Unit D: Agricultural Equipment Systems

Lesson 4: Operating, Calibrating, and Maintaining Irrigation Systems
Terms

- Available water
- Border strip irrigation
- Center-pivot irrigation
- Chemigation
- Efficiency
- Evaportranspiration
- 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

To main supply canal

Head ditch Siphons

Uniform Grade

Level

Dikes to separate strips

(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

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