

Unit F: Soil Fertility and Moisture Management

Lesson 4: Using Irrigation

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Describe the benefits of irrigation.
2. Identify ways of determining the need of irrigation.
3. Describe irrigation scheduling.
4. Explain methods of water application.
5. Describe the efficient use of water.

Recommended Teaching Time: 2 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has also been developed for use with this lesson plan

List of Equipment, Tools, Supplies, and Facilities:

Writing surface
PowerPoint Projector
PowerPoint Slides
Transparency Masters

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slides 2 and 3):

- Border strip irrigation
- Center-pivot irrigation
- Chemigation
- Ground truthing
- Irrigation scheduling
- Moisture sensor
- Remote sensing
- Ribbon test
- Sap flow sensor
- Soil moisture meter
- Sprinkler irrigation
- Subsurface irrigation
- Surface irrigation
- Tensiometer
- Trickle or drip irrigation
- Wheel-move irrigation
- Wilting point

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Display to the students a plant that has had plenty of water and one that is deficient in its water supply. Ask students to identify difference between the two. Ask if anyone would share the process they use to irrigate their crops. Lead the class through discussion towards the use of irrigation and introduce the first objective.

Summary of Content and Teaching Strategies

Objective 1: Describe the benefits of irrigation.

(PowerPoint Slide 4)

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

(PowerPoint Slide 5)

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.

(PowerPoint Slide 6)

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.

(PowerPoint Slide 7)

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

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

(PowerPoint Slide 8)

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.

Objective 2: Identify ways of determining the need of irrigation.

(PowerPoint Slide 9)

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

(PowerPoint Slide 10)

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.

(PowerPoint Slide 11)

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.

(PowerPoint Slide 12 shows the ribbon test)

(PowerPoint Slides 13)

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.

(PowerPoint Slides 14 shows a vegetative index map)

(PowerPoint Slides 15)

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.

(PowerPoint Slides 16)

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.

(PowerPoint Slides 17)

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.

(PowerPoint Slides 18)

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

(PowerPoint Slides 19)

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

****Use TM: F3-1, F3-2, and F3-3 as visual material for lecture and discussion. PowerPoint Slides 13 and 14 can also be used. You can also find soil for students to perform the ribbon test. Guide them through in order to approximate the moisture content. Then have the students determine if the soil would need to be irrigated in order to grow crops sufficiently.**

Objective 3: Describe irrigation scheduling.

(PowerPoint Slides 20)

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

(PowerPoint Slides 21)

- 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.

(PowerPoint Slides 22)

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.

(PowerPoint Slides 23)

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.

****Talk about the climate in Afghanistan. How does it vary in your region compared to other regions in Afghanistan. When does your area need irrigation the most? Have the class come up with a tentative irrigation schedule that fits your area.**

Objective 4: Explain methods of water application.

(PowerPoint Slides 24)

IV. Irrigation has a long history in world agriculture. Irrigation water can be applied through several methods.

(PowerPoint Slides 25 and 26)

- 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.

(PowerPoint Slides 27 and 28)

- 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. 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.

(PowerPoint Slides 29 and 30)

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.

(PowerPoint Slides 31 and 32)

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.

(PowerPoint Slides 33 and 34)

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.

(PowerPoint Slides 35)

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.

(PowerPoint Slides 36)

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.

(PowerPoint Slides 37)

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.

(PowerPoint Slides 38 and 39)

I. Traveling-gun irrigation uses one very large sprinkler mounted on a trailer 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.

(PowerPoint Slides 40 and 41)

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.

(PowerPoint Slides 42 and 43)

- 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.

(PowerPoint Slides 44 and 45)

- 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.

(PowerPoint Slides 46)

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

****Use TM: F3-4 as visual material for lecture and discussion. Ask students if they use any of these methods at their home. Have them explain their experiences.**

Objective 5: Describe the efficient use of water.

(PowerPoint Slides 47)

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

(PowerPoint Slides 48)

- 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.

(PowerPoint Slides 49)

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.

(PowerPoint Slides 50)

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.

(PowerPoint Slides 51)

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.

(PowerPoint Slides 52)

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.

****Use TM: F3-5 as visual material for lecture and discussion.**

Review/Summary: Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used to determine which objectives need to be reviewed or taught over using a different approach. Questions on PowerPoint Slides 53 and 54 can also be used.

Application: Students can apply the information learned in this lesson.

Evaluation: Evaluation should focus on student achievement of the objectives for each lesson. Various techniques can be used, such as performance on the application activities. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1 = b, 2 = d, 3 = a, 4 = c, 5 = e

Part Two: Completion

1. trickle or drip
2. Irrigation scheduling
3. Sprinkler
4. Subsurface

Part Three: Short Answer

1. When the plant cannot take in water as quickly as it is lost from the plant.
2. Poor plant growth, stunted mature plants, lower crop yields and loss of potential profit, death of plants, stress, loss of aesthetics caused by dead plants
3. Provides water when adequate water would not otherwise be available for plant growth; promotes plant growth by applying fertilizer, growth regulators and other materials with the water; disposes of waste water by land application; protects plants from extreme cold temperatures, such as preventing frost damage in fruit and vegetable crops; reduces dust from field and other surfaces.

Test

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Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | |
|--------------------|-----------------------|
| a. Moisture sensor | d. Surface irrigation |
| b. Ribbon test | e. Tensiometer |
| c. Sap flow sensor | |

- _____ 1. Test used to determining soil moisture content by feel.
- _____ 2. Involves flooding the soil surface with water released from canals or piping systems.
- _____ 3. Electronic instrument that is used to probe the soil and provide a reading on moisture content.
- _____ 4. Device that measures the movement of water (sap) inside the stem of a plant.
- _____ 5. Device that assesses moisture content by determining the pull of soil particles in the soil.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. The use of plastic pipes on the ground running down a crop row with special emitters spaced along the pipe is known as _____ irrigation.
2. _____ is providing the right amount of water at the right time.
3. _____ irrigation systems pump water under pressure through pipes to sprinklers that spray water out in a circular pattern.
4. _____ irrigation is watering from below using capillary rise from a zone of saturating soil lower in the soil profile.

TM: F3-1

RIBBON TEST FOR SOIL TYPES

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

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

0-25 percent available

Dry, soil aggregations break away easily, no staining on fingers, clods crumble with applies pressure (not pictured)



25-50 percent available

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



50-75 percent available

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



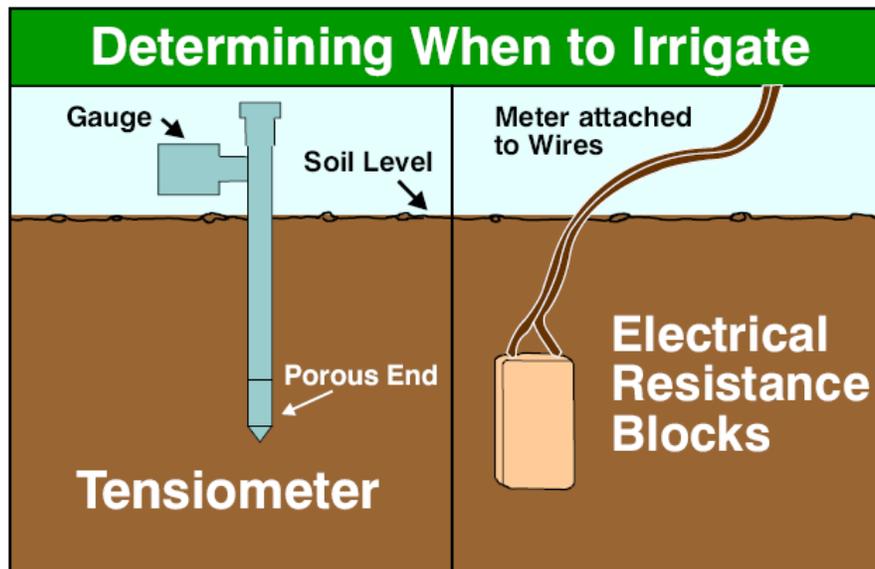
75-100 percent available

Wet, forms a soft ball, free water appears briefly on soil surface after squeezing or shaking, medium to heavy soil/water coating on fingers.

100 percent available

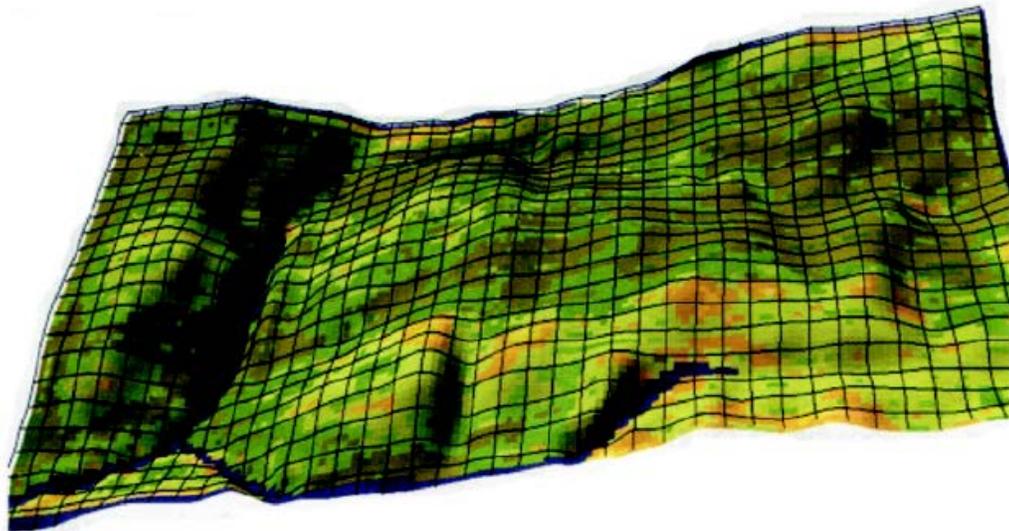
Wet, forms a soft ball, free water appears briefly on soil surface after squeezing or shaking, medium to heavy soil/water coating on fingers (Not pictured)

INSTRUMENTS TO MEASURE AND MONITOR SOIL



TM: F3-3

A VEGETATIVE INDEX MAP



TM: F3-4

COMMON WATER APPLICATION METHODS



TM: F3-5

MAKING EFFICIENT USE OF WATER

