Unit 1

Irrigation Management in Vegetable Crops

Introduction

Vegetable crops require frequent irrigation for better growth and development. Irrigation requirement may vary from crop to crop. If water is the limiting factor, then proper management and conservation practices can be fruitful to grow vegetables round the year. Conservation, management and use of irrigation water are critical to successful vegetable production, especially when the fields are under drought condition. A well-organised water management plan and irrigation scheduling is the key to water management in vegetables crop production. Leafy vegetables require frequent irrigation. Fruiting vegetables and root and tuber vegetables have different critical stages of water requirement. This unit will help you understand about the water sensitive or critical stage of vegetable crops.

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Role of Water in Plants

- Water is an essential element for plants.
- It helps in the growth and development of plants.
- It helps plants to absorb and transport minerals from soil.
- It is essential for the conduct of biochemical reactions.
- It is integral for making food through photosynthesis.

- It helps plants to manage heat or frost stresses.
- It is necessary for seed germination and seedling establishment.

Sources of Water for Plants

Rainfall and irrigation are the two main sources of water for plants.

Rainfall is a natural source of water and the quality of water is also good. But, it is a limited and unpredictable natural source. Whereas, the artificial application of water to the soil in order to maintain a proper soil moisture regime for plant growth is called irrigation. Irrigation is the practice of planning and applying water artificially to maintain soil moisture. It can be made an assured source.

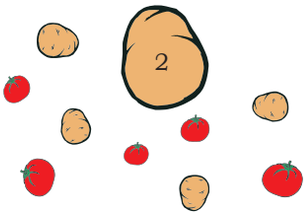
The irrigation requirement of crop plants depends on

- the type of vegetable crop. Shallow-rooted crops need light but frequent irrigation as compared to deep-rooted vegetable crops.
- the growing season. Summer vegetable crops need more frequent irrigation than the winter crops. Occasionally the rainy season crops also need irrigation.
- the climate. Crops should be irrigated less frequently during the cool climate and more frequently in tropical or hot climate.
- the soil type. Frequent but light irrigation should be done in sandy soil and deep but less frequent irrigation is required in clayey soil.
- the type of irrigation system. Regular irrigation is needed in the drip system and less frequently in the surface, sub-surface and sprinkler irrigation system.

Session 1: Irrigation and Water Quality

Importance of Irrigation

- Since vegetable crops contain 80–90% water they require a large amount of water and frequent irrigation for proper growth and development.



- In water shortage conditions the yield and quality of vegetable crops suffer. Hence, irrigation is essential for higher yield and good quality vegetables.
- Vegetable crops grow fast, hence, they require frequent and more water.
- A sufficient amount of water in the roots is a pre-requisite for better yield and quality produce.
- Irrigation reduces dependence on rainfall because it can be done as and when required.
- If irrigation is scheduled properly, it can save water and minimise weed problems.
- Irrigation helps in growing more crops in a year in the same field.

Sources of Irrigation Water

1. **Surface water sources** are found on the surface of the land. These sources are rivers, canals, ponds, lakes, dams, etc. Generally the quality of water from these sources is quite good and fit for irrigation.
2. **Groundwater** is underground water lifted through dug wells, tube wells and bore wells. This water quality varies from poor to good.

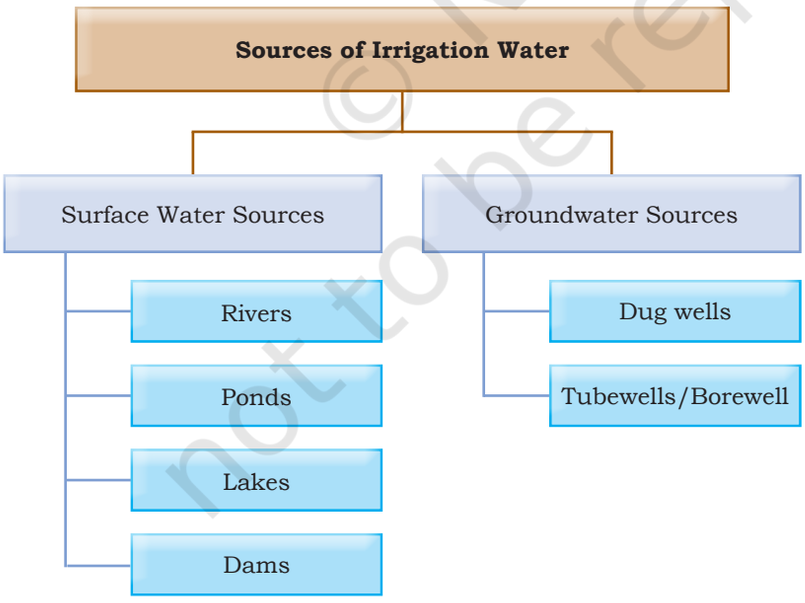


Fig. 1.1: Sources of irrigation water

Do you know?

- India has very few water resources and the groundwater level is also depleting at an alarming rate. Therefore, it is essential to conserve rainwater. Also, mulching in crops can save water and increase irrigation interval.
- In some areas, poor quality water full of toxins, heavy metals and microbes is used in the cultivation of vegetables. It can be used but only after proper treatment.

The quality of water is as important as the quantity for successful vegetable cultivation. In India, water quality concerns have often been neglected because of the availability of good quality water but nowadays this situation is changing in many areas. Poor quality water from urban-industrial areas and the salinity of groundwater need to be properly treated before using for irrigation.

Good quality water is a crucial factor for soil to remain productive for long. It allows growing of any kind of vegetable crop and also gives a high yield and better quality of vegetable crops.

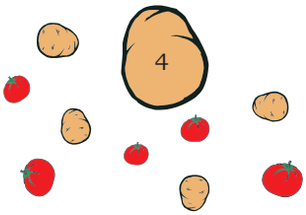
Various regions in the country use poor quality water to irrigate the crops. Untreated water from urban-industrial areas is of poor quality. In some areas, groundwater is very deep and poor in quality.

Using poor quality water for irrigation may

- deteriorate the soil health.
- deposit excess salt in the root zone.
- reduce uptake of minerals and affect crop yield.
- reduce soil permeability and increase water runoff.
- show toxicity of metals in some plants.

Criteria of Suitable Water for Irrigation

1. **pH** of water being used for irrigation should range between 6.5 to 8.5.
2. **Water salinity** is an indicator of total dissolved salts present in the water. It is of prime concern for both the soil structure and crop yield. Salt concentration is measured by electrical conductivity (EC) in mili Siemens per meter (mSm^{-1}) or micromhos per cm. Water having EC below 1500 micromhos/cm is good for irrigation.



3. **Sodium adsorption ratio (SAR)** is a measure of the relative proportion of sodium (Na+) to calcium (Ca^{+2}) and magnesium (Mg^{+2}) in water. High sodium causes breaking of soil aggregates and sealing of the soil pores. Sodium weakens the binding capacity of soil. A small SAR value indicates low sodium content in water. It should be below 10 in irrigation water.
4. **Residual sodium carbonate and bicarbonate concentration** content in water increases the pH. This can have an alkalising effect and raise the SAR index. Residual sodium carbonate below 1.5 mg/litre in irrigation water is safe. The following measures can be adopted for the management of this water quality.
   (i) Addition of gypsum in low calcium soil + leaching
   (ii) Addition of sulphur + lime + leaching
   (iii) More frequent irrigation
   (iv) Avoid the sprinkler method of irrigation
   (v) Avoid using fertilisers containing chloride and boron
   (vi) Select tolerant crops
5. **Boron** is the most common element found in toxic concentrations in water. It cannot be easily removed from water. The only remedy is to dilute high boron water. Below 1.0 ppm boron content is acceptable level in irrigation water.

Quality Testing Instruments

It is important to test the suitability of water quality for its intended purpose. Water testing will help to know whether the quality of water is fit for irrigation or not. If it is not, then one needs to find out what is the specific reason for the poor quality of water. Generally, the pH and electrical conductivity (EC) are the two most important parameters for water quality analysis. When a pH colour strip is dipped into alkaline or acidic water the colour changes as shown in Fig. 1.2.

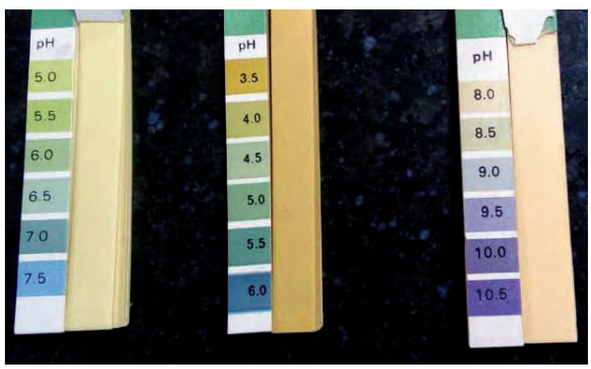


Fig.1.2: pH colour strip scale

1. **pH meter** is an equipment by which we can measure the pH level of any solution. It consists of a display unit and electrode. When the electrode is

Fig.1.3: Digital pH meter

Fig.1.4: Digital Electrical Conductivity (EC) meter

inserted into the solution the display unit shows the pH value. Ideally, the pH of the soil and water has to be 6-6.5 and that of the nutrient solution should be 5.6-6.5. For accurate data collection, the pH meter, like all other equipment, should be calibrated beforehand. It is more accurate than the pH colour strip. (Fig. 1.3)

2. **Electrical conductivity (EC) meter** is used to measure the total dissolved salts in irrigation water. It is reported in terms of millimhos per centimetre (mmhos/cm), deci Siemens per metre (dS/m), micro Siemens per centimetre (µS/cm) or milli Siemens per centimetre (mS/cm), which gives information on the degree of salinity in water. Micro Siemens per centimetre is the standard unit to represent EC value of freshwater measurements. They are all similar on numerical count. The numerical value remains the same per unit area, only the reference varies. Electrical conductivity of irrigation water is more when it contains more soluble salts and vice versa. The temperature of water affects conductivity and it is usually reported at 25°C. The EC measurement is the easiest and a rapid method to analyse the salinity level of water, but it is non-specific. It measures only the combined effect of all ions present and cannot distinguish between the different types of ions (Fig. 1.4).

Practical Exercises

Activity 1

Collection of water samples for quality testing

Material required

Plastic sample bottle (500 ml)

Procedure

a. Tubewell or handpump

- Start the tubewell or handpump and let it run for about 15-20 minutes. It is necessary to drain out all the water retained in the pipe of the well or pump to avoid 'pipe effect' (metals, salts deposited in the pipe).

- Take a water sample in sample bottles (500 ml–1 litre) just before the water falls into the channel.
- To analyse the quality of water from a tubewell or handpump, never collect the water sample once it falls into the channels because it affects the water quality.

b. Ponds or tanks
- Sample water from a pond or tank should be taken at least 5-10 metres inside the boundary area to avoid boundary effect.
- Take a properly washed plastic container for sampling.
- Displace the surface water of the pond or tank gently and take the sample from the intermediate depth.

c. Collect the water in a sample bottle immediately and close the bottle cap tightly.

d. Label the sample by writing name, address, source, place and date of sampling.

e. Submit the collected samples to the water quality testing laboratory within 2-3 days.

Precautions

- Avoid possibility of any external contamination.
- Don't wash the bottle with detergents or soap.
- Don't take water from the pond surface because it may contain organic material and affect the correct representation of water quality.
- Gently shake the pond surface to collect the water sample more accurately.

Activity 2

Measure pH by using litmus paper or pH meter

With litmus paper or pH paper

Material required

Litmus or pH paper strip, water from different sources, writing material, practical file, etc.

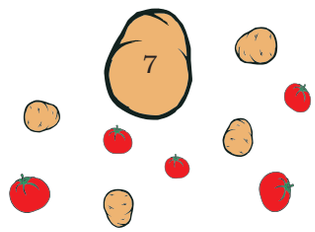
Procedure

1. Collect the water from different sources and places.
2. To observe the pH of the water sample, take the sample in a beaker (100 ml).
3. Dip the litmus paper in the sample and observe the colour change.
4. The litmus or pH paper changes colour based on the pH of the water sample.
5. Match the colour change with the help of a colour strip.
6. Note down the pH of water.

With a pH meter

Procedure

1. Collect the water sample.
2. Take 40 ml (5 ml more or less) of the water sample in a beaker.



3. Stabilise the temperature of the water sample.
4. Insert the pH meter electrode in the water beaker and turn the beaker to adjust for good contact between the pH meter electrode and water.
5. Before taking a recording, stabilise the pH reading of the sample for 20-30 seconds (automatic pH meter provides signals).
6. After reading, wash the electrode with distilled water to remove any film on it.

Precautions

- Calibrate the pH meter by using a pH 7 buffer solution before noting the observations.
- Insert the electrode into water. It should not touch the bottom of the beaker.
- During the electrode storage, keep it in pH 7 buffer.

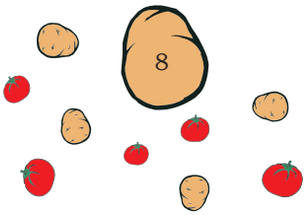
Check Your Progress

A. Fill in the blanks

1. Water is an essential _____ for plant life.
2. Vegetable crops grow fast, hence they require _____ and _____.
3. The untreated water from urban-industrial areas is _____ in quality.
4. _____ pH range of water is considered safe for irrigation.

B. Multiple choice questions

1. Irrigation is a practice of_____.
   (a) only artificial application of water
   (b) watering through rainfall
   (c) recharging groundwater
   (d) storing rainwater
2. Irrigation water suitable for most of the crops contains _____ boron.
   (a) below 1.0 ppm
   (b) 1.0 ppm - 1.5 ppm
   (c) 1.0 ppm - 2.0 ppm
   (d) above 2.0 ppm
3. The most common surface water source is a _____.
   (a) tube well
   (b) dug well
   (c) river
   (d) bore well



4. Total dissolved salt in water is measured with a _____.
   (a) Hygrometer
   (b) Lux meter
   (c) pH meter
   (d) EC meter
5. Electrical conductivity in irrigation water should be_____.
   (a) below 1500 micromhos/cm
   (b) 2000-3000 micromhos/cm
   (c) 2500-3500 micromhos/cm
   (d) above 3000 micromhos/cm

C. Short answer questions

1. Define irrigation and enlist the role of irrigation water.
2. Point out the criteria for suitability of irrigation water.
3. When is water suitable for irrigation?
4. Classify irrigation sources with proper examples.
5. How is water testing helpful for a farmer?

D. Match the columns

A	B
1. Quality test	(a) Mulching
2. Poor quality water	(b) Frequent watering
3. Increase water pH	(c) Deposit salts in root zone
4. Increase irrigation interval	(d) Suitability of water
5. Shallow rooted crops	(e) Carbonate and bicarbonate

SESSION 2: WATER REQUIREMENT AND IRRIGATION METHODS

Water Requirement

Water requirement (WR) of a crop is the total quantity of water needed for crop growth and yield that may be supplied by rainfall or irrigation or both. Water requirement varies from crop to crop and soil profile. It is different from irrigation requirement (IR), which is the total quantity of water applied to a cropped field to supplement rainfall and soil profile contribution.

When the entire water requirement is supplied by irrigation, then both WR and IR are the same. It is expressed as the unit of absorbed water required for the production of one unit of dry matter.

Water requirement (mm) =Evapo-transpiration + Application losses + Special needs

Where,

Evapo-transpiration (ET) = Total loss of water by transpiration from crop and evaporation from soil

Application losses = Water loss during the application of irrigation water

Special needs = Water required for land preparation, transplanting, leaching,etc.

How much to irrigate

If the water requirement of a particular crop is 6 mm per day, it means every day we need to give 6 mm of water to the crop. In field condition practically, it is not possible so it can be given as 30 mm for every 5 days or 60 mm for every 10 days. The frequency of irrigation varies with the growing season, types of crop and types of soil and its condition.

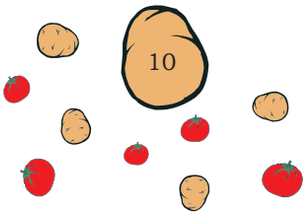
Water requirement of vegetable crops

- Tomato: 600-800 mm
- Chili: 450-500 mm
- Brinjal: 1000 mm
- Potato: 500-700 mm
- Onion: 640-700 mm
- Watermelon:500 mm
- Pea: 350-500 mm
- Cauliflower: 350 mm
- Bean: 300-500 mm
- Cabbage: 380-500 mm

Source: Reddy, 1999

Points to understand

- The water requirement of a crop is expressed in mm/season.
- The crops require more water in summer than in winter.
- Long duration crops have more water requirement.
- Shallow rooted vegetable crops need light but frequent irrigation.



- Timely irrigation means higher yield and better quality of produce.
- Only a few vegetables, such as brinjal, chili, watermelon, amaranthus, can tolerate partial drought.
- Unlike clayey soil, sandy soil requires low but more frequent depth of water.
- Avoid over flooding otherwise it will cause poor aeration and poor germination.
- With regular irrigation, keep the ridges and fields moist but not wet, for better crop growth and development.

Vegetable crops are divided into three major categories depending upon the rooting depth.

Table 1.1: Rooting depth of various vegetable crops

Rooting depth category	Root depth	Vegetable crops
Shallow rooted	45-60 cm	Onion, cabbage, cauliflower, celery, potato, radish, cowpea, lettuce, broccoli
Moderately deep-rooted	90-20 cm	Beans, beetroot, turnip, cucumber, brinjal, chili, sweet pepper, muskmelon, tomato
Deep-rooted	(More than 120 cm)	Asparagus, pumpkin, winter squash, sweet potato, watermelon

(Source: Swarup, 2014)

When to irrigate?

While growing vegetable crops, some stages of the plants are very sensitive to water stress. If it is not irrigated at this stage, the growth and yield of the crop can be adversely affected. This is known as the critical stage.

Water shortage in early crop stages delay crop maturity and reduce the yield, while moisture stress in the later stages of the crop reduce the quality of the produce. Hence, adequate moisture is essential for a high yield and good quality produce.

The frequency of irrigation and the amount of water to be given depend on a number of factors, such as the depth of the root system, water use efficiency, growth stage, soil type, prevailing weather conditions and the actual consumptive use of the vegetable crops.

Vegetables need frequent and timely irrigation for higher yield and good quality produce.

The decision on 'when to irrigate' can be taken on the basis of visual plant indices, soil appearance and climatic parameters. Visual symptoms, such as dropping and rolling of plants in mid-day are used to determine the time of irrigation. When soil samples from the root zone do not form a 'soil ball' properly, irrigation can be planned. Critical periods of water needs have been identified in most crops, the stage when they must be irrigated to maintain adequate moisture in the root zone (Table 1.2).

Table.1.2: Critical stages of vegetable crops

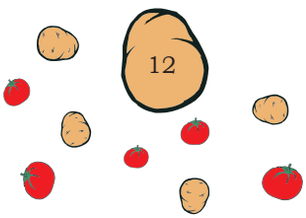
Crop	Critical Stages
Tomato, chili, brinjal	Flowering, fruit set and fruit development
Potato	Tuber initiation and tuber development
Okra	Flowering and pod development
Radish, carrot, turnip, beetroot	Root enlargement/development
Onion, garlic	Bulb formation and enlargement
Pea, beans	Flowering, pod set and pod development
Cabbage, cauliflower	Head formation and enlargement
Leafy vegetables	Entire crop duration

(Source: Swarup, 2014)

Methods of Irrigation

The system of irrigation water application into a crop field is called method of irrigation. The selection of suitable irrigation method mainly depends on the soil characteristics, cropping system, land topography, quantity and quality of irrigation water and the nature and availability of inputs like labour and energy. There are four principal systems of irrigation: surface, sub-surface, aerial or overhead or sprinkler irrigation and drip irrigation.

An efficient method aims at the proper use of irrigation water in conjunction with other inputs to enhance yield. Land topography, soil and crop types, water quality and quantity, availability of labour and energy are factors for deciding the irrigation method.



The system of irrigation and common methods are given in Fig. 1.5.

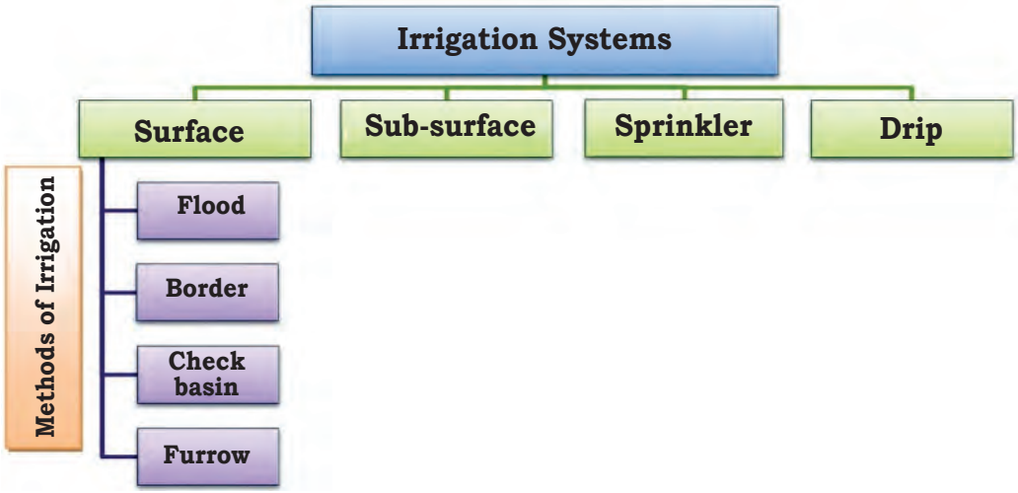


Fig.1.5: Irrigation systems and methods

Surface irrigation system

It is the most common and cheapest method of irrigation and is also known as gravity irrigation method. In this method the field is usually watered by introducing a stream of water through channels, pipes or ditches at the head of the field and allowing gravity and hydrostatic pressure to spread the flow over the surface of the entire field. Land leveling and smoothing are essential operations. The important surface irrigation methods are: (i) flooding; (ii) bed or border method; (iii) basin (ring and basin) method; and (iv) furrow (ridge and furrow, broad ridge or raised bed) method.

Flood

It is an ancient irrigation practice, where a water channel is opened into a field and water is allowed to flow freely in all directions to cover the land surface like a sheet. This is practiced in an area where water is abundant and the topography is leveled. The flooding method is still practiced in vegetable crops, such as onion, garlic, pea, spinach, coriander, fenugreek and amaranthus, grown by the broadcasting method on a well-levelled field. (Fig. 1.6)

Fig.1.6: Flood irrigation method

Advantages

1. It is applicable to properly leveled soils.
2. Low cost of operation due to use of gravity and hydrostatic pressure.
3. Skilled human resource is not required.
4. No specialised equipment is required.

Disadvantages

1. It is an unscientific and inefficient method of irrigation.
2. Maximum loss of irrigation water occurs in this method.
3. It requires more water per unit area than all other methods of irrigation.
4. Unsuitable for spacious crops and crops sensitive to waterlogging. It spreads soil borne diseases.
5. It results in wetting of the entire field surface. Hence, it increases weed population in the field.
6. Variability in infiltration rate of soil in the field causes non-uniformity of water distribution in the root zone.
7. There is more loss of nutrients.

Border irrigation method

In this method, the land is leveled and divided into different strips of appropriate size by making the borders 30 cm high between each strip. Strips of 3-10 m width and 30-90 m length with up to 0.5% slope are formed. This is suitable for growing vegetable crops (Fig. 1.7).

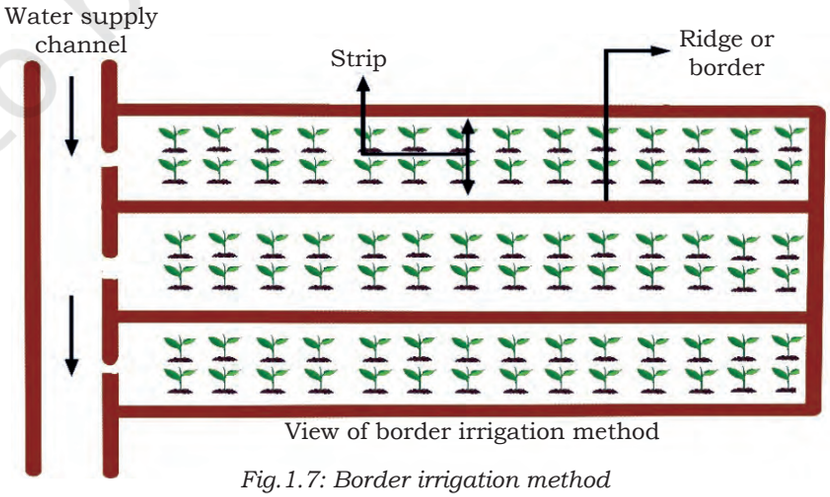


Fig.1.7: Border irrigation method

Advantages

1. It is easy to prepare, operate and maintain borders and strips.
2. It is suitable to irrigate crops on steep slopes by making small strips.

Disadvantages

1. It requires a flat and smooth topography.
2. More water flow is required to irrigate border strips.
3. Not suitable for sandy soil.
4. To avoid waterlogging a proper drainage system is required.

Check basin irrigation method

In this method, the field is divided into square or rectangular checks or plots surrounded by ridges for irrigation (Fig. 1.8). The plots are generally leveled or have a mild slope. It is used successfully for both field and row crops. A modification in the basin method is the ring and basin method in which a circular basin of about 45-60 cm width is made around the plant for irrigation of the crop. In this method, water is impounded to irrigate a single tree or vine vegetables (Fig. 1.9). In vegetable crops, this method is practised for bitter gourd, bottle gourd, ridge gourd, melons, etc. This method is not used for solanaceous vegetable crops.

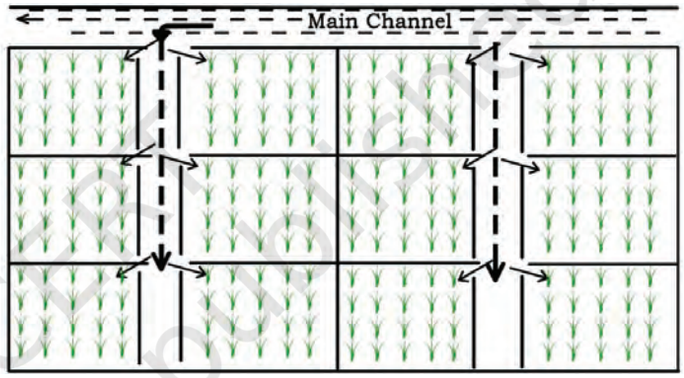


Fig.1.8: Line diagram of check basin irrigation method

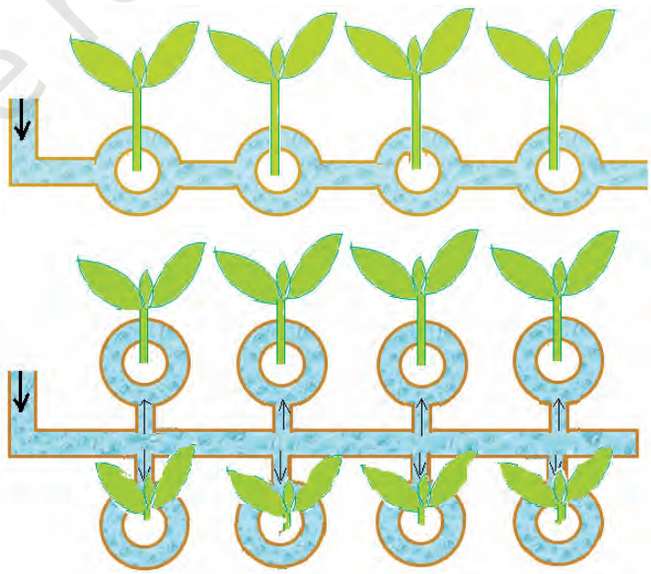


Fig. 1.9: Line diagram of ring and basin irrigation methods

Advantages

1. It can be used to irrigate irregular shaped fields.
2. Water application and distribution efficiencies are generally high.

Disadvantages

1. It requires proper land leveling.
2. It is comparatively more labour intensive.
3. The borders interfere with the use of farm machines.
4. It is not suitable for crops sensitive to water logging.

Fig. 1.10: Furrow irrigation method

Furrow irrigation method

In this method, water is moved to the field in furrows between two ridges. These furrows are lined among rows of the crop according to the slope of the land (Fig. 1.10). Furrows are channels with continuous and nearly uniform slope in the direction of irrigation. Furrows, 3-6 m in length are spread in such a way that water reaches every nook and corner of the field. Planting is done on the side of the ridges or raised beds (about 15-22 cm high) and water is given in 15-20 cm deep furrows of 30-50 cm width. This method is commonly adopted in vegetable crops like tomato, brinjal, potato, chili, radish, carrot, cauliflower, etc.

Advantages

1. Water efficiency is high due to less wastage because irrigation is done in furrows only.
2. The entire land surface is not covered with water therefore the problem of weeds is minimised.
3. It is more suitable for vegetables grown on rows or beds.
4. Relatively easy to operate and requires less labour, hence it is not expensive.
5. Evaporation losses are less because it exposes a smaller area of open water.
6. It is adapted to most soils.

Disadvantages

1. Labour requirement is more for making ridges and furrows and streaming irrigation water.
2. Furrows interfere with farm machinery during weeding, spraying and crop harvesting.

3. Not suitable for sandy soils because of poor stability of furrows, land leveling problem and high infiltration rate.
4. Not applicable on uneven lands because a leveled field is required for proper flow of water.

Sub-surface irrigation

It is the application of water below the ground surface and using capillaries for the movement of water. When an impervious layer exists naturally below the root zone, it allows water to enter a series of ditches dug up to the impervious layer, which then moves laterally to wet the root zone. In artificial sub-surface irrigation, perforated or porous pipes are laid out underground below the root zone and water is led into the pipes by suitable means.

Advantages

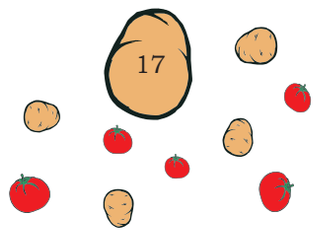
1. Reduces water loss due to less evaporation.
2. Do not create any interference with the farm operations.
3. Easy to maintain water level at optimum depths as per crop requirements.

Disadvantages

1. It requires high cost for installation.
2. Difficult to locate leaks in the system.
3. Repairing is expensive.
4. This method is not suitable, where irrigation is often needed to germinate crops.

Sprinkler or overhead irrigation

In the sprinkler system, water is sprinkled over the crop and the soil in a circular manner similar to rain. With the help of revolving sprinkler nozzles, water is forced out with pressure through pipes fitted with a stand. The nozzles rotate due to the water pressure and spread water in the form of a thin spray. Water can be applied in a controlled way and distributed uniformly. Compared to the other method, this is a much more efficient system. It is ideal for hilly and undulating regions where



other systems cannot be used Fig. 1.11(a-d). The major components of the sprinkler system are the pump, main line, lateral pipe and sprinkler.

Advantages

1. It can be used to irrigate undulating land.
2. There are no obstacles when farm implements are being used.
3. Water saving is around 30–35%.
4. Fertilisers and pesticides can also be applied by this method.
5. The amount of water can be controlled as per the crop requirement.
6. More land area can be covered for irrigation.
7. This system is useful to control frost during freezing temperature.

Disadvantages

1. The installation and maintenance cost is high.
2. High wind velocity influences the distribution pattern of water.
3. It is not suitable if the water contains appreciable amount of dissolved salts.
4. Skilled labour is required for the operation and maintenance of this system.
5. It is not useful in case of tall crops with more spacing.

a

b

c

d

Fig. 1.11(a-d): View of the sprinkler or the overhead irrigation system

Drip irrigation system

This is also known as trickle irrigation or micro irrigation, which supplies water in the form of discrete, continuous drops at a slow rate through emitters, either onto the soil surface or directly to the root zone. There is direct and continuous wetting of the root region. Fertilisers and chemical amendments can also be applied using this method. It is a highly water use efficient system with little irrigation water requirement. Thus, it is suitable for water scarce areas. It saves 40-60 % of water over the other conventional methods (Figs 1.12 and 1.13).

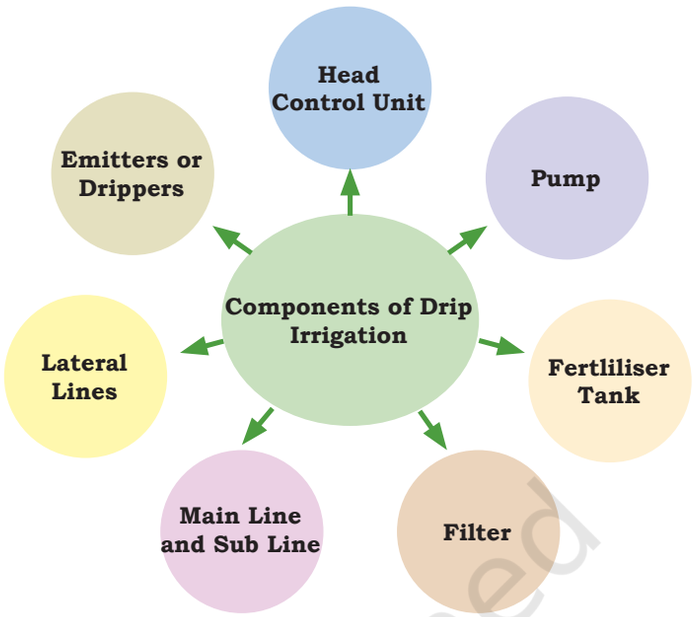


Fig.1.12:Components of a drip irrigation system

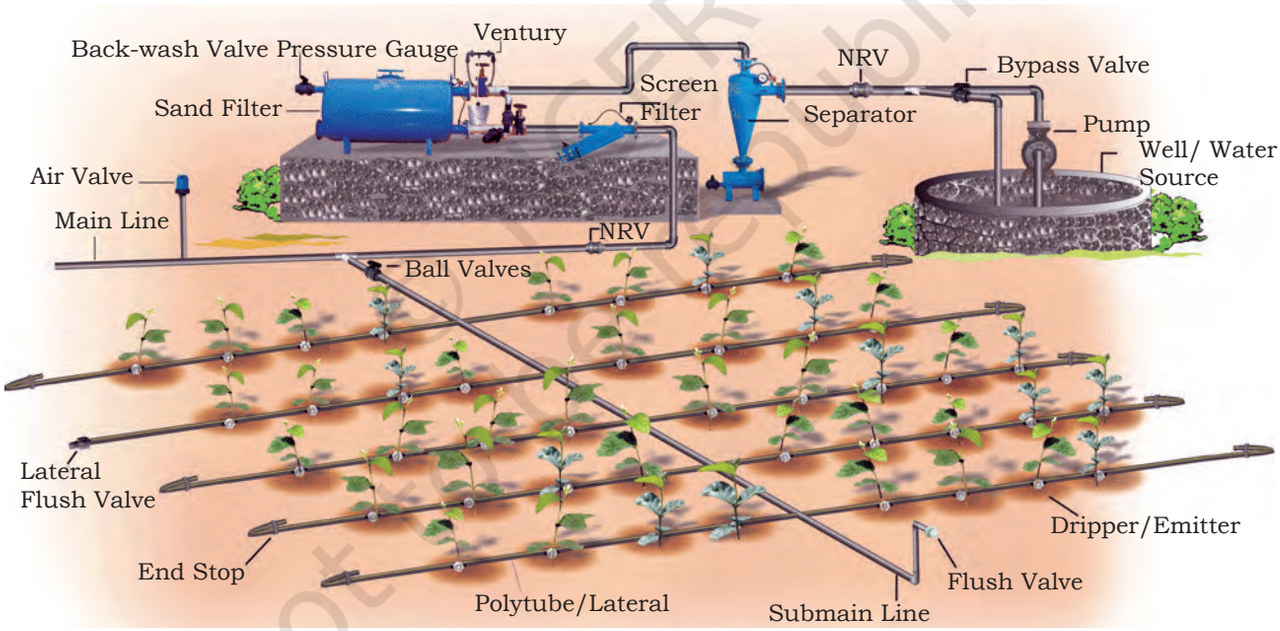


Fig. 1.13: Component and layout of a drip irrigation system

Components of a drip irrigation system

Based on the system's requirements, the head control unit consists of the following equipment.

- **Pump** provides pressure to lift water from the source and distribute through the nozzles.

- **Fertiliser tank** is used when fertilisers are applied along with irrigation.
- **Filter** is used to clean the suspended impurities in water.
- **Main line and sub line** are flexible black poly vinyl chloride (PVC) pipes used for distribution of water to laterals from the water source.
- **Lateral lines** are 1 to 1.25 cm diameter black flexible PVC tubes that take of from the mains or sub mains. Laterals are normally laid parallel to each other.
- **Emitters or drippers** are fixed at regular intervals in the laterals. It is the most important component in the drip system and regulates the discharge rate of water.

Advantages

1. It is a highly efficient system with 80 to 90% water use efficiency.
2. It saves up to 40 to 60% water.
3. This system also facilitates the supply of liquid fertilisers directly to the root zone.
4. Increases plant yield up to 10 to 25%.
5. Problem of weeds and cost of labour is minimised.
6. Ideal for slopes or undulating land, especially in the hills.

Disadvantages

1. The installation cost is very high.
2. It needs regular care and maintenance
3. Technical skill is essential to maintain and operate it.
4. It is not suitable for areas where water or subsoil contains appreciable amount of salt.

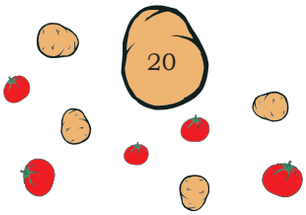
Practical Exercise

Activity 1

Identification of different components of drip irrigation system and their function

Material required

Sketching and writing material and different components of a drip system



Procedure

1. Visit a nearby farm where a drip system has been installed.
2. Observe the types of drip system.
3. Note down the different components of a drip unit.
4. Identify different components, such as drippers, laterals, valves,etc.
5. Draw a figure of the drip system and write the functions of its different components.

Activity 2

Demonstrate the border irrigation method

Material required

Sketching and writing material.

Procedure

1. Visit a nearby farm where border irrigation method is being followed.
2. Select a piece of land and prepare a layout.
3. Transplant the seedling of the given crop.
4. Irrigate and observe the performance of the crop.

Check Your Progress

A. Fill in the blanks

1. Applying irrigation water in the crop at definite frequency is known as _____.
2. A particular stage of the plants that is sensitive to water stress is known as _____.
3. Land, levelled and divided into different strips of appropriate size by making borders, is called the _____ method.
4. Sprinkler irrigation is also known as _____.
5. The critical stage of irrigation in onion and garlic crops is _____.
6. In drip irrigation system, water is let out through devices called _____.
7. A highly efficient irrigation system with 80–90% water use efficiency is _____.

B. Multiple choice questions

1. The critical stage of irrigation in cabbage is _____ _____.
   (a) head formation
   (b) flowering stage
   (c) seed germination
   (d) harvesting stage

2. Irrigation water spread over the crop as well as on the soil in a circular manner is called _____.
   (a) flood
   (b) border
   (c) overhead irrigation
   (d) check
3. The process of applying liquid fertilisers through an irrigation system is known as _____.
   (a) fertigation
   (b) drip irrigation
   (c) sprinkler irrigation
   (d) furrow irrigation
4. The irrigation method, which is suitable in undulating lands is _____.
   (a) flood irrigation
   (b) furrow irrigation
   (c) sprinkler irrigation
   (d) basin irrigation
5. Drip irrigation helps in _____.
   (a) saving water
   (b) increasing yield
   (c) increasing quality
   (d) All of the above

C. Short answer questions

1. Define irrigation and its methods.
2. How is a drip irrigation system useful?
3. Write the advantages and disadvantages of the furrow method of irrigation.
4. If you are a farmer with undulating land but good quality water, which method of irrigation will you prescribe? Justify.
5. Among the surface irrigation methods,which method is good? Explain.

D. Match the columns

A	B
1. Sprinkler system	(a) Cucurbitaceous crops
2. Furrow irrigation	(b) Drip system
3. Check basin irrigation	(c) Nozzles
4. Bulbous crop	(d) Vegetable crop
5. Highest water use efficiency	(e) Onion