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Drip Irrigation: Pivotal Type of Irrigation System

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SUMMARY

In drip irrigation, water is applied to each plant separately in small, frequent, precise quantities through dripper. It is the most advanced irrigation method with the highest application efficiency. The water is delivered continuously in drops at the same point and moves into the soil and wets the root zone vertically by gravity and laterally by capillary action. The planted area is only partially wetted. Drip irrigation is widely accepted as the most efficient irrigation technique as it allows high uniformity of water and nutrient application.

INTRODUCTION

Drip irrigation is defined as the precise, slow and frequent application of small quantities of water to the soil in the form of discrete drops, continuous drops, and tiny streams through emitters located at selected points along a water delivery lateral line. It differs from sprinkler irrigation by the fact that only part of the soil surface is wetted. Current drip irrigation technology dates back to the work of Symcha Blass (1964). Based on the observation that a large tree near a leaking faucet exhibited a more vigorous growth than other trees in the area, he developed the first patented drip irrigation system. From Israel, the concept spread to Australia, North America and South Africa by the late 1960s, and eventually throughout the world. The availability of low cost plastic pipe for water delivery lateral lines helped to speed up the field use of drip irrigation system.

Surface drip irrigation

The application of water to the soil surface as drops or tiny streams through emitters with discharges rate for point-source emitters less than 8 L/h for single outlet emitter and for line-source emitters less than 4 L/h. Often the terms drip and trickle irrigation are considered synonymous.

Subsurface drip irrigation

The application of water below the soil surface through emitters, with discharge rate generally in the range of 0.6 to 3 L/h. This method of water application is different from and not to be confused with the method where the root zone is irrigated by water table control, herein referred to as sub irrigation.

Advantages

- Enhanced plant growth, crop yield and premium quality produce.
- Water Saving due to increased beneficial use of available water and higher water application efficiency.
- Precise and uniform delivery of water to crops due to controlled water application.
- Maintenance of higher soil water potential in the root zone.
- Compact and efficient root system.
- Combined water and fertilizer (fertigation) application minimizes nutrient losses and improves fertilizer use efficiency and contributes to fertilizer saving in some crops.
- Reduced salinity hazards to crop plants when low quality saline water is used for irrigation.
- Suitable for irrigating high-value crops raised in greenhouses, plastic tunnels, potted plants and under plastic mulches.
- Lower operating pressures means reduced pumping energy costs.
- Limited weed growth because only a fraction of the soil surface is irrigated.
- Reduced operational and labour costs due to improved weed control and simultaneous application of water, fertilizers, herbicide, insecticide, fungicide and other additives through the drip irrigation system.
- Feasible to irrigate crops raised in small & irregularly shaped narrow lawns, and on undulated land terrains.
- Maintenance of dry foliage means improved disease and pest management.

- Suitable to highly permeable & low water holding sandy and desert soils, saline and slowly permeable alkaline soils, wastelands, slopy lands and rocky hills, road embankments, abandoned mine areas etc.
- Improved and continuous cultural operations such as spraying, weeding, thinning and harvesting of tree and row crops is possible without interrupting the drip irrigation cycle for any prolonged period of time.
- Environmental protection and ecological security.

Disadvantages

- Sensitivity to emitter clogging.
- Salt accumulation in soil.
- Mechanical damage to system components.
- Lack of microclimate control such as frost protection and evaporative cooling.
- Operational constraints such as high technical skills, stringent filtration and operating. Pressures etc.
- High initial cost.

Drip Irrigation System Layout and Components

The drip irrigation system consists of three subsystems viz., control head unit, water carrier system and water distribution system besides water source & pumping station.

- Head control unit – Non return valve, Air release valve, Vacuum breaker, Filtration unit, Fertigation unit, Throttle valve, Pressure gauge, Water meter, Pressure regulator and Pressure relief valve.
- Water carrier system – PVC main pipeline, PVC sub main pipeline, Control valve, Flush valve and other fittings.
- Water distribution system – Drip lateral, Emitters, Grommet, Start connecter, Nipple, End cap.

Components of Drip Irrigation

Head Equipment's

- Water source - Subsurface tank
- Pump -Suction, monoblock pump, delivery non return valve, gate valve
- Filter station- Sand filter, screen filter, Centrifugal Filters and Disk Filters
- Fertiliser application - Fertiliser tank and ventury assembly

Distribution System

- Conveyance line- Main line, sub main, gromet takes off assembly, laterals, micro tubes and end caps.
- Drippers - Pressure corresponding drippers (moulded/threaded type)
- Valves- Non-return valve (NRV), Ball valves, Air release valve (ARV), flush valves
- Water meter- If necessary
- Water source

a. Water Source Subsurface Tank

To minimise the energy requirement and also to get a uniform or constant level of water owing to the accumulation of bore wells in one pat1 of the irrigation regime; keeping in the effective hydraulic DIS design, it is necessary to construct a subsurface tank in an elevation point at the centre. The capacity of the tank is calculated from the water requirement of the crop, dripper capacity, type of soil etc.

b. Pump

Pump/Overhead Tank: It is required to provide sufficient pressure in the system. Centrifugal pumps are generally used for low pressure trickle systems. Overhead tanks can be used for small areas or orchard crops with comparatively lesser water requirements.

c. Filters:

The hazard of blocking or clogging necessitates the use of filters for efficient and trouble free operation of the micro irrigation system. The different types of filters used in micro irrigation system

- Gravel or Media Filter
- Screen Filters
- Centrifugal Filters
- Disk Filters

Gravel or Media filter: This type of filtration is essential for primary filtration of irrigation water from open water reservoirs, canals or reservoirs in which algae may develop.

Screen Filter: Screen filters are always installed for final filtration as an additional safeguard against clogging. While majority of impurities are filtered by sand filter, minute sand particles and other small impurities pass through it.

Centrifugal Filters: Centrifugal filters are effective in filtering sand, fine gravel and other high density materials from well or river water. Water is introduced tangentially at the top of a cone and creates a circular motion resulting in a centrifugal force, which throws the heavy suspended particles against the walls.

Disk Filters: Disk filter contains stacks of grooved, ring shaped disks that capture debris and are very effective in the filtration of organic material and algae.

Pressure relief valves, regulators or bye pass arrangement: These valves may be installed at any point where possibility exists for excessively high pressures, either static or surge pressures to occur. A bye pass arrangement is simplest and cost effective means to avoid problems of high pressures instead of using costly pressure relief valves. Check valves or non-return valves: These valves are used to prevent unwanted flow reversal. They are used to prevent damaging back flow from the system to avoid return flow of chemicals and fertilizers from the system into the water source itself to avoid contamination of water source.

Distribution Network

It mainly constitutes main line, submains line and laterals with drippers and other accessories.

Mainline: The mainline transports water within the field and distribute to submains. Mainline is made of rigid PVC and High Density Polyethylene (HDPE). Pipelines of 65 mm diameter and above with a pressure rating 4 to 6 kg/cm2 are used for main pipes.

Submains: Submains distribute water evenly to a number of lateral lines. For sub main pipes, rigid PVC, HDPE or LDPE (Low Density Polyethylene) of diameter ranging from 32 mm to 75 mm having pressure rating of 2.5 kg/cm2 are used.

Laterals: Laterals distribute the water uniformly along their length by means of drippers or emitters. These are normally manufactured from LDPE and LLDPE. Generally pipes having 10, 12 and 16 mm internal diameter with wall thickness varying from 1 to 3 mm are used as laterals.

Emitters / Drippers: They function as energy dissipaters, reducing the inlet pressure head (0.5 to 1.5 atmospheres) to zero atmospheres at the outlet. The commonly used drippers are online pressure compensating or online non-pressure compensating, in-line dripper, adjustable discharge type drippers, vortex type drippers and micro tubing of 1 to 4 mm diameter. These are manufactured from Poly- propylene or LLDPE.

- **Online Pressure Compensating drippers**: A pressure compensating type dripper supplies water uniformly on long rows and on uneven slopes.
- **Online Non-Pressure Compensating drippers:** In such type of drippers discharge tends to vary with operating pressure.

- **In-Line Drippers or Inline tubes:** These are fixed along with the line, i.e., the pipe is cut and dripper is fixed in between the cut ends, such that it makes a continuous row after fixing the dripper.

Suitable crops

Drip irrigation, like other irrigation methods, will not fit every agricultural crop, specific site or objective. Presently drip irrigation has the greatest potential in the following crops:

- Fruit crops – Mango, citrus, grapes, guava, pomegranate, banana, papaya, and watermelon, Litchi, Fig, Ber, Amla, and Sapota etc.
- Vegetable crops – Tomato, Brinjal, Bhendi, Cabbage, Cauliflower, Capsicum, Chillies gourds etc.
- Plantation crops – Oil palm, Coconut, Arecanut, Cashewnut, Coffee, Tea etc.
- Field crops – Cotton, Sugarcane, Tobacco, Sugar beet, Castor etc.
- Tuber & Bulb crops – Potato, Cassava, Onion, Sweet potato, Radish, Colocasia etc.
- Spices – Turmeric, Ginger, Cardamom etc.
- Flowers – Roses, Rose, Gerbera, Orchids, Anthurium, Gladiolus, Carnations, Jasmine, Chrysanthemum, Marigold etc.

Further this method of irrigation continuous to be important in greenhouse production of vegetables & flowers. Drip irrigation is also used for landscaping of parks, highways, commercial developments and residences. As labour, water and land preparation costs increase, more drip irrigation systems will be substituted for conventional irrigation methods.

CONCLUSION

In above information it is concluded that, in drip irrigation savings of water (50-60%) of that required for flow irrigation, effective use of fertilizers, less labour and energy cost. The limitation for adopting of this method is its high initial cost which is beyond the purchasing capacity of small and marginal farmers and thus mainly adopted by large farmers.

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