Unit 1

Introduction to Microirrigation System

171108CH01

In India, perhaps more than 80 per cent of the available water is used for irrigation. Irrigation is the controlled application of water through man-made systems to meet the water requirements of agriculture. Irrigation is an artificial application of water to crops or plants, especially when an agricultural field does not get enough water through rains. Having perhaps the largest irrigated area in the world, India faces acute water scarcity. We need to adopt irrigation methods that help in not only in saving freshwater, but also provide sufficient water to plants for growth. One such method now being followed in India is 'microirrigation'.

In this Unit, you will learn about the main features and functions of drip and sprinkler irrigation system. The Unit also deals with the classification of microirrigation system, types of drip and sprinkler irrigation system, characteristics of land gradient, crops grown under microirrigation system, and the various aspects related to layout and design of the system.

Sprinklers spraying water over lawns, gardens and agricultural fields, are a common sight in both urban and rural areas. They not only spray water evenly but also help conserve the valuable natural resources. In sprinkler irrigation system, the sprinklers sprinkle

The Government of India launched the *Pradhan Mantri Krishi Sinchai Yojana* (PMKSY) or *Prime Minister's Agriculture Irrigation Programme*, with the slogan 'Per Drop More Crop' in July 2015. It is a policy initiative to shift towards microirrigation so as to 'save' water in agriculture and boost crop yield.

Notes

water into the air through nozzles, which subsequently, break into droplets and fall on crop canopy as well as the field surface.

You might have seen certain equipment, pipes and drippers in nurseries and agricultural fields through which water is supplied to irrigate plants directly. This mostly happens in drip irrigation system, wherein the water is supplied to plant roots directly through a network of plastic pipes, lateral tubes, valves and emitters.

Session 1: Microirrigation Systems

Microirrigation is the slow application of continuous drips, tiny streams or miniature sprays of water above or below the soil surface. In this Session, you will learn about the main features of microirrigation system and its classification.

Microirrigation system is effective in saving water and increasing water use efficiency as compared to the conventional surface irrigation method. Besides, it helps reduce water consumption, growth of unwanted plants (weeds), soil erosion and cost of cultivation.

Microirrigation can be adopted in all kinds of land, especially where it is not possible to effectively use flooding method for irrigation. In flooding method of irrigation, a field is flooded with water. This results in significant run-off, anaerobic conditions in the soil and around the root zone, and deep irrigation below the root zone, which does not supply sufficient water to the plants. It is, therefore, one of the most inefficient surface irrigation methods.

Microirrigation can be useful in undulating terrain, rolling topography, hilly areas, barren land and areas having shallow soils. According to depth, soil types can be classified as shallow (depth less than 22.5 cm), medium deep (22.5–45 cm) and deep soil (more than 45 cm).

Features of microirrigation system

- Water is applied via pressurised piping system. Microirrigation requires pumps for developing the required pressure for delivering water through pipelines, regardless of whether the source of water is surface or underground.

- Water is applied drop-by-drop for a long period in case of drip irrigation system.
- Water is applied at a low rate to maintain the optimum air–water balance within the root zone.
- Water is applied at frequent intervals as per the requirement of plants.
- Water is supplied directly to the plants and not to the other areas of the field, thus, reducing wastage.
- Soil moisture content is always maintained at 'field capacity' of the soil. Hence, crops grow at a faster rate, consistently and uniformly.

Field capacity is the moisture or water content present in the soil after excess water has drained away and the rate of downward movement has decreased, which takes place within 2–3 days after a spell of rain or irrigation. It means that after drainage stops, the large soil pores are filled with both air and water, while the smaller ones are still filled with water. At this stage, the soil is said to be at field capacity and is considered to be ideal for crop growth.

Classification of microirrigation system

Microirrigation system can be broadly classified into two categories:

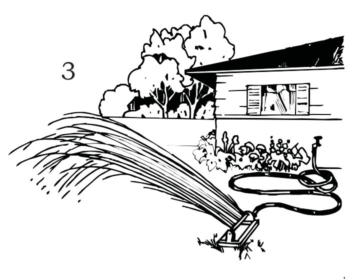
(1) Drip irrigation system
(2) Sprinkler irrigation system

However, there are distinct differences in the water flow rate, operating pressure requirement and measurement of the wetted area between drip and sprinkler irrigation systems. Water flow rate means the amount of water discharged in an area at a particular time. It is expressed in litre/minute (lpm) or gallons/minute (gpm). The system operating pressure must compensate for pressure losses through system components and field elevation effects.

Drip irrigation system

Drip irrigation system, also known as 'trickle irrigation system', is a method of applying the required

NOTES



amount of water directly to the root zones of plants through drippers or emitters at frequent intervals. In this system, water is applied drop-by-drop or by a micro jet on the soil surface or sub-surface at a rate lower than the infiltration rate of the soil. The emitters dissipate pressure from the distribution system by means of orifices, vortexes and tortuous or long flow paths, thus, allowing a limited volume of water to be discharged. Most emitters are placed on ground but they can also be buried. The emitted water moves within the soil system largely by unsaturated flow. The water moves into the soil and wets the root zones of plants vertically by gravity and laterally by capillary action. The lateral movement of water beneath the surface is greater in medium to heavy soil as compared to sandy soil. The wetted soil area for widely spaced emitters will, normally, be elliptical in shape. Drip irrigation can be used on windy days and during various land operations.

Fig.1.1: Drip irrigation system in a garden

Types of drip irrigation system

Drip irrigation system can be classified into the following:

(i) Surface drip irrigation
(ii) Sub-surface drip irrigation
(iii) Family drip
(iv) Online drip
(v) In-line drip

Surface drip irrigation

Surface drip irrigation is used to irrigate perennial crops (plants that live for more than two years) and annual crops (plants that germinate, produce seeds, flower and die in one year). Typical surface drip irrigation system consists of the following.

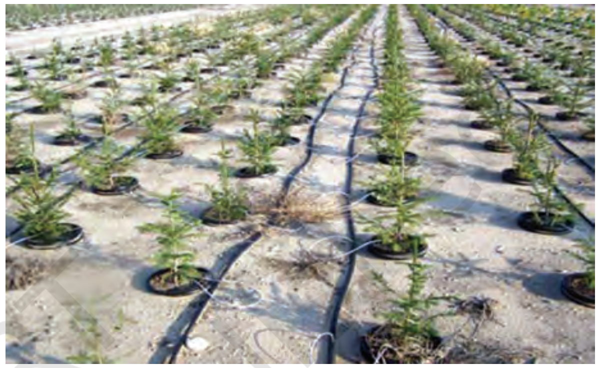


Fig. 1.2: Surface drip irrigation system

Pump unit: It comprises a pump and a power unit to supply electricity to the pump. The pump draws water from the source and provides the right pressure for its delivery into the pipe system.

Head control unit: It consists of shut-off, air and check (non-return) valves to control the discharge and pressure of water in the entire system. A pressure relief valve is installed after the pump unit to return excess water when the system is not operated at its full capacity. It may also have filters to clear the water. The filters remove sediment and debris, which can clog the system. Disc filters are commonly used to filter water from ponds, reservoirs, tanks and other sources that contain algae. Some head control units contain a fertiliser or nutrient tank to supply fertiliser solution to plants.

Tubings: It consists of a main line, sub-main lines or sub-mains and laterals. The main line conveys water from the source and distributes it to the sub-mains. The sub-mains convey water to the laterals, which in turn supply it to the emmiters or drippers. The laterals are, usually, 13–32 mm in diameter and supply water into fields through the head control unit.

Emitters or drippers: These devices are used to control the discharge of water from the laterals to plants. They are made of High Density Polythylene (HDPE) plastic. Water enters the drippers at approximately 1 kg/cm^2 pressure and is delivered at zero pressure in the form of droplets at a low rate of 1–2.4 litre/hour. There are mainly two types of emitters.

(a) Online emitters: These are small plastic devices, which convey small streams of water from polyethylene (PE) tubing to the soil. The water, then, moves through the soil via capillary flow and creates a wetted circle, the size of which depends on the soil type, flow rate and irrigation schedule. Online emitters are attached to the PE tubing wall by inserting the emitters' barb-shaped base through a punched hole. These can be placed anywhere along the length of the pipe. Some emitters have self-piercing barbs. The diameter of pipes used for installing online emmitters is usually, between 12 and 20 mm.

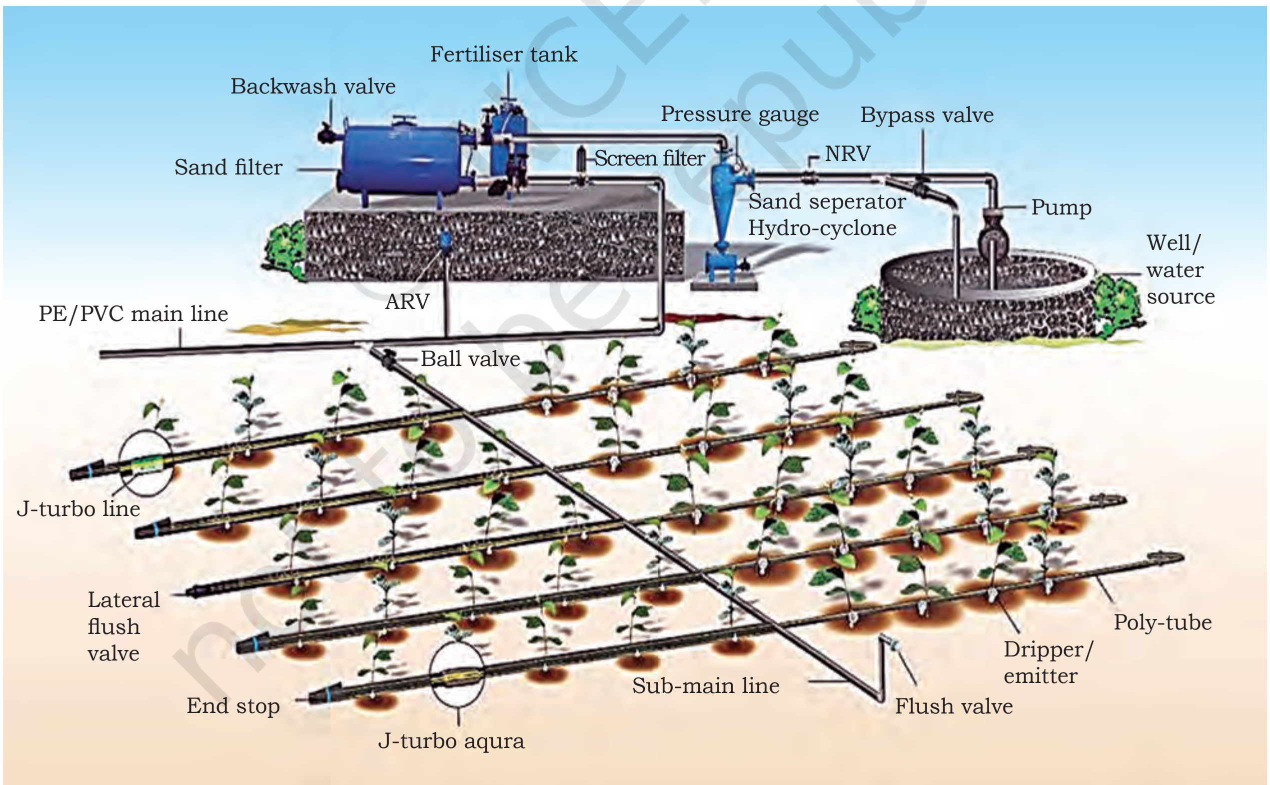


Fig. 1.3: Components of surface drip irrigation system

(b) In-line emitters or drip lines: These consist of small plastic emission devices, which are pre-inserted into the PE tubing at specified intervals during the tubing extrusion process. Their rate of water flow depends on the inlet pressure. With lower inlet pressure, the water flow decreases, whereas, with high pressure, it increases. This emitter is available in 0.8 lph to 4 lph discharge rate.

Surface drip irrigation system is, generally, used to irrigate high-value vegetable crops, such as tomato, broccoli, celery, cauliflower, spinach, *kohlrabi*, leaf lettuce, etc.

Sub-surface drip irrigation

Sub-surface drip irrigation is a method of irrigating crops through buried plastic tubes, containing embedded emitters located at regular spacings. A sub-surface drip irrigation system has a similar design as surface drip irrigation system. But in this case, the drip tubes are typically located 38–84″ (97–213 cm) apart and 6–10″ (15–25 cm) below the soil surface. In sub-surface drip irrigation, evaporation is minimised and water is used more efficiently as compared to surface irrigation.

In sub-surface irrigation, the effects of surface infiltration like crusting, water losses via evaporation and surface run-off are eliminated. Water is applied directly to the root zone of a crop as opposed to surface irrigation, in which most weed seeds hibernate. Water application is efficient and uniform in this system. Sub-surface drip irrigation helps in water conservation in open field agriculture, often resulting in saving up to 25–50 per cent water as compared to the flood irrigation system.

Fig. 1.4: Sub-surface drip irrigation

Family drip or gravity fed drip irrigation

Family drip or 'gravity fed drip irrigation' system is a low-cost system developed for small family plots. It is suitable for house gardening and

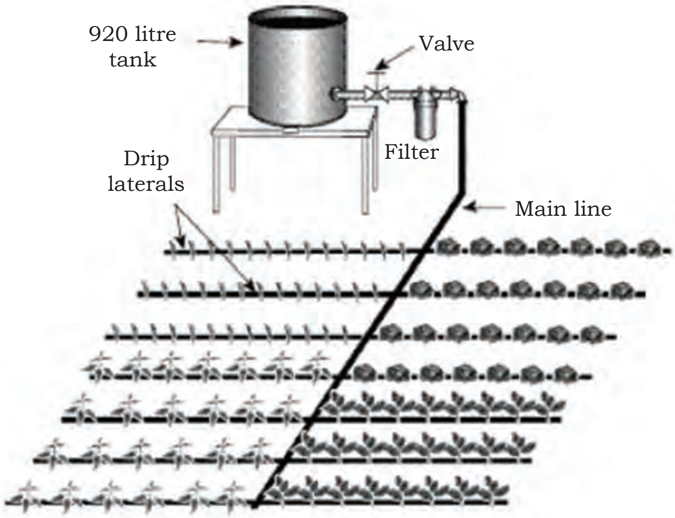


Fig. 1.5: Family drip irrigation

peri-urban agriculture. It can also be used to demonstrate the working of drip irrigation system. Family drip system is designed for areas measuring 500–1000 m^2. It consists of five components — elevated tank, shut-off valve, filter, main line and drip line.

Generally, a family drip irrigation system comprises a drum, control or shut-off valve, filter (small disc or screen filter), main line and drip laterals. The drip outlets are spaced at 30 cm. No central pressurised water system or power source is required in this system. Therefore, it is cheap, easy to install and operate.

Online drip irrigation

In this system, emitters or drippers are fixed externally on the laterals at designed spacings. Thus, the drippers can be checked and cleaned easily in case of clogging. The dripper spacing can be changed any time to cover the increased root zone of a plant. Online dripper system is used in orchards, vineyards, artificial landscapes and nurseries. It is, generally, used for irrigating horticultural plants like mango, coconut, orange, lemon, banana, grapes, pomegranate, papaya, sapota, guava, teakwood, bamboo, *amla* (Indian gooseberry), etc.

Fig. 1.6: Online drip irrigation

In-line drip irrigation

In this system, drippers are fixed in the lateral tube at designed spacings at the time of manufacturing to meet the requirement of various crops. It is effective for row crops like cotton, sugarcane, groundnut, vegetables and flowering crops. Dripper spacing depends on the water requirement of a crop and the water-holding capacity of the soil. Once installed, the dripper spacing cannot be changed.

Fig. 1.7: In-line drip irrigation

Sprinkler irrigation system

Sprinkler irrigation is a method of applying water in a manner similar to rain. It is suited for most row, field and tree crops. Water can be sprayed over or under the crop canopy. If a site is known to be windy most of the time, sprinkler irrigation will not be suitable. The sprinkler breaks up the water into droplets sized 0.5–4 mm. The drop size is controlled by pressure and nozzle size of the sprinklers. The average rate at which water is sprayed onto the crops is measured in mm/hour.

The application rate depends on the size of sprinkler nozzles, operating pressure and distance between the sprinklers. The application rate must not exceed the maximum allowable infiltration rate for the soil type. Excess application rate will result in water loss, soil erosion and surface sealing. There may be inadequate moisture in the root zone of crops or plants after irrigation and they may get damaged.

The force with which the water flows out of the sprinkler is known as its 'water pressure'. Water pressure is measured in pounds per square inch (psi). Sprinklers are, therefore, designed to work at certain pressure levels, which are recommended as their operating pressure. If the pressure is above or below than the recommended level, then the distribution of water will be affected. When the pressure is low, the water drops become larger and they cannot irrigate the crops that are far from the system. If the pressure is high, then the droplets will be smaller and the crops will not be irrigated evenly. It can also damage the sprinkler heads. Although sprinklers are adaptable to most soils, they are best suited for sandy soil. These can be used for irrigating lawns, gardens and agricultural fields.

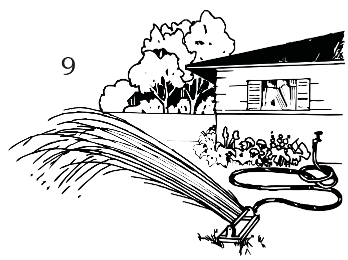


Fig. 1.8: Sprinkler irrigation

Types of sprinkler irrigation system

(i) Centre pivot
(ii) Towable pivot
(iii) Rain gun
(iv) Impact sprinkler
(v) Pop up sprinkler
(vi) Linear move sprinkler

Centre pivot

The centre pivot is capable of irrigating most field crops. It consists of a single sprinkler lateral supported by a series of towers. It is anchored at one end and rotates around a fixed central point called 'pivot point'. The control panel attached to the pivot point gives commands to the central pivot machine. A drive unit or drive tower touches the ground, which contains necessary components for the machine to move. It consists of a base beam, drive train, wheels and other structural support equipment. The towers are self-propelled so that the lateral rotates around the pivot point installed in the centre of the irrigated area. The long pipes between the drive units are called 'spans'.

Spans consist of the main water line, sprinklers and a supporting structure to hold the weight between the towers. A tower box controls the drive unit components, with regard to the direction and duration.

(a) (b)

Fig.1.9 (a and b): Centre pivot

Towable pivot

Towable pivot is similar to centre pivot. But here, the pivot is towed away by a tractor. There are 3–4 wheels in the centre of the pivot, which make it possible to move the pivot from one place to another by pulling it with the help of the tractor. It helps farmers to carry out mechanised irrigation in an economical manner. It can easily irrigate fields as the machine can be towed away from one field to another in minimum time.

Rain gun

A rain gun is used as a water spray mist or fog beam. It discharges water at less than 175 lph. It is used to irrigate trees and other crops separated widely. Fruit tree crops like citric fruits, mango, guava, avocado, etc., can be irrigated with a rain gun. The passage diameter of the rain gun is small. Therefore, the release of filtered water is essential,

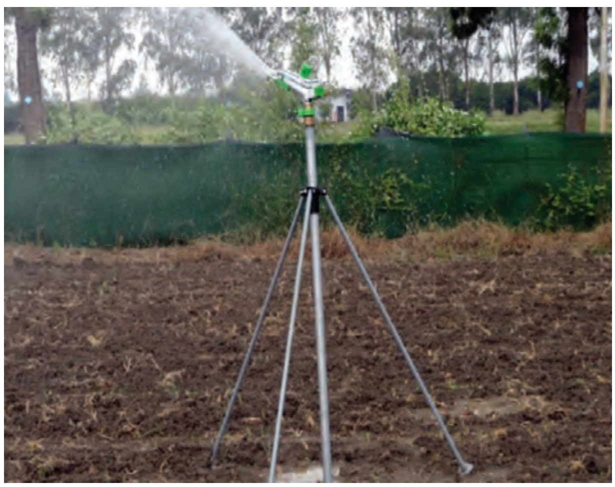


Fig.1.10: Rain gun

amounting up to a requirement of 60–80 mesh (250 to 177 microns). The minimum operating pressure is 1.5–2 kg/cm^2. The heads of rain gun are mounted on plastic wedges (or piles) 20–30 cm above the ground. Rain gun is suitable for field crops like groundnut, onion, potato, sugarcane, cotton and plantation crops, such as coffee and tea.

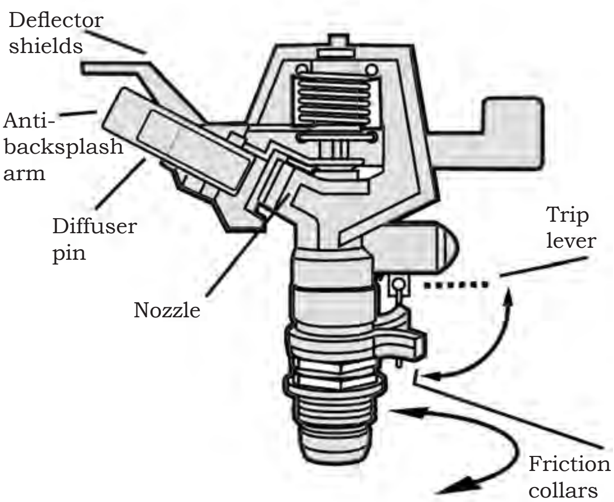


Fig.1.11: Impact sprinkler

Impact sprinkler

This sprinkler is driven in a circular motion by the force of outgoing water, and at least, one of its arms extends from the head. The sprinkler arm is repeatedly pushed back into the water stream by a spring. When the arm strikes the water stream, it scatters the stream and re-orients the flow, enabling a uniform watering area around the sprinkler. Impact sprinkler is recommended for closely spaced field crops like potato, leafy vegetables, cotton, oilseeds, pulses, cereals, fodder crops, etc.

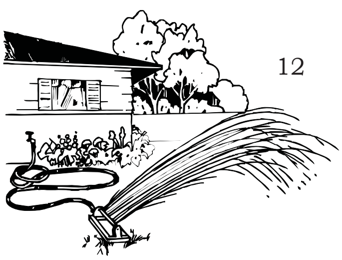
Fig.1.12: Pop up sprinkler

Pop up sprinkler

A pop up sprinkler consists of an inlet, body, cap, wiper seal, riser, nozzle and radius adjustment screw. Such a sprinkler is portable and easy to install, thereby, making it ideal for irrigating lawns, seasonal flowers and planting beds.

Linear move sprinkler

Linear move sprinkler irrigation system is similar to the centre pivot system in construction, except that neither end of the lateral pipeline is fixed. It is composed of a series of towers that are



suspended and move laterally in the direction of rows. The whole line moves down the field perpendicular to the lateral. Water delivery to the continuously moving lateral is by a flexible hose or open ditch pickup. Both the centre pivot and linear move systems are capable of high efficiency water application. By 'water efficiency', it means reducing water wastage by measuring the amount of water required for a specific purpose and the amount of water delivered or used. Such a system requires high capital investment but is not labour intensive.

Micro-sprinklers

Micro-sprinklers are emitters, commonly, known as sprinkler or spray heads. They operate by spreading water through air, usually, in predetermined patterns. Depending on the water throw patterns, micro-sprinklers are referred to as 'mini-sprays', 'micro-sprays', 'jets' or 'spinners'. The sprinkler heads are external emitters individually connected to lateral pipes, typically, using what can be called 'micro-tubes' or a small diameter tubing. The sprinkler heads can be mounted on a support stake of 25–30 cm height, connected to the supply pipe. Micro-sprinkler system requires less energy, and generally, operates at a pressure range of 1–3 kg/cm^2 and a discharge range of 40–75 lph. Micro-sprinklers are desirable because fewer sprinkler heads are required to cover a large area. The system is suited for crops with shallow rooting pattern like garlic, onion, etc.

Fig.1.13: Linear move sprinkler

Other types of microirrigation system

Bubbler irrigation

Bubblers are used to irrigate bigger areas and apply water on 'per plant' basis. Water from the bubbler head either runs down from the emission device or spreads a few inches in an umbrella pattern. Bubbler emitters

Fig. 1.14: Bubbler irrigation

Fig. 1.15: Spray irrigation

dissipate water pressure through a variety of diaphragm material (a silicon diaphragm inside an emitter flexes to regulate water output) and deflect water through small orifices. Bubbler emission devices are equipped with single or multiple port outlets. Bubblers are available in adjustable flow and pressure compensating types.

Spray irrigation

In this system, jets, foggers or misters, also called 'spitters', are used. Water is applied only to a fraction of the ground surface. However, instead of dripping water from narrow orifice emitters, micro-sprayer systems eject fine jets that fan out from a series of nozzles. Each nozzle can water an area of several square metres, which tends to be much larger than individual areas wetted by a single drip emitter.

Advantages of microirrigation system

As mentioned earlier, microirrigation system has a number of advantages over surface irrigation system. Some of the advantages of microirrigation system over surface irrigation system are described as follows.

Helps in saving water

Water requirement in drip or sprinkler irrigation is much less as compared to any other conventional method of irrigation. This is because of irrigation of a smaller portion of land, decreased evaporation from the soil surface and reduction or elimination of run-offs. Waterlogging, which occurs under flat surface flood irrigation, is rare in case of microirrigation. Since microirrigation system allows high level of water control application, water can be applied only when needed and losses due to deep percolation can be minimised or avoided. Microirrigation can reduce water usage by 25–40 per cent as compared to overhead systems and 45–60 per cent as compared to surface irrigation.

Uniform water application

Microirrigation systems ensure uniform water application. Therefore, all plants in a field receive equal amount of water. Higher uniformity results in efficient irrigation, thereby, causing less wastage of water, power and fertilisers. Consistent water application results in better and uniform crop yields as each plant is given the required amount of water and nutrients for optimum growth. Crop yield is the measurement of the amount of agricultural production harvested per unit area.

Helps in saving electricity

Microirrigation systems require less electricity as compared to other systems. Usually, delivery pipe in microirrigation systems operate at low pressure (2–4 bar). Therefore, these require less energy for pumping.

Improves chemical application

Microirrigation system can apply chemicals to plants through fertigation unit. 'Fertigation' is the application of fertilisers used for making soil amendments in order to improve plant growth. Since the fertilisers are applied directly to the root zones of the plants, a reduction in the total amount of fertiliser applied is possible, which saves an average of 25–50 per cent of the total cost. Microirrigation systems apply the right fertiliser to the plants at a given time. Herbicides, insecticides and fungicides can also be applied through microirrigation systems, and thereby, help improve the crop yield.

Reduces weeds and diseases

Weeds are the unwanted plants that grow in lawns, gardens and agricultural fields. They compete with the crops for nutrients, moisture and sunlight, which can reduce the crop quality and the yield. These also serve as a habitat for diseases and insect-pests, which attack the main crop. Weed growth is inhibited in areas irrigated by drip irrigation as only a limited area gets irrigated. Hence, the threat of weeds and diseases is reduced.

NOTES

Notes

Improves tolerance of crops to soil salinity

Microirrigation reduces the sensitivity of most crops to saline water or soil–water conditions due to high moisture content in the root zones of plants. Microirrigation (especially, drip irrigation) keeps the soil moisture continuously at a high level near the root zone, and thus, maintains a low level of salt concentration. Therefore, crops under microirrigation system are more tolerant to saline water.

Suitable to various topography and soil type

Microirrigation systems can function efficiently on any topography, if appropriately designed and managed. Low water application rate with microirrigation systems is ideal for clayey soil as water can be applied slowly enough for the soil to absorb without any surface run-off.

Regulates water through automation

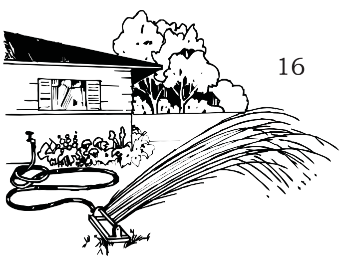
Microirrigation system can be semi or fully automatic. It uses automatic controller, which can be simple mechanical clocks or timers that open or close the valve on a pre-set time schedule. These can be programmed to run at night when evaporation is low. A microirrigation system can be easily automated using electrical solenoid valves and a controller. This allows the system to operate at any time of the day and for any duration.

Reduces labour costs

One of the major advantages of microirrigation system is that it reduces labour costs. Labour requirement is reduced as it is an automated system and does not require labourers to irrigate an area. A large area of land can be irrigated at once with microirrigation system.

Improves quality and yield

Crop quality and yield is improved under microirrigation system because of slow, regular and uniform application of water and nutrients. Besides, damages and losses due to the contact of water with fruits or foliages are practically eliminated.



Practical Exercise

Activity

Visit a farm, where a microirrigation system has been installed. Discuss the following with the owner of the farm.

(i) What are the advantages of drip or sprinkler irrigation system?

(ii) In which crop(s), drip or sprinkler irrigation system has been more useful?

(iii) What are the common problems that you encounter in maintaining drip or sprinkler irrigation system?

Check Your Progress

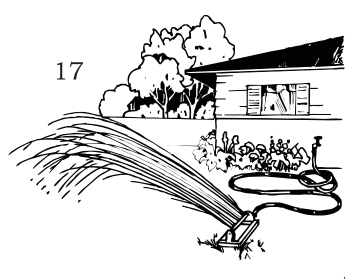
A. Multiple Choice Questions

1. If a site is known to be windy most of the time, ___________ irrigation will not be suitable.
   (a) sprinkler
   (b) drip
   (c) both (a) and (b)
   (d) None of the above
2. ___________ irrigation system makes use of very low pressure.
   (a) rain gun
   (b) gravity drip
   (c) drip
   (d) sprinkler
3. The wetted soil area for widely spaced emitters in drip irrigation system will normally be ___________ in shape
   (a) round
   (b) elliptical
   (c) circular
   (d) triangular
4. The sprinkler breaks up water into small droplets, usually, of 0.5 to ___________ mm in size.
   (a) 3
   (b) 5
   (c) 4
   (d) 2

B. Fill in the Blanks

1. The ___________ emitters dissipate water pressure through small orifices.
2. Microirrigation helps in reducing ___________ consumption, weeds, soil erosion and the total cost of cultivation.

Notes



NOTES

3. A __________ irrigation system can be used on windy days and during various land operations.
4. In microirrigation system, water is applied via __________ piping system.

C. State True or False

1. One of the major advantages of microirrigation system over surface irrigation system is that it helps reduce labour costs.
2. A microirrigation system cannot be easily automated using electrical solenoid valves and a controller.
3. Crop quality and yield under microirrigation system is improved because of irregular application of water and nutrients.

D. Subjective Questions

1. What are the different components of sprinkler irrigation system?
2. What are the advantages of microirrigation system?
3. Write a short note (100 words) on the following:
   (i) Centre pivot
   (ii) Rain gun
   (iii) Impact sprinkler
   (iv) Pop up sprinkler

What have you learned?

After completing this Session, you will be able to:

- describe the main features of a microirrigation system.
- identify the components of a microirrigation system.
- identify different types of drip irrigation system.
- identify different types of sprinkler irrigation system.
- describe the criteria for selecting a microirrigation system.
- state the advantages of using a microirrigation system.

Session 2: Land Gradient and Suitability of Irrigation System

Notes

Agricultural crops are cultivated in different agroclimatic conditions and topographies. Crops are grown in rain-fed, as well as, irrigated conditions for better yields. There are different irrigation methods suitable for various types of crop and land. To choose a suitable and efficient method of irrigation, a farmer must know the advantages and disadvantages of various irrigation methods. Irrigation systems are implemented primarily to save water and increase water use efficiency in agriculture. 'Water use efficiency' is the ability of a crop to produce biomass per unit of water transpired.

The method of irrigation to be adopted is, generally, determined by the type of soil, topography of land, water source (suface or underground) and the crop to be irrigated. 'Topography' is the slope of the ground and how much uneven or levelled it is. The irrigation method is selected accordingly. A topographic map is one that contains information about the general topography of an area. The map includes contour lines, location of natural features like gullies and ditches, and man-made features, such as buildings, roads, culverts, bridges, etc. These are needed for detailed planning of the irrigation method to be used.

Land gradient

Land or field gradient and uniformity are important factors that are considered for determing the type of irrigation method to be used. 'Gradient' refers to the 'slope of land'. It is calculated by dividing the rise (vertical difference) by the run (horizontal difference). The magnitude or size of gradient is the 'slope', while the direction in which the maximum value of this magnitude occurs is known as 'aspect'. Slope gradient is a key factor in influencing the relative stability of a slope. Slopes are often irregular and complex.

If the slope of the land is 0.4–8 per cent, corrugation method of irrigation (e.g., furrow irrigation) is suitable. If the slope is more, then sprinkler method is more suitable for soils that are shallow and have faster permeability.

NOTES

The land to be irrigated is levelled to obtain the required surface and drainage. Land levelling modifies the land surface for efficient surface irrigation. Pressurised irrigation methods may not need high degree of land levelling, whereas, surface irrigation methods need slight land grading and levelling.

Selection of irrigation method

There are several factors that need to be considered while selecting an irrigation method. A farmer or land owner must have knowledge of the soil condition, topography, size and shape of a field, cropping system and labour availability.

In pressurised irrigation system, water is applied to plants under pressure through a network of pipes and pumping system. This system may not be feasible unless energy resources are available at reasonable cost. For example, a farmer must have access to electricity supply in order to run a pump unit, which is needed to dissipate water with pressure.

Development and annual operational costs are the most important factors while selecting an irrigation method. It is not only the equipment, construction and installation cost but also the operation cost that needs to be taken care of. These costs must be compared with the expected yield benefits. The farmers will be interested in implementing a certain method only if they find it economically attractive.

Irrigation systems

There are two types of irrigation system — gravity flow or surface irrigation and pressurised irrigation

Gravity flow irrigation system

Gravity flow or 'surface irrigation system' refers to the application and distribution of water from higher to a lower topography by gravity flow. In this method, the land to be irrigated must have a gentle slope, else the cost of land levelling and preparation go may up considerably. It is by far the most common form of irrigation method in the world. There are four basic methods of surface irrigation.

(i) Border-strip irrigation
(ii) Check basin irrigation
(iii) Furrow irrigation
(iv) Wild-flooding irrigation

Border-strip irrigation

In this method of irrigation, the field is divided into a number of long parallel strips called 'borders'. These borders are 2–10 m wide and 52–300 m long, depending on the soil type and slope of the field. Parallel earth bunds or leeves are made in order to guide the advancing water. These borders are separated by low ridges. The border strip has a uniform gentle slope in the direction of irrigation. The water spreads and flows down the strip in a sheet confined by the border ridges. Examples of crops irrigated by this method include wheat, leafy vegetables and fodder. However, the method is not limited only to these plants.

Check basin irrigation

In this method, the field is divided into smaller areas so that each has a nearly level surface. Bunds or ridges are constructed around each 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 basins is 10–25 m^2,

Fig. 1.16: Check basin irrigation

depending on the soil type, topography, stream size and crop. It is the most common method of irrigation. The shape and size of basins are mainly determined by land slope, soil type, stream size available, required depth of the irrigation application and agricultural practices. Examples of crops irrigated by this method include maize, rice, wheat, barley, etc.

Fig. 1.17: Furrow irrigation

Furrow irrigation

In this method of surface irrigation, water is applied to the field through furrows, which are small canals having continuous or nearly uniform slope in the direction of water flow. The furrows are, generally, V–shaped or U–shaped in cross section and are 15–30 cm deep and 25–40 cm wide at the top. Water flowing into the furrows spreads laterally to irrigate the area between the furrows. The rate of lateral spread of water into the soil depends on the soil type, i.e., for a given time, water will infiltrate more vertically and less laterally in relatively sandy soil than in clayey soil. The spacing of furrows depends on the crop type and the type of machinery used for cultivation and planting. Shallow-rooted crops require shallow furrows. Examples of crops irrigated by this method include cotton, sugarcane and potato. However, the method is not limited only to these plants.

Wild-flooding irrigation

In this method of irrigation, water is applied from field channels without a ridge to guide its flow or control. This is the most inefficient method of surface irrigation.

Pressurised irrigation system

Pressurised irrigation system includes drip, sprinkler and an array of similar systems, in which water is distributed over the farmland through pressurised network of pipes.

Factors influencing suitability of irrigation system

The suitability of various irrigation methods, i.e., surface, sprinkler or drip depends mainly on the following factors.

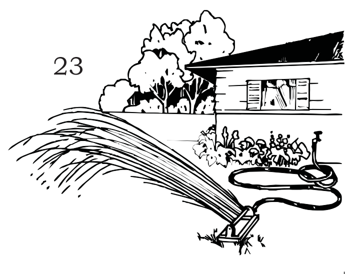
(i) Natural conditions
(ii) Crops
(iii) Technology
(iv) Labour inputs
(v) Cost

Natural conditions

Natural conditions, such as soil type, slope, climate, water quality and availability have the following impacts on the choice of an irrigation method.

Soil type	Sandy soil, which contains more than 85 per cent standardised particles by mass, have a low water storage capacity and a high infiltration rate. They, therefore, need frequent but small irrigation application, particularly, when the soil is shallow. Under these circumstances, sprinkler or drip irrigation is more suitable than surface irrigation. In loamy or clayey soils, all three irrigation methods can be used but surface irrigation is the most common. Surface irrigation is ideal for clayey soil having low infiltration rate.
Slope	Sprinkler or drip irrigation is preferred to surface irrigation on steeper or uneven sloping lands as they require little or no levelling. If an area to be irrigated has a high slope gradient, then a tapered pipeline can be used to economise on pipe costs and keep pressure head variations within the desired limits.

Notes

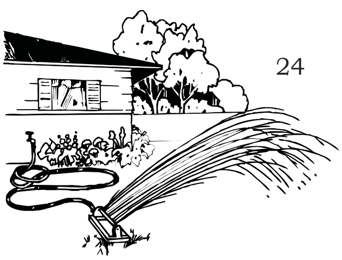


NOTES

Climate	The major climatic factors, which influence crop water needs are sunlight, temperature, humidity and wind speed. For example, strong winds can disturb the spraying of water by sprinklers. Therefore, drip or surface irrigation methods are preferred in windy conditions. In areas of supplementary irrigation, sprinkler or drip irrigation may be more suitable than surface irrigation as these can be adapted to meet varying irrigation demands on a farm.
Water application efficiency	Water application efficiency is, generally, higher in sprinkler and drip irrigation than surface irrigation. Therefore, these methods are preferred when water is in short supply.
Water quality	Surface irrigation is preferred if the irrigation water contains sediments. Sediments may clog the drip or sprinkler irrigation system. If the irrigation water contains dissolved salts, then drip irrigation is suitable as less water is applied to the soil as compared to surface irrigation. Sprinkler irrigation system is more efficient than surface irrigation, where leaching out of nutrients is likely a problem.

Let us now look at the suitability of some of the surface irrigation methods vis-à-vis land gradient.

Irrigation methods	**Land gradients**
Basin irrigation	It is the simplest of all surface irrigation methods. Flat lands, with a slope of 0.1 per cent or less, are suited for basin irrigation. In such a case, little land levelling is required. If the slope is more than 1 per cent, terraces can be constructed.
Furrow irrigation	This irrigation method can be used on flat (short and near horizontal furrows) and mildly sloping land with a slope of maximum 0.5 per cent. On steeper sloping land, contour furrows can be used up to a maximum land slope of 3 per cent.
Border irrigation	This can also be used on sloping land. A minimum slope of 0.05 per cent is recommended to ensure adequate drainage. If the infiltration rate is more than 30 mm/hour, then sprinkler or drip irrigation must be used.



Crops

Different crops have different water requirements. They need specific amounts of water at various stages of their growth and ripening. Some crops need more water, whereas, others require less water. For example, paddy is transplanted in standing water and requires continuous irrigation, whereas, crops like wheat, gram and most vegetables do not require as much water.

Growth stage of crops

There are, generally, four growth stages of crops, during which the water requirement varies.

Initial stage

The period from sowing or transplanting, until the crop covers about 10 per cent of the ground. During this stage, the crop uses little water.

Crop development stage

This stage starts at the end of the initial stage and lasts until the full vegetative stage has reached (70–80 per cent). At this stage, water consumption increases.

Mid-season stage

It starts at the end of the crop development stage and lasts until maturity, which includes flowering and grain-setting. During this stage, water consumption reaches its peak.

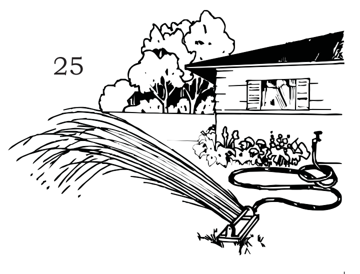
Late-season stage

This stage starts at the end of the mid-season stage and lasts until the last day of the harvest, which includes ripening. During this stage, the maturing crop requires less water.

Crop sensitivity

Crop sensitivity to water stress varies from one growth stage to another. 'Crop–water use', also known as 'evapotranspiration' (ET), is the water used by a crop for growth and cooling. This water is extracted from the root zone by the root system, which represents transpiration. Crop–water use at critical growth stages can be used in irrigation scheduling to avoid stressing

Notes



NOTES

crops. Crop sensitivity is weather dependent, as well as, soil, water and plant dependent.

Irrigation scheduling scheme

An irrigation scheduling scheme must consider the sensitivity of a crop to water stress at different growth stages. The purpose of an irrigation scheduling is to keep the water content in the root zone above the allowable water depletion level. This ensures that the crop will not suffer from water stress and will produce optimum yield. For irrigation scheduling, it is necessary to know how much water (in mm) is to be applied per irrigation application.

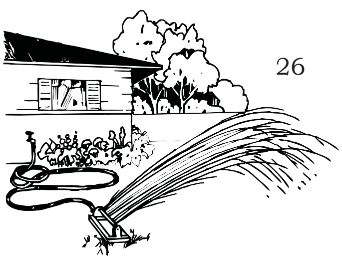
Irrigation requirement

Crop–water requirement in irrigation is defined as the quantity of water needed by a crop at a given time for its growth under open field conditions. It includes evaporation and other unavoidable water losses. Water requirement is expressed in water depth per unit area. Irrigation requirement is based on the type of crop, soil and climate. The net irrigation water requirement is the depth of irrigation water, exclusive of precipitation, stored moisture or groundwater that is required consumptively for crop production and other purposes, such as leaching out. It is expressed in millimeters per year.

Required depth of irrigation application

Surface irrigation can be used for all type of crops. Furrow irrigation is best used for irrigating row crops, such as maize, vegetables and trees. Border irrigation is, particularly, suitable for close growing crops but can also be used for row crops and trees.

In case of surface irrigation methods, maximum water is applied per irrigation. Usually, 40–70 mm water is applied in basin irrigation, 30–60 mm in border irrigation and 20–50 mm in furrow irrigation. For example, on sandy soil and a shallow rooting crop, furrow irrigation will be the most appropriate. If a large amount of water is to be applied per application, e.g., on clayey soil and a deep rooting crop, border or basin irrigation will be more appropriate.



Notes

Sprinkler and drip irrigation are mostly used for high-value cash crops as they involve high investment for installation and operation of equipment. Sprinkler irrigation can be chosen for eliminating the possibility of levelling a land when:

- the soil is too shallow.
- it is too steep (>1% slope).
- light (<5 cm) and frequent irrigations are to be given.
- the soil is sandy (rapidly permeable coarse textured soil) with poor water selection.
- supplementary irrigation is to be given to dry land crops during prolonged dry spells, without any land preparation.

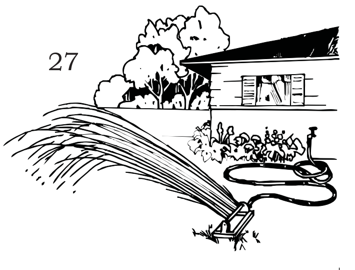
Drip irrigation is suitable for irrigating individual plants, trees or row crops, such as vegetables and sugarcane. It is considered to be less suitable and economical for close growing crops like rice.

Technology

The choice of irrigation method is also influenced by technology. In general, drip and sprinkler irrigation require advanced technological know-how. They are not only capital intensive but also require regular maintenance. Surface irrigation system, usually, requires less sophisticated equipment for construction and maintenance. However, the equipment are less efficient as compared to those used in drip and sprinkler irrigation systems.

Labour inputs

Surface irrigation often requires more labour input for construction, operation and maintenance than sprinkler or drip irrigation. It requires considerable land levelling and regular maintenance, whereas, sprinkler and drip irrigation require little land levelling and maintenance, and hence, are less labour-intensive. Labour and water requirement are high in case of furrow irrigation. In case of soils with steep or irregular slopes, high infiltration rate and water scarcity, sprinkler and drip irrigation may be more appropriate.



NOTES

Costs

The installation of a microirrigation system is capital intensive as it requires higher investment than surface irrigation system. However, if the investment is evaluated based on the cost benefit analysis, then microirrigation system has a major benefit. A farmer, using microirrigation system, experiences and increase in crop yield, which leads to a rise in the annual income.

Significant returns from microirrigation are possible if the farmer makes judicious selection of crops and follows the standard operating procedures.

Practical Exercise

Activity

Visit a nearby agricultural field and study the following:

(i) types of soil, water sources and crops grown

(ii) different irrigation methods used by the farmers working there

(iii) reasons for using a particular irrigation method by the farmers

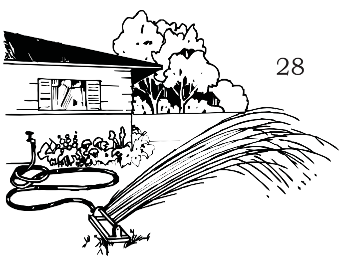
Check Your Progress

A. Multiple Choice Questions

1. Sandy soils have __________ .
   (a) low water storage capacity
   (b) high infiltration rate
   (c) more than 85 per cent sand particles by mass
   (d) All of the above
2. Sprinkler and drip irrigation are mostly used for high-value cash crops, such as vegetables and fruits because of __________ .
   (a) high capital investment
   (b) low capital investment
   (c) less requirement of water
   (d) None of the above

B. Fill in the Blanks

1. A __________ soil has low water storage capacity and high infiltration rate.
2. Strong __________ can disturb the spraying of water by sprinklers.



3. Surface irrigation is preferred, if the irrigation water contains much __________.
4. Surface irrigation often requires more __________ input for construction, operation and maintenance than sprinkler or drip irrigation.
5. Surface irrigation requires accurate __________ levelling and regular maintenance.
6. Sprinkler and __________ irrigation require little land levelling as compared to surface irrigation.
7. In soils with steep or irregular slopes, high infiltration rate and scarcity of __________, sprinkler and drip irrigation may be more appropriate.

C. State True or False

1. Strong winds cannot disturb the spraying of water from sprinklers.
2. Under strong wind conditions, drip or surface irrigation methods are not preferred.
3. Surface irrigation systems, usually, require less sophisticated equipment for both construction and maintenance.

What have you learned?

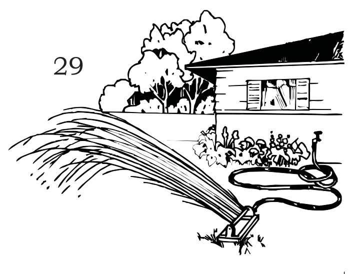
After completing this Session, you will be able to:

- describe the factors that determine the suitability of an irrigation system.
- describe the various aspects of land gradient that need to be considered while selecting and installing an irrigation system.
- describe the factors that influence crop–water requirements.
- corelate crop water requirement with the required depth of irrigation application.

Session 3: Design and Layout of Microirrigation System

Microirrigation systems must aim at maximising the returns and minimising the cost per unit volume of water used, thus, contributing to the overall reduction in the total investment. Planning and purchasing the correct components are the key factors for the installation and smooth functioning of a microirrigation

Notes



Notes

system. A checklist of tools, equipment and material required to install the system must be prepared before purchasing them.

Design and layout

The primary objective is to choose the appropriate layout and components required for installing a microirrigation system in order to attain adequate and uniform distribution of water and nutrients across the field at high efficiency. Information, preferably, backed by data on crop, cropping pattern, irrigation water quality, topography, soil characteristics and climate are required for planning the layout and design of the microirrigation system.

The basic steps that need to be followed while planning the design and layout the microirrigation system are as follows.

Collection of basic farm data

Farm data may include layout of the area, details of water source, soil type, agronomic details (plants to be grown, crop spacing, crop period, etc.) and climatic data (temperature, rainfall, evapotranspiraton, etc.). It may also include the topographic map of a farm, showing the area to be irrigated. The map contains contour lines, farm boundaries, water source(s), roads and electricity lines. The basic farm data also include the quantity and quality of water available, climate of the area and its influence on the water requirements of the selected crops, soil characteristics, type of crops intended to be grown and current agricultural practices.

Analysis of the data

The collected farm data is analysed to understand the irrigation requirements of the crops, infiltration rate of the soil to be irrigated, depth of water application per irrigation, irrigation frequency and cycle, system capacity, etc. 'Irrigation frequency' is the time it takes a crop to deplete the soil moisture at a given soil moisture depletion level. Depth of water application refers to the quantity of water, which needs to be applied during irrigation in order to replenish the water used by the crop during evapotranspiration.

Preparation of microirrigation system layout

The microirrigation system layout for the field is prepared after taking into account the affordability of a farmer. Microirrigation system design starts with the selection of emitters, which depends on the type of crop, water requirement, operating time, soil type and water quality. Layout includes alignment of the network of main, sub-main and lateral pipes, and their connection with a water source. The whole area is then divided into units, depending on the number of sub-mains to be installed, keeping in view the pumping capacity of the pump. The main line is then planned for connecting to the sub-mains by considering the shortest possible route. The length of the main line is determined on the basis of the water flow rate so that the frictional head loss is within the specified limits and the total pressure head required for the system is within the pump capacity.

Water sources

Surface and groundwater are the main sources of water supply for agricultural purposes. One always needs to locate the water source before installing a microirrigation system. The location of water source needs to be marked on a map. The following information with regard to the water source must be collected.

- Height above the ground level or depth from the ground surface
- Details of the pump to be installed
- Quality of water in terms of impurities present (sand, silt, algae, etc.)

The various sources of surface and underground water, which can be utilised for irrigation purposes, are tanks, canals, wells, lakes, rivers, ponds, reservoirs, streams, etc. Surface water contains large amount of impurities, therefore, it must be filtered before use. Fig. 1.18 shows the symbol that is commonly used to represent the water source on an irrigation plan.

Fig. 1.18: Symbol for water source

Tanks

In India, tanks are the most popular source of irrigation, especially in States like Tamil Nadu, Karnataka, Andhra

NOTES

Pradesh, Telangana and Maharashtra. Most tanks are small in size and built by individuals or groups of farmers by raising bunds across seasonal streams. Evaporation of water is relatively rapid in tanks due to large expanse of shallow water. However, tanks do not provide perennial water supply. In small areas, plastic overhead tanks can also serve the purpose of supplying water to the main and sub-main lines of the microirrigation system.

Canals

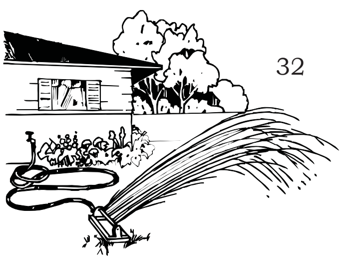
Canals are the second most important source of irrigation in India. Canal irrigation is possible in areas that are extensive like plains and are drained by perennial rivers, such as the northern plains, coastal plains, deltas and broad valleys of the Indian peninsula. The plain areas of India are mostly canal irrigated. States that follow canal irrigation system are Andhra Pradesh, Assam, Haryana, West Bengal, Punjab, Rajasthan, Bihar, Karnataka, Tamil Nadu and Uttar Pradesh.

Wells

Wells are an important source of irrigation. The water in wells is obtained from the sub-soil and has to be extracted manually, using animal power or pumps. Well irrigation is most common in alluvial plain areas, where the water table is high. States having 50 per cent or more irrigated area under wells and tubewells are Punjab, Uttar Pradesh, Rajasthan, Gujarat, Maharashtra, Madhya Pradesh and Tamil Nadu.

Design of drip irrigation system

Drip irrigation, also known as ‘trickle irrigation’, is a planned irrigation system, in which water is applied directly to the root zones of plants by means of applicators (orifices, emitters, porous tubing, perforated pipes, etc.) operated under low pressure. The applicators are placed either on or below the surface off the ground. As already mentioned in Session 1, drip irrigation system consists of pump unit, head control unit, main line, sub-main lines or sub-mains, laterals and emitters or drippers.



The design of surface drip irrigation system must describe the pump requirements. There is a range of options for the type of filter. There are filters with mesh, disc and media type. A major consideration in the design of surface drip irrigation system is drip tubing lateral spacing. In normal irrigation design, the pipe size must be specified based on economic and friction loss, and water hammer considerations. Drip line depth will depend on soil characteristics, rooting depth and cultivation practice being followed in a field. Soil having more sand content requires closer spacing of drip tubing laterals, which increases the cost of the drip irrigation system. Wider spacings are possible with heavy soil, which contains more clay (e.g., black soil), as lateral movement of water is greater in such soil.

Typical spacing of 4 lph (1.06 gph) emitters

Coarse soil (sand): 60 cm (24″)
Medium soil: 1m (39″)
Fine soil (clay): 1.3 m (48″)

Typical spacing of 2 1ph (0.53 gph) emitters

Coarse soil (sand): 30 cm (12″)
Medium soil: 60 cm (24″)
Fine soil (clay): 1 m (39″)

Components and symbols of drip irrigation system

Pump unit

The pump unit lifts water and produces the desired pressure for distributing water through emitters. Electric motor driven pumps can be activated using a pump start relay that is activated by a computer.

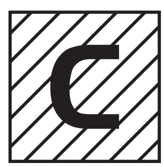


Fig. 1.19: Symbol for head control unit

Head control unit

It consists of valves to control the discharge and pressure of water in the entire system. It may also have filters to clean the water. The head control unit turns the automatic valves on or off through control signals. These valves then run water to the required sections.

The symbol given in Fig. 1.19 represents the head control unit.

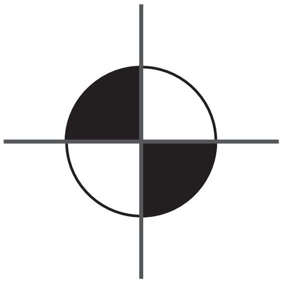


Fig. 1.20: Symbol for automatic control valve

Automatic control valve

Valves allow to turn different sections on and off automatically. The symbol used to represent an automatic control valve, also known as 'solenoid', is given in Fig. 1.20.

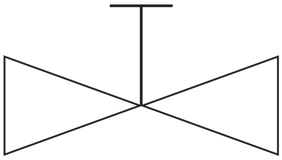


Fig. 1.21: Symbol for gate valve

Gate valve

Gate valves may be used in place of electric valves to turn different sections on or off. They are manually operated isolation valves. The symbol used to represent a gate valve, also known as a 'hand operated valve', is given in Fig. 1.21.

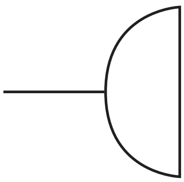


Fig. 1.22: Symbol for flush valve

Flush valve

It is a self-opening valve that allows lines to be flushed when the pipe pressure is low. It shuts when the pressure builds up. The symbol used to represent a flush valve is given in Fig. 1.22.

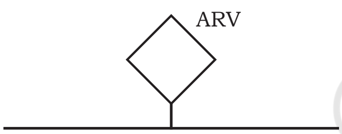


Fig. 1.23: Symbol for automatic air release valve

Automatic air release valve

Automatic air release valves (ARV) are used to displace air contained within an irrigation system, which can adversely affect its performance. The symbol used to represent an automatic air release valve is given in Fig. 1.23.

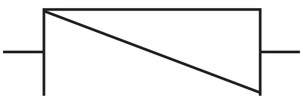


Fig. 1.24: Symbol for check valve

Check valve

A check valve, also called 'non-return valve', is a mechanical device in a pipe that permits the flow of water in one direction only. It prevents the backward flow of water. The symbol used to represent a flush valve is given in Fig. 1.24.

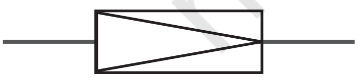
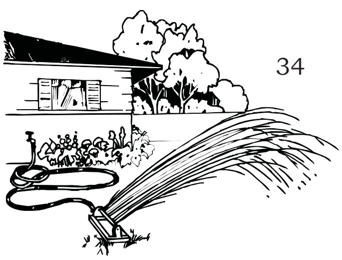


Fig. 1.25: Symbol for pressure reducing valve

Pressure reducing valve

It is commonly used when installing a drip irrigation system or where high pressures can pose a problem. The symbol used to represent a pressure reducing valve is given in Fig. 1.25.



Filter

Common types of filter include screen and graded sand filters, which remove fine material suspended in water. Filters come in different volume capacities and mesh sizes (filtration particle exclusion capacities). The symbol used to represent a filter is given in Fig. 1.26.

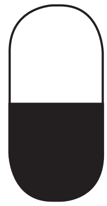


Fig. 1.26: Symbol for filter

Screen filter

It uses a fine mesh formed into a column to filter out undesirable elements from water. The symbol used to represent a screen filter is given in Fig. 1.27.

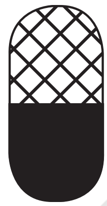


Fig. 1.27: Symbol for screen filter

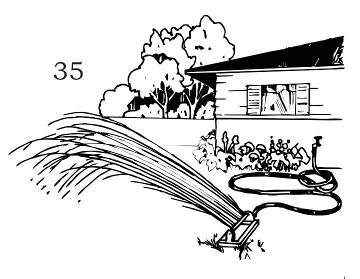
Mains, sub-mains and laterals

Main lines, sub-mains and laterals supply water from the control head into the fields. They are, normally, made of flexible material, such as PVC pipes. Laterals or drip lines are small diameter (1–1.25 cm) flexible lines made of Low Density Polyethelene Pipes (LDPE). Generally, the main and sub-mains are laid across the slopes, while laterals are placed along the slopes. If a field is divided into sub-block, each block is provided with one sub-main and a control valve. Based on the available data of water capacity, water requirement of a plant and pressure required at the lateral layout, designs for the microirrigation system are made.

Fig: 1.28: Sub-mains and laterals

The symbol that represents the **main line**, which carries water to different sections of the irrigation system, is given in Fig. 1.29.

Fig. 1.29: Symbol for main line



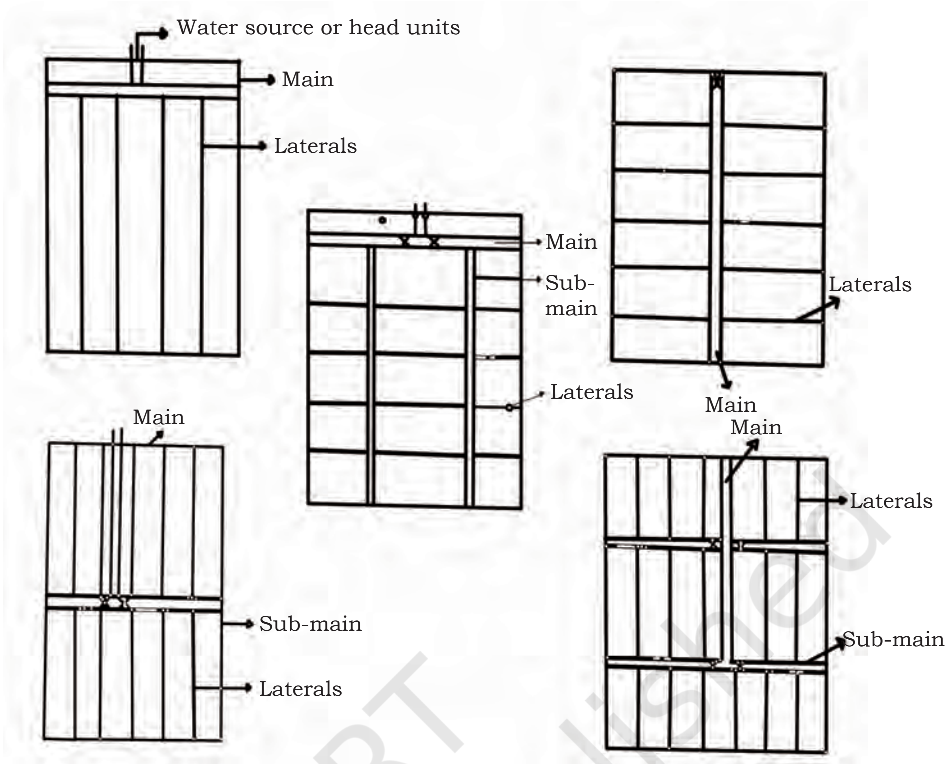


Fig. 1.30: Layout of drip irrigation system based on water source location

Fig. 1.31: Symbol for lateral lines

Laterals are, normally, laid parallel to each other. There is, usually, one lateral line for each crop row. The symbol used to represent **lateral lines** is given in Fig. 1.31.

Emitters or drippers

These are fixed at regular intervals in the laterals. They are, usually, spaced more than 1 m apart. For row crops, more closely spaced emitters may be used to wet a strip of soil. They supply specified quantity of water to plants

Fig. 1.32(a): Drip online

Fig. 1.32(b): In-line emitter

in a field. Water is delivered at or near the root zones of plants, drop-by-drop. The PVC valves allow water to flow at a slow rate (2–16 litre per hour) and in various shapes and designs. Emitters are selected on the basis of soil texture and crop root zone system.

To measure the anticipated variations in the discharge of water in emitters, a pressure gauge is used. The symbol for pressure guage is shown in Fig. 1.33.

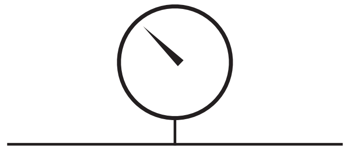


Fig. 1.33: Symbol for pressure gauge

Design of sprinkler irrigation system

The layout of a sprinkler irrigation system will include measuring of the land and drawing its sketch to scale on a graph paper. Mark the location of hedges, shrubs, trees, and also walls and driveways on the sketch. Divide the area into zones for laying out the main lines and laterals. The next step is to determine the available water flow for the sprinkler system so as to ascertain how many sprinkler heads can run at one time. Plan the pipe layout according to the placement of risers and sprinkler heads.

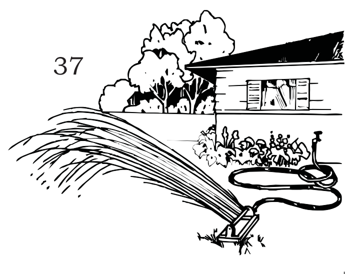
Sprinkler irrigation system consists of a pump unit, main line, laterals, risers and sprinkler heads along with filter screens, desilting devices, flow regulators and fertiliser application system. It is mostly used to humidify the atmosphere, especially for young plants, sandy loam soils, greenhouses or poly-houses, and land having up and down slope. In sprinkler irrigation, water is conveyed under pressure through pipes to the area to be irrigated, where it is discharged through sprinklers.

Components of sprinkler irrigation system

Pump unit

A pump is used for developing the required pressure. It can be used under the following conditions.

- The land is undulating for levelling (the levelling work will be cost-intensive).
- The soil is porous, erodible and impermeable (which makes it difficult to irrigate it by any other method).
- The flow rate is too less for employing surface irrigation method.



Filtration unit

Filtration unit is required to remove the impurities present in the irrigation water. Hydro-cyclone, media and screen are the different types of filter. The choice of filter depends on the quality of water. If the quality of water is poor, then a filter of higher mesh size is used.

Pipeline

The layout of mains, sub-mains and laterals depends on local conditions like topography, soil characteristics and source of water. The main line must be laid along the slope and the laterals across the slope or nearly on the contours. In portable system, the laterals need to be of the same size so that they can be changed easily.

Sprinklers

The selection of sprinkler depends on its nozzle size and the pressure with which it discharges water. It must also be ensured that the water discharged does not cause run-off or damage to the crops. Besides, it must supply water to the crops sown in a field uniformly under the prevailing wind conditions. It must meet the irrigation water requirement of a crop and the irrigation frequency. The common symbols used when designing sprinkler irrigation plans are as follows.

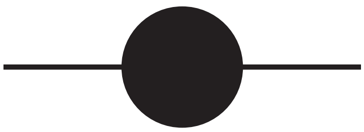


Fig. 1.34: Symbol for sprinkler – full

Sprinkler – full

This nozzle will, generally, throw water all around it at 360° and at a distance of 3.6–4.5 metre. The symbol used to represent sprinkler – full is given in Fig. 1.34.

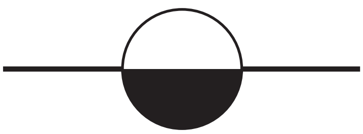


Fig. 1.35: Symbol for sprinkler – half

Sprinkler – half

This nozzle will, generally, throw water all around it at 180° and at a distance of 3.6–4.5 metre. The symbol used to represent sprinkler – half is given in Fig. 1.35.

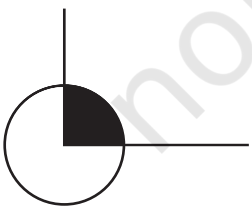


Fig. 1.36: Symbol for sprinkler – quarter

Sprinkler – quarter

This nozzle will, generally, throw water all around it at 90° and at a distance of 3.6–4.5 metre. The symbol used to represent sprinkler – quarter is given in Fig. 1.36.

Sprinkler – one-third

This nozzle will, generally, throw water all around it at 120° and at a distance of 3.6–4.5 metre. The symbol used to represent sprinkler–one-third is given in Fig. 1.37.

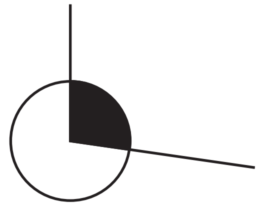


Fig. 1.37: Symbol for sprinkler – one-third

Sprinkler — three quarter

This nozzle will, generally, throw water all around it at 270° and at a distance of 3.6–4.5 metre. The symbol used to represent it is given in Fig. 1.38.

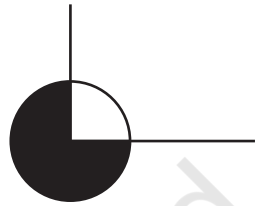


Fig. 1.38: Symbol for sprinkler – three quarter

Sprinkler — two-third

This nozzle will, generally, throw water all around it at 240° and at a distance of 3.6 to 4.5 metre. The symbol used to represent sprinkler–two-third is given in Fig. 1.39.

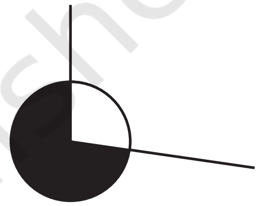


Fig. 1.39: Symbol for sprinkler – two-third

Sprinkler – variable arc nozzle

The symbol used to represent sprinkler – variable arc nozzle is given in Fig. 1.40. It represents a pop up with a variable arc nozzle, which means it can be adjusted from 0 to 360 degree. This nozzle will, generally, throw water at a distance of 3.6–4.5 metre.

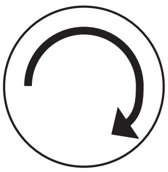


Fig. 1.40: Symbol for sprinkler – variable arc nozzle

Units of measurement in microirrigation system

Measurement of any physical quantity involves comparison with a certain basic, arbitrarily chosen, internationally accepted reference standard called 'unit'. The standards of measurement are useful for minimising errors. The units for fundamental or base quantities are called 'fundamental' or 'base' units. The units of all other physical quantities can be expressed as combinations of the base units. Such units obtained for the derived quantities are called 'derived units'. A complete set of these units, both the base and derived units, is known as 'system of units'.

Notes

These units, which are adopted for international use under the Système Internationald' Unités, are now employed for all scientific and technical purposes. There are seven fundamental units — metre, kilogram, second, ampere, kelvin, candela and mole, and two supplementary units — radian and steradian. All other units are derived by the multiplication or division of these units without the use of numerical factors.

Table 1.1: Units of measurement

psi	Pound per square inch
kPa	Kilopascal
gal	Gallon
gpm	Gallon per minute
gph	Gallon per hour
l	Litre
lph	Litre per hour
lps	Litre per second
ml	Millilitre
ml/min	Millilitre per minute
mm/h	Millimetre per hour
cm	Centimetre
mm	Millimetre
m	Metre
m/sec	Metre per second
A	Area
in/hr	Inches per hour
ft	Feet
ft/sec	Feet per second

Practical Exercises

Activity 1

Visit an agricultural farm having a drip irrigation system, and study its layout and design. Note down the following:

(i) Length of laterals
(ii) Number of sub-mains
(iii) Diameter of the sub-mains
(iv) Length of the main line
(v) Number of laterals
(vi) Diameter of lateral
(vii) Length of the sub-mains
(viii) Number of the main line
(ix) Diameter of the main line
(x) Total power of the pump

Notes

Activity 2

Prepare a drip irrigation layout of 200×100 m, when water source is:

(i) at the middle of the command area
(ii) at the corner of the command area
(iii) around the side of the command area

Activity 3

Prepare a chart showing symbols for the following:

(i) Sprinkler–full
(ii) Sprinkler–half
(iii) Pressure gauge
(iv) Screen filter
(v) Head control unit
(vi) Flush valve

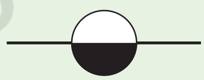
Check Your Progress

A. Multiple Choice Questions

1. This symbol is used to represent ___________.
   (a) screen filter
   (b) filter scale
   (c) control unit
   (d) micro sprayer

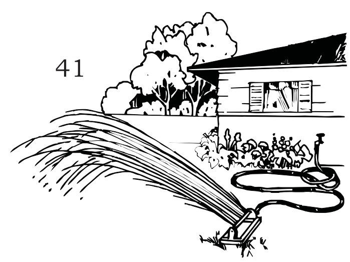
2. This symbol represents ___________.
   (a) main line
   (b) check valve
   (c) head control unit
   (d) filter

3. This symbol is used to represent ___________.
   (a) sprinkler – half
   (b) micro sprayer
   (c) gate valve
   (d) flush valve



B. Fill in the Blanks

1. A typical drip irrigation system consists of a pump unit, head ___________ unit, main and sub-main lines, laterals and emitters or drippers.
2. A pump is used for developing the required water ___________.
3. A ________ filter uses a fine mesh formed into a column to filter out undesirable elements from the water supply.



NOTES

C. Match the Columns

A	B
1. Sprinkler — quarter	(a) 120°
2. Sprinkler — three quarter	(b) 360°
3. Sprinkler — two-third	(c) 270°
4. Sprinkler — one-third	(d) 90°
5. Sprinkler — variable arc nozzle	(e) 240°

D. Subjective Questions

1. Write the full forms of the following.
   (i) psi : ____________________
   (ii) lph : ____________________
   (iii) lps : ____________________
   (iv) gpm : ____________________
2. Name any three type of sprinklers.
3. List any three factors that affect the choice of irrigation method.
4. Describe the purpose of the following components of drip irrigation system.
   (i) Pump
   (ii) Main line
   (iii) Filtration unit

What have you learned?

After completing this Session, you will be able to:

- describe the basic steps that need to be followed while doing the layout and design a microirrigation system.
- identify the symbols that are used in preparing an irrigation plan.
- prepare a layout, considering the design aspects for a microirrigation system.