

# Unit D: Agricultural Equipment Systems

Lesson 4: Operating, Calibrating, and Maintaining Irrigation Systems

# Terms

- Available water
- Border strip irrigation
- Center-pivot irrigation
- Chemigation
- Efficiency
- Evapotranspiration
- Field capacity
- Permanent wilting point
- Sprinkler irrigation
- Subsurface irrigation
- Surface irrigation
- Trickle or drip irrigation
- Water-application efficiency
- Water-conveyance efficiency
- Water-use efficiency
- Wheel movement irrigation

# Objective #1



What are the irrigation methods used in agriculture?

# Methods of irrigation

- ***Subsurface irrigation***
  - Watering from below using capillary rise from a zone of soil lower in soil profile
  - Water comes from open ditches, mole drains, pipe drains
- ***Surface irrigation***
  - Involves flooding the soil surface with water released from canals or piping systems
  - Field needs to have a slight slope to drain properly

# Methods of irrigation

- ***Border strip irrigation***
  - Involves covering the entire soil surface of a field with a sheet of water
  - Divide fields into smaller parts by using dikes, then each section is flooded in turns
- Furrow irrigation
  - Distributes water through furrows with crops planted on ridges
  - Best suited for row crops

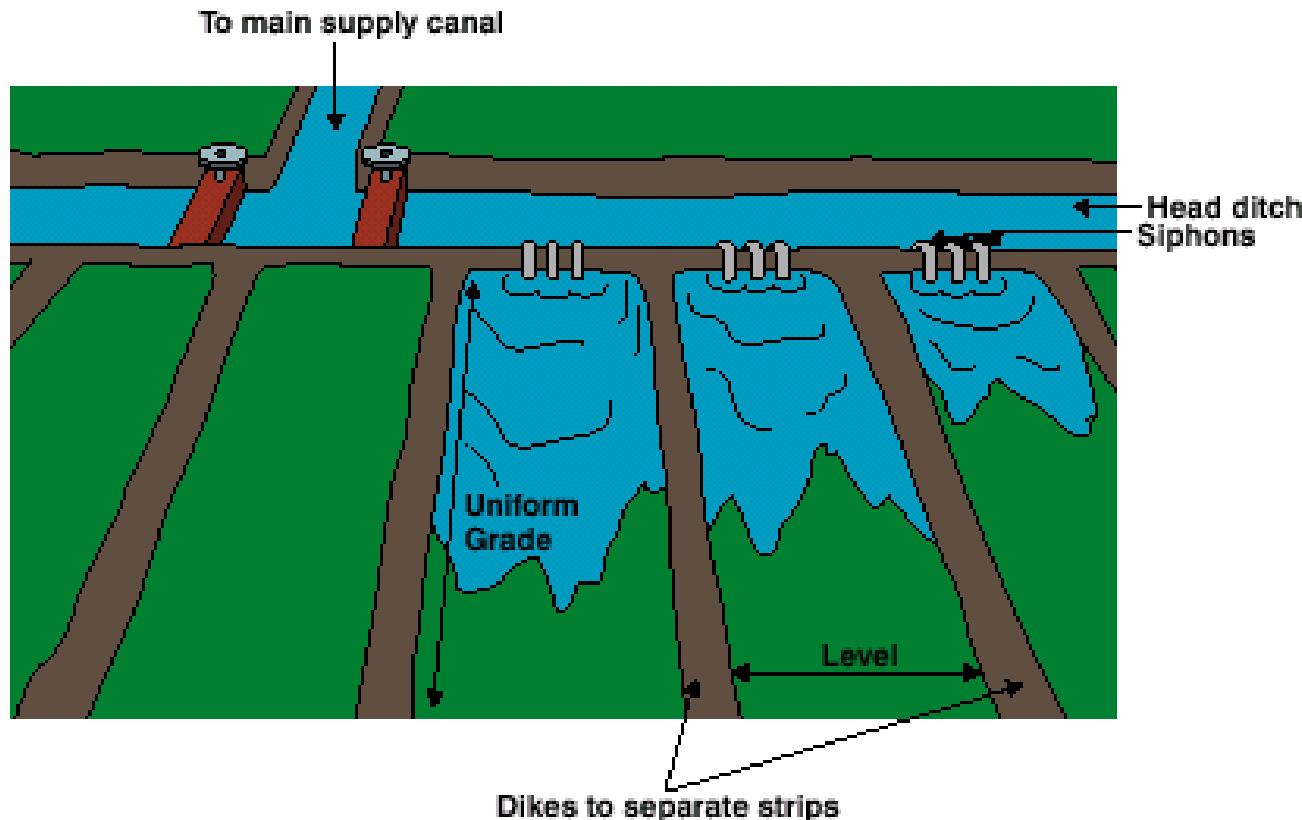
# Methods of irrigation

- ***Sprinkler irrigation***
  - Systems that pump water under pressure through pipes to sprinkler that spray water
  - Can be used for ***chemigation***
    - Applying chemicals like fertilizer or herbicides
- Solid-set irrigation
  - Entire field set up for irrigation and left until harvest
- Traveling-gun irrigation
  - Uses one large sprinkler mounted on a trailer that moves across the field

# Methods of irrigation

- ***Center-pivot irrigation***
  - Central pivot point with the watering line elevated above the crop
  - Line slowly moves around to cover entire field
- ***Wheel-move irrigation***
  - Consists of a line of sprinklers mounted on the wheels at both ends
- ***Trickle or drip irrigation***
  - Involves the use of plastic pipes on the ground running down a crop row with special emitters spaced along pipe

# BORDER STRIP IRRIGATION



(Courtesy, Interstate Publishers, Inc.)

# Objective #2



What are the operating principles of irrigation systems used in agriculture?

# Human dependence on irrigation

- Current concepts made possible by modern power sources to deep well pumps and reservoirs
- Increasing demands of water makes effective use of water essential
- Irrigation is a major user of water, system needs to be planned, designed, and operated efficiently
- Water requirements and time vary with crops
- Where sufficient water is available, the soil water content should be maintained for optimum growth

# Irrigation operating principles

- ***Evapotranspiration***
  - Amount of moisture lost due to evaporation and transpiration
- Planning and managing irrigation, the soil's capacity to store available water is important
- Water-holding capacity of the soil must be known

# Irrigation operating principles

- ***Field capacity***
  - Water content after a soil is wetted and allowed to drain 1 to 2 days.
  - Represents the upper limit of water available to plants
- ***Permanent wilting point***
  - Represent the lower limit of water available to plants
- ***Available water***
  - Difference between field capacity and permanent wilting point

# Scheduling methods

- Measure soil water and plant stress by soil samples and estimate amount of water available to plants
- Insert instruments such as tensiometers or electrical resistance blocks to take readings at intervals
- Measure plant characteristics and relate them to water stress

# **BEHAVIOR OF SOIL AT SELECTED SOIL-WATER DEPLETION AMOUNTS**

Available Water Remaining in the Soil	Soil Type	
	Sands	Loamy sand/sandy loam
Soil saturated, wetter than field capacity	Free water appears when soil ball is squeezed	Free water appears when soil ball is squeezed
100% available (field capacity)	When soil ball is squeezed, wet outline on hand but no free water	When soil ball is squeezed, wet outline on hand but no free water
75 to 100%	Sticks together slightly	Forms a ball that breaks easily
50 to 75%	Appears dry; will not form a ball	Appears dry; will not form a ball
Less than 50%	Flows freely as single grains	Flows freely as grains with some small aggregates

# Objective #3



How are irrigation systems calibrated?

# Calibrating irrigation systems

- ***Efficiency***
  - Output divided by an input usually expressed as a percentage
- ***Water-conveyance efficiency***
  - Output is the water delivered by distribution system and input is water introduced into distribution system
- ***Water application efficiency***
  - Output is the water stored in soil root zone and input is the water delivered to area being irrigated
- ***Water use efficiency***
  - Output is the water beneficially used and input is water delivered to area being irrigated

# Other considerations

- Uniformity of distribution
- Use the most water-efficient system that is practical
- Where feasible use trickle irrigation
- Surface systems have level land
- Use amount of irrigation water that gives best return
- Irrigate based on the crop needs not time

# **EFFICIENCY IN IRRIGATION**

**Efficiency**—output divided by input.  
usually expressed as a percentage.

## **Three Types of Efficiency:**

### **1. Water-Conveyance Efficiency**

- Output is water delivered by distribution system
- Input is water introduced into the system

### **2. Water-Application Efficiency**

- Output is the water stored in the soil root zone
- Input is the water being delivered to the area being irrigated

### **3. Water-Use Efficiency**

- Output is water beneficially used
- Input is the water being delivered to the area being irrigated

# Objective #4



How are irrigation systems maintained?

# Irrigation system maintenance

- Follow manufacturer's recommendations
- Saving water is an important consideration
- Avoid water pollution
- System is matched to crop, soil and terrain
- Maintain all systems efficiency
- Transport water in sealed ditches to avoid evaporation
- Systems should contain devices to measure and control water flow

# Review

- What are the irrigation methods used in agriculture?
- What are the operating principles of irrigation systems used in agriculture?
- How are irrigation systems calibrated?
- How are irrigation systems calibrated?