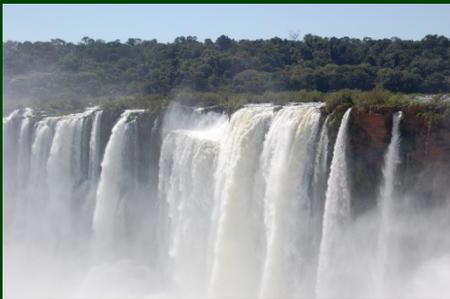


# ISA Arborist Certification Training Chapter 4 - Water Relations

Illinois Arborist Association  
Arborist Certification  
Training

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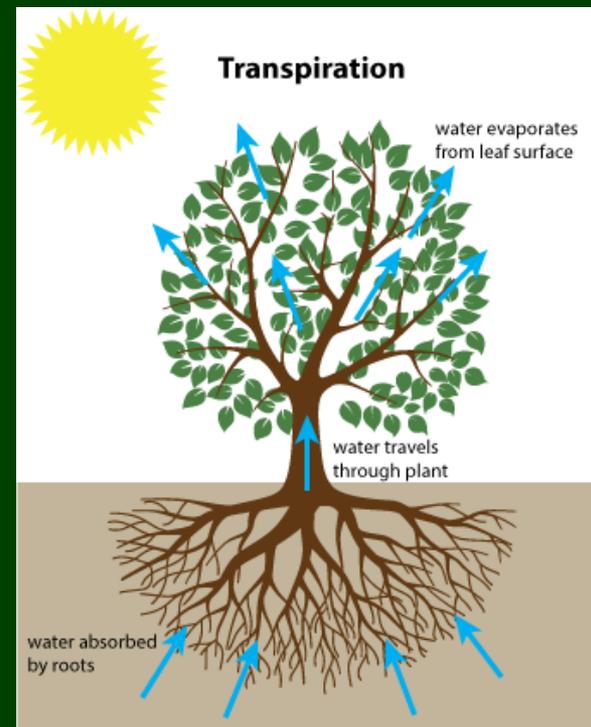


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# Introduction

## Water is essential for tree growth:

- ❖ Trees absorb water and minerals (in water solution) from the soil. Large trees can absorb hundreds of gallons per day.
- ❖ However, most water is lost through transpiration. This is the loss of water vapor through leaf stomates.



# Introduction

**Water is essential for tree growth:**

With reduced soil moisture nutrient uptake and photosynthesis is reduced.



Photo Credit: Kramer Tree



# Tree/Soil Relations

## Soil Texture

**Texture is a combination of three soil particle types.**

- ☼ Sand – largest particles, coarse textured**
- ☼ Silt – medium texture**
- ☼ Clay – smallest particles, fine textured**

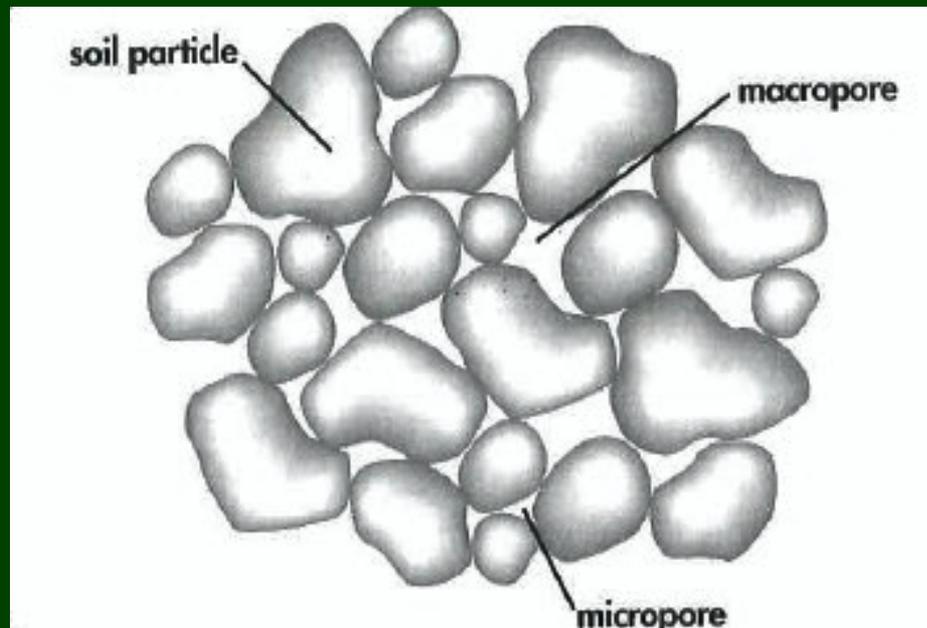
**Water holding capacity and other attributes of the soil is determined by texture.**



# Tree/Soil Relations

**Macropores** – Large gaps between soil and aggregate particles, normally filled with air, temporarily holds gravitational water.

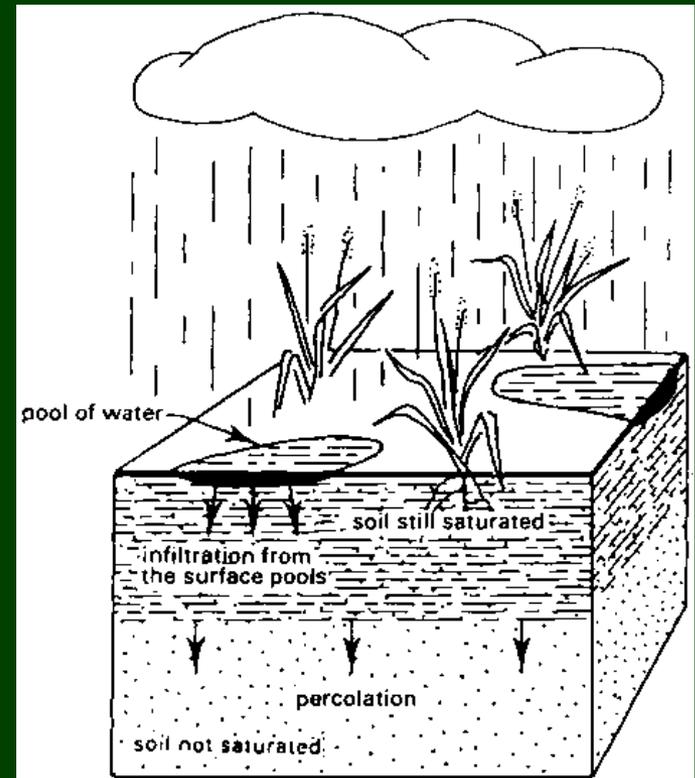
**Micropores** – Small gaps between soil and aggregate particles, normally filled with water.



# Water Movement

 **Infiltration** - how water moves into the soil from the surface

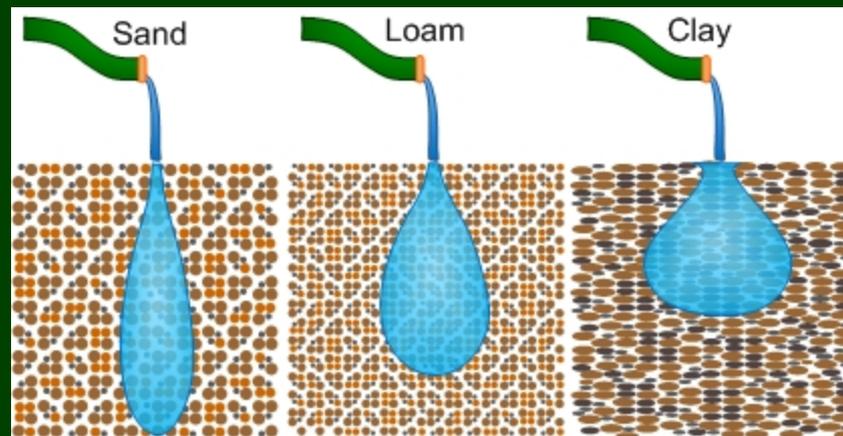
 **Percolation** - how water moves through the soil



# Water Movement

## Movement rates vary with soil texture

- ❖ Sandy soils process water quickly and must be irrigated more often
- ❖ Clay absorbs slowly so water must be applied slower and longer



# ...But Not Too Much

## Too much water causes bigger problems

- ❧ Inadequate drainage decreases available soil oxygen
- ❧ Highly soluble salts in irrigation water



# Water Needs Vary

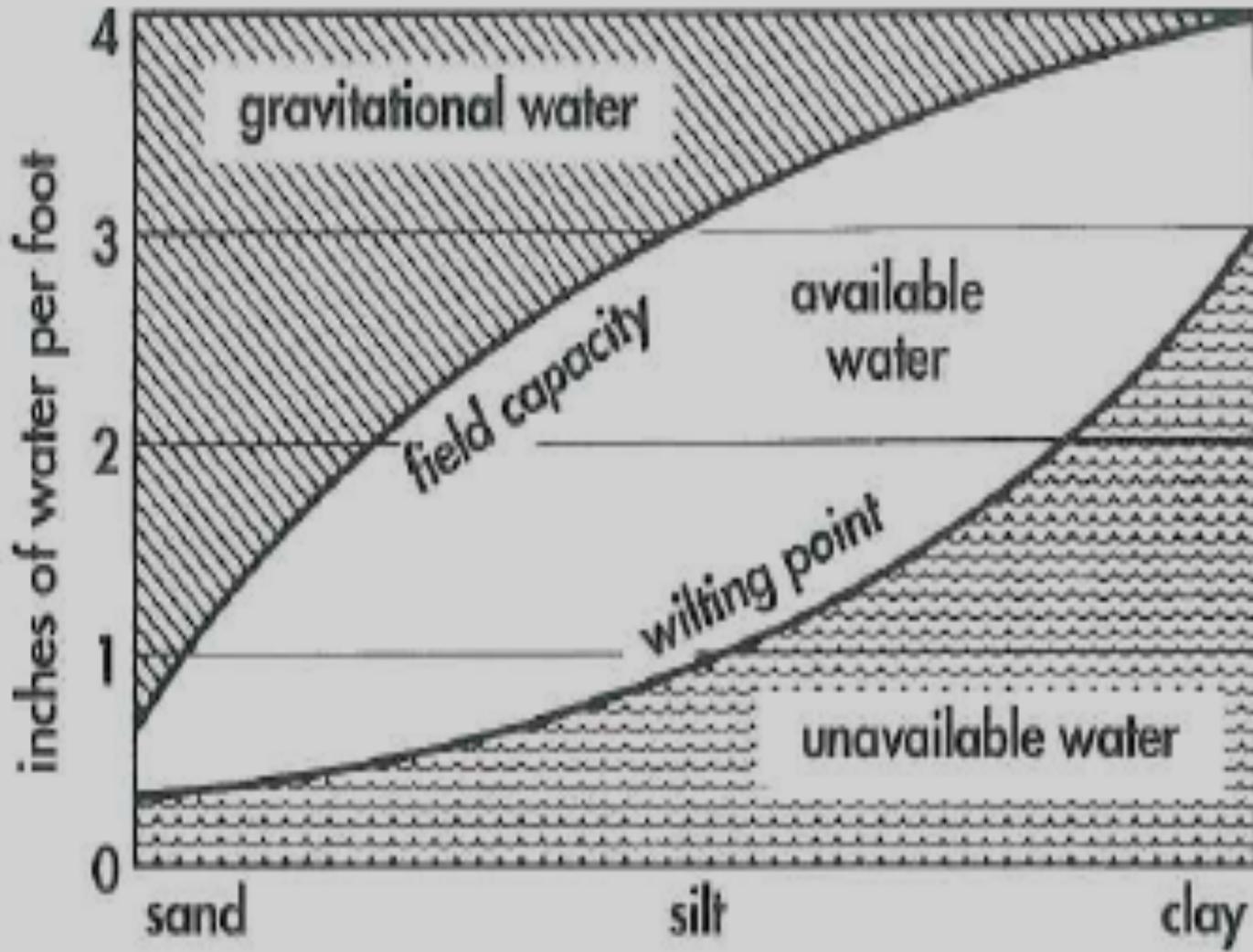
- ❖ **Species specific requirements**
- ❖ **Fluctuations in Microclimate Affect Immediate Demands**
  - **Air temperature**
  - **Humidity**
  - **Light**
  - **Wind**



# Lack of Water (Drought) Causes:

- ❧ **Wilting**
- ❧ **Leaf drop**
- ❧ **Modified leaf development**
- ❧ **Reduces development of absorbing roots**





# Difference in Water Requirements

## ☞ High Water Use Species

- Large amounts of water
- Large, spreading root systems
- Not drought tolerant

## ☞ Drought Impacts High Water Use Species

- Wilting is common during hot, sunny days
- Recovery happens over night. Leaves become fully hydrated (turgid)
- Too much wilt: leaves and roots can be lost causing decline

# Difference in Water Requirements

## Low Water Use Species

- Minimal water consumption
- Less loss through foliage
- Smaller, thicker, leathery leaves
- Sunken stomata
- Adversely affected by supplemental water



# Effects of Flooding

- ❧ Soil oxygen is reduced
- ❧ Chemical changes of essential elements
- ❧ Mineral toxicities
- ❧ Fermentation in root cells (root rot)



# Effects of Flooding – Short Term

- ❧ **Photosynthesis stops**
- ❧ **Transpiration slows**
- ❧ **Some soil organisms die**



# Effects of Flooding – Long Term

- ❧ Unable to tolerate future flooding
- ❧ Unable to defend against pests
- ❧ Stability issues – root loss and saturated soils
- ❧ More prone to collar/root rot
- ❧ Grade, drainage, and erosion changes



# Irrigation – How Much?

**Enough water should be supplied to the soil to replace what the plant uses, and what is lost to evaporation and percolation**



# How Much is That?

- ✦ Newly planted trees require frequent watering
- ✦ Mature trees require far less
- ✦ Water enough to ensure good soil saturation which promotes deeper rooting.
- ✦ Frequent watering on mature trees promotes
  - shallow rooting (reduce drought tolerance)
  - soil compaction (which can deter infiltration)



# Irrigation Tips

- ❁ **Water during late night or early morning**
- ❁ **Water as much of the root system as possible**
- ❁ **Do not water lower trunk (fungal decay)**
- ❁ **Watch for poor drainage, runoff, and evaporation**
- ❁ **Do not exceed infiltration rate**
- ❁ **Minimize water on foliage**
- ❁ **Sprinklers can cause surface compaction**
- ❁ **Use mulch to retain moisture and reduce compaction**
- ❁ **Irrigate longer, but less frequently to avoid salt buildup**



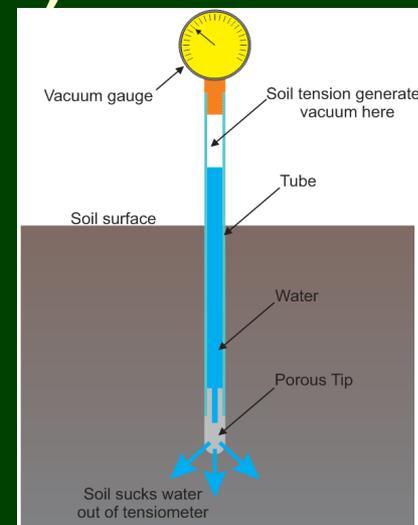
# Irrigation Methods

- ❧ Sprinklers
- ❧ Drip irrigation
- ❧ High pressure water injection
- ❧ Soaker hoses
- ❧ Portable systems



# Methods to Minimize Irrigation

- ❧ Xeriscaping (Landscaping with drought tolerant plants)
- ❧ Understanding evapotranspiration (plant and soil water loss calculations)
- ❧ Soil moisture monitoring (tensiometers)



# Recycled Water

- ❁ **Potential for high amounts of dissolved mineral salts or other minerals**
- ❁ **pH changes**
- ❁ **Can be high in nitrogen, phosphorus, and sulfur**
- ❁ **Monitor soil conditions and plant health often**



# Water Conservation

## Benefits of Mulch

- Reduces water evaporation
- Less weed competition
- Less soil erosion
- Better soil aeration
- Moderates soil temperature
- Less mechanical damage
- It looks good



# Antitranspirants

- ❧ Spray coating used to prevent water loss due to transpiration (reduces water loss through stomates)
- ❧ Used when transplanting in off season
- ❧ Protect from drought
- ❧ On evergreens in winter
- ❧ Can be phytotoxic to some species



# Water Saturated Soils

## Drainage

- ❧ Most plants do not like saturated soils
- ❧ Use drain tiles, or re-grade the site (careful of existing trees)
- ❧ Choose the right plants. If site is chronically wet, some trees will work (Taxodium, Salix, Alnus, etc.)

