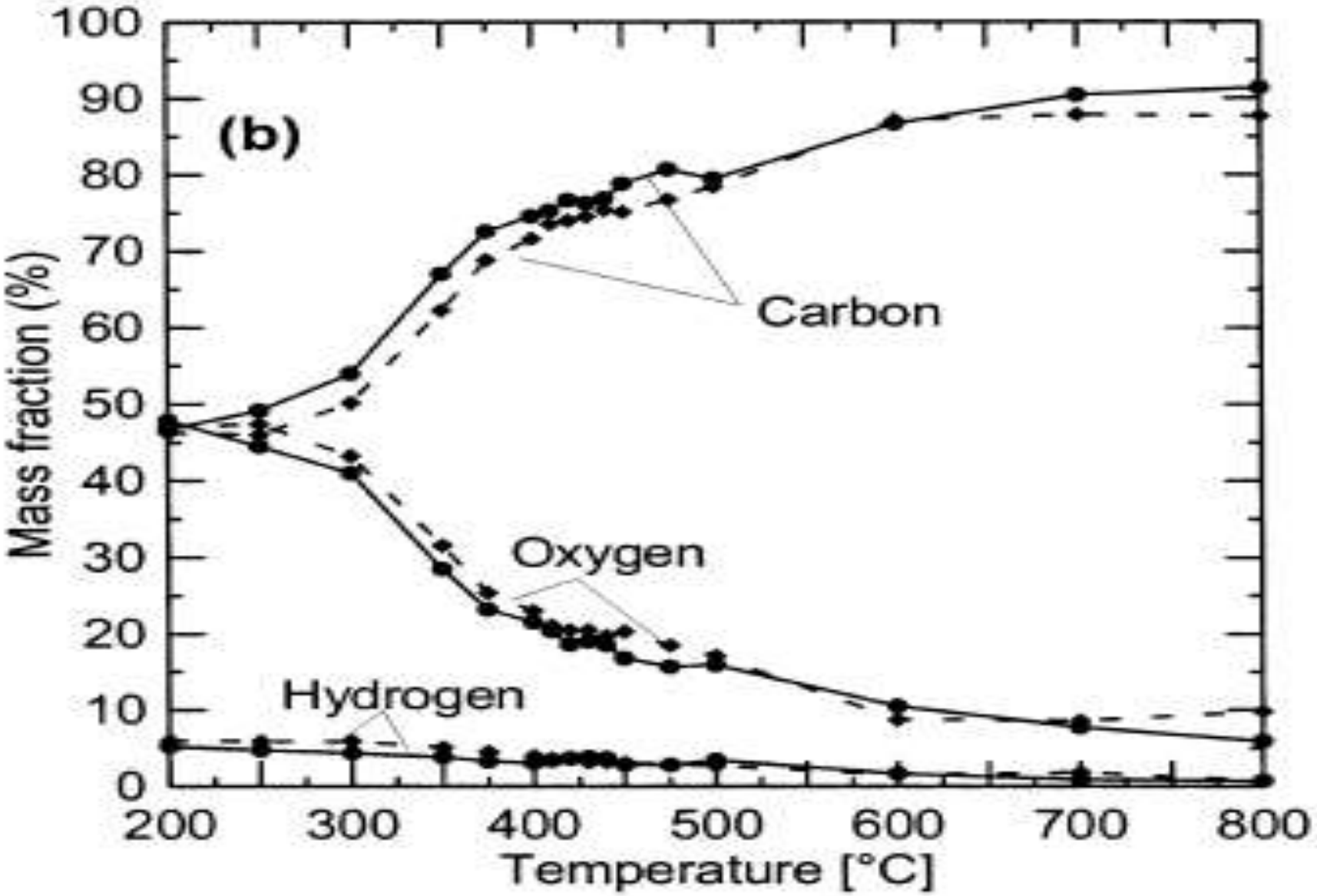
Small patches of fertile soil found in otherwise low-productive area

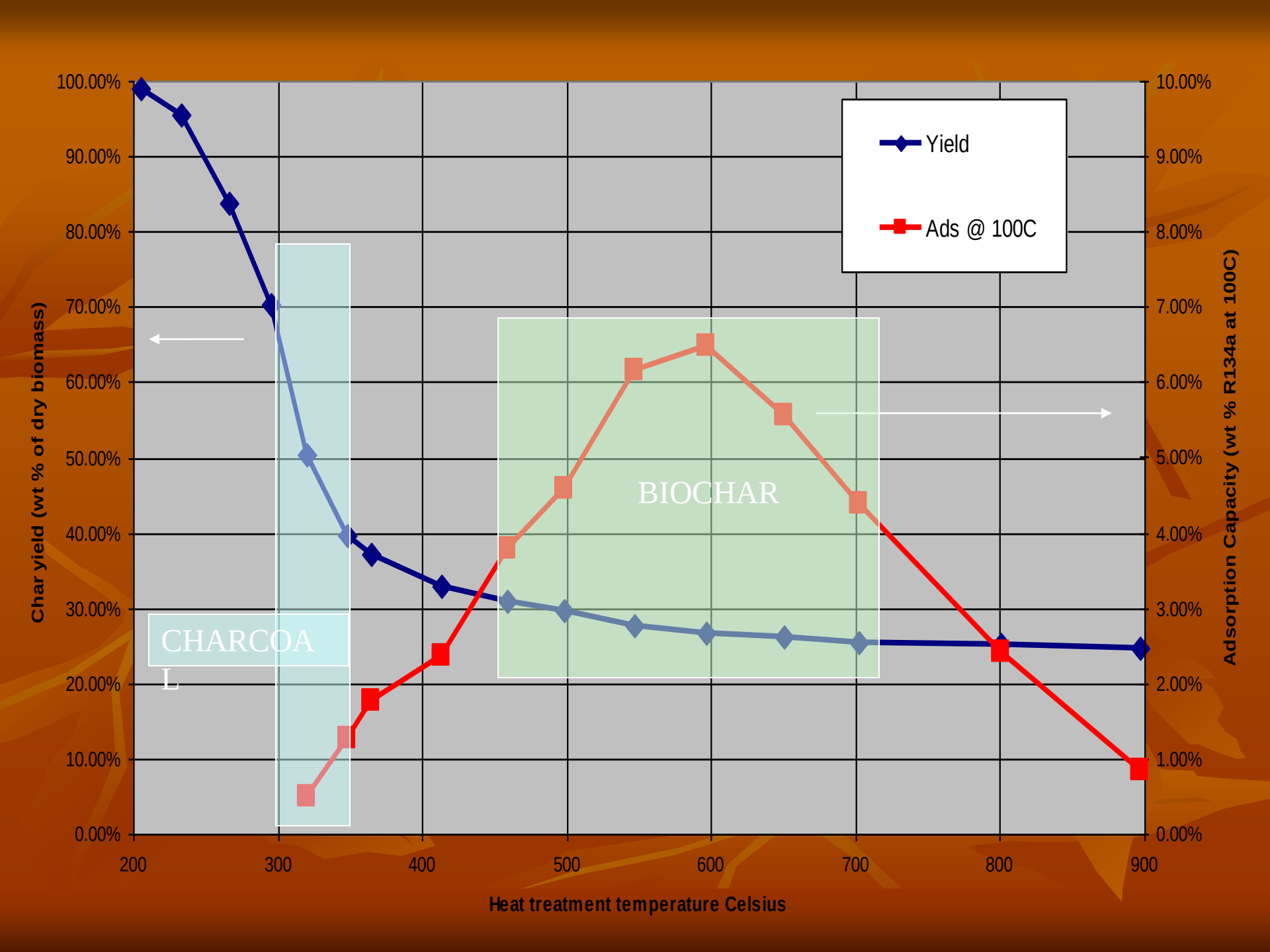
- Tropical soils are typically very nutrient poor
- Linked to soil content of "black carbon" or biochar particles

www.biochar-international.org/biochar/soils

Ancient cultures burned waste, incorporated char into soil



Excerpt from: The Art, Science, and Technology of Charcoal Production, Antal, et.al., Ind. Eng. Chem. Res., Vol. 42, No. 8, 2003 (page 1621).


Yield
Ads @ 100C
BIOCHAR
CHARCOAL
Char yield (wt % of dry biomass)
Adsorption Capacity (wt % R134a at 100C)
Heat treatment temperature Celsius
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
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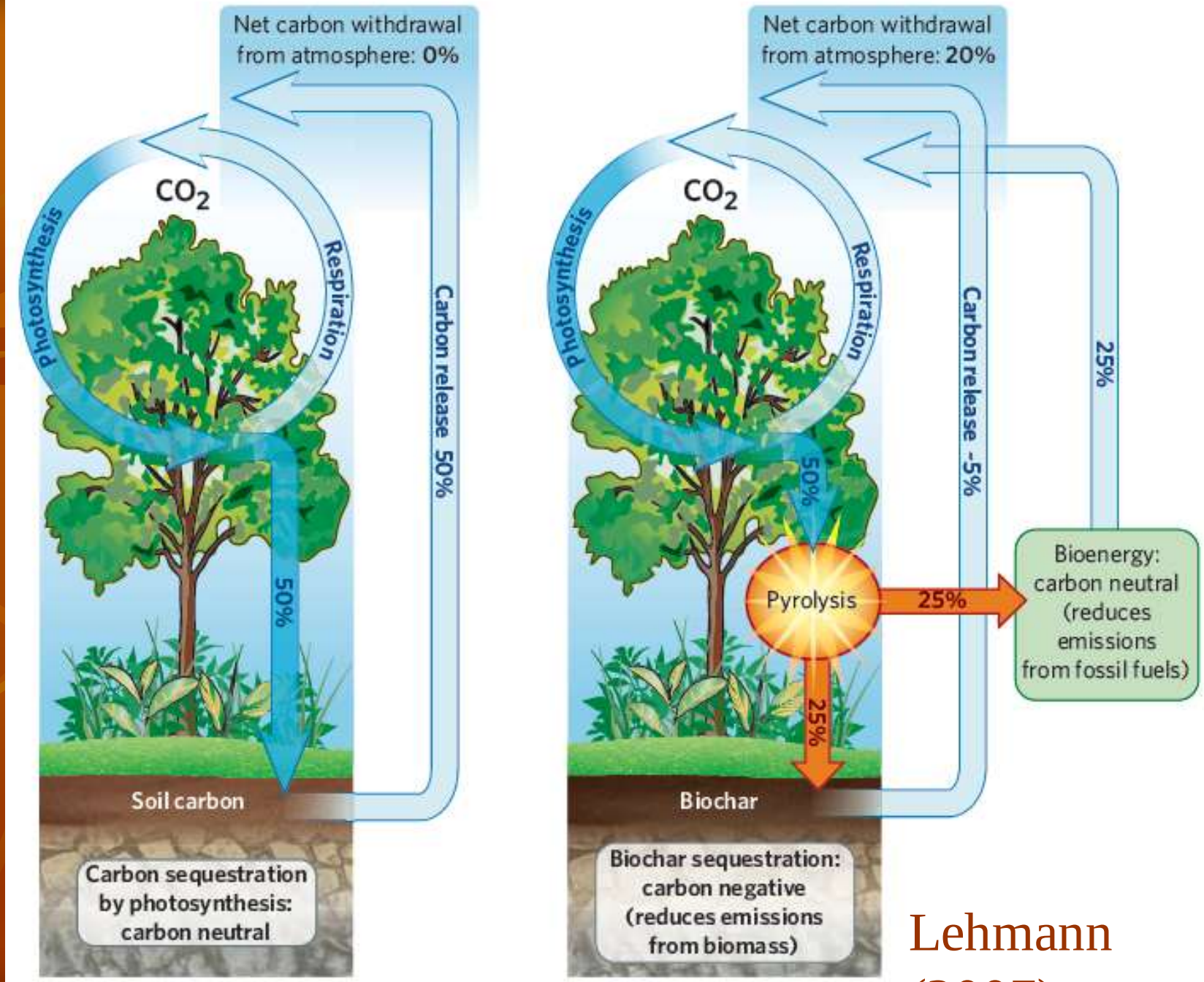
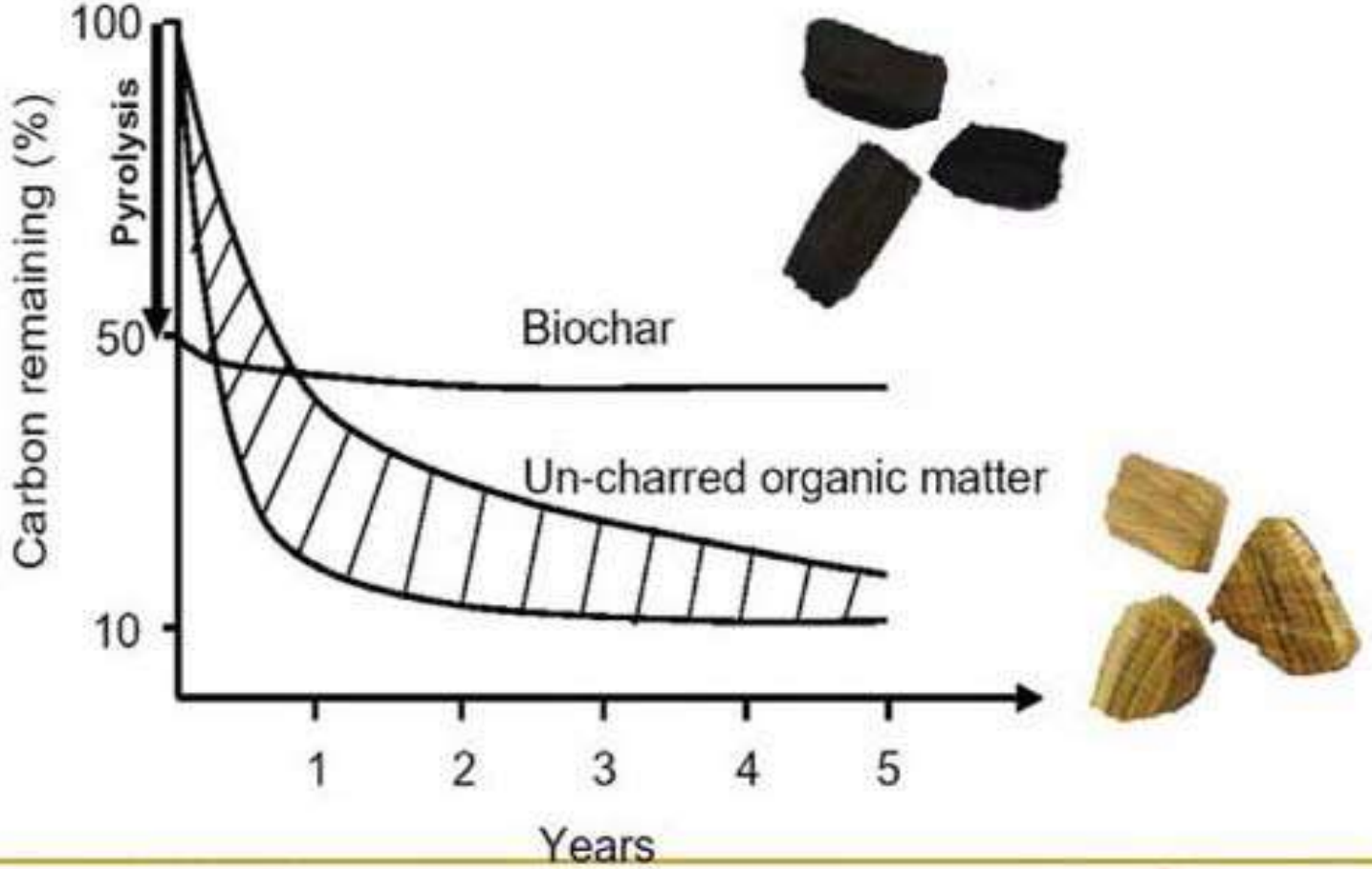


Lehmann (2007)

The essential stability of biochar

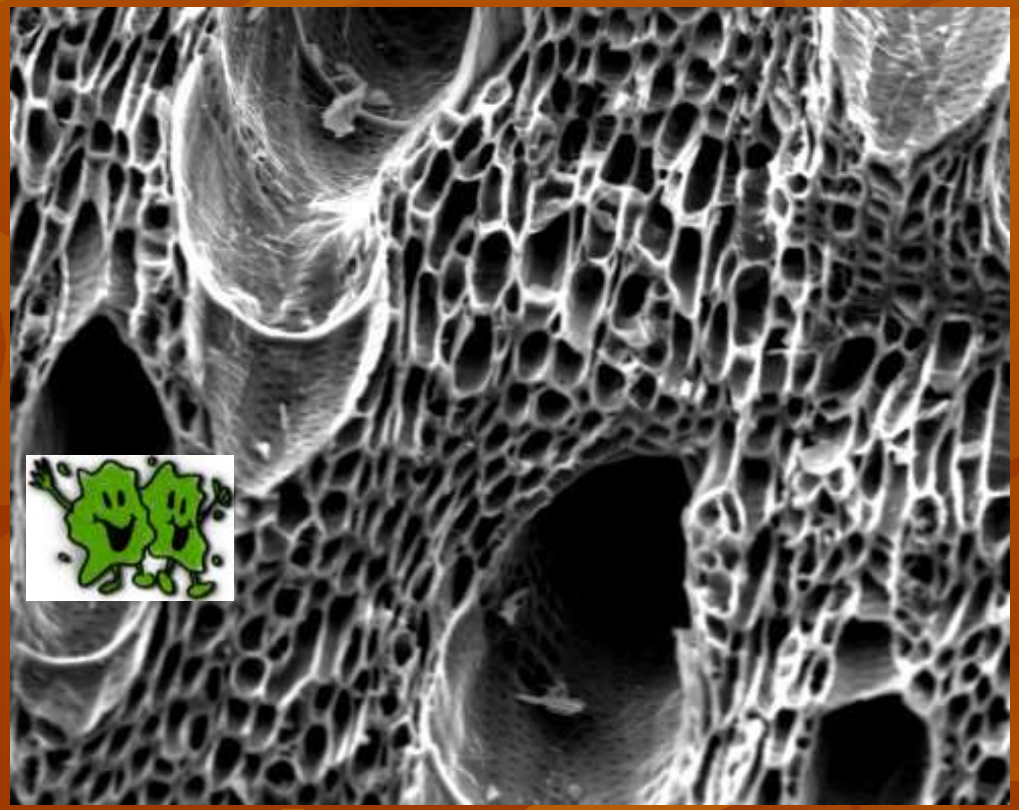


Lehmann et al., 2006, *Mitigation and Adaptation Strategies for Global Change* 11, 403-427

Cornell University

Bartlett Premium Landscape Biochar

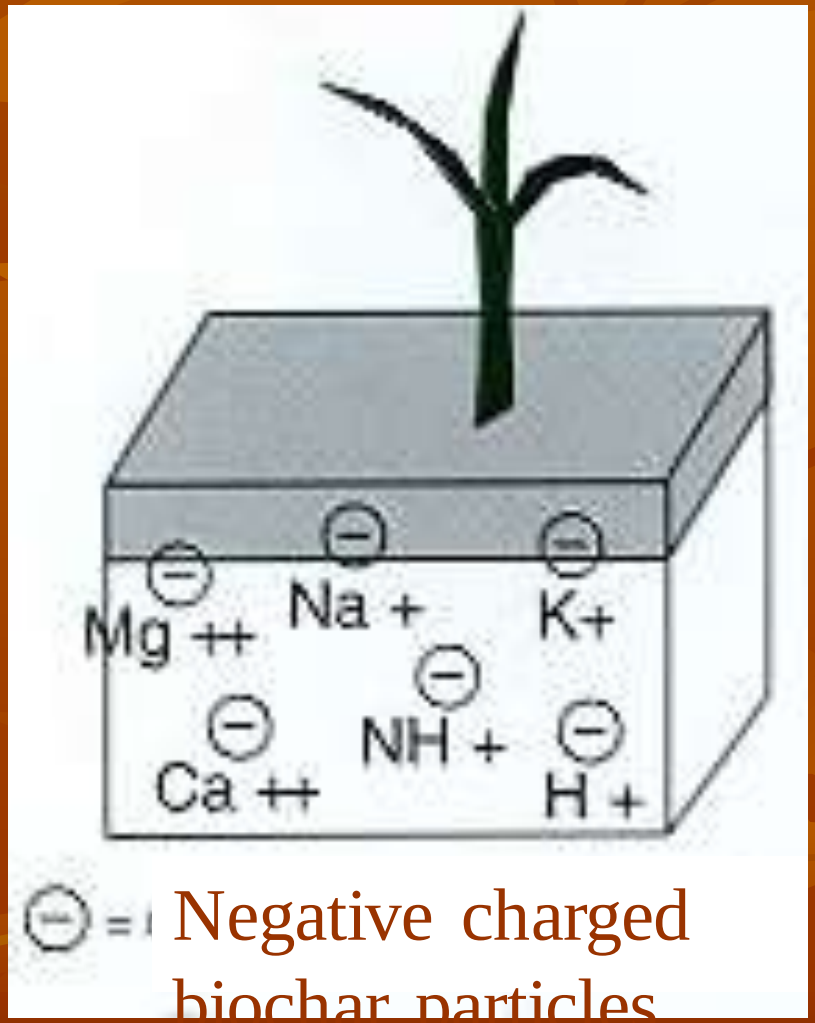
Surface area, charge, pore space all key to biochar effect on plants



Habitat for beneficial microbes

What is Cation Exchange Capacity (CEC)?

- Many essential elements are positively charged ions in soil solution.
  - Potassium, Magnesium, Calcium, some N forms
- Negative charges on biochar attract these cations, preventing leaching
  - But are available to plant



Post Construction Care & Conclusion

- Monitor plant health after construction
  - Fertilize, treat disease/pest problems, & irrigation
- Must be proactive (before & after construction)
- Involve arborist before construction begins
- Prevention is the key to survival

Acknowledgements

- **Patrick Brewer, S.W. Division Manager, the Bartlett Tree Experts**
- **E. Thomas Smiley, Ph.D, Soil Scientist, F.A. Bartlett Tree Experts Laboratory, Charlotte, NC**
- **Mike Griffith, Parks Dept., City of Irving**

State Champion Baldcypress, Rio Frio, Texas