

# Urban Tree Root System Management and Care





# Manage for (Physiological) Balance





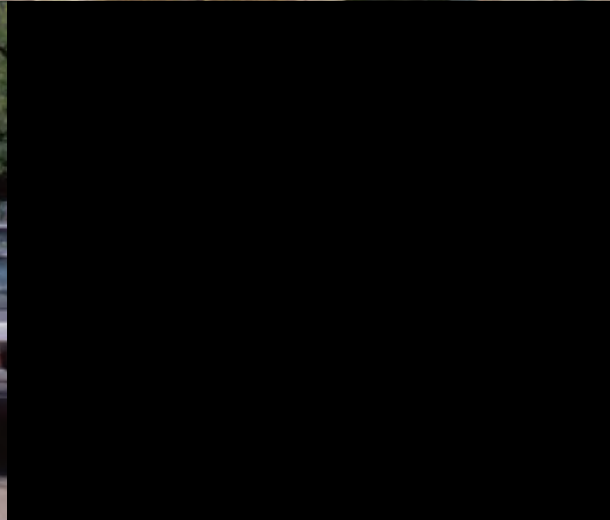
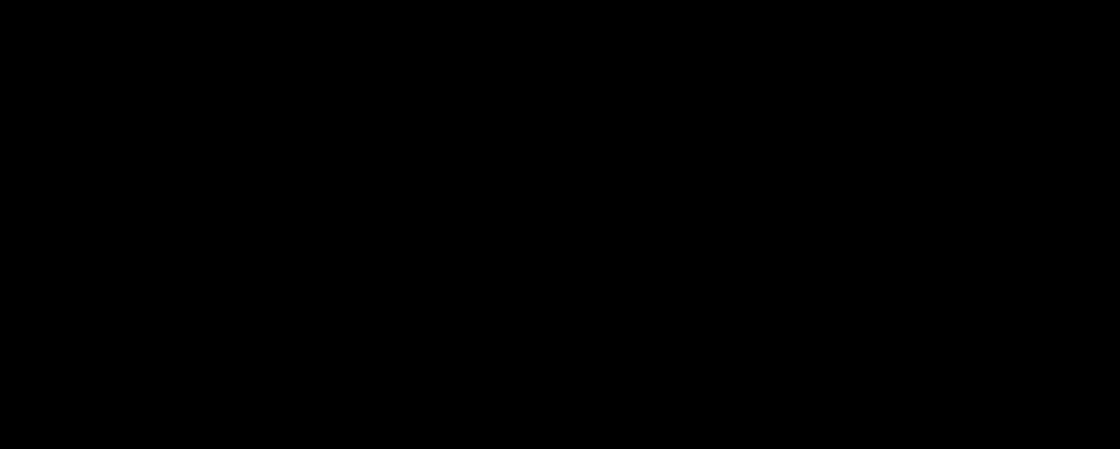




























The most  
limiting factor  
determines  
growth potential





Dry



Structure



Wet



No Structure







0-12 in.

12-20 in

20-30 in





0-12 in

12-20 in

20-30 in

Soil with structure





Coarse texture

Fine Texture



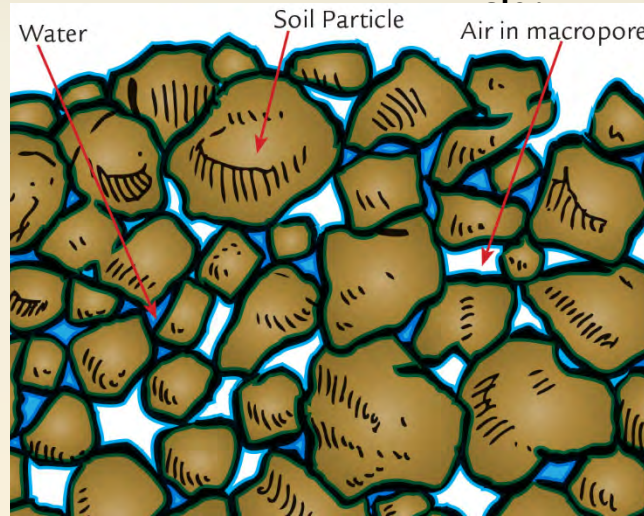
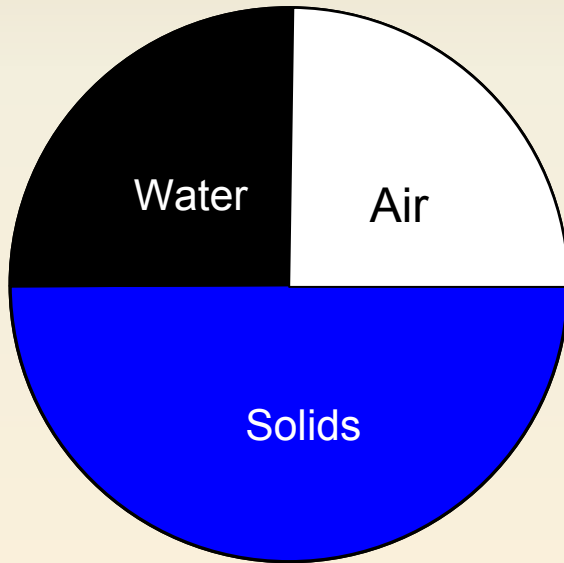




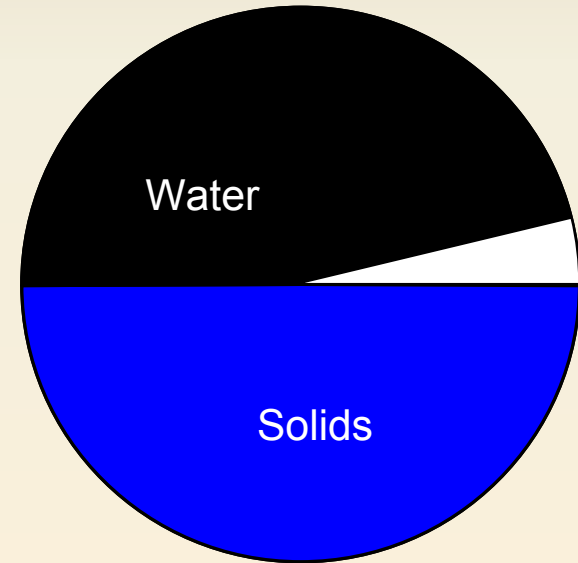


# Excess Moisture Restricts Aeration

Ideal Soil

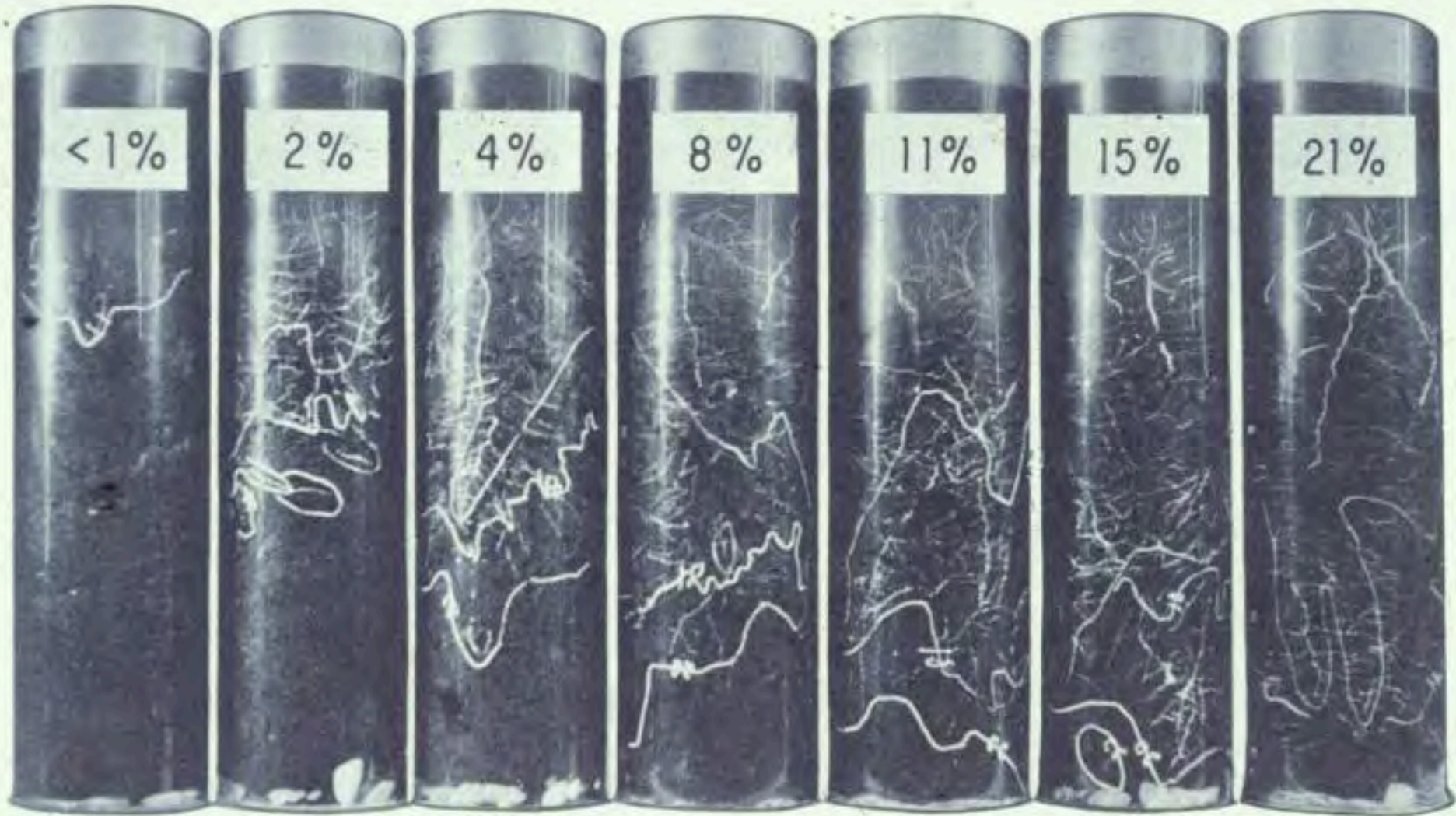


Waterlogged soil





Root growth is reduced at about 10 percent oxygen





# A Good Indicator of Soil Aeration

First used for the determination of the depth of onset of waterlogged conditions in the soil (Carnell and Anderson 1986)

Rust = good aeration

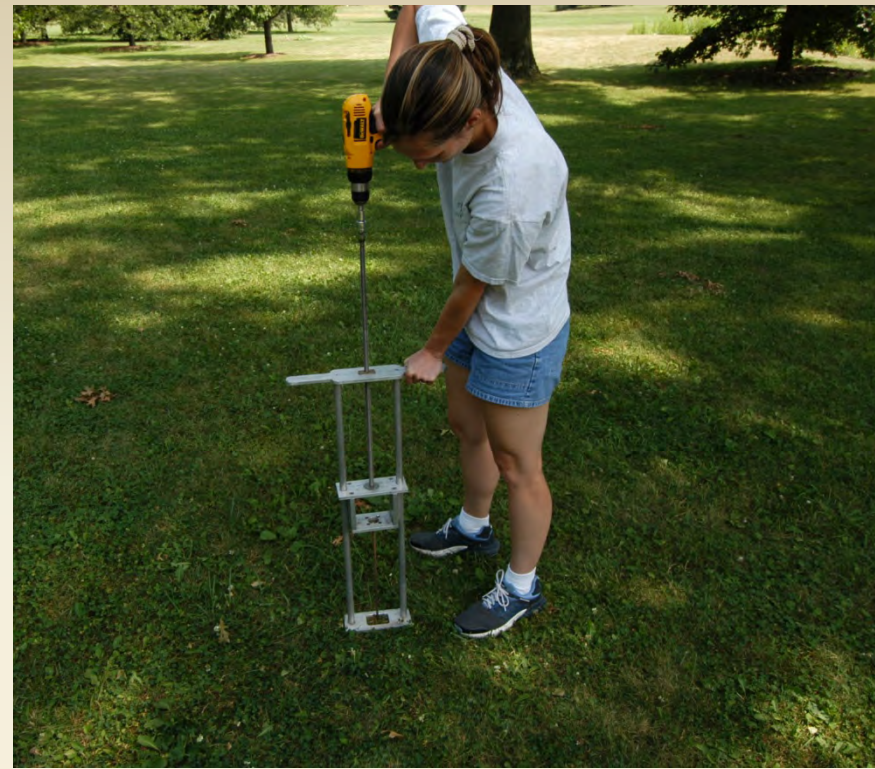


Matt gray = anaerobic conditions



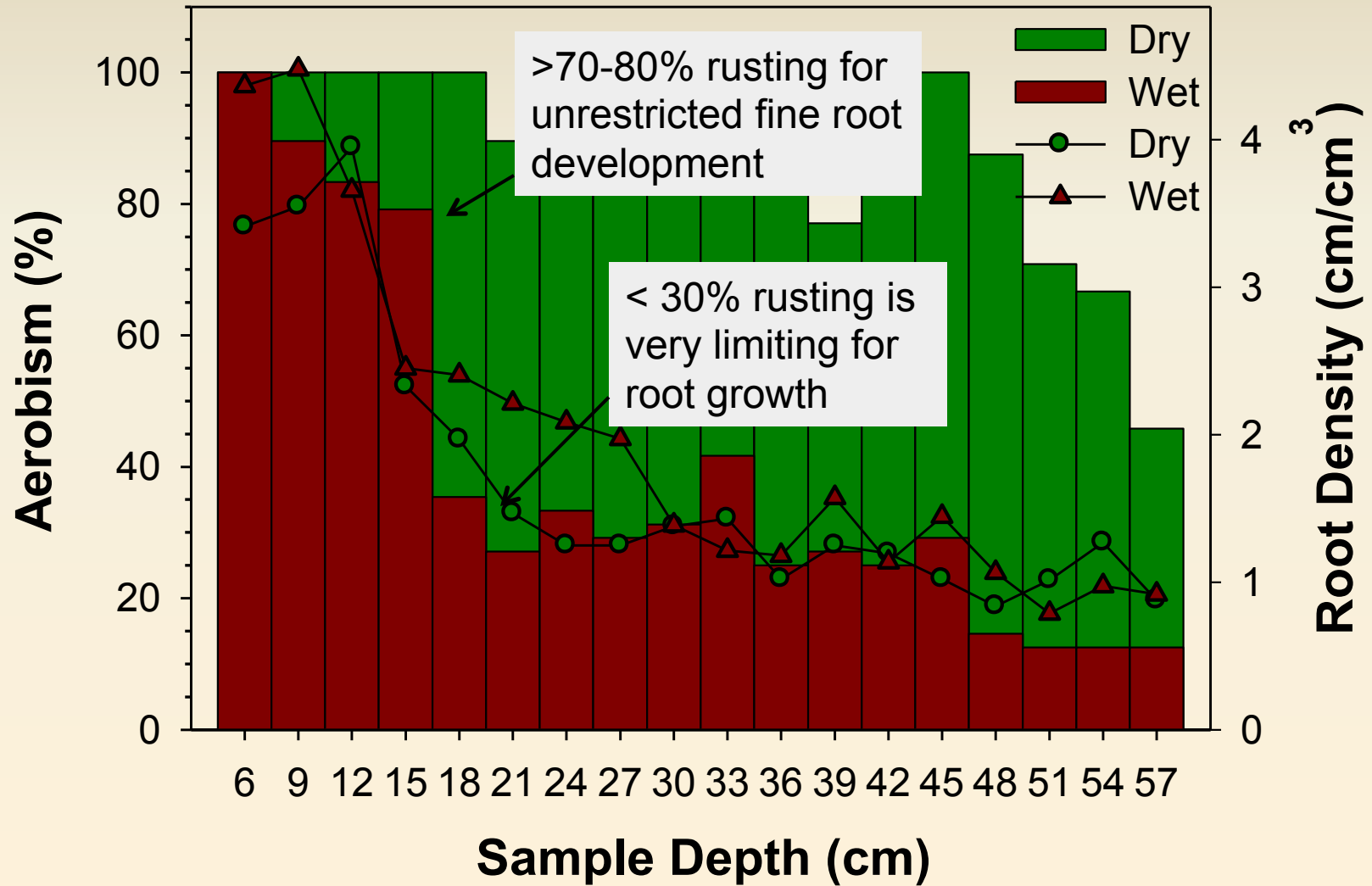


Placement and removal of the rods is easy with the right equipment





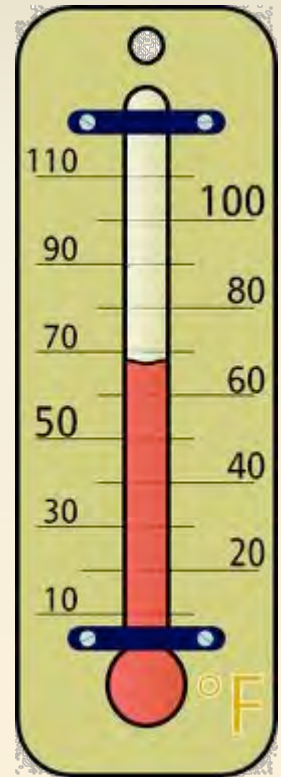
# Sugar Maple





# Root Sensitivity to Temperature

- Root tissues of woody plants can be killed at soil temperatures of 20 to 7°F (-7 to -12°C)
- Minimum temperatures for root growth range from 36-52°F (2-11°C)
- Active root growth occurs above soil temperatures of 50-60°F (10-15°C)
- Maximum temperatures for active growth have been reported at 77-100°F (25-37°C)
- Direct heat injury of roots can occur when the soil remains above 90°F (32°C) for an extended period





# Fine Root Turnover







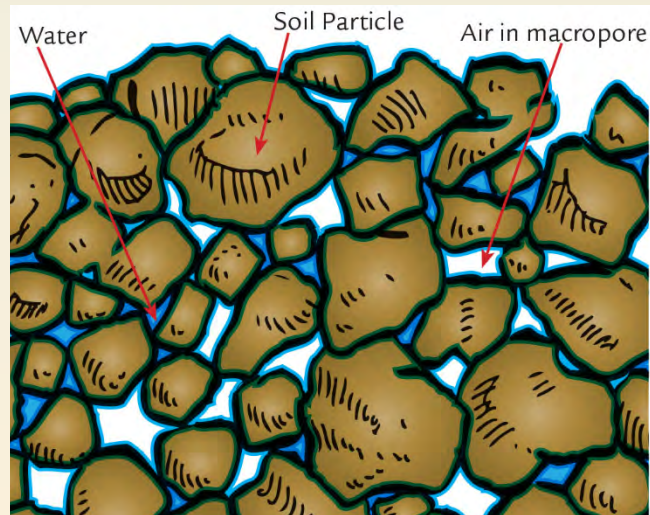
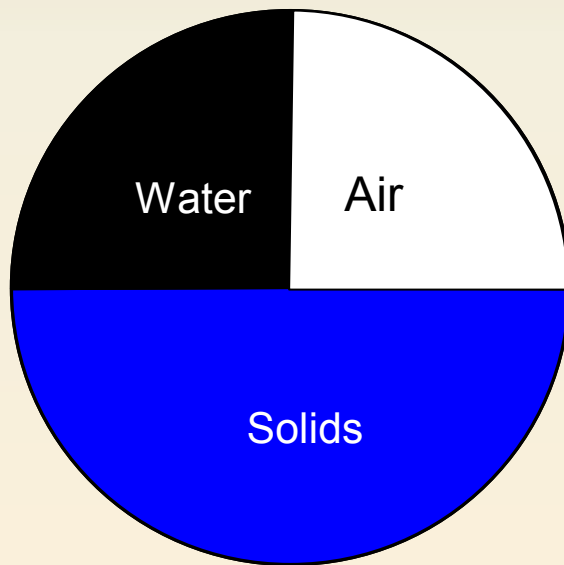




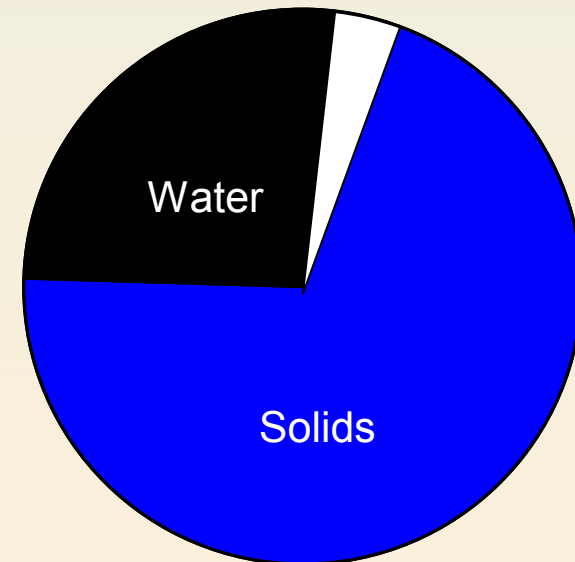


# Soil Compaction Restricts Aeration

Ideal Soil



Compacted Soil









# Soil Bulk Density and Root Growth

<b>Soil texture</b>	<b>Ideal (g/ cm<sup>3</sup>)</b>	<b>May affect root growth (g/cm<sup>3</sup>)</b>	<b>Restricts root growth(g/ cm<sup>3</sup>)</b>
Sands, loamy sands	<1.60	1.69	>1.80
Sandy loams, loams	<1.40	1.63	>1.80
Sandy clay loams, clay loams	<1.40	1.60	>1.75
Silts, silt loams	<1.30	1.60	>1.75
Silt loams, silty clay loams	<1.10	1.55	>1.65
Sandy clays, silty clays, some clay loams (35-45% clay)	<1.10	1.49	>1.58
Clays (>45% clay)	<1.10	1.39	>1.47





Fast forward



# Consider These Two Systems



**Would the Same Types and Quantities of Soil Microorganisms Present be the Same in Both?**



# Organisms in Healthy Soils

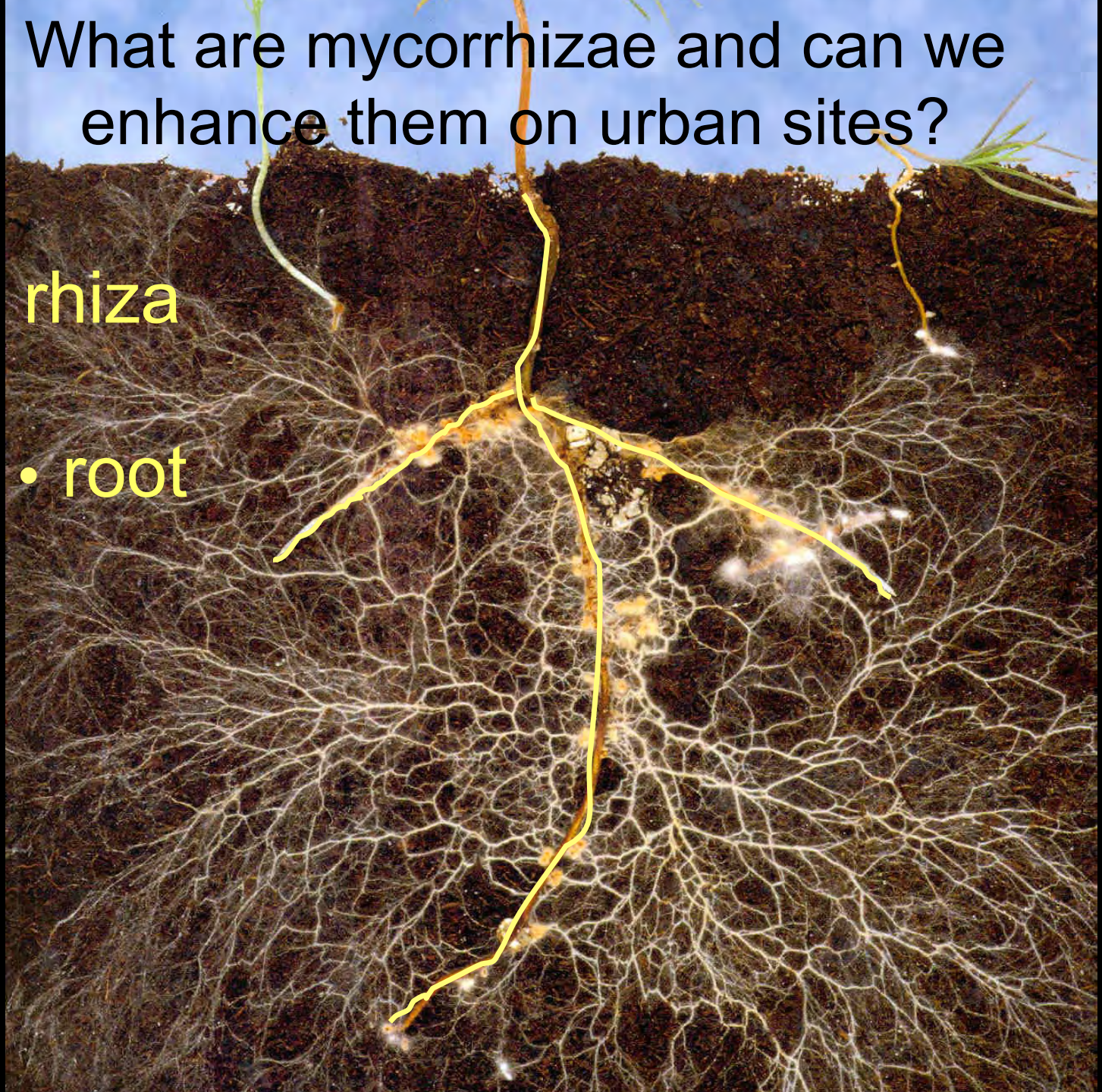
	Grass	Forest
Bacteria	1	1
Fungi	1	2000
Protozoa	1	100
Nematodes	1	10
Arthropods	1	15
Earthworms	1	1



What are mycorrhizae and can we enhance them on urban sites?

Mycor • rhiza

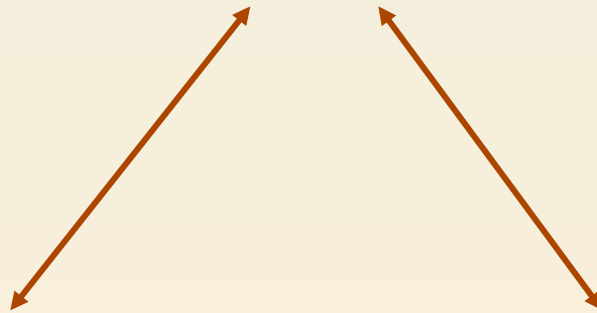
Fungus • root





# Mycorrhizal Triangle

**Susceptible Plant Root**  
(sugars, “helper microbes”)



**Viable Fungal  
Inoculum**  
(spores, hyphae)

**Favorable Soil  
Environment**  
(temp. O<sub>2</sub>, pH, H<sub>2</sub>O,  
fertility)







Natural Mulch



# Effect of Wood Chip Mulch on White Oak Roots

	Mulch	Grass
Moisture Content (%)	30.8	18.9
Soil pH	5.8	6.7
Bulk Density (g/cc)	0.78	1.14
Root Density	6.2	3.2
Mycorrhizal tips (%)	31.8	14.5



# Grass



# Mulch





# Can fertilizer promote root growth?

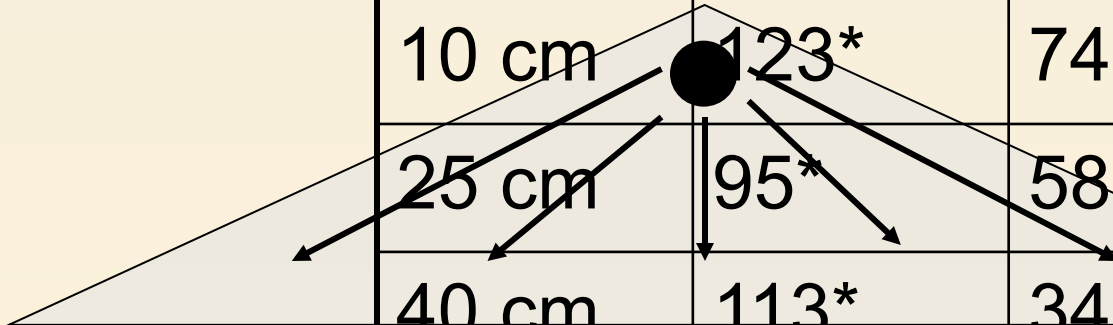
**Table 2. When nitrogen fertilizer was applied in holes in the soil, root density of trees was increased by the nitrogen, alone or in a balanced formulation.**

		Root density ( mm <sup>2</sup> surface area/cm <sup>3</sup> soil)								
		Nitrogen only			Balanced fertilizer			Control		
Sample depth	10 <sup>a</sup>	17.5	25	10	17.5	25	10	17.5	25	
<b>Honeylocust</b>										
5 - 10 cm	123*	74	53	117*	87	68	52	50	60	
20 - 25 cm	95*	58*	43	192*	59*	41	36	29	30	
35 - 40 cm	113*	34*	22*	107*	36*	13	18	13	12	
<b>Pin oak</b>										
5 - 10 cm	80*	26	26	41	36	30	28	28	29	
20 - 25 cm	32*	16	16	28	19	17	13	11	9	
35 - 40 cm	20*	12	8	8	10	7	10	9	9	



# Roots concentrate in nutrient rich soil

	Distance from Nitrogen Source		
Depth	10 cm	17.5 cm	25 cm
10 cm	123*	74	53
25 cm	95*	58*	43
40 cm	113*	34*	22*



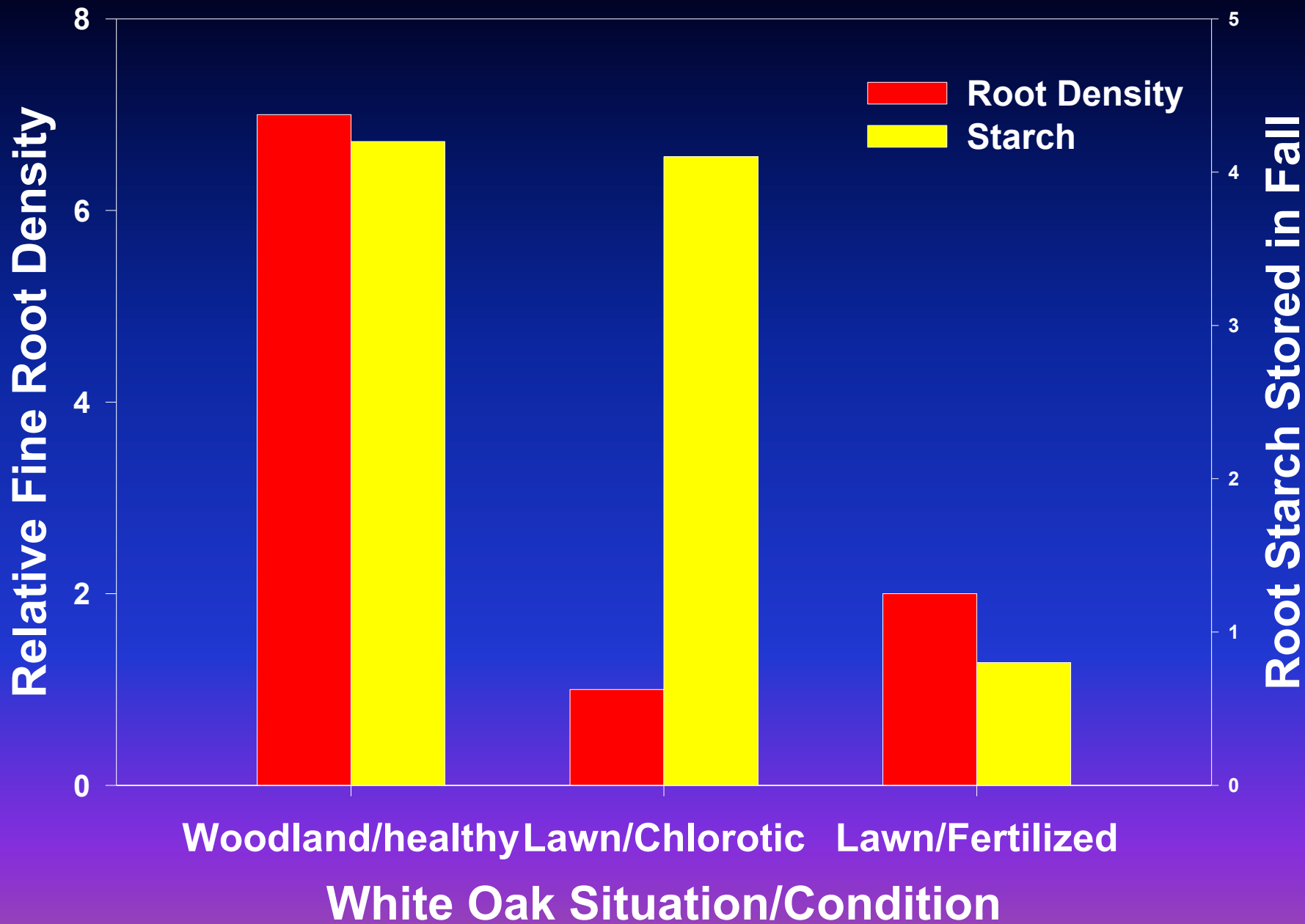
The diagram illustrates the root distribution in soil layers. A black dot is positioned at the intersection of the 10 cm depth row and the 10 cm distance column. Arrows point from this dot to the 10 cm, 25 cm, and 40 cm depth rows in the 10 cm distance column. Another arrow points from the dot to the 10 cm depth row in the 17.5 cm distance column. A shaded triangular region is shown on the left side of the table, with its base at the 40 cm depth row and its apex at the 10 cm depth row, spanning the 10 cm and 17.5 cm distance columns.

\* significantly greater than control



Can (over) fertilization harm trees?







30 feet



