RAMA UNIVERSITY, KANPUR, UTTAR PRADESH

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Course: Hi- tech Horticulture (UGE-321)

Lecture-6

Method and Techniques, Micro Irrigation Systems and It,s Components

Micro irrigation System

Micro irrigation 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 micro irrigation system and its classification. Micro irrigation 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. Micro irrigation 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. Micro irrigation 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 micro irrigation system

• Water is applied via pressurized piping system. Micro irrigation 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 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.

Drip irrigation system can be classified into the following:

(i) Surface drip irrigation
(ii)
(iii) Sub-surface drip irrigation
(iv) 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. 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/cm2 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.

(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.

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.

Component of Micro irrigation:

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.

1. Drip Emitter (Most Micro- Irrigation emitters qualify)
2. Polyethylene Tubing (Or any drip irrigation tubing of your choice)
3. Irrigation Valve (You can use any irrigation valve as long as pressure is lowered by a pressure regulator).
4. Micro-Irrigation Valve Filters (Our program requires micro irrigation systems to have filters on each valve being used).
5. Micro Jet Nozzles (Another example of a type of emitter for micro irrigation).
6. Valve Pressure Regulator (Required: Helps Micro- Irrigation systems achieve maximum efficiency by lowering water pressure).
7. Spray Micro- Irrigation (Optional, also qualifies for our rebate program).
8. Backflow Prevention Device (Required to ensure safe irrigation practices).
9. Pressure Vacuum Breaker (A recommended backflow prevention device that would be placed before all irrigation valves).
10. Multi-Port Drip Connector (Recommended: Assists with proper drip line distribution and has built-in filter and pressure regulator)