

# **Unit F: Soil Fertility and Moisture Management**

## **Lesson 3: Using Irrigation**

# Terms

- Border strip irrigation
- Center-pivot irrigation
- Chemigation
- Ground truthing
- Irrigation scheduling
- Moisture sensor
- Remote sensing
- Ribbon test
- Border strip irrigation
- Center-pivot irrigation
- Chemigation
- Ground truthing

# Terms

- Irrigation scheduling
- Moisture sensor
- Remote sensing
- Ribbon test
- Wheel-move irrigation
- Wilting point



# What are the benefits of irrigation?

I. Irrigation is an important part of soil moisture management in many locations.



# What are the benefits of irrigation?

A. The artificial application of water to promote plant growth, irrigation, can have several important benefits, irrigation:

1. Provides water when adequate water would not otherwise be available for plant growth.
2. Promotes plant growth by applying fertilizer, growth regulators, and other materials with the water.

# What are the benefits of irrigation?

3. Disposes of waste water by land application.
4. Protects plants from extreme cold temperatures, such as preventing frost damage in fruit and vegetable crops.
5. Reduces dust from field and other surfaces.

# What are the benefits of irrigation?

B. There are several effects of water deficiency. They are:

1. Poor plant growth.
2. Stunted mature plants.

# What are the benefits of irrigation?

3. Lower crop yields and loss of potential profit.
4. Death of plants.
5. Stress, which lowers disease and insect resistance.
6. Loss of aesthetics caused by dead plants.



# In what ways can the need for irrigation be determined?

- II. Knowing when to irrigate is important in soil moisture balance.
  - Waiting until the plant shows signs of stress may be too late.

# In what ways can the need for irrigation be determined?

A. Irrigation should be used before the wilting point.

- Wilting point is when the plant cannot take in water as quickly as it is lost. When plants wilt, damage has already been done to production.
- Always assess moisture in the soil before applying water.

# In what ways can the need for irrigation be determined?

B. There are ways of determining the need for irrigation without stressing the plants.

1. The *ribbon test* is determining soil moisture content by feel.
  - Small amounts of soil are rolled between the thumb and fingers.
  - The feel and appearance of the soil are used to assess moisture content.

# RIBBON TEST FOR SOIL TYPES

## Appearance of sandy clay loam, loam, and silt loam soils at various soil moisture conditions.

**Available Water Capacity**  
1.5-2.1 inches/foot

**Percent Available:** Currently available soil moisture as a percent of available water capacity.

**In./ft. Depleted:** Inches of water needed to refill a foot of soil to field capacity.

### 0-25 percent available

Dry, soil aggregations break away easily, no staining on fingers, clods crumble with applied pressure. (Not pictured)



### 50-75 percent available

Slightly moist, forms a weak ball with rough surfaces, no water staining on fingers, few aggregated soil grains break away.



### 75-100 percent available

Moist, forms a ball, very light staining on fingers, darkened color, pliable, forms a weak ribbon between the thumb and forefinger.



### 100 percent available

Wet, forms a ball with well-defined finger marks, light to heavy soil/water coating on fingers, ribbons between thumb and forefinger.

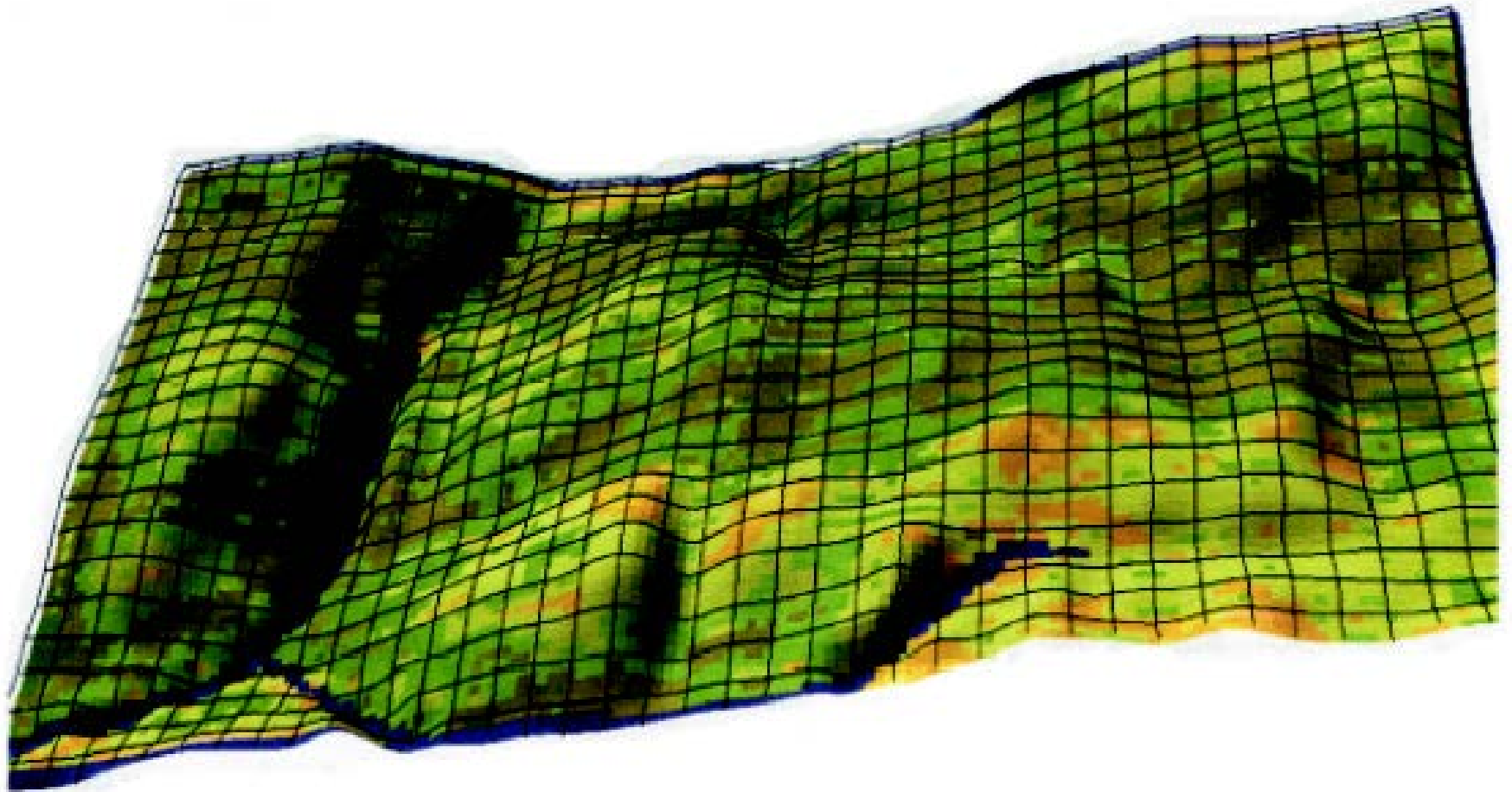
### 100 percent available

Wet, forms a soft ball, free water appears briefly on soil surface after squeezing or shaking, medium to heavy soil/water coating on fingers. (Not pictured)

# In what ways can the need for irrigation be determined?

2. Soil that is slightly sticky and holds together does not need irrigation.
  - Soil that crumbles is dry and needs to be irrigated.
3. A moisture sensor is an electronic instrument that is used to probe the soil and provide a reading on moisture content.
  - Moisture sensors utilize a single probe.

# A VEGETATIVE INDEX MAP



# In what ways can the need for irrigation be determined?

4. A *sap flow sensor* is a device that measures the movement of water (sap) inside the stem of a plant.
- The process is used on small herbaceous plants as well as the branches and trunks of trees.
  - The device clamps onto the stem of the plant.

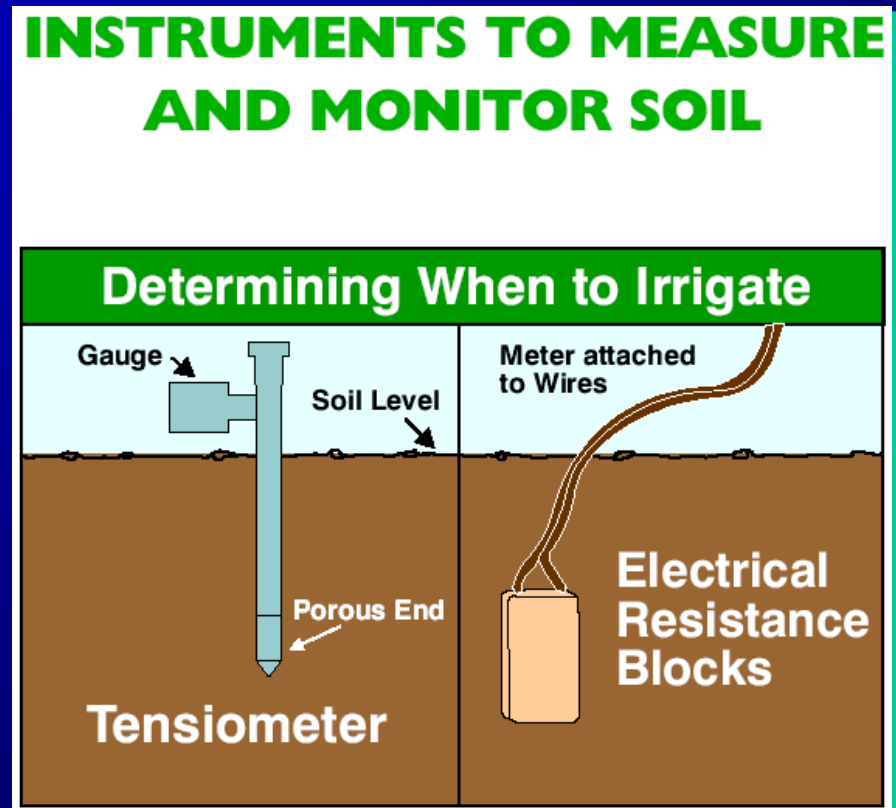


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# In what ways can the need for irrigation be determined?

5. A tensiometer is a device that assesses moisture content by determining the pull of soil particles in the soil.
- Tensiometers are permanently placed in the soil and can be damaged by freezing weather.





# In what ways can the need for irrigation be determined?

6. A **soil moisture meter** is a device that assesses moisture based on the flow of low-level electric current between its two probes.
  - Weather information and published reports on soil moisture can be used as sources of information.

# In what ways can the need for irrigation be determined?

7. Remote sensing on soil moisture is collecting information without actually going into the field.
  - Most remote sensing is done with satellites and airplanes.



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# In what ways can the need for irrigation be determined?

8. **Ground truthing** is used to verify the accuracy of remote sensing information.
  - It involves actual field investigation.

# How is irrigation scheduled?

III. Experienced irrigators have developed their own procedures for scheduling applications.

# How is irrigation scheduled?

- A. Irrigation scheduling** is providing the right amount of water at the right time.
- Water should be available when the plant needs it.
  - The greatest need for water is usually during the middle of the growing season for most crops.

# How is irrigation scheduled?

1. Water supplies are increased before the peak need.
2. Scarce water supplies are more efficiently used through good scheduling.
3. Good scheduling prevents over irrigating and supplies water to the crop just before the time of highest demand.

# How is irrigation scheduled?

4. Most crops are not watered each day. Water needs are calculated and the amount of water is applied to meet the need for a specific period.
5. A few specialty crops have daily irrigation, which depends on the irrigation system used.
6. Scheduling the use of water may involve gaining an allocation and time with the local water management district.

# What methods of water application are used in irrigation?

IV. Irrigation has a long history in world agriculture.

- Irrigation water can be applied through several methods.



# What methods of water application are used in irrigation?

- A. **Subsurface irrigation** is watering from below, using capillary rise from a zone of saturating soil lower in the soil profile.
1. The zone must be high enough that water can rise into the root zone, but not so high that it saturates the root zone.
  2. Water may be introduced into the soil profile through open ditches, mole drains, or pipe drains.

# *Subsurface irrigation*



# What methods of water application are used in irrigation?

B. Surface irrigation of fields involves flooding the soil surface with water released from canals or piping systems.

1. Surface irrigation is most suitable for level or slightly sloping land of moderate permeability.
  1. When preparing land, fields are carefully leveled to the slight slope needed for water to flood the land.
2. A system of canals uses gravity to carry water to the farm and among the fields.

# Surface irrigation



# What methods of water application are used in irrigation?

- C. **Border strip irrigation** involves covering the entire soil surface of a field with a sheet of water.
1. Each field is divided into smaller parts by the use of low dikes. Each of these sections is flooded in turn from a ditch or pipe running along the head of the field.
  2. Because of the large surface area of the water flooding the ground, evaporation causes some waste of water.

# *Border strip irrigation*



# What methods of water application are used in irrigation?

- D. *Furrow irrigation* distributes water through furrows, with crops planted in the ridge between two furrows.
1. Furrows are best suited for row crops.
  2. Evaporation is less of a problem than in border strips because less surface area is exposed to the air.

# *Furrow irrigation*

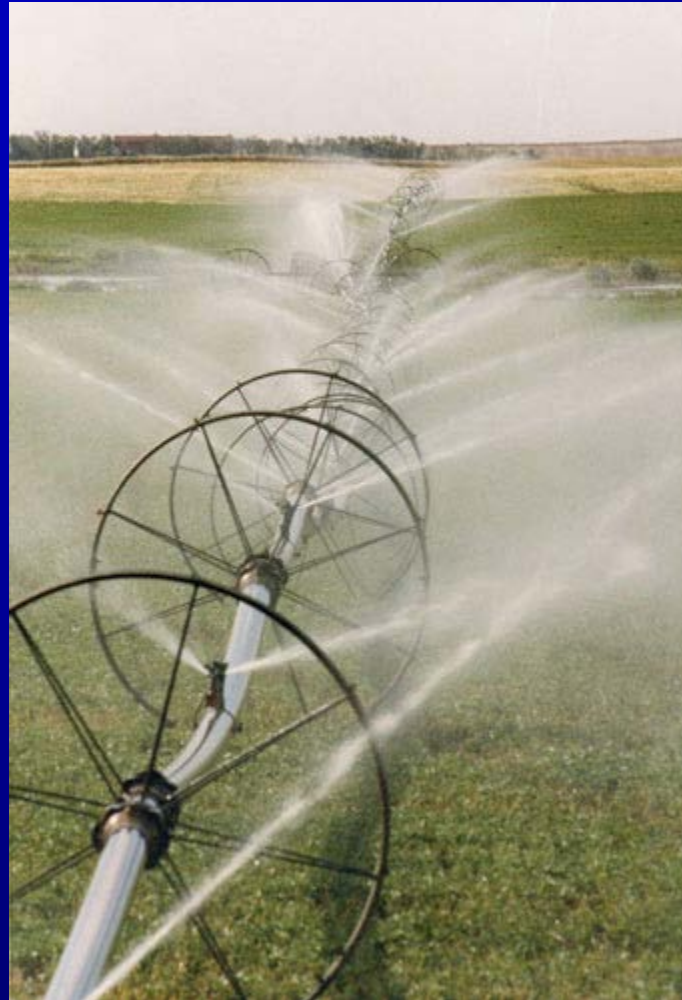




# What methods of water application are used in irrigation?

- E. *Sprinkler irrigation* systems pump water under pressure through pipes to sprinklers that spray water out in a circular pattern.
  1. Sprinklers can be used where the soil is too permeable or too impermeable or the ground is not level.
  2. Sprinkler irrigation equipment can be used for other purposes in addition to watering crops.

# *Sprinkler irrigation*



# What methods of water application are used in irrigation?

- F. **Chemigation** is applying chemicals like fertilizers or herbicides.
  - It is used as substitute for rainfall for the activation of herbicides or for frost control.

# What methods of water application are used in irrigation?

- G. *Hand-move irrigation* is the least expensive sprinkler system to install.
- This system is very labor intensive and consists of a lightweight aluminum pipe that can be moved from place to place by a single person.



# What methods of water application are used in irrigation?

- H. *Solid-set irrigation* uses the same equipment as hand-move set-ups, except that an entire field is set up at planting.
- The large number of pipes needed to supply all fields increases the cost of the additional initial equipment purchase, but almost eliminates additional labor during the growing season since the pipes remain in place until harvest.

# What methods of water application are used in irrigation?

- I. *Traveling-gun irrigation* uses one very large sprinkler mounted on a trailer or that moves across a field.
  1. The sprinkler sends out a single large stream of water and can also be used to spray liquid manure and other slurries.
  2. The gun is very liable to wind problems.



# *Traveling-gun irrigation*



# What methods of water application are used in irrigation?

- J. *Center-pivot irrigation* has a central pivot point with the watering line elevated above the crop.
1. As the system operates, the line slowly turns around the pivot point.
  2. Center pivot has the lowest labor requirement of any irrigation method.



# Center-pivot irrigation



# What methods of water application are used in irrigation?

- K. Wheel-move irrigation consists of a line of sprinklers mounted on wheels at both ends.
1. The line of sprinklers slowly rolls down the field until it reaches the end of its hose.
  2. The pattern of moisture that is distributed is rectangular and irrigates all parts of the field.

# *Wheel-move irrigation*



# What methods of water application are used in irrigation?

- L. *Trickle or drip irrigation* involves the use of plastic pipes on the ground running down a crop row with special emitters spaced along the pipe.
  1. The emitters drip water, at controlled rates, onto the soil surface near the plants.

# *Trickle or drip irrigation*



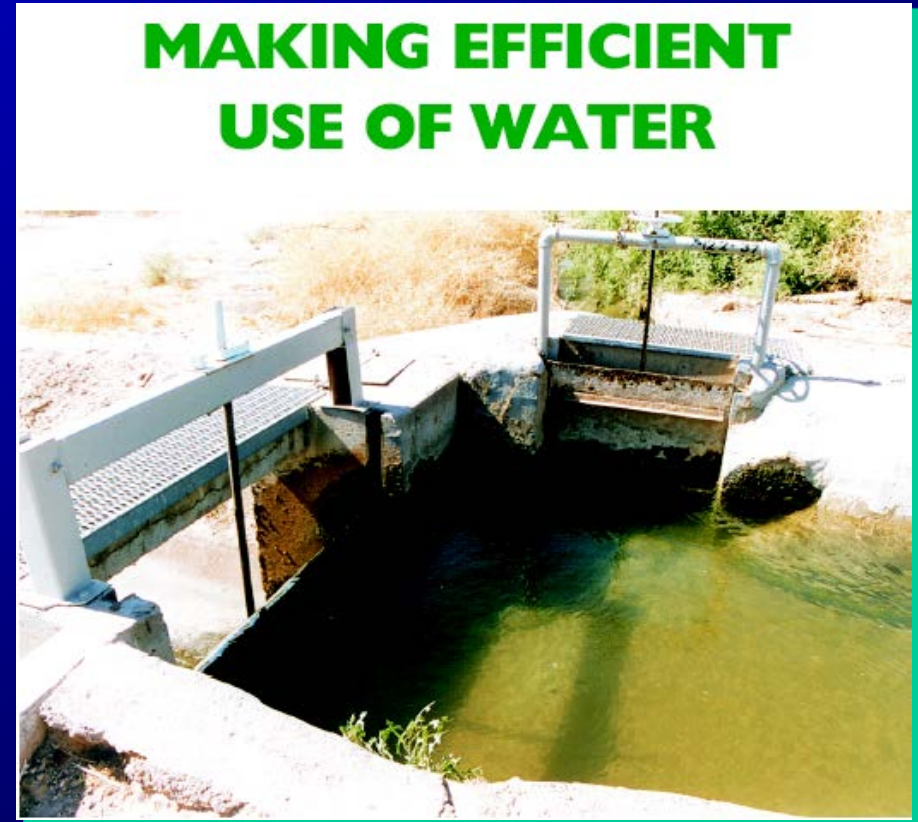
# What methods of water application are used in irrigation?

2. The system operates at low water volume and pressure.
  - Problems occur with plugging of the emitters and variation in flow rates between emitters.



# How is water used efficiently?

V. Irrigation water is valuable. It should be used properly and not wasted.



# How is water used efficiently?

- A. Using water more efficiently results in greater production.
  - 1. Use sprinkler irrigation during the cooler part of the day and when the wind is not blowing.
    - More water is lost to evaporation in heat and when the wind is blowing.



# How is water used efficiently?

2. Monitor moisture in the root zone. Irrigate enough to have good root zone moisture.
  - Stop adding water when the water has penetrated to the root zone.
  - Adding more water will result in loss by percolation of the water outside the root zone.

# How is water used efficiently?

3. Keep the irrigation system in good condition.
  - Leaks in pipes, canals, and other water structures should be prevented.
  - Be sure all connections fit properly to avoid leaks.
4. Apply water uniformly so that all areas of a field receive the appropriate amount.

# How is water used efficiently?

5. Depending on the irrigation method used, land forming may be needed to efficiently use the water.
  - High places may not be irrigated adequately and low places may get too much.

# How is water used efficiently?

6. Water needs vary within a field and adjustments should be made accordingly in the rate of application.
  - Apply only the amount of water that can be used. Avoid over irrigation where excess water runs from the field into nearby creeks.
  - Not only is the water not used, it may carry nutrients, sediment, or pesticides from the field.

# Review / Summary

- Irrigation is an important part of soil moisture management in many locations.
- Knowing when to irrigate is important in soil moisture balance.
  - Waiting until the plant shows signs of stress may be too late.

# Review / Summary

- Experienced irrigators have developed their own procedures for scheduling applications.
- Irrigation scheduling is providing the right amount of water at the right time.
- Irrigation water is valuable. It should be used properly and not wasted.