WATER MANAGEMENT

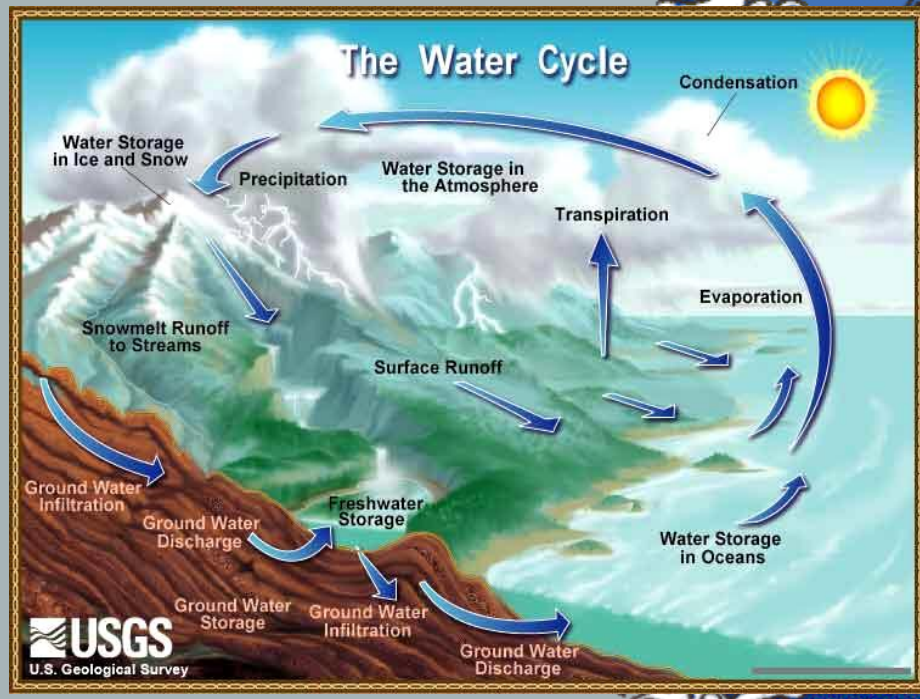
Water requirements for trees

Good water management

Watering and soils

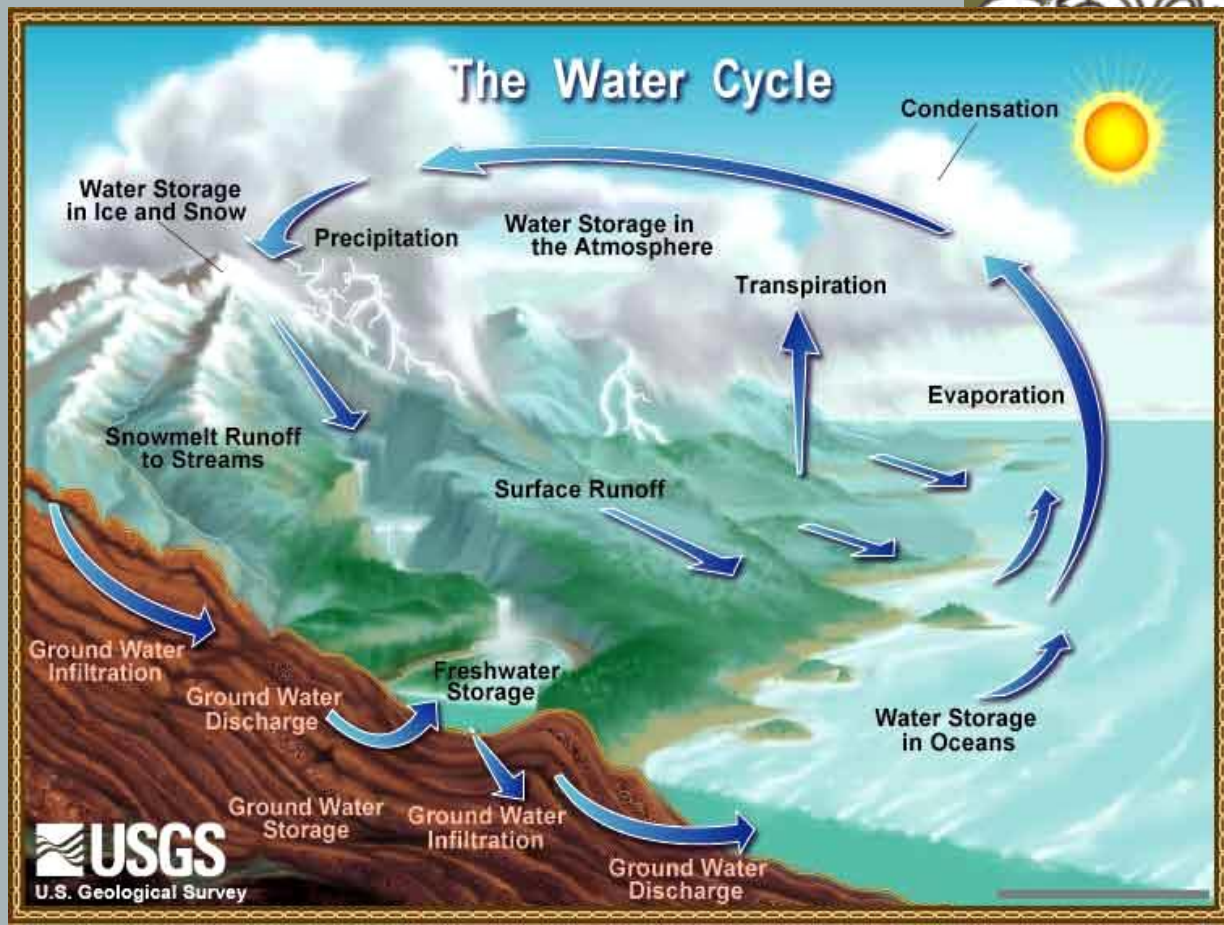
Watering techniques

Importance of drainage



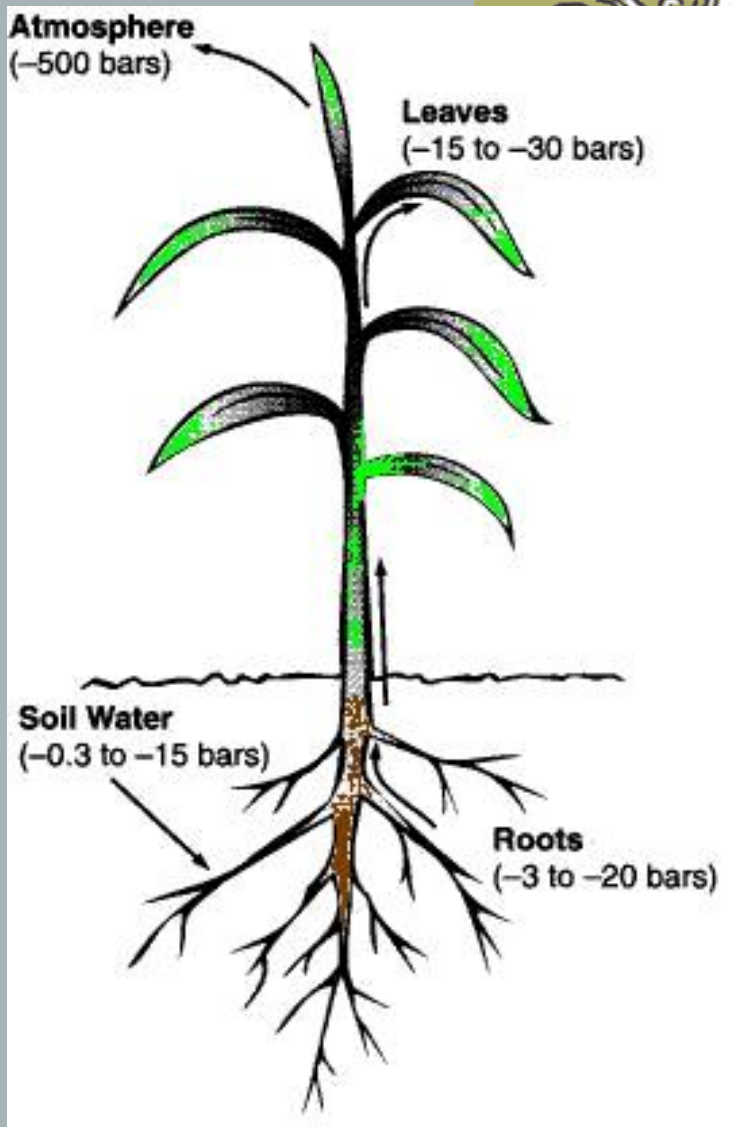
INTRODUCTION

- *Water is vital to plants*
- *95% of water absorbed is transpired*
- *Lack of water limits nutrient uptake and photosynthesis*



PLANT SOIL AND WATER REQUIREMENTS

- *Species* *Plant size*
- *Air temperature* *Humidity*
- *Light levels* *Wind* *movement*
- ***Wilting occurs when transpirational water losses exceed the ability of the plant to take up water***



DROUGHT

- ***Tolerant species*** *can go for 4-5 months without water*
  - *Small in size*
  - *Grow farther apart*
  - *Deeper more extensive root systems*
  - *Small, thick leaves with fewer stomates*
- ***Intolerant species will begin to suffer after just several weeks without water***

MODERATE AND SEVERE DROUGHT

- *Wilting and leaf drop*
- *Development of modified leaves*
- *Increased development of absorbing roots*

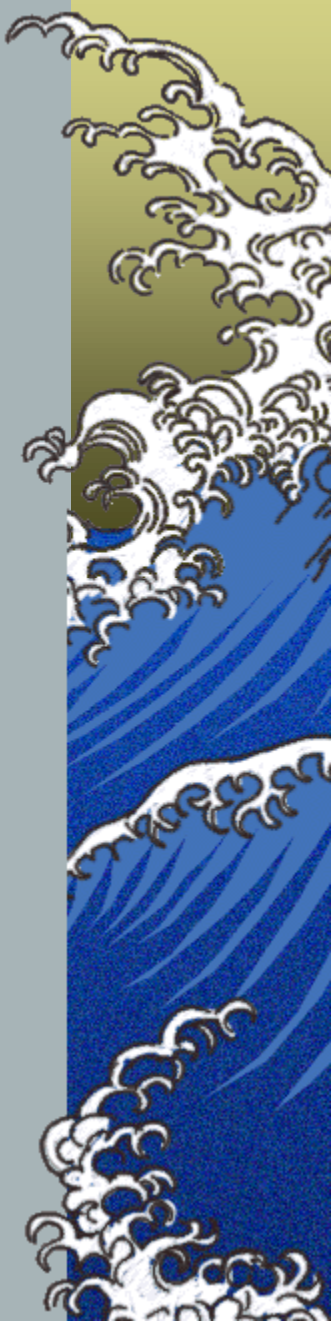
- *Extensive root loss*
- *Leaf abscission*
- *Plant decline and death*

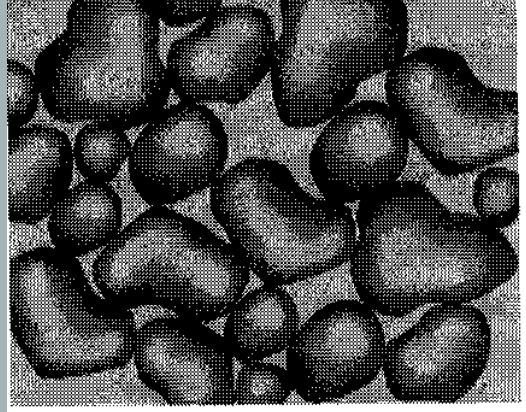
DROUGHT SYMPTOMS

- *Wilting of foliage*
- *Lack of leaf turgidity (fully hydration)*
- *Leaves turn brown or drop*
- *Root death*
- *Tree decline and death*

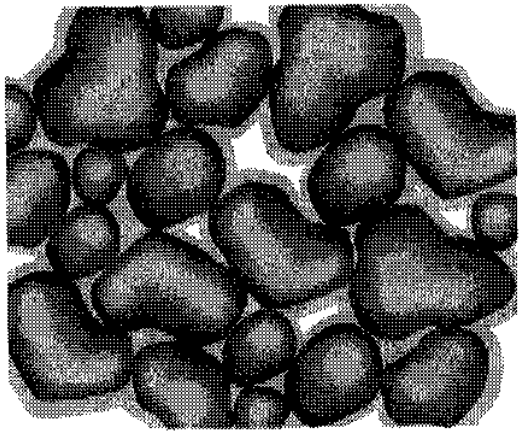
PLANT SOIL AND WATER REQUIREMENTS

- ***Available water*** *– the amount of water in the soil between* ***field capacity (FC)*** *and* ***permanent wilting point (PWP)***
- ***Infiltration*** *– water movement* ***into*** *the soil*
- ***Percolation*** *– water movement* ***within*** *the soil*
- ***Infiltration rate*** *– water applied to clay soils must be slower compared to water applied to sandy soils*

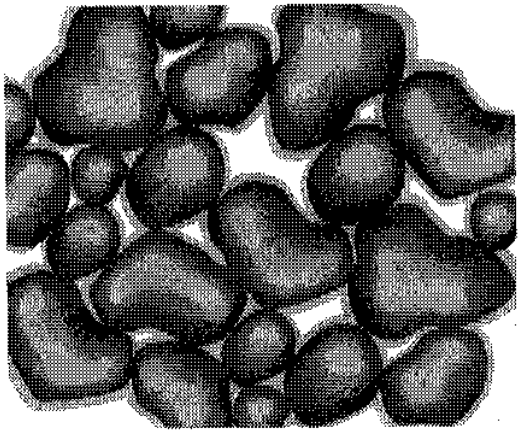




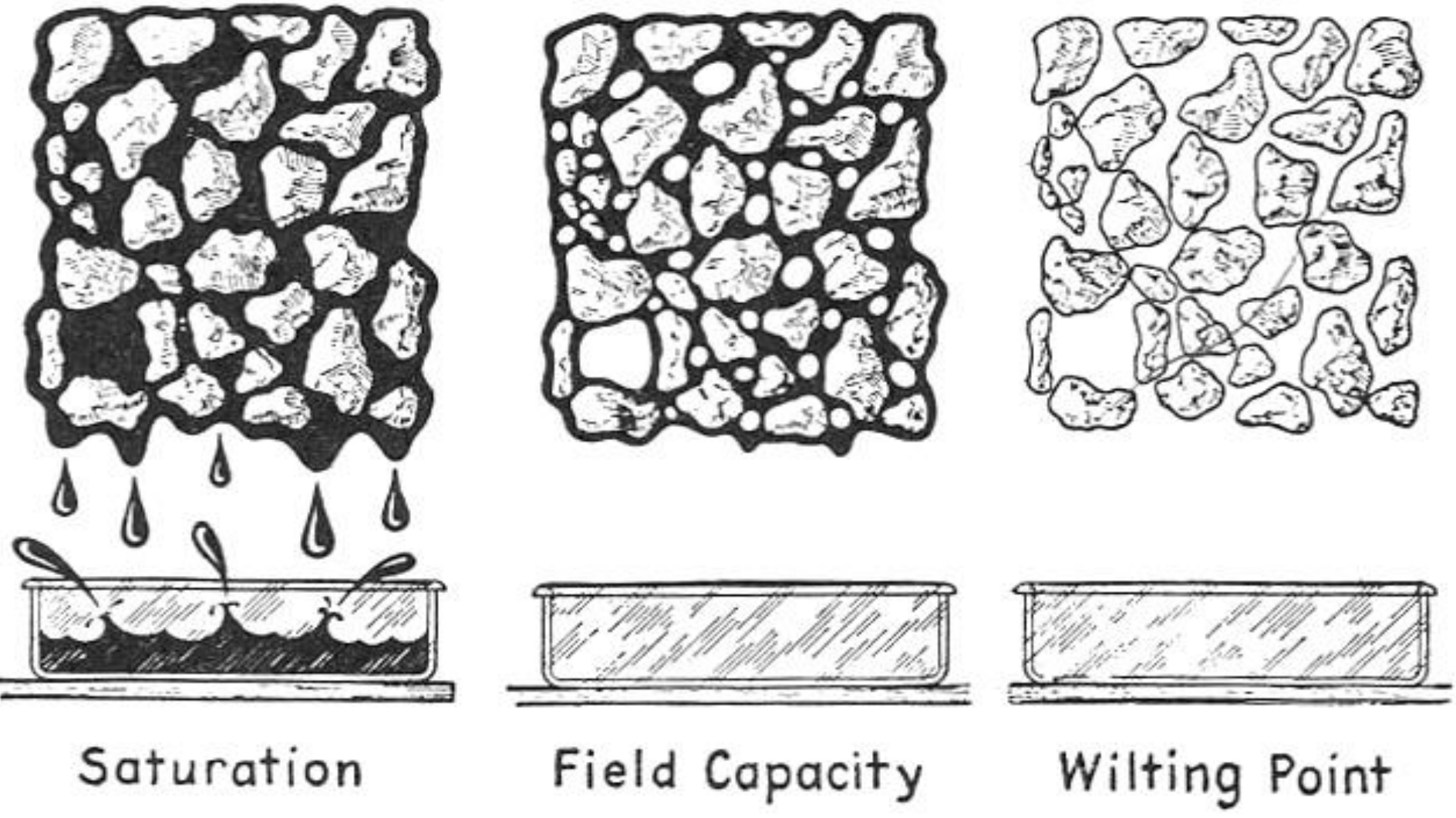
a. Saturation—water fills both the macropores and micropores.



b. Field capacity—water is held by soil particles after surplus has drained by gravity. Oxygen is available in macropores.



c. Permanent wilting point—water is held tightly by soil particles and is unavailable to plants.

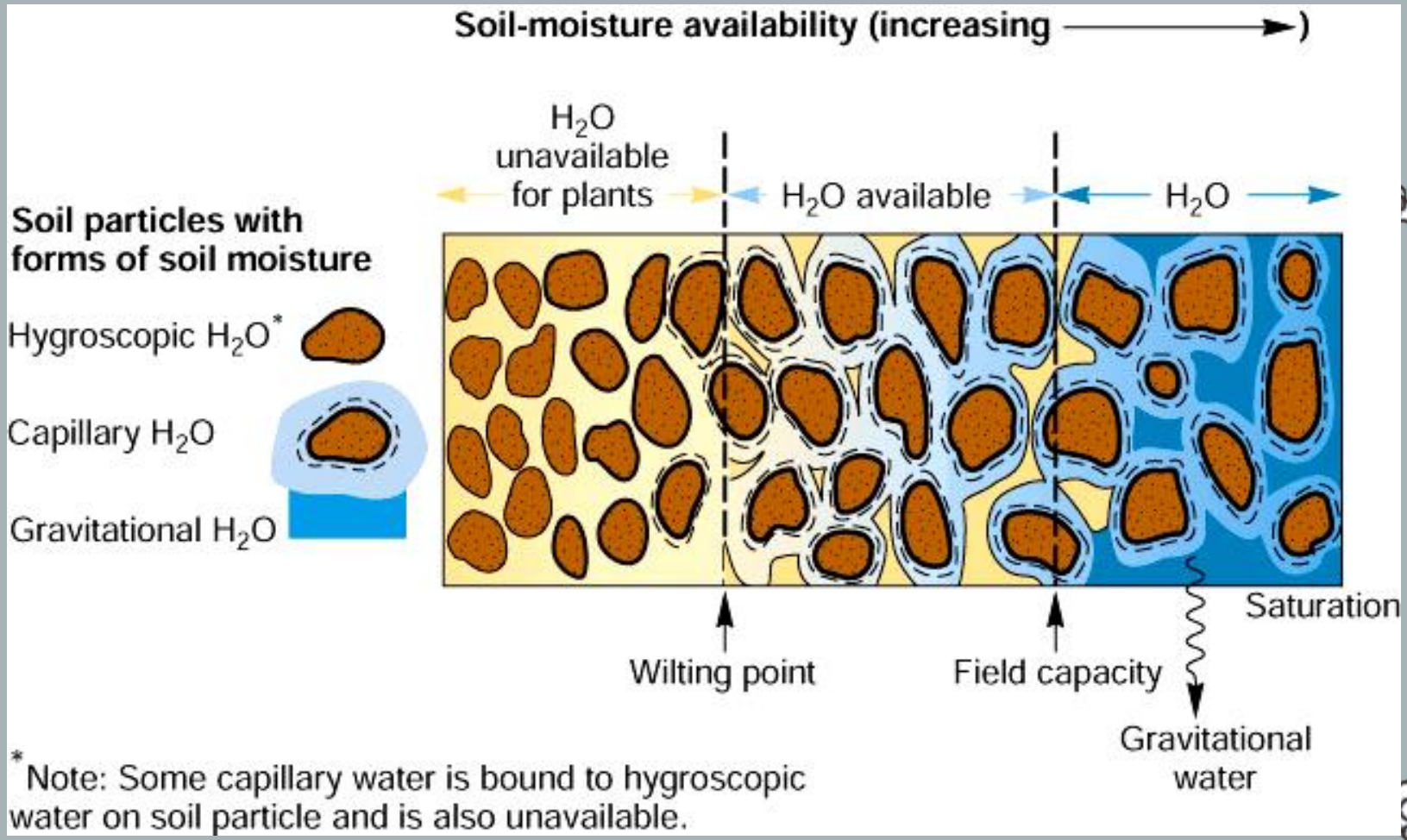

Saturation
Field Capacity
Wilting Point

PLANT SOIL AND WATER REQUIREMENTS

- ***Above field capacity****, water moves downward through the soil in response to gravity as excess water drains from the* ***macropores***

- ***Below field capacity****, water moves through the* ***micropores*** *from areas of higher moisture content to areas of lower moisture content*

SATURATION, FIELD CAPACITY, WILTING POINT



TREES AND WATER REQUIREMENTS

- *Most tree species are categorized as **"water spenders"** or use large amounts of water*
  - *Develop spreading root systems*
  - *Cannot tolerate prolonged drought conditions*

- ***"Water conservers"** - use less water*
  - *Reduce water loss through their foliage*
  - *Small, thick, leathery leaves with sunken stomata*

FLOODING AND TREES

- *Can be very damaging to trees*
- *Root damage and death due lack of* O_2
- *Soil mineral toxicities may develop*
- *Fermentation of root cells*

FLOODING AND TREES

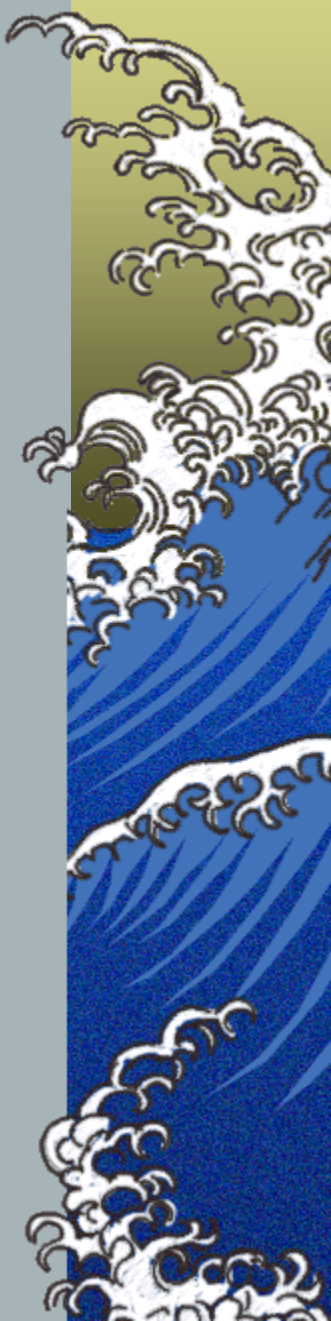
- *Photosynthesis stops*
- *Transpiration slows*
- *Soil organisms die*
- *Tree decline and death*
- *Trees are prone to toppling*
- *Root and collar rots*

IRRIGATION

Basic Principles of Watering

- ***Apply enough water to the soil to replace what the plant uses, and what is lost to evaporation and percolation***

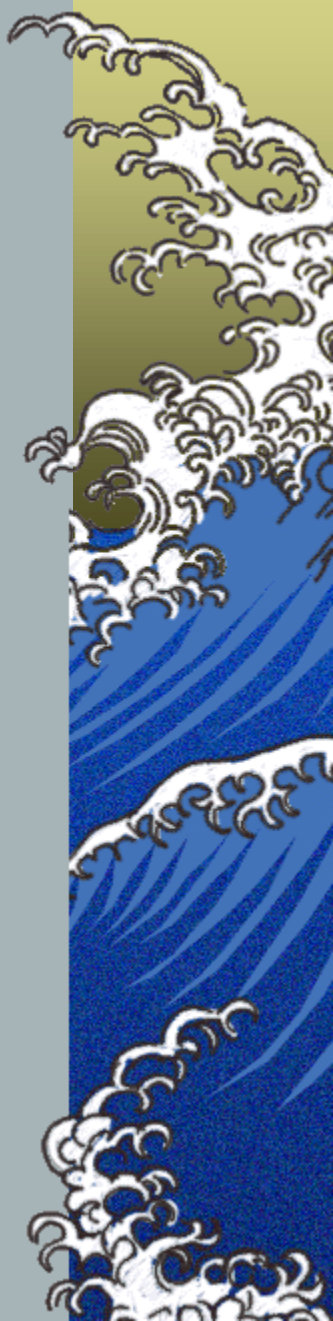
- ***Water requirements will vary with:***
  - *Species*
  - *Age of tree (new transplant versus mature tree)*

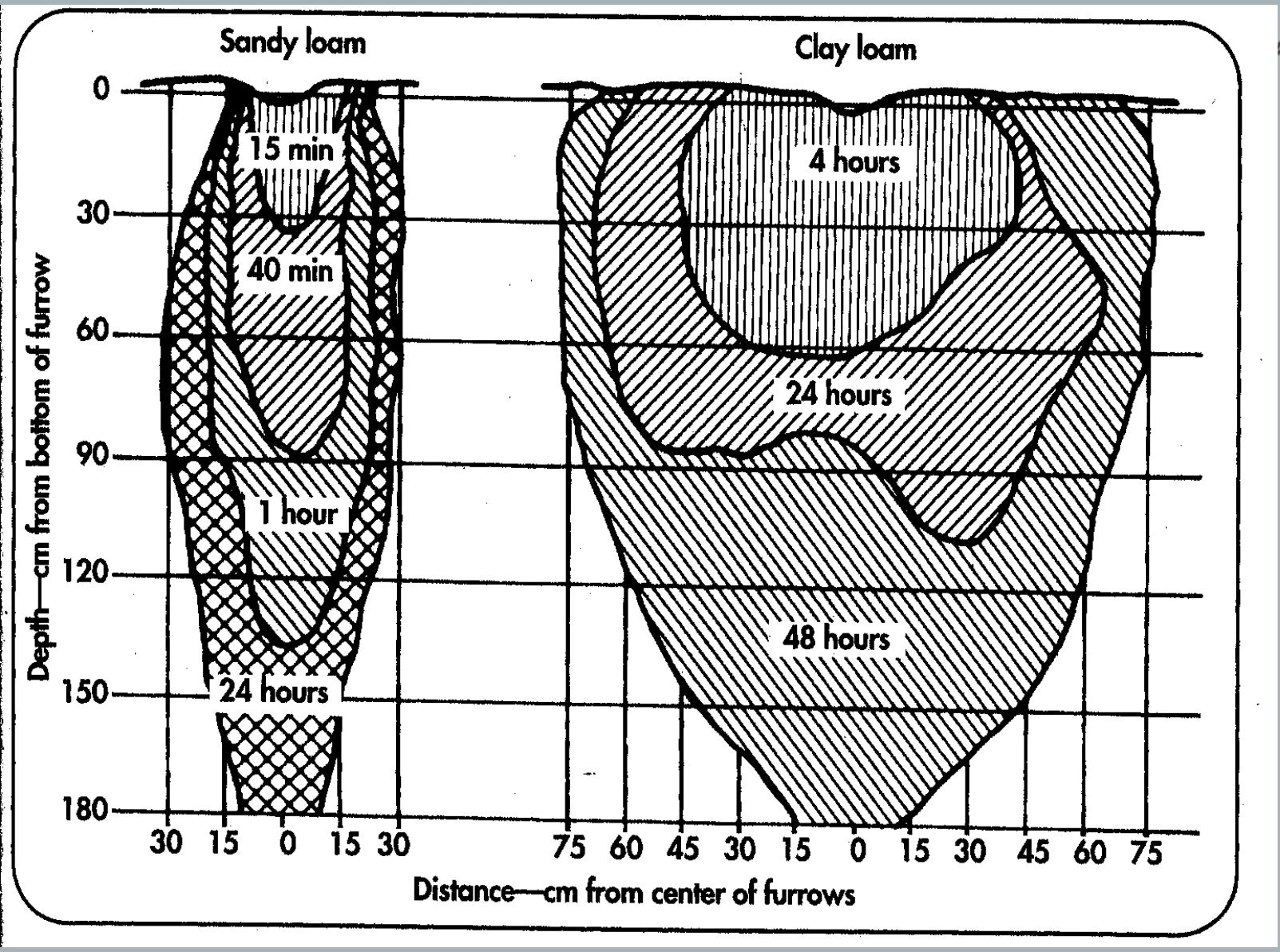


IRRIGATION

- *Frequent, **shallow waterings** lead to surface rooting resulting in root **desiccation** (drying out),a compacted soil surface, and reduced rate of water infiltration*

- *Infrequent, **deep soakings** lead to a deeper root system resulting in more drought tolerant trees, and improved soil structure*

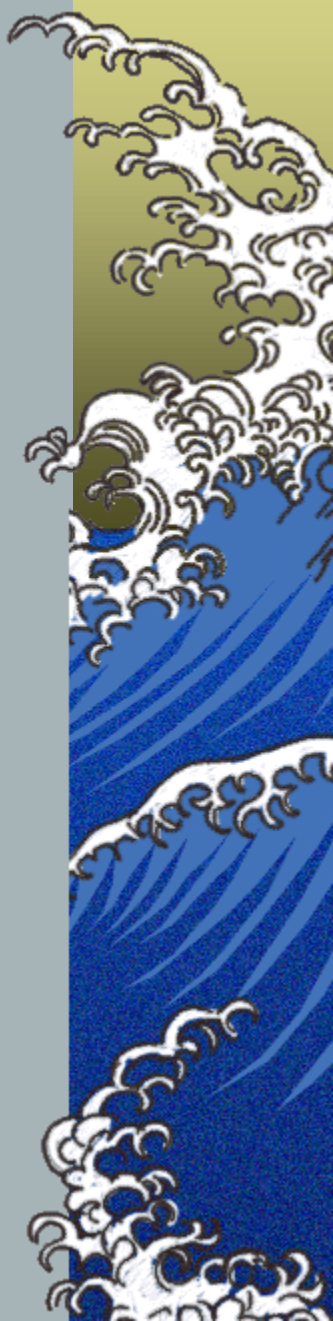



Sandy loam
Clay loam
0
30
60
90
120
150
180
15 min
40 min
1 hour
24 hours
4 hours
24 hours
48 hours
Depth—cm from bottom of furrow
30 15 0 15 30
75 60 45 30 15 0 15 30 45 60 75
Distance—cm from center of furrows

IRRIGATION

- ***Best time to irrigate is during late night and early morning hours***
  - *Minimizes disease incidence*
  - *Transpiration is minimized*
  - *Water should be evenly distributed over the root system*

- ***Water application rate should not exceed the soil infiltration rate***



IRRIGATION METHODS

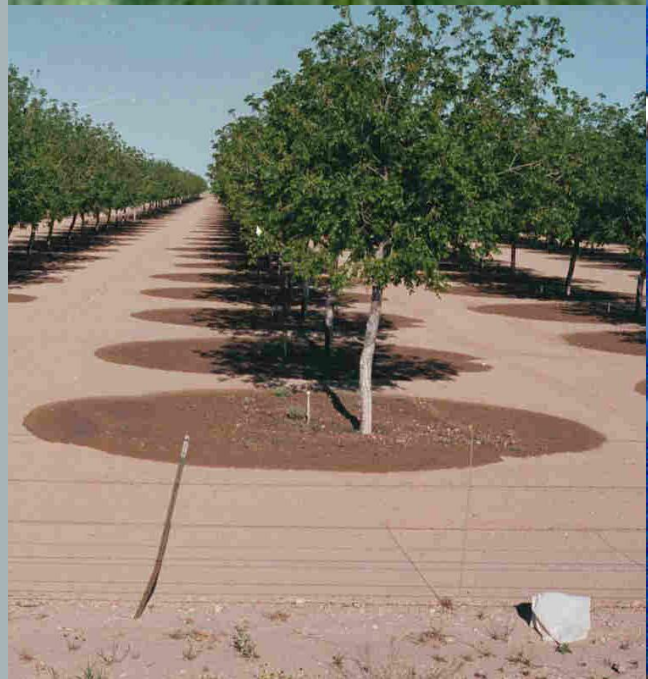
- ***Sprinkler systems*** *is most common*
  - *May cause surface compaction*
  - *Soil damage may result due to sodium in water*

- ***Drip irrigation***
  - *Conserves water*
  - *Allows for better infiltration and reduced water loss*

IRRIGATION METHODS

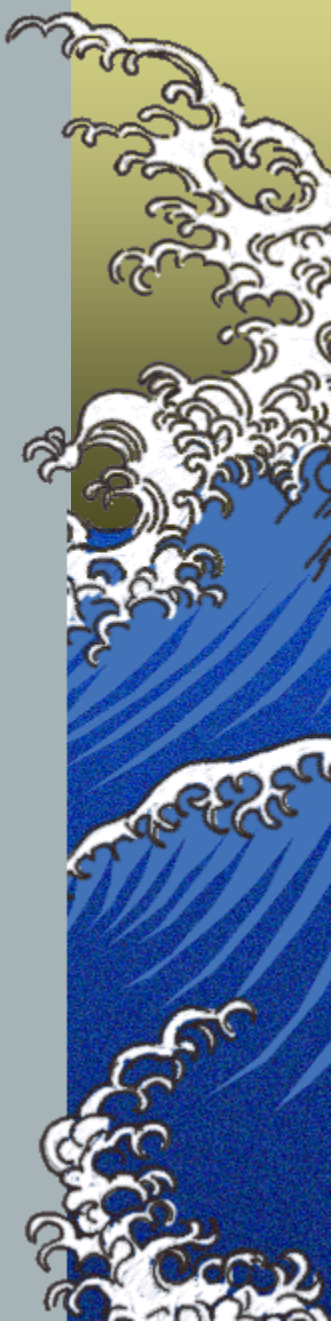
- *High pressure water injection*
- *Soaker hoses*
- *Basic irrigation*
- *Portable drip systems*

- *Most irrigation systems are designed for turf resulting in excessive irrigation of trees*



MINIMUM IRRIGATION

- ***Designed to maintain plants during periods of reduced rainfall***
  - *Characteristic canopy density and leaf color of trees*
  - *Group plants of similar water requirements together as well as shade requirements*
- ***Evapotranspiration (ET)*** *– moisture lost by evaporation of the soil's water and transpiration of the plant*



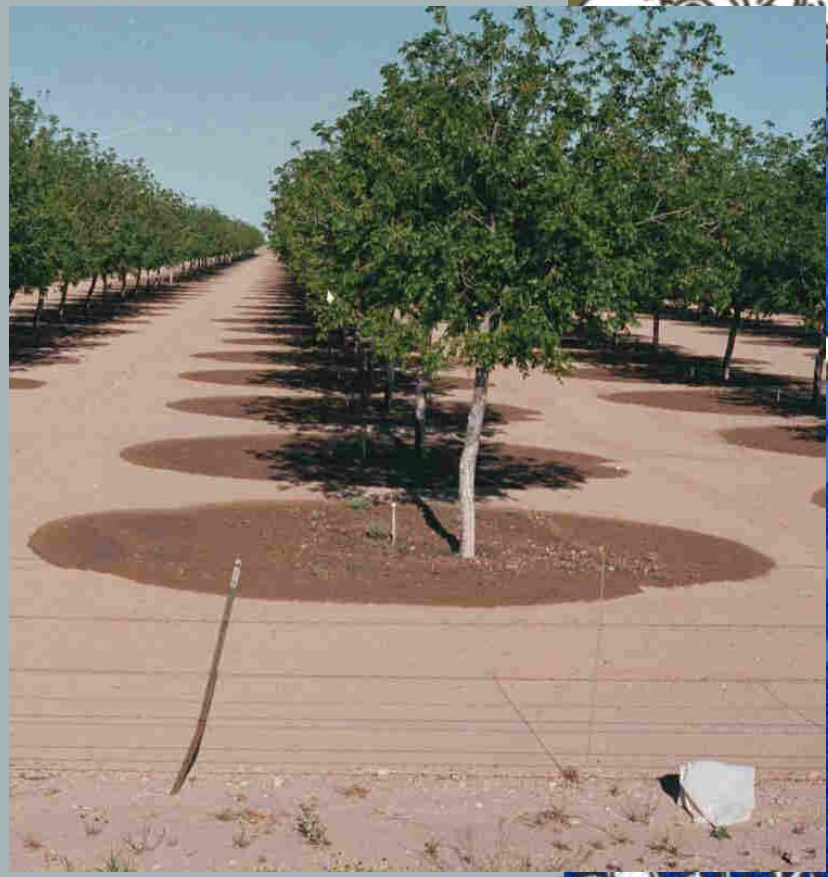
MINIMUM IRRIGATION

- *Combines water loss information (ET) with the amount of water available in the soil to determine appropriate irrigation schedules*

- ***Tensiometers*** *– soil moisture sensors used to measure soil wetness or dryness*

MINIMUM IRRIGATION

- ***Appropriate watering schedule includes:***
  - *Information on ET*
  - *Water-holding capacity*
  - *Irrigation efficiency*
  - *Infiltration*
  - *Application rates*



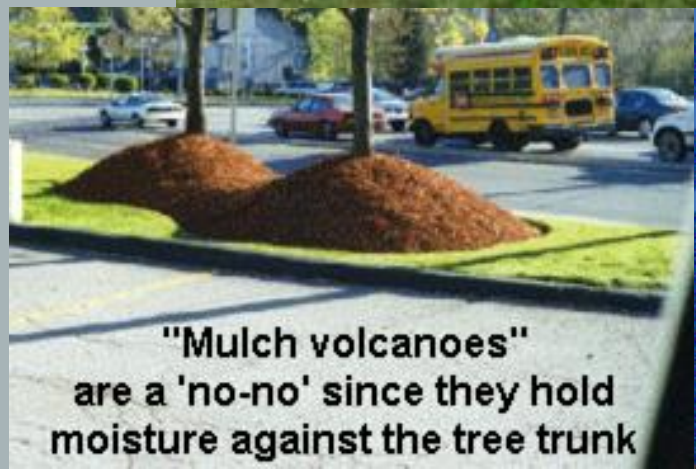
IRRIGATING WITH RECYCLED WATER

- ***Water source affects water quality***
  - *Can be high in salts and other minerals*
  - *Can be high in nitrogen, phosphorus, sulfur*
    - *May raise soil pH*
    - *Increase soil salinity*
    - *Cause phytotoxicity*
    - *Clog irrigation nozzles*

- ***Success rate depends on:***
  - *Soil type*
  - *Plant sensitivity to salts*
  - *Water quality*
  - *Good drainage*

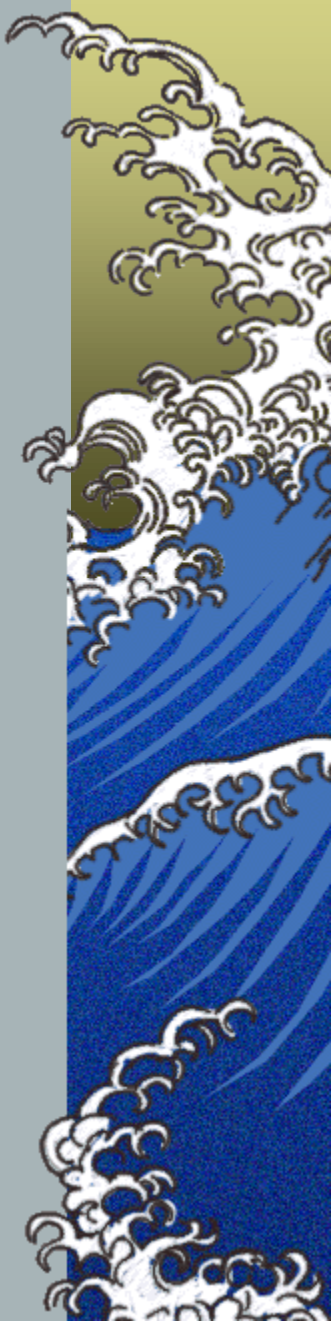
WATER CONSERVATION

- *Major issue in arid climates*
- *Be aware of plant water use*
- *Water efficiency when planting and maintaining plants*
- *Be competent in minimum irrigation*
- ***Ways to reduce water use:***
- ***Mulches***
  - *Organic or inorganic mulches*
  - *2-4 inch depth*
  - ***No “volcano mulching”***



WATER CONSERVATION

- ***Antitranspirants*** *– chemicals sprayed on plants to reduce water loss through transpiration*
  - *Increases chances of transplant survival*
  - *Help get plants through drought*
  - *Prevent winter desiccation of evergreens*
  - *Some may be phytotoxic to certain plant species*
  - *May be effected by temperature and humidity*

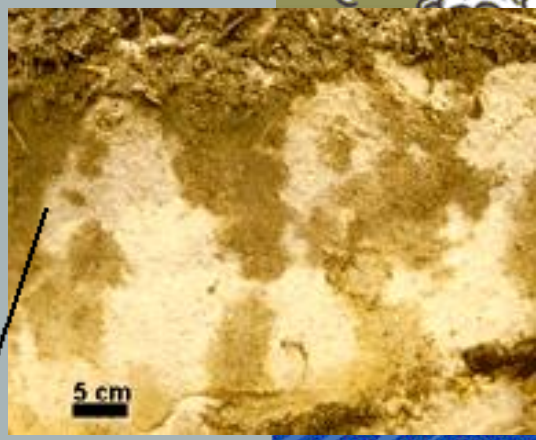


DRAINAGE

- ***Poorly drained sites can initiate plant decline and lead to plant death***
- *Excessive moisture suffocates roots and may kill roots*
- *Must consider:*
  - *Grade*
  - *Drainage flow pattern*

INFILTRATION

- *Process by which water enters soil pore spaces and becomes soil water*



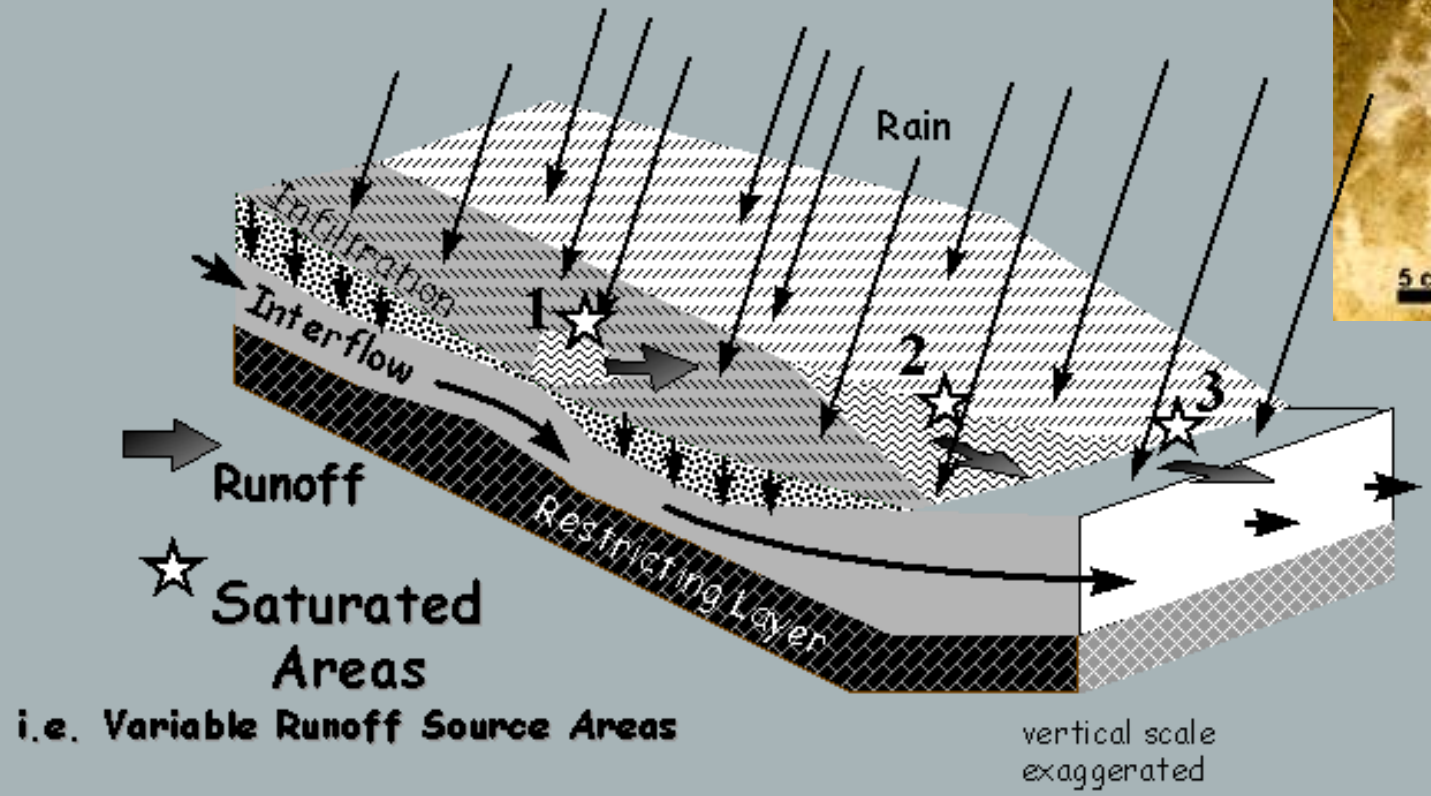


Figure 3: Incidents of saturation excess hydrology: 1) shallow soil, 2) convergence area, 3) downhill slope decreases

DRAINAGE METHODS

- ***Use of drain tiles***
  - *Made of clay, concrete, plastic*
  - *Placed above impervious layer or hardpans*
  - *Slope away from plantings at a rate of ¼ inch per linear foot*
  - *Placed on sand or fine gravel about 3 ft. below soil surface*
- ***Grading or trenching** may improve surface drainage*

SUMMARY

- *Plant soil and water requirements*
- *Drought*
- *Flooding*
- *Irrigation*
- *Water conservation*
- *Drainage*