LEC. 18 & 19. METHODS OF IRRIGATION - SUITABILITY, ADVANTAGES AND LIMITATIONS

Water application methods are grouped as:

1. Flooding
2. Applying it beneath the soil surface
3. Spraying it under pressure
4. Applying in drops

Irrigation methods

I. Surface

II. Sub-surface

III. Pressurized irrigation

Surface is grouped as Border, Check basin and Furrow irrigations. Border is again classified in to two as straight and contour. Check basins may be of rectangular, contour or ring, whereas furrow irrigation is classified as deep furrow and corrugated furrows. These may be again straight or contour according to direction and leveled and graded as per their elevation

I. Surface irrigation

1. Border irrigation

- The land is divided into number of long parallel strips called borders.
- These borders are separated by low ridges.
- The border strip has a uniform gentle slope in the direction of irrigation.
- Each strip is irrigated independently by turning the water in the upper end.
- The water spreads and flows down the strip in a sheet confined by the border ridges.

Suitability : To soils having moderately low to moderately high infiltration rates. It is not used in coarse sandy soils that have very high infiltration rates and also in heavy soils having very low infiltration rate. Suitable to irrigate all close growing crops like wheat, barley, fodder crops and legumes and not suitable for rice.

Advantages

1. Border ridges can be constructed with simple farm implements like bullock drawn "A" frame ridger or bund former.
2. Labour requirement in irrigation is reduced as compared to conventional check basin method.
3. Uniform distribution of water and high water application efficiencies are possible.
4. Large irrigation streams can be efficiently used.
5. Adequate surface drainage is provided if outlets are available.

Width of border strip: It varies from 3-15 m

Border length

Slope	Soil	Length
0.25 - 0.60%	Sandy and sandy loam	60-120 m
0.20 - 0.40%	Medium loam soil	100-180 m
0.05 – 0.20%	Clay loam and clay soil	150-300 m

2. Check basin irrigation

- It is the most common method.
- Here the field is divided into smaller unit areas so that each has a nearly level surface.
- Bunds or ridges are constructed around the area forming basins within which the irrigation water can be controlled.
- The water applied to a desired depth can be retained until it infiltrates into the soil.
- The size of the basin varies from $10m^2$ to 25 m^2 depending upon soil type , topography, stream size and crop.

Adaptability

- ✓ Small gentle and uniform land slopes
- ✓ Soils having moderate to slow infiltration rates.
- ✓ Adapted to grain and fodder crops in heavy soils.
- ✓ Suitable to permeable soils.

Advantages

1. Check basins are useful when leaching is required to remove salts from the soil profile.
2. Rainfall can be conserved and soil erosion is reduced by retaining large part of rain
3. High water application and distribution efficiency.

Limitations

1. The ridges interfere with the movement of implements.
2. More area occupied by ridges and field channels.
3. The method impedes surface drainage
4. Precise land grading and shaping are required
5. **Labour requirement is higher.**
6. Not suitable for crops which are sensitive to wet soil conditions around the stem.

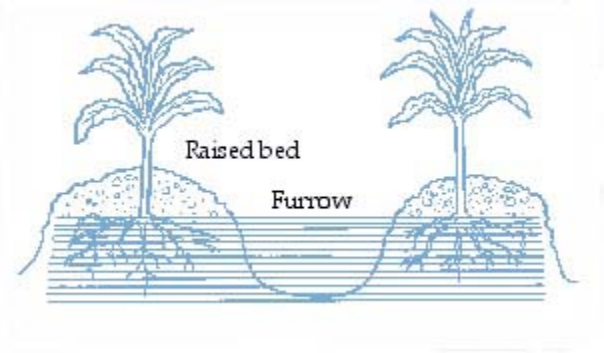
Furrow irrigation

⇒ Used in the irrigation of row crops.

⇒ The furrows are formed between crop rows.

⇒ The dimension of furrows depend on the crop grown, equipment used and soil type.

⇒ Water is applied by small running streams in furrows between the crop rows.



⇒ Water infiltrates into soil and spreads laterally to wet the area between the furrows.

⇒ In heavy soils furrows can be used to dispose the excess water.

Adaptability

1. Wide spaced row crops including vegetables.
2. Suitable for maize, sorghum, sugarcane, cotton, tobacco, groundnut, potatoes
3. Suitable to most soils except sand.

Advantages

1. Water in furrows contacts only one half to one fifth of the land surface.
2. Labour requirement for land preparation and irrigation is reduced.
3. Compared to check basins there is less wastage of land in field ditches.

Types of furrow irrigation

Based on alignment of furrows : 1. Straight furrows
2. Contour furrows

Based on size and spacing : 1. Deep furrows 2. Corrugations

Based on irrigation:

A. **All furrow irrigation:** Water is applied evenly in all the furrows and are called furrow system or uniform furrow system.
B. **Alternate furrow irrigation:** It is not an irrigation layout but a technique for water saving. Water is applied in alternate furrows for eg. During first irrigation if the even

numbers of furrows are irrigated, during next irrigation, the odd number of furrows will be irrigated.

C. **Skip furrow irrigation:** They are normally adopted during the period of water scarcity and to accommodate intercrops. In the skip furrow irrigation, a set of furrows are completely skipped out from irrigation permanently. The skipped furrow will be utilized for raising intercrop. The system ensures water saving of 30-35 per cent. By this method, the available water is economically used without much field reduction.

D. **Surge irrigation:** Surge irrigation is the application of water in to the furrows intermittently in a series of relatively short ON and OFF times of irrigation cycle. It has been found that intermittent application of water reduces the infiltration tare over surges thereby the water front advances quickly. Hence, reduced net irrigation water requirement. This also results in more uniform soil moisture distribution and storage in the crop root zone compared to continuous flow. The irrigation efficiency is in between 85 and 90%.

II. Sub-surface irrigation

- In subsurface irrigation, water is applied beneath the ground by creating and maintaining an artificial water table at some depth, usually 30-75 cm below the ground surface.
- Moisture moves upwards towards the land surface through capillary action
- Water is applied through underground field trenches laid 15-30 m apart.

- Open ditches are preferred because they are relatively cheaper and suitable to all types of soil.
- The irrigation water should be of good quality to prevent soil salinity.

Advantages

1. Minimum water requirement for raising crops
2. Minimum evaporation and deep percolation losses
3. No wastage of land
7. No interference to movement of farm machinery
8. Cultivation operations can be carried out without concern for the irrigation period.

Disadvantages

1. Requires a special combination of natural conditions.
2. There is danger of water logging
3. Possibility of choking of the pipes lay underground.
4. High cost.

DRIP IRRIGATION SYSTEM

- Drip or trickle irrigation is one of the latest methods of irrigation.
- It is suitable for water scarcity and salt affected soils.
- Water is applied in the root zone of the crop

Standard water quality test needed for design and operation of drip irrigation system.

(Major inorganic salts, hardeners, suspended solids, total dissolved solids, biological oxygen demand, chemical oxygen demand, organic, and organic matter, micro-organisms, iron, dissolved oxygen, H2S, iron bacteria, sulphur reducing bacteria etc have to be tested)

Components

- A drip irrigation system consists of a pump or overhead tank, main line, sub-mains, laterals and emitters.

- The mainline delivers water to the sub-mains and the sub-mains into the laterals.
- The emitters which are attached to the laterals distribute water for irrigation.
- The mains, sub-mains and laterals are usually made of black PVC (poly vinyl chloride) tubing. The emitters are also made of PVC material
- The other components include regulator, filters, valves, water meter, fertilizer application components, etc.,

Pump

The pump creates the pressure necessary to force water through the components of the system including the fertilizer tank, filter unit, mainline, lateral and the emitters and drippers. Centrifugal pump operated by engines or electric motors are commonly used. The laterals may be designed to operate under pressures as low as 0.15 to 0.2 kg/ cm^2 and as large as 1 to 1.75 kg/cm^2. The water coming out of the emitters is almost at atmospheric pressure.

Chemical tank

A tank may be provided at the head of the drip irrigation systems for applying fertilizers, herbicides and other chemicals in solution directly to the field along with irrigation water.

Filter

It is an essential part of drip irrigation system. It prevents the blockage of pipes and drippers/emitters. The filter system consists of valves and a pressure gauge for regulation and control.

Emitters

Drip nozzles commonly called drippers or emitters are provided at regular intervals on the laterals. They allow water to emit at very low rates usually in trickles. The amount of water dripping out of each emitters in a unit time will depend mainly upon the pressure and size of the opening. The discharge rate of emitters usually ranges from 2 to 10 litres per hour.

Micro-tubes are also used in a drip lateral. They are used mainly in the following ways (1) as emitters (2) as connectors, (3) as pressure regulators

Advantages

1. Water saving - losses due to deep percolation, surface runoff and transmission are avoided. Evaporation losses occurring in sprinkler irrigation do not occur in drip irrigation.
2. Uniform water distribution
3. Application rates can be adjusted by using different size of drippers
4. Suitable for wide spaced row crops, particularly coconut and other horticultural tree crops
5. Soil erosion is reduced
6. Better weed control
7. Land saving
8. Less labour cost

Disadvantages

1. High initial cost
2. Drippers are susceptible to blockage
3. Interferes with farm operations and movement of implements and machineries
4. Frequent maintenance
5. Trees grown may develop shallow confined root zones resulting in poor anchorage. LAYOUT OF SPRINKLER IRRIGATION SYSTEM

- The sprinkler (overhead or pressure) irrigation system conveys water to the field through pipes (aluminium or PVC) under pressure with a system of nozzles.
- This system is designed to distribute the required depth of water uniformly, which is not possible in surface irrigation.

- Water is applied at a rate less than the infiltration rate of the soil hence the runoff from irrigation is avoided.

A sprinkler system usually consists of the following parts.

1. A pumping unit
2. Debris removal equipment
3. Pressure gauge / water-meter
4. Pipelines (mains – sub-mains and laterals)
5. Couplers
6. Raiser pipes
7. Sprinklers
8. Other accessories such as valves, bends, plugs, etc.

Pumping unit

A high speed centrifugal or turbine pump can be installed for operating the system for individual farm holdings. The pumping plants usually consist of a centrifugal or a turbine type pump, a driving unit, a suction line and a foot valve.

Pipe lines

Pipelines are generally of two types. They are main and lateral. Main pipelines carry water from the pumping plant to many parts of the field. In some cases sub main lines are provided to take water from the mains to laterals. The lateral pipelines carry the water from the main or sub main pipe to the sprinklers. The pipelines may be either permanent, semi permanent or portable.

Couplers

A coupler provides connection between two tubing and between tubing and fittings.

Sprinklers

Sprinklers may rotate or remain fixed. The rotating sprinklers can be adapted for a wide range of application rates and spacing. They are effective with pressure of about 10 to 70 m head at the sprinkler. Pressures ranging from 16-40 m head are considered the most practical for most farms. Fixed head sprinklers are commonly used to irrigate small lawns and gardens.

Other accessories / fittings

1. Water meters - It is used to measure the volume of water delivered.
2. Pressure gauge - It is necessary to know whether the sprinkler is working with the desired pressure in order to deliver the water uniformly.
3. Bends, tees, reducers, elbows, hydrants, butterfly valves, end plugs and risers
4. Debris removal equipment: This is needed when water is obtained from streams, ponds, canals or other surface supplies. It helps to keep the sprinkler system clear of sand, weed seeds, leaves, sticks, moss and other trash that may otherwise plug the sprinklers.
5. Fertilizer applicators. These are available in various sizes. They inject fertilizers in liquid form to the sprinkler system at a desired rate.

Types of sprinkler system

On the basis of arrangement for spraying irrigation water

1. Rotating head (or) revolving sprinkler system
2. Perforated pipe system

Based on the portability

1. Portable system: It has portable mainlines and laterals and a portable pumping unit

2. Semi portable system: A semi portable system is similar to a fully portable system except that the location of the water source and pumping plant are fixed.

3. Semi permanent system: A semi permanent system has portable lateral lines, permanent main lines and sub mains and a stationery water source and pumping plant.

The mainlines and sub-mains are usually buried, with risers for nozzles located at suitable intervals.

4. Solid set system: A solid set system has enough laterals to eliminate their movement. The laterals are placed in the field early in the crop season and remain for the season.

5. Permanent system: It consists of permanently laid mains, sub-mains and laterals and a stationary water source and pumping plant. Mains, sub-mains and laterals are usually buried below plough depth. Sprinklers are permanently located on each riser.

Advantages

1. Water saving to an extent of 35-40% compared to surface irrigation methods.
2. Saving in fertilizers - even distribution and avoids wastage.
3. Suitable for undulating topography (sloppy lands)
4. Reduces erosion
5. Suitable for coarse textured soils (sandy soils)
6. Frost control - protect crops against frost and high temperature
7. Drainage problems eliminated
8. Saving in land
9. Fertilisers and other chemicals can be applied through irrigation water

Disadvantages

1. High initial cost
2. Efficiency is affected by wind
3. Higher evaporation losses in spraying water
4. Not suitable for tall crops like sugarcane
5. Not suitable for heavy clay soils
6. Poor quality water can not be used (Sensitivity of crop to saline water and clogging of nozzles)

Steps to be taken for reducing the salt deposits on leaves and fruits during sprinkler irrigation

- Irrigate at night
- Increase the speed of the sprinkler rotation
- Decrease the frequency of irrigation