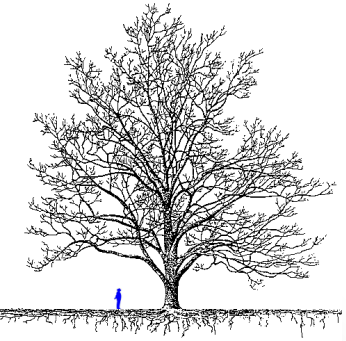
Root Systems: The Forgotten 50%

Cultivating Community:

A Garden Symposium

Master Gardeners of Mercer County

Spring, 2024



NEED TO KNOW
SHOULD KNOW
NICE TO KNOW

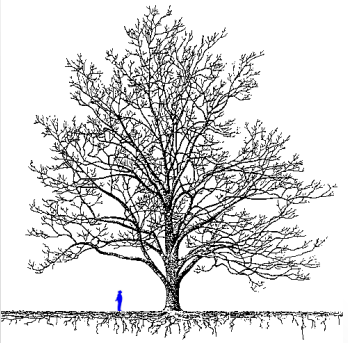
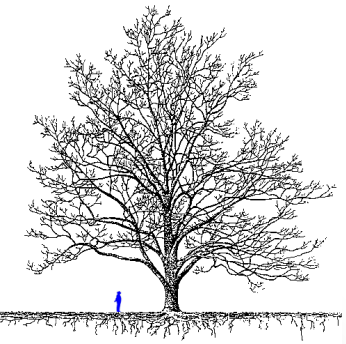


Photo: Jim Blake

- Critical Base-line Information
- Enables Basic Understanding
- Essential for Critical Thinking
- Basis of Problem-Solving

“Need to Know”

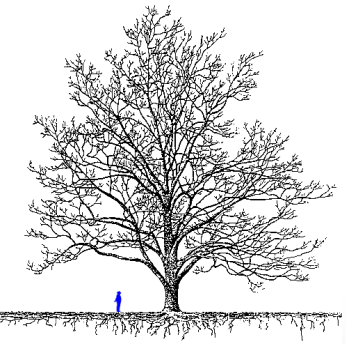


Need to Know: Where are Roots?

Photo: Ben Johnson

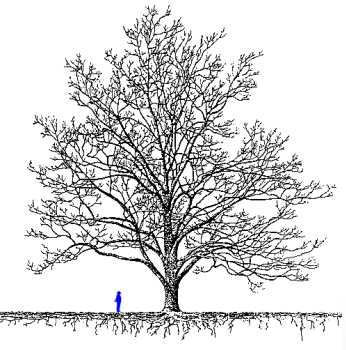
Need to Know: They Are Not Always Where You Think

Photo: Jim Blake



- Part of Professional Development
- Better Management, Diagnostic Skills
- The “Extra Step” Information

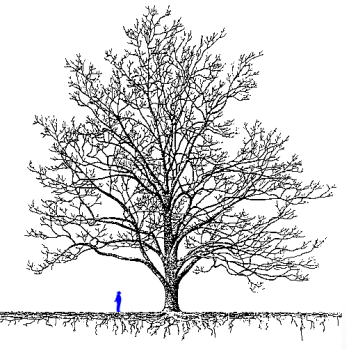
“Should Know”



Should Know: What is Abnormal? Dysfunctional?

- Explanations for “Uncommons”
- Diagnostic Tips
- Tree Specific
- Action Specific

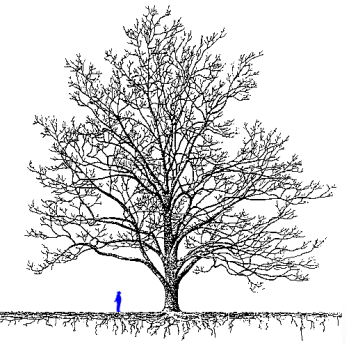
“Nice to Know”



Nice to Know: Bad Root Systems Can Be Corrected

I. Roots…the Forgotten 50%

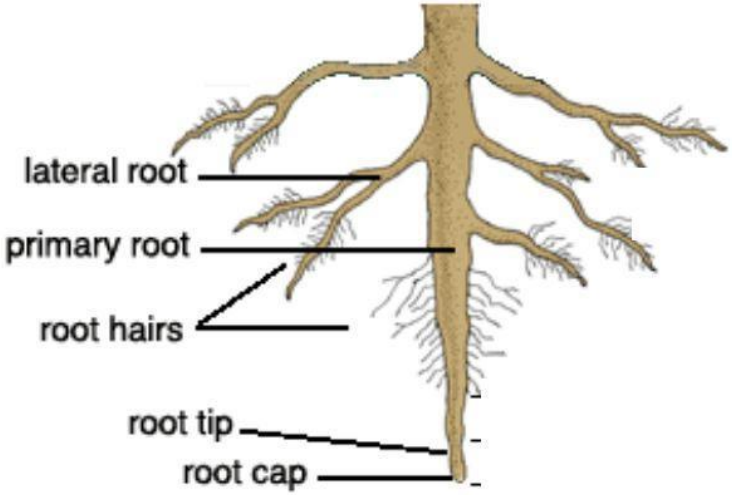
- Origins
- Types
- Anatomy
- Lifespans
- Growth
- Functional Roots

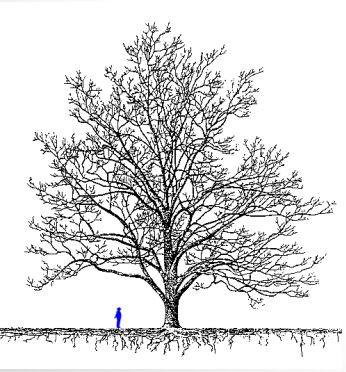


Origins and Anatomy of Roots

- Primary Root
- Secondary Elements of Roots

Photo credit: Treegrowersdiary.com

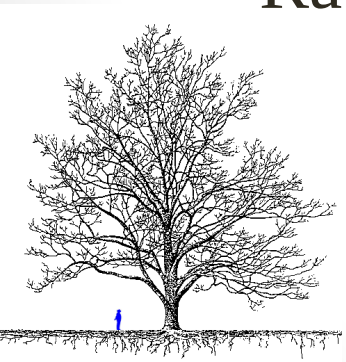


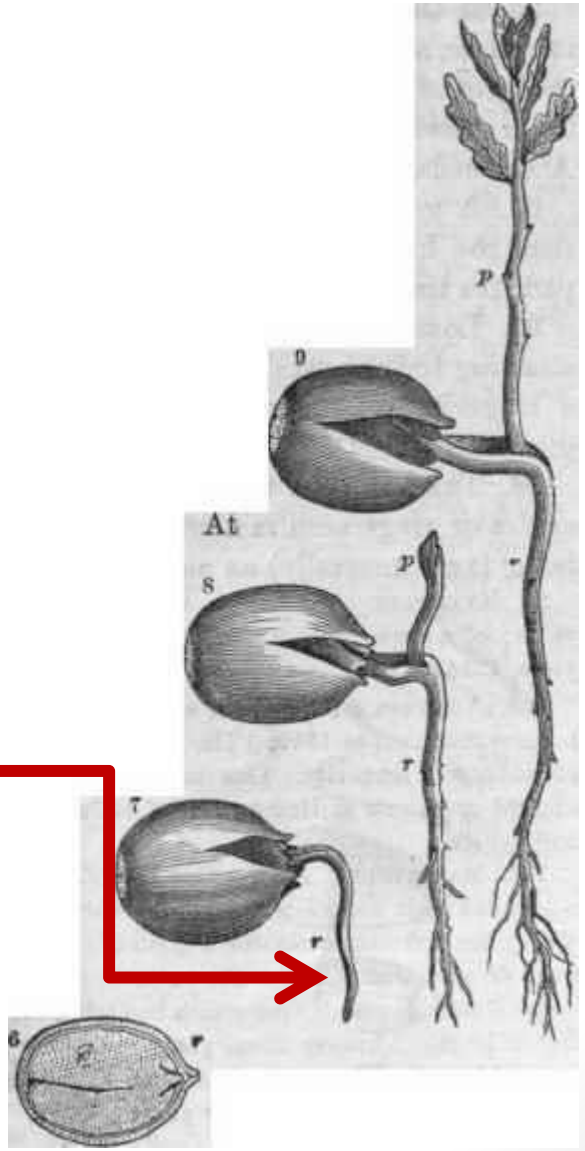


Primary Roots

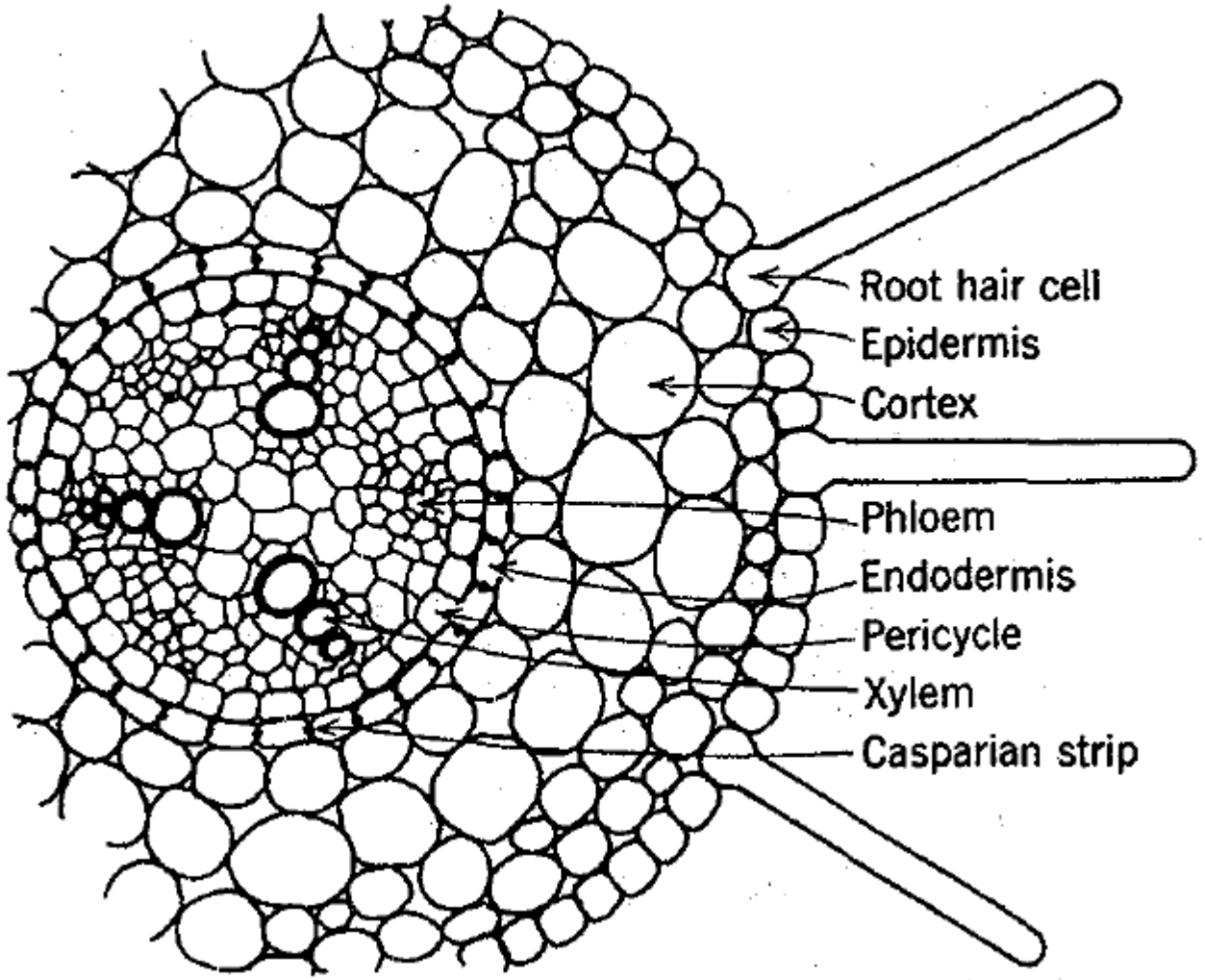
Photo credit: Willkillforfood.com

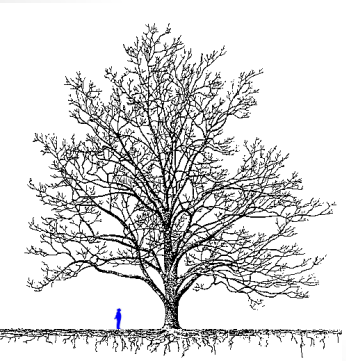
Radicle: The Seed Root



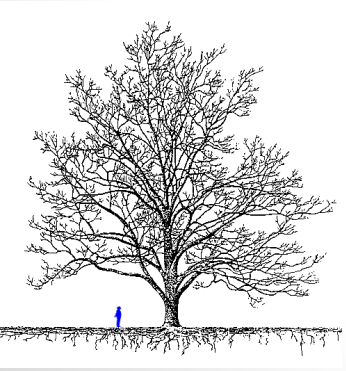


Secondary Elements of Roots: Root Hairs

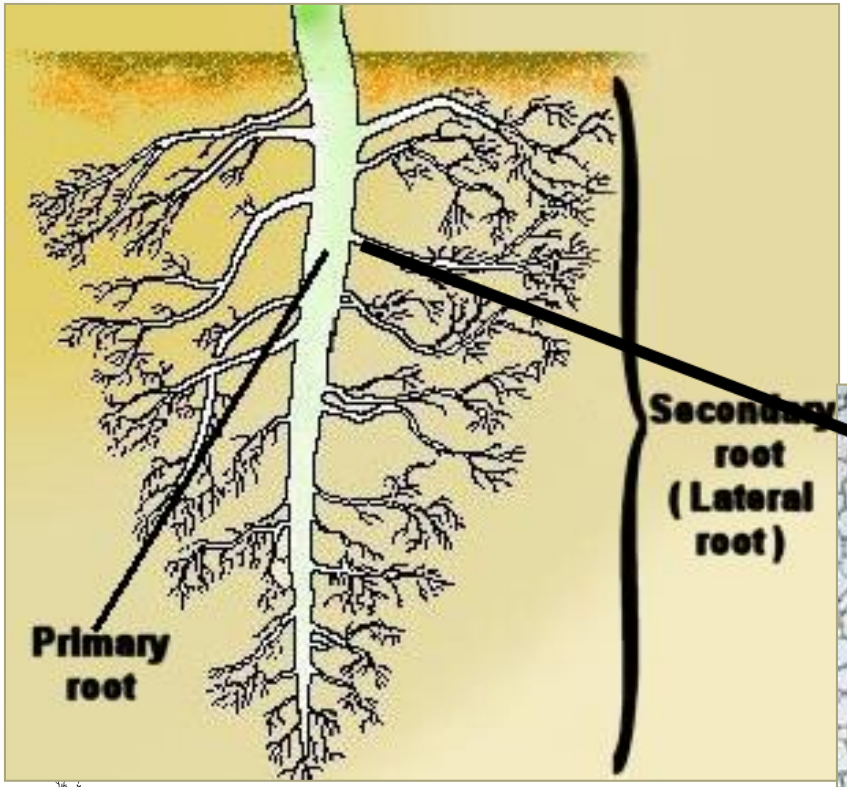


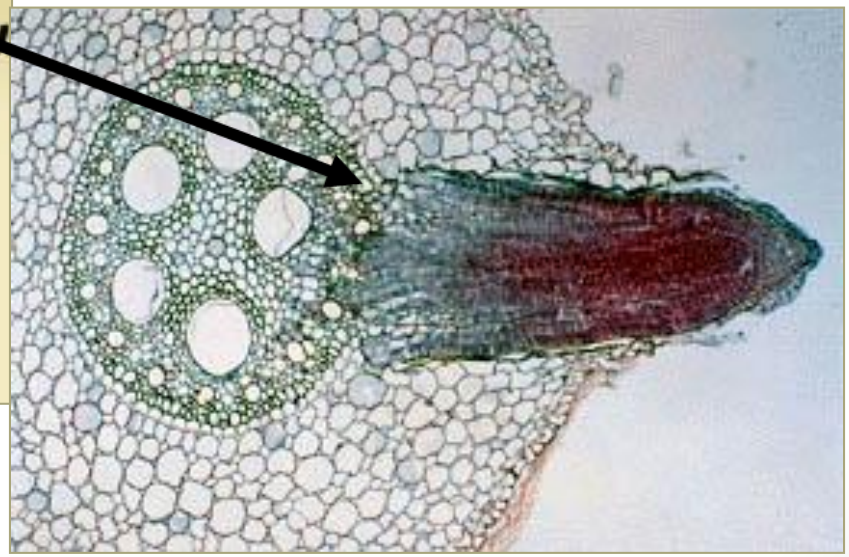


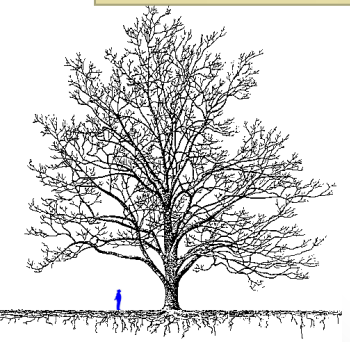
Primary Root of Black Walnut



Secondary Elements of Roots: Lateral Roots

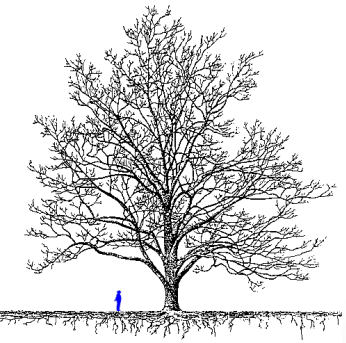




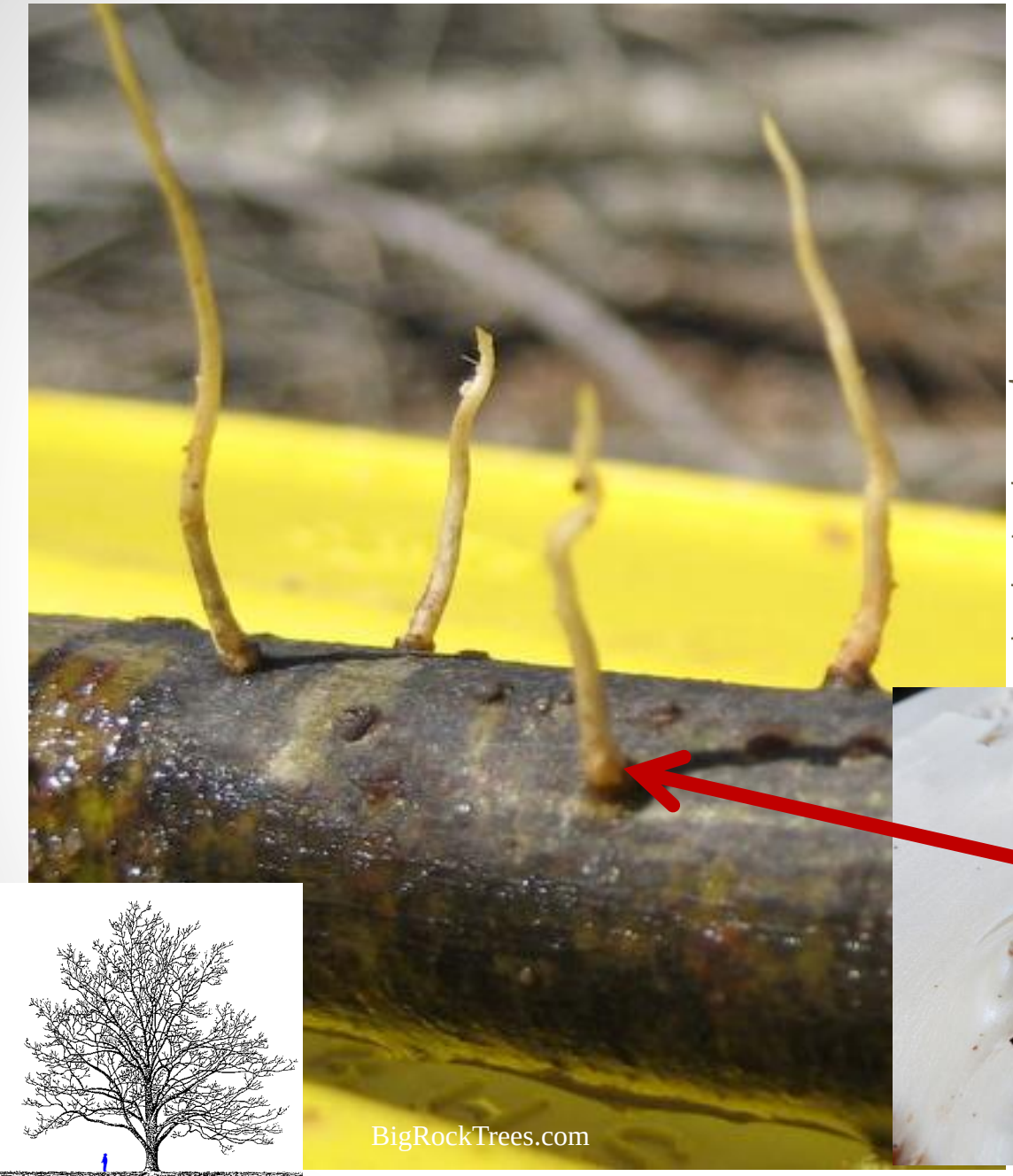


Secondary Elements of Roots: Short Roots

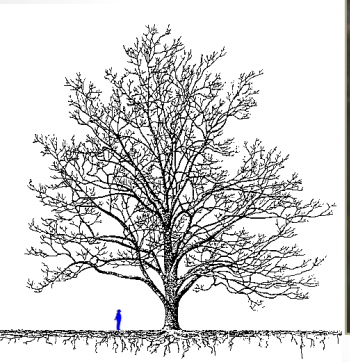
Secondary Elements of Roots: Adventitious Roots



Willow: Preformed Bud Initials

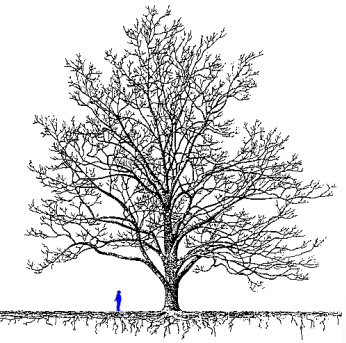


Stem Adventitious Roots of Hackberry in a Floodplain



Stem Adventitious Roots of Hackberry in a Floodplain

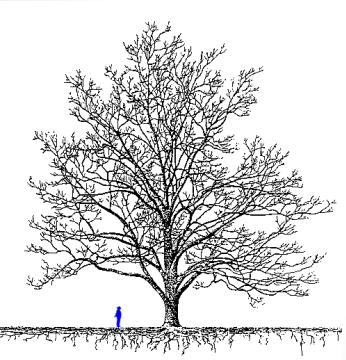
Stem Adventitious Roots of Linden Buried Too Deep in the Landscape



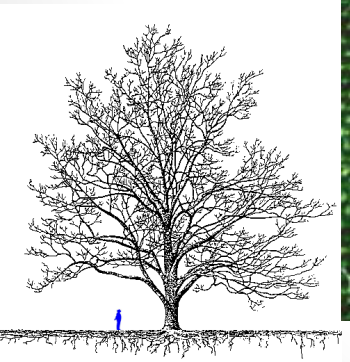
Consequences of Stem Girdling Roots

Consequences of Stem Girdling Roots

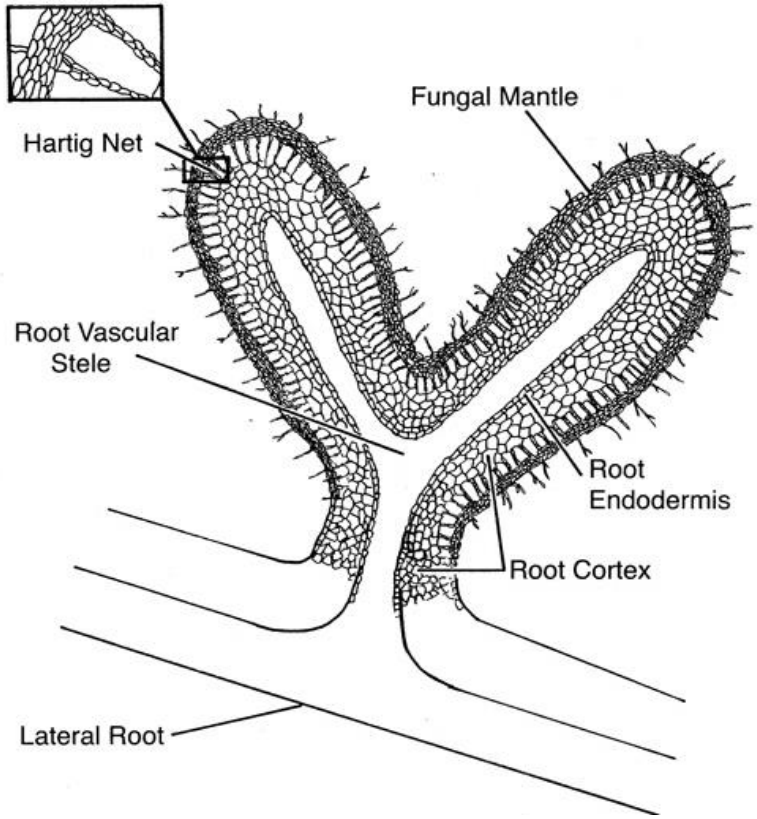
Symbiotic Roots - Mycorrhizae

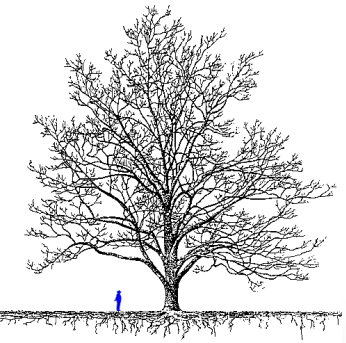


Symbiotic Roots - Mycorrhizae

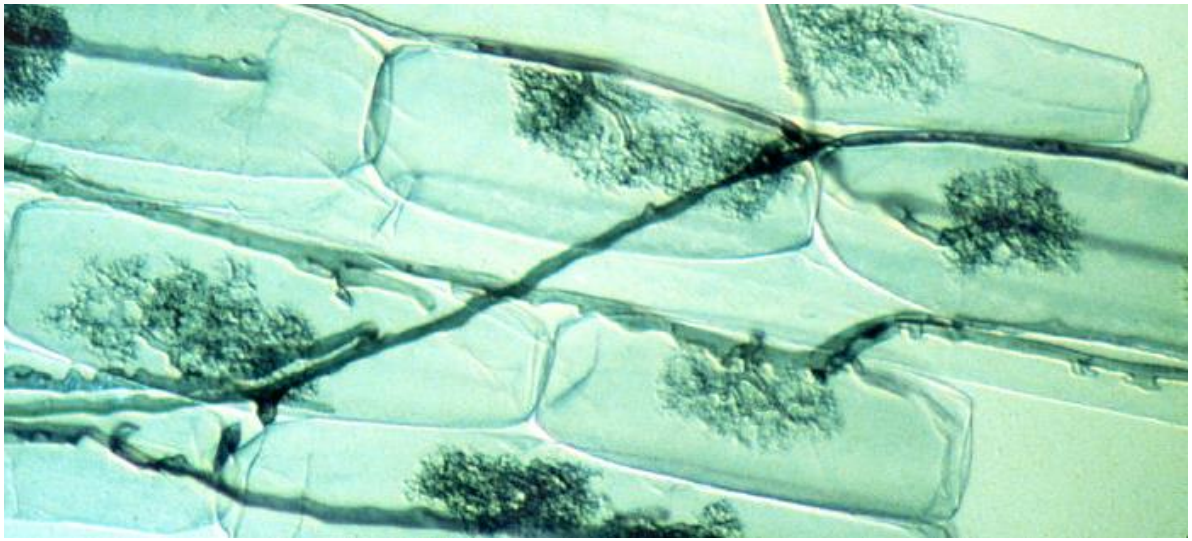


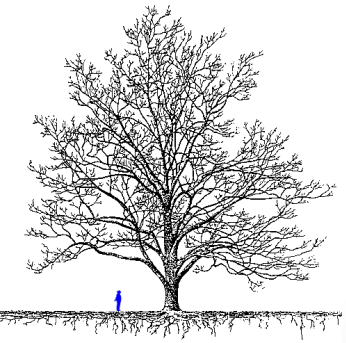
Symbiotic Roots - Ectomycorrhizae

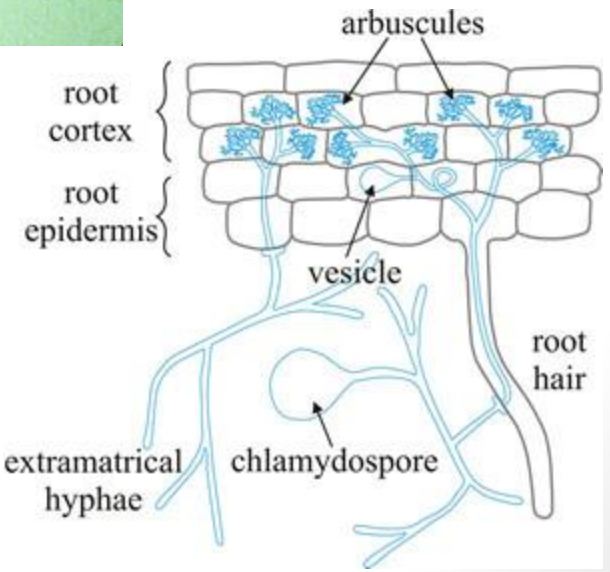




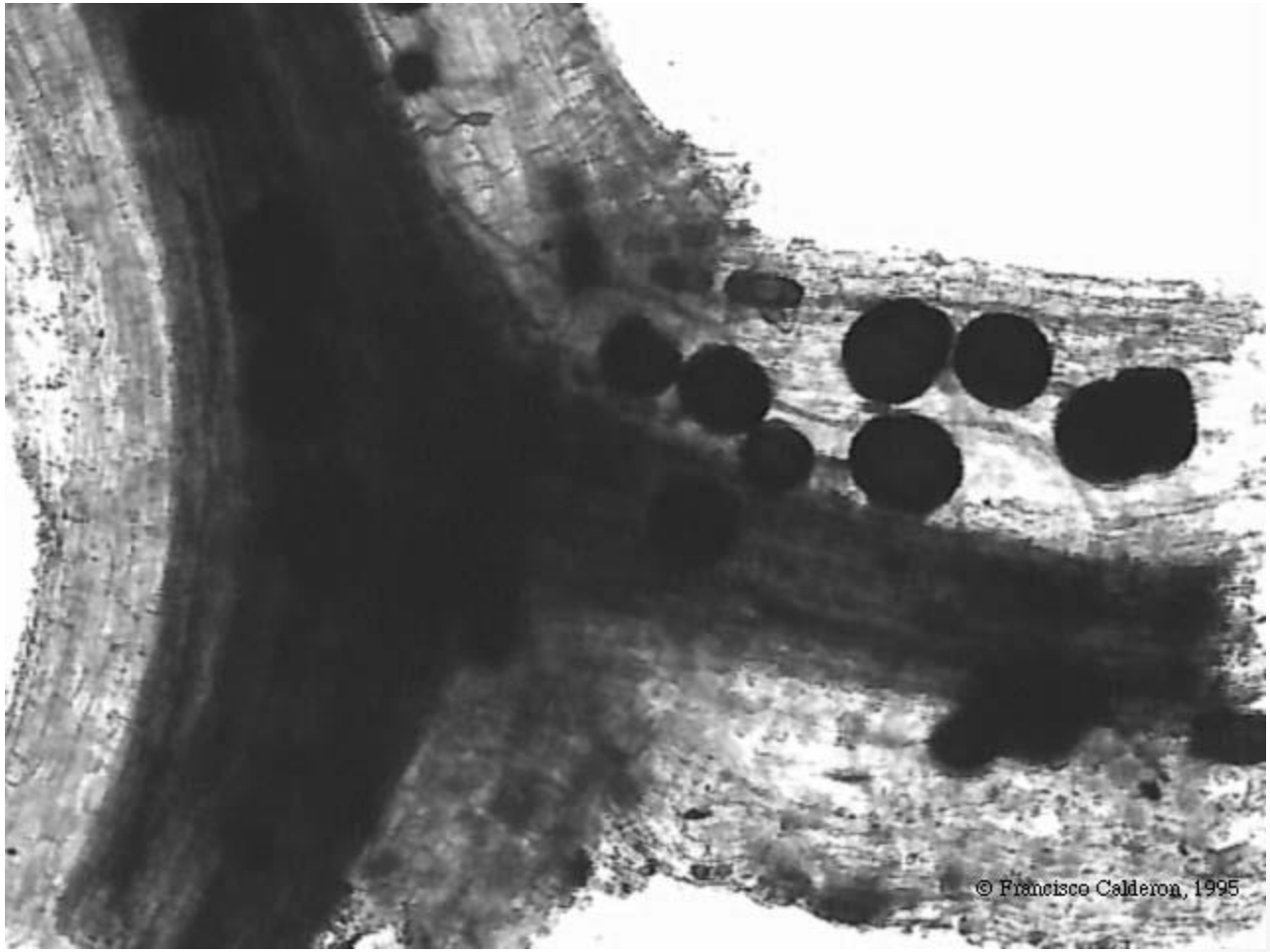
Symbiotic Roots – Arbuscular Mycorrhizae

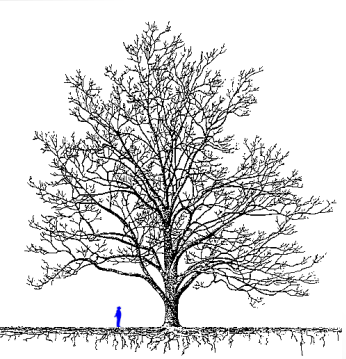




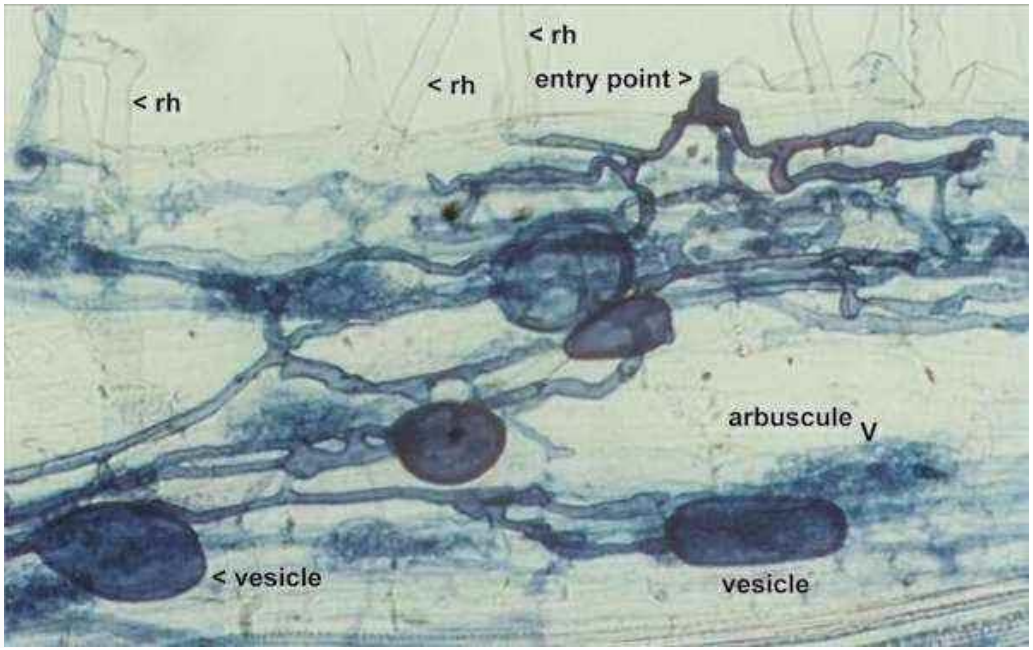


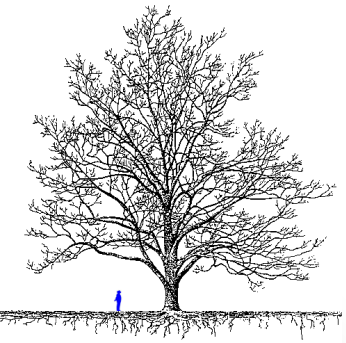
Symbiotic Roots – Vesicular-Arbuscular (VA) Mycorrhizae

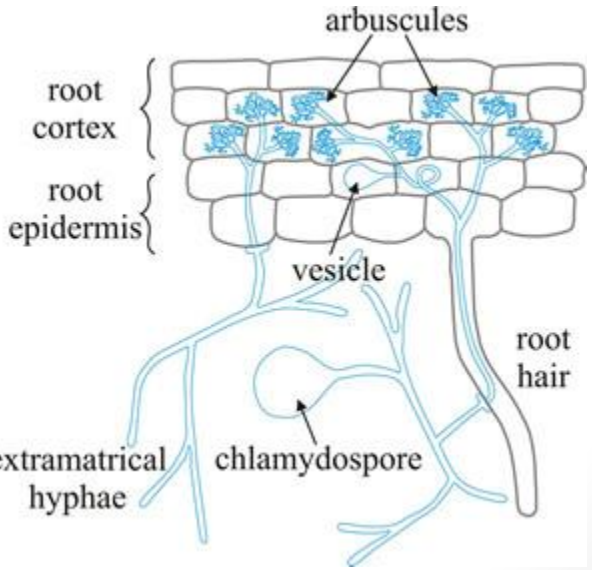




Symbiotic Roots – Vesicular-Arbuscular (VA) Mycorrhizae







Symbiotic Roots – Bacterial Nodules

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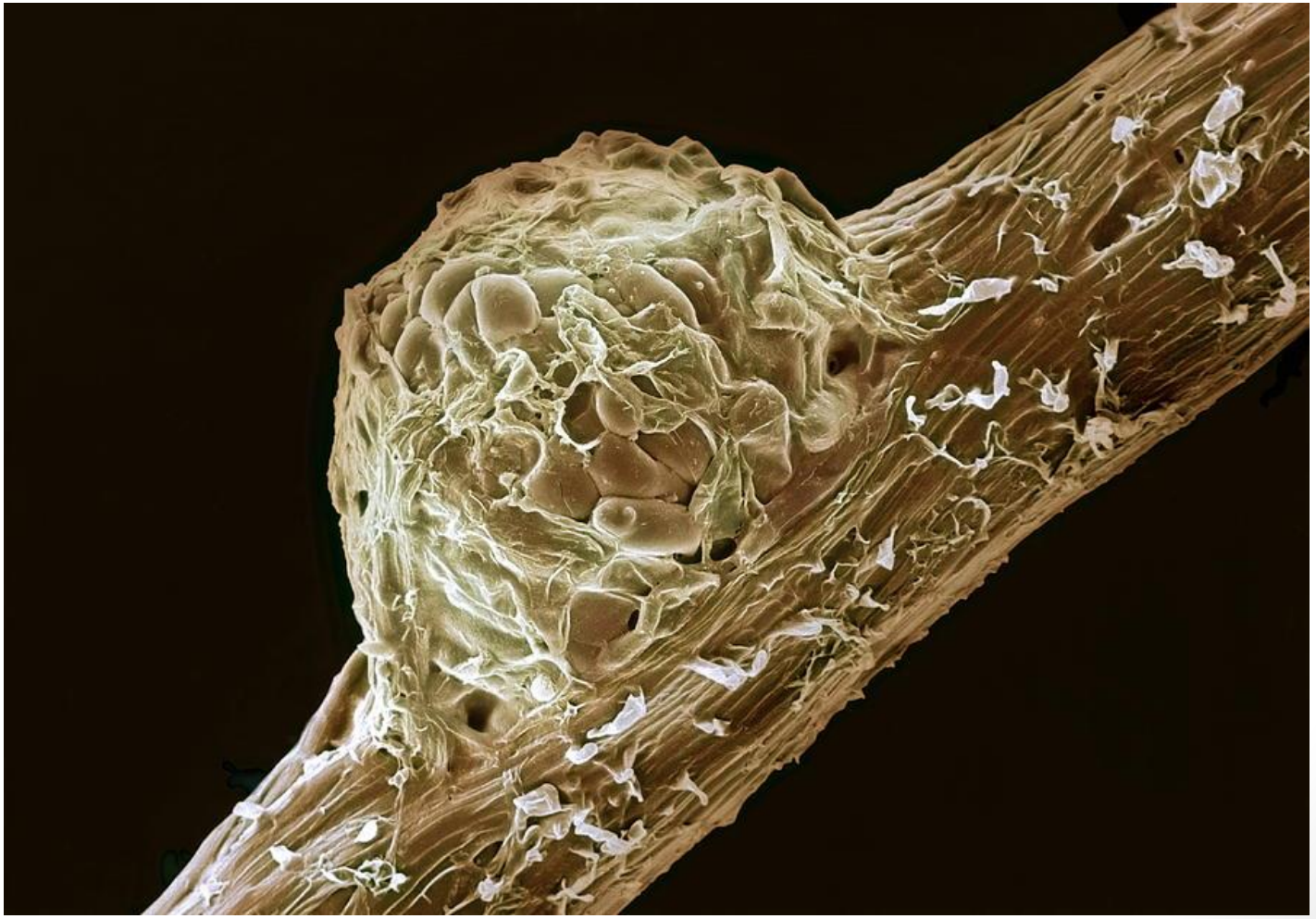
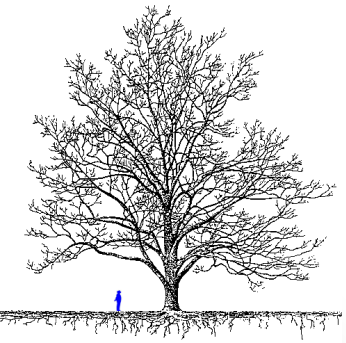
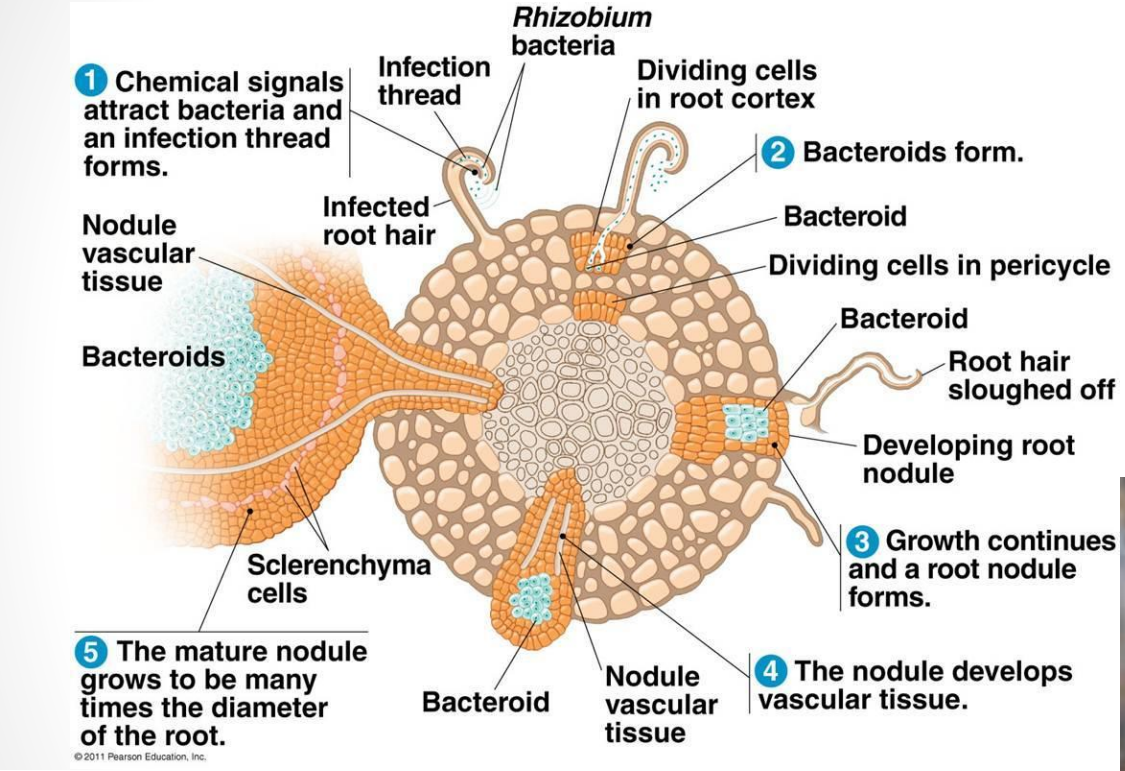


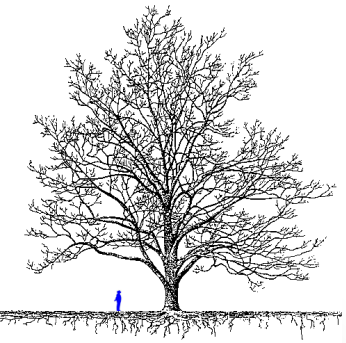
Photo Credit: FineartAmerica.com

Symbiotic Roots – Black Locust Bacterial Nodules



Symbiotic Roots - Alder





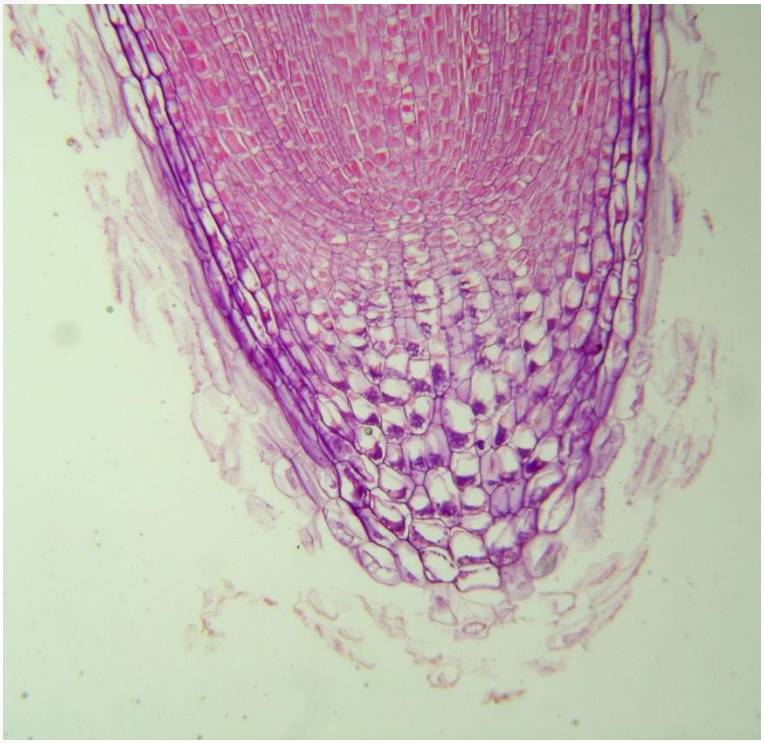
Do Trees Communicate?

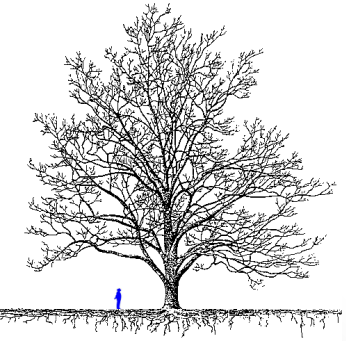
Do Pets Communicate?

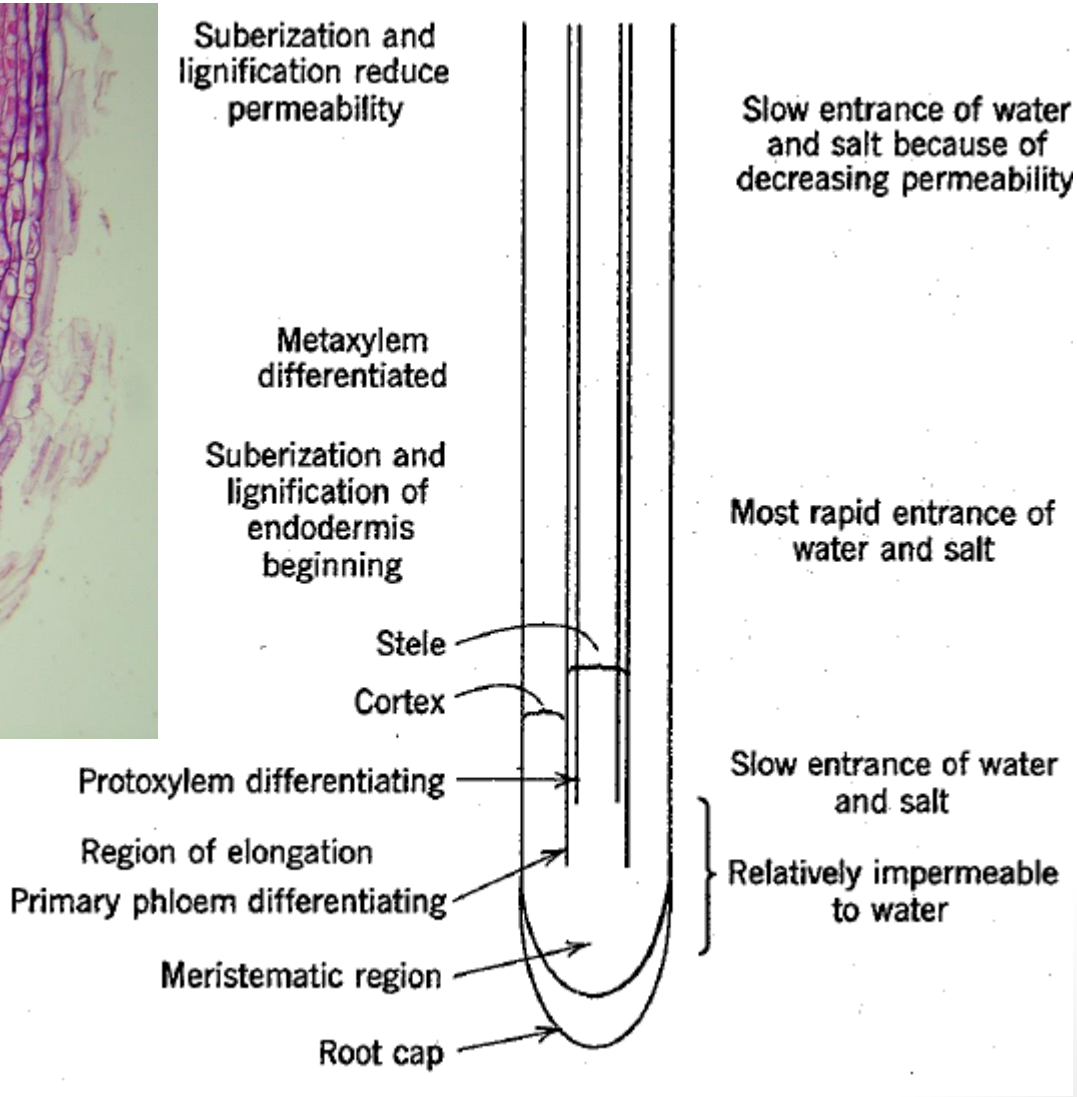
How Do Trees Communicate?

The Wood Wide Web

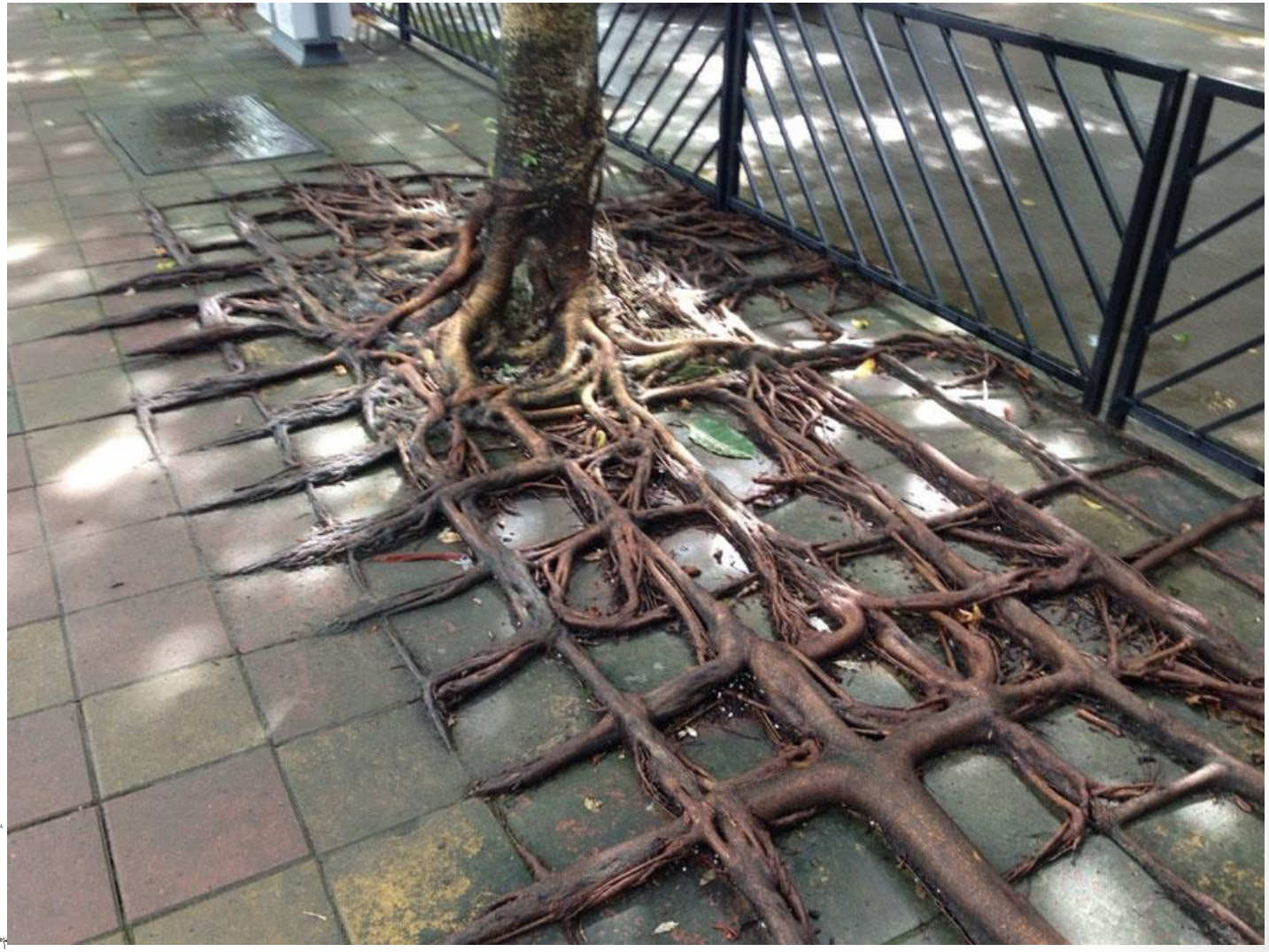
Root Growth

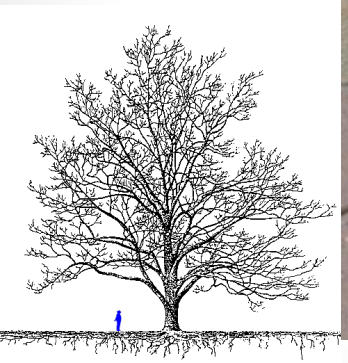




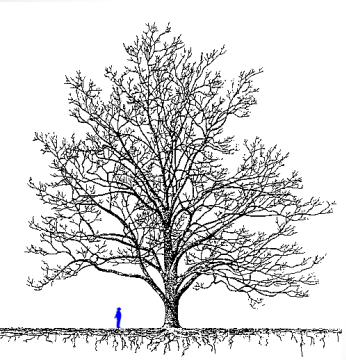

Suberization and lignification reduce permeability
Slow entrance of water and salt because of decreasing permeability
Metaxylem differentiated
Suberization and lignification of endodermis beginning
Most rapid entrance of water and salt
Stele
Cortex
Protoxylem differentiating
Slow entrance of water and salt
Region of elongation
Primary phloem differentiating
Relatively impermeable to water
Meristematic region
Root cap

Root Growth



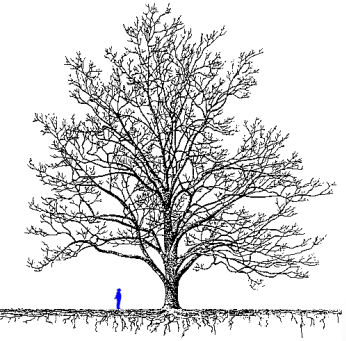


Distribution Criteria - Depth



Root Systems: Top Three Feet

Massive Fine Root System

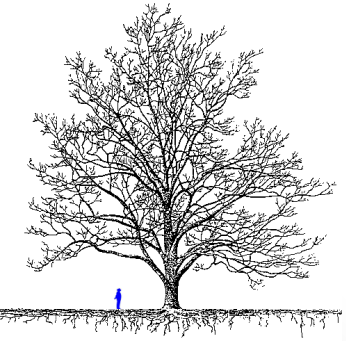


Distribution Criteria - Spread

1:38

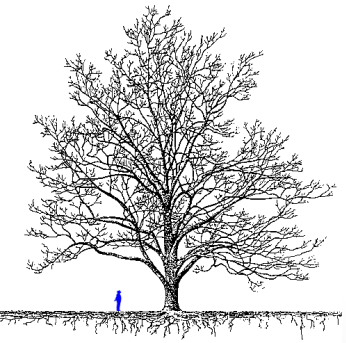
Root Longevity

- Life of the Tree: Most Primary Roots
- Several Years: Most Lateral Roots
- Few Years: Long and Short Roots, Mycorrhizal Roots
- Hours to days or weeks: Root Hairs



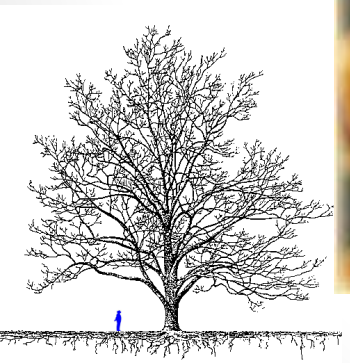
"It must be remembered that a root system is never completed"

R.F. Sutton



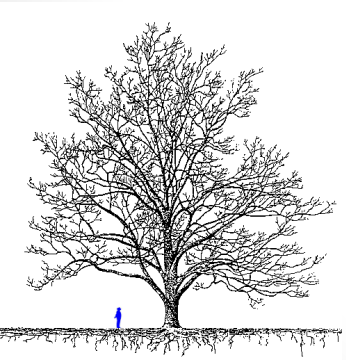
Functional Roots

- Absorption of Water, Mineral Nutrients



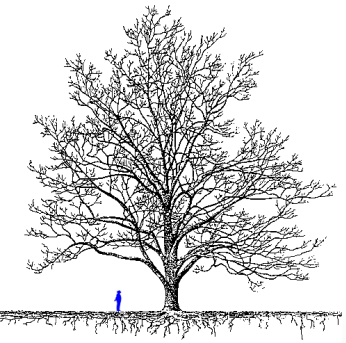
Functional Roots

- Anchorage



Functional Roots: Branch Roots

Photo Credit: Jim Blake



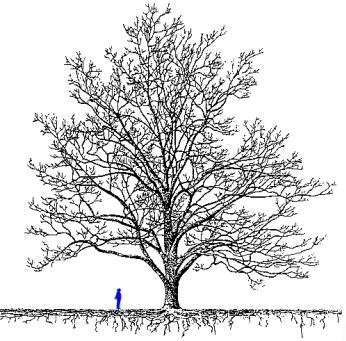
Functional Roots: Branch Roots

Photo Credit: Jim Blake

What Happens When Branch Roots Are Damaged?

Zone of Rapid Taper vs Concrete

Zone of Rapid Taper

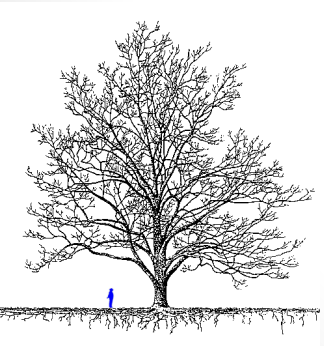


Zone of Rapid Taper vs Concrete

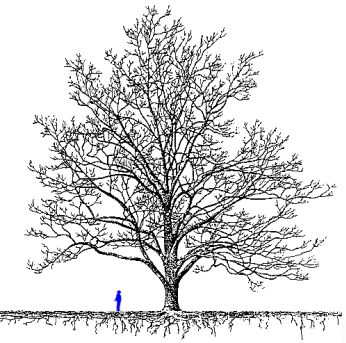
Results: Sidewalk Replacement

Results: Sidewalk Replacement

- The major finding is that having replacement work done **increased the odds of root failure by 2.24** times ($p<0.0001$).
- For illustration, when no replacement work was done, the average Tilia had a 10.6% chance of root failure; this increased to 21.0% when replacement work was done.



Functional Roots – Energy Storage



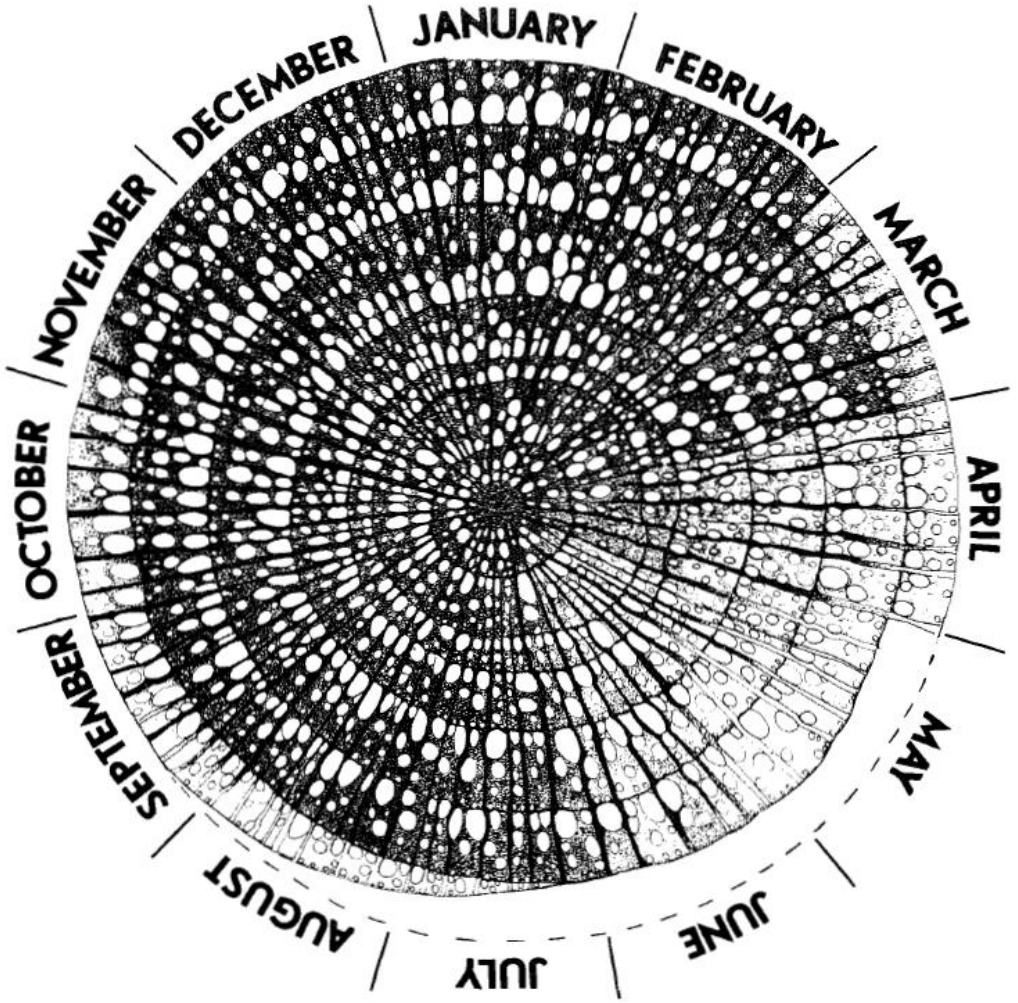


FIG. 10. Diagram of a cross section of a sugar maple root showing the annual cycle of starch depletion and storage, and new xylem growth. Information presented here is based on data included in this study and data gathered in conjunction with another study (Wargo 1975) but not included in that publication.

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