

# Irrigation Water Management



# I.W.M. Concepts

Simple formula  $QT = DA$

- $Q$  = Flow rate ( $\text{ft}^3/\text{s}$ )
- $T$  = Time (hr)
- $D$  = Depth (in)
- $A$  = Area (acres)

When to irrigate

- Anticipation
- Visual signs of stress come too late

Rainfall management (effective rainfall)

- Anticipation
- Applied irrigation water should always be considered supplemental to rainfall events



# Water Delivery

- Fixed and rotation
  - Easiest to use and the least costly
  - Promotes philosophy of use the water (whether the crop needs it or not) or lose it.
  - Not conducive to proper irrigation scheduling
- Arranged
  - Advanced notice on start and stop
  - Temporary storage are typically needed
- Demand
  - Municipal
  - Well water
  - Reservoir



# Water

## Water supply limitations

- Deficit irrigation – low value field crops
- Yields are generally reduced

## Water measurement

- The importance of measuring the flow for proper irrigation management can not be over stated.



# Soil-Plant-Water Balance (Soil)

## Field capacity (FC)

- Is the amount of water remaining in the soil when the downward water flow from gravity become negligible

## Permanent Wilting Point (PWP)

- The soil-water content below which plants can not obtain sufficient water to maintain plant growth and never totally recover

# Soil-Plant-Water Balance (Soil)

## Available water capacity (AWC)

- The portion of water in the soil (plant root zone) that can be absorbed by the plant roots

## Soil-water content (SWC)

- Is the water content of a given volume of soil at any specific time.

# Soil-Plant-Water Balance (Soil)

## Management Allowed Depletion (MAD)

- Is the desired soil-water deficit a time of irrigation

## Bulk density

- Is the mass of dry soil per unit bulk volume. Bulk Density is an indicator of how well plants roots are able to extend into the soil.

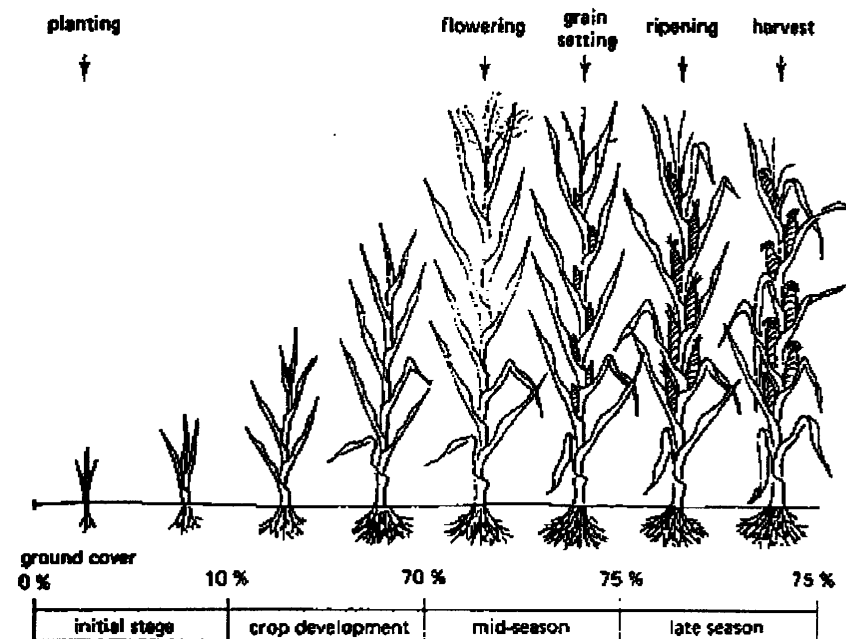
# Soil-Plant-Water Balance (Crops)

## Evapotranspiration- ET

- Is the amount of water used by the crop in transpiration building of plant tissue and evaporated from the soil or plant foliage surface.

## Critical growth periods

- Most crops are sensitive to water stress during one or more critical growth periods during their growing season.





# Soil-Plant-Water Balance (Crops)

## Root development

- Roots develop as plants grow and mature. Irrigation should be planned to provide water only to the usable plant root zone unless leaching for salinity control is necessary



# Soil-Plant-Water Balance (Crops)

## Measuring Soil Water Content

### Soil feel and appearance

- Easy to implement and with experience becomes very accurate

### Gravimetric

- Weigh sample wet
- Cook out moisture
- Weigh sample dry
- Multiply by bulk density = volume

# Soil-Plant-Water Balance (Crops)

## Tensiometer

- Soil water potential (tension) is a measure of the amount of energy with which water is held in the soil

## Electrical Resistance

- Water moves readily into and out of the blocks. Measures the resistance

# Soil-Plant-Water Balance (Crops)

## Thermal dissipation

- Porous ceramic materials in which a small heater and temperature sensors are imbedded. Allows measurement of the rate at which heat is conducted away from heater.

## Neutron scattering

- A neutron gauge estimates the total amount of water in a volume of soil by measuring the amount of hydrogen molecules in the soil

# Soil-Plant-Water Balance (Crops)

## Dielectric Constant

- Time Domain Reflectometry
  - Measures the average volumetric soil-water percentage along the length of a wave guide, (a parallel pair of probes)
- Frequency Domain Reflectometry
  - Measures soil capacitance. The soil acts like a dielectric completing a capacitance circuit, which is part of a feedback loop of a high frequency transistor oscillator.

# Soil-Plant-Water Balance (Crops)

## Crops Characteristics

### Crop Evapotranspiration

- Is the amount of water used by crop in transpiration, building of plant tissue, and evaporation from the soil and plant foliage surfaces.

### Critical Growth Periods

- Plants generally need sufficient moisture throughout their growing season.
- Most crops are sensitive to water stress during one or more critical growth periods

# Soil-Plant-Water Balance (Crops)

## Root Development

- Roots develop as plants grow and mature
- Factors controlling root development
  - Stage of plant growth
  - Usable soil depth
  - Soil compaction
  - Soil condition
  - Amount of water in the soil
- Observe and Measure
  - Dig a shallow pit and observe actual root development

# Soil-Plant-Water Balance (Crops)

Measuring plant moisture stress.

- Crop Water Stress Index (CWSI)
- Leaf moisture stress (pressure chamber)
- Evaporimeter (atmometer)
- Evaporation pans
- Infrared photography
- Visual



# Irrigation Scheduling

## General

- When to irrigate
- How much water to apply
- Amount of irrigation water used
- Soil condition
- Plant response to fertilizer used
- Water quality onsite

## Identifying physical effects

- Energy cost per season
- Irrigation labor
- Wear and tear on irrigation equipment
- Plant response compared to potential
- Quality of crop



# Irrigation Scheduling

## Irrigation Scheduling Methods

### Soil and crop monitoring

- Crop Water Use monitoring
- Soil Moisture monitoring

### Checkbook method

### Computer Assisted methods

- Daily Crop ET
- Local Real-Time Climate data

### Consultative Services

### Commercial Service