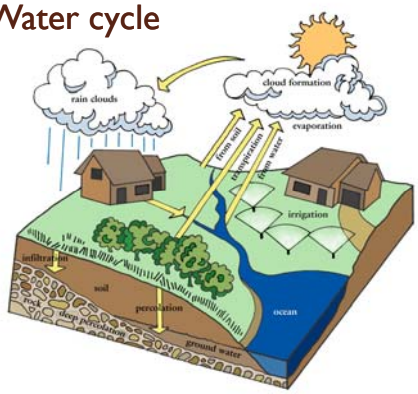
Soil, Plant & Water Relationships

Dr. Ron Sheffield
LSU Ag Center, Biological & Agricultural Engineering
rsheffield@agcenter.lsu.edu

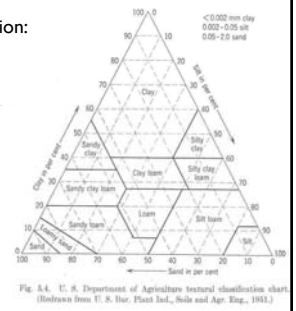
Water cycle



Soil, Plant & Water Relationships

Understanding Soil Water Holding Capacity

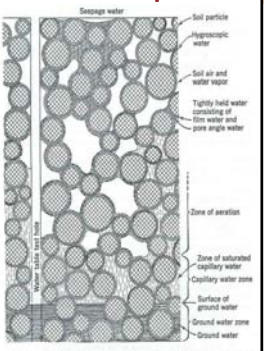
- Soil textural classification:
  - *Sand, silt, clay content*



Soil, Plant & Water Relationships

Understanding Soil Water Holding Capacity

- Soil textural classification:
  - Sand, silt, clay content
  - Voids (air spaces) in the soil
  - How water is held in the soil



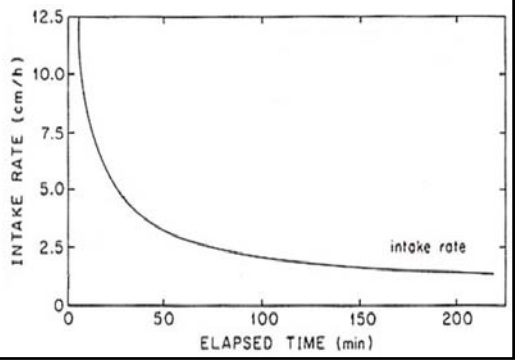
Porosity

- Porosity is a measure of how much pore space exists in the soil
- Volume of pores/volume of the soil x 100
- Porosity is given as % and may be 30% to 40% in soil and higher in artificial media
- Porosity of a clay and a silt loam can be the same

Permeability

- How fast can water move into/through the soil (inches/hour)?
- Higher in dry soil/lower in wet soil
- Higher in soils with larger pore spaces (sands, loams, amended soils, potting mix)
- Lower in soils with smaller pore spaces (silts, clays, compacted soil or soil layer)

Soil Intake Rate



Permeability

- Saturated permeability for clay soils may be <0.06"/hour
- Saturated permeability for silt loam soils may be 0.2"/hour
- Permeability generally declines with compaction, rainfall, irrigation, increased moisture content, decreased organic matter or amendments, and increased density

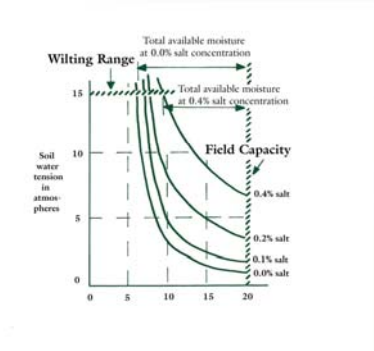
Compaction

- Compaction reduces porosity, infiltration, and water holding capacity
- Compaction can be increased by traffic, tillage, impact (mechanical or hydraulic), and chemical changes (sodium, calcium)

Salts

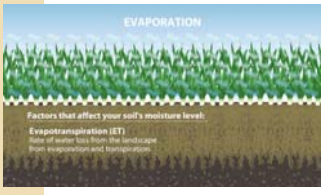
- Due to the dissolved ions in salty water it takes more pressure for water taken up into plants
- As salt concentrations increase it reduces the availability of water to plants

Salts & Water Intake



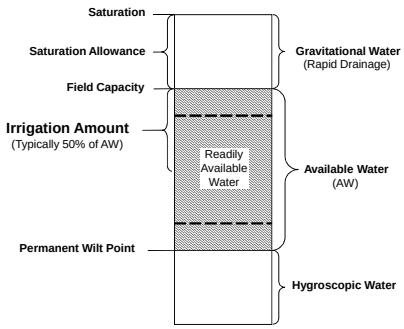
Soil is a Reservoir

- Capacity
  - Soil type
  - Root depth



- Moisture Level
  - Evaporation
  - Rain
  - Irrigation

The Soil Reservoir



Why do we want to irrigate?

To replace rain water that has evaporated.

Evapotranspiration (ET)

- Evaporation of water from the soil or plants surfaces and transpired from leaves.
  - It is typically measured in inches
- Weather conditions affect ET:
  - Solar radiation
  - Temperature
  - Wind
  - Humidity

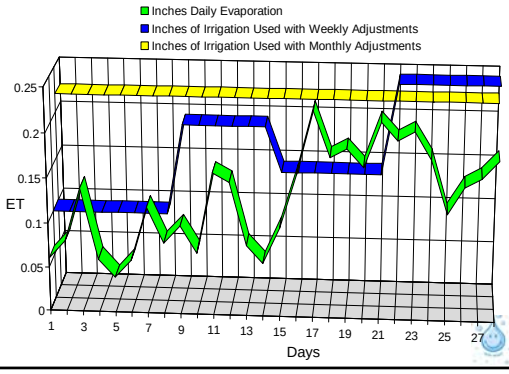
Effective Rain Fall

- Measurement of rain is as important as the measurement of ET
- Rainfall replenishes soil moisture
- Rainfall that runs off is NOT effective rain
  - Soil percolation rate and slope limit effective rain.
- Rain that soaks below the roots is NOT effective rain
  - A soil moisture balance calculation determines when the root zone is saturated.

Irrigation Requirement

- ET – Effective Rain = Irrigation Requirement
- The Irrigation Requirement is met when sprinklers run long enough to return the soil moisture level back to desired levels – no more / no less.

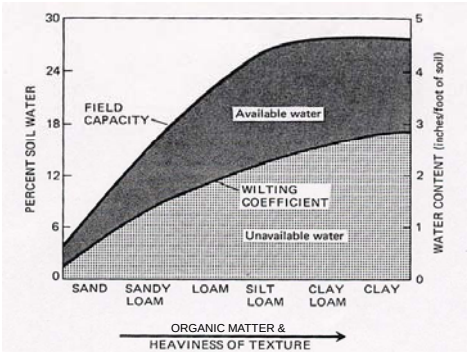
Typical Irrigation System Adjustments



Benefits of ET-Based Water Management

- Efficient Water Use
  - Save Money
  - Preserve Natural Resources
- Healthy Landscapes
  - Watered when needed
  - Watered right

The Soil Reservoir



Soil, Plant & Water Relationships

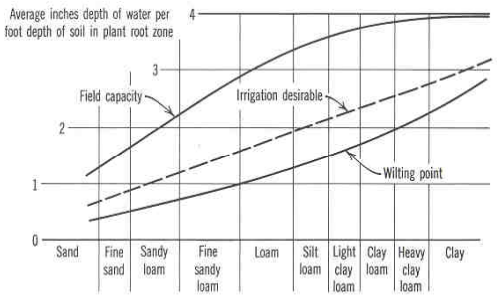


Fig. 5.12. Simplified comparison of the water-holding characteristics of different textured soils. (Courtesy U. S. Department of Agriculture, 1955.)

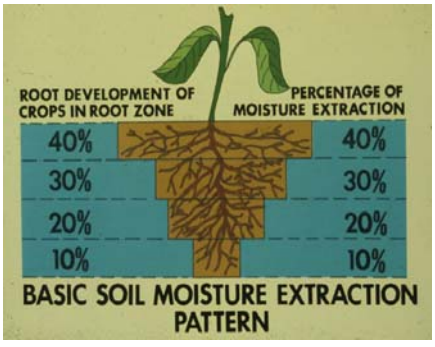
Soil, Plant & Water Relationships

Table 3.1. Range in available water-holding capacity of soils of different texture

Soil texture	Water-holding capacity: Range mm/m	Water-holding capacity: Average mm/m
1. Very coarse texture—very coarse sands	33 to 62	42
2. Coarse texture—coarse sands, fine sands, and loamy sands	62 to 104	83
3. Moderately coarse texture—sandy loams	104 to 145	125
4. Medium texture—very fine sandy loams, loams, and silt loams	125 to 192	167
5. Moderately fine texture—clay loams, silty clay loams, and sandy clay loams	145 to 208	183
6. Fine texture—sandy clays, silty clays, and clays	133 to 208	192
7. Peats and mucks	167 to 250	208

NOTE: 1 mm/m = 0.012 in./ft.

Moisture Extraction

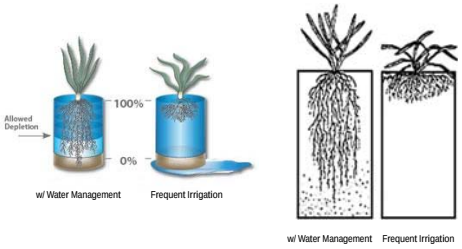


Soil, Plant & Water Relationships

Where do plants get their water?

- Soil root zone – available water
  - Typical sandy soils:
    - 1.5 inches of water can be held in the soil (per foot of soil) ~ 0.75 in. of that is ***available***
    - Typical root zone: 1 to 1.5 ft.

Water Management



Soil, Plant & Water Relationships

Concept:

- *MAD* – Management-allowed deficit/depletion
  Percentage of available water within the soil that you will allow to be removed before you irrigate
- *MAD %*
  - 25-40, Shallow-rooted, high value fruit and vegetable crops
  - 40-50, Orchards, vineyards, berries, ornamentals, and medium rooted row crops.
  - 50, mature trees, forage crops, grain crops, and deep-rooted row crops

Soil, Plant & Water Relationships

- How much do you apply during an irrigation?:

$$d_x = (MAD/100) * W_a * Z$$

d_x = maximum net depth of water to be applied per irrigation (mm/inches)

MAD = management-allowed depletion (%)

W_a = available water-holding capacity of the soil (mm/m or in./ft)

Z = effective root depth, (m or ft)

Slope effects

- Sloping terrain will increase the chance of runoff and will decrease water infiltration
- *The greater the slope, the greater the problems will be*
- Consider splitting irrigation in multiple cycles

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