Drip Irrigation
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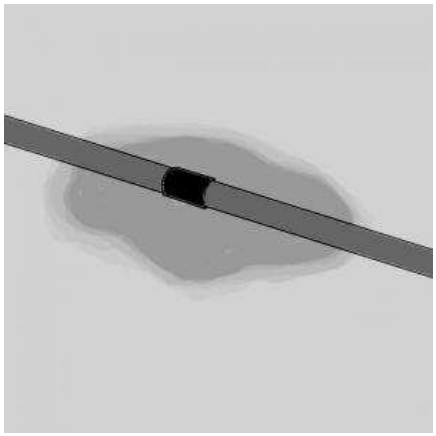


Compiled by: ***Beat Stauffer (seecon international gmbh)***

Drip irrigation is a technique in which water flows through a filter into special drip pipes, with emitters located at different spacing. Water is distributed through the emitters directly into the soil near the roots through a special slow-release device. If the drip irrigation system is properly designed, installed, and managed, drip irrigation may help achieve water conservation by reducing evaporation and deep drainage. Compared to other types of irrigation systems such as flood or overhead sprinklers, water can be more precisely applied to the plant roots. In addition, drip can eliminate many diseases that are spread through irrigation water. Drip irrigation is adaptable to any farmable slope and is suitable for most soils. In contrary to commercial drip irrigation, simple self-made systems are cheap and effective.

In	Out
Freshwater, Urine or Yellowwater, Fertigation Water, Treated Water, Energy	Food Products

Introduction

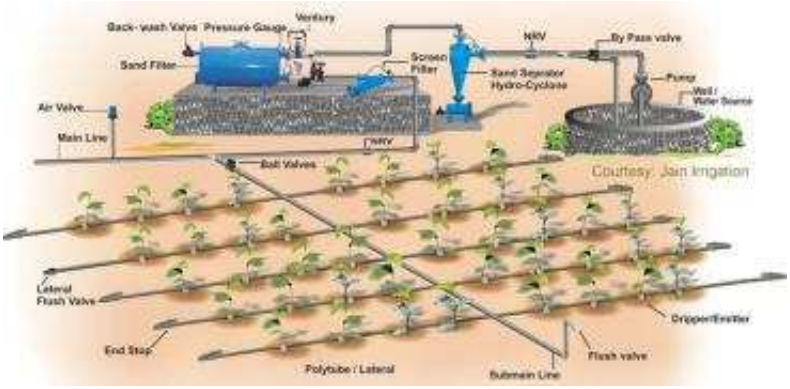
With drip irrigation, water is conveyed under pressure through a pipe system to the fields, where it drips slowly onto the soil through emitters or drippers which are located close to the plants. Compared to other types of irrigation (sprinkler irrigation or surface irrigation), only the immediate root zone of each plant is wetted. Therefore this can be a very efficient method of irrigation. Drip irrigation is sometimes called trickle irrigation (FAO 1988).

Drip irrigation can be a very technical irrigation system for food or plant production fields. But compared to other technical systems (e.g. sprinkler irrigation) it is a low-technique solution. Furthermore it is possible to combine this system with a water treatment plant (e.g. non-planted filter or constructed wetlands (horizontal flow or vertical flow) and use the treated water as irrigation water.

Drip irrigation requires little water compared to other irrigation methods. About 40-80 litres per day are needed per 100-200 plants (INFONET-BIOVISION 2010). The small amount of water reduces weed growth and limits the leaching of plant nutrients down in the soil. In organic fertiliser or urine tea can be applied efficiently to the plants through the drip system (INFONET-BIOVISION 2010).

Basic Design Principles

Commercial Drip Irrigation System

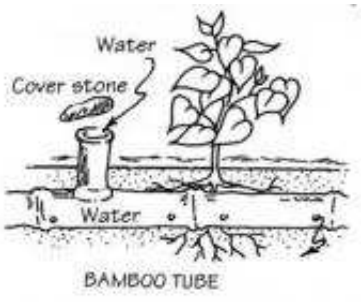


Schematic design of a commercial drip irrigation system. This includes technical components such as filters, pumps and hydraulic control valves. Source: INFONET-BIOVISION (2010)

Expensive commercial drip irrigation systems are employed in highly technical and industrial farming. The used systems are very expensive and needs expert design and maintenance (INFONET-BIOVISION 2010).

Most large drip irrigation systems employ some type of filter to prevent clogging of the small emitter flow path by small waterborne particles. New technologies are now being offered that minimise clogging. Some residential systems are installed without additional filters since potable water is already filtered at the water treatment plant. Virtually all drip irrigation equipment manufacturers recommend that filters be employed and generally will not honour warranties unless this is done. Last line filters just before the final delivery pipe are strongly recommended in addition to any other filtration system due to fine particle settlement and accidental insertion of particles in the intermediate lines. Drip systems often mix liquid fertiliser with the irrigation water. This is called fertigation and chemigation (application of pesticides and other chemicals to periodically clean out the system) (WIKIPEDIA 2011).

Small Scale and Self-Made Drip Irrigation Systems



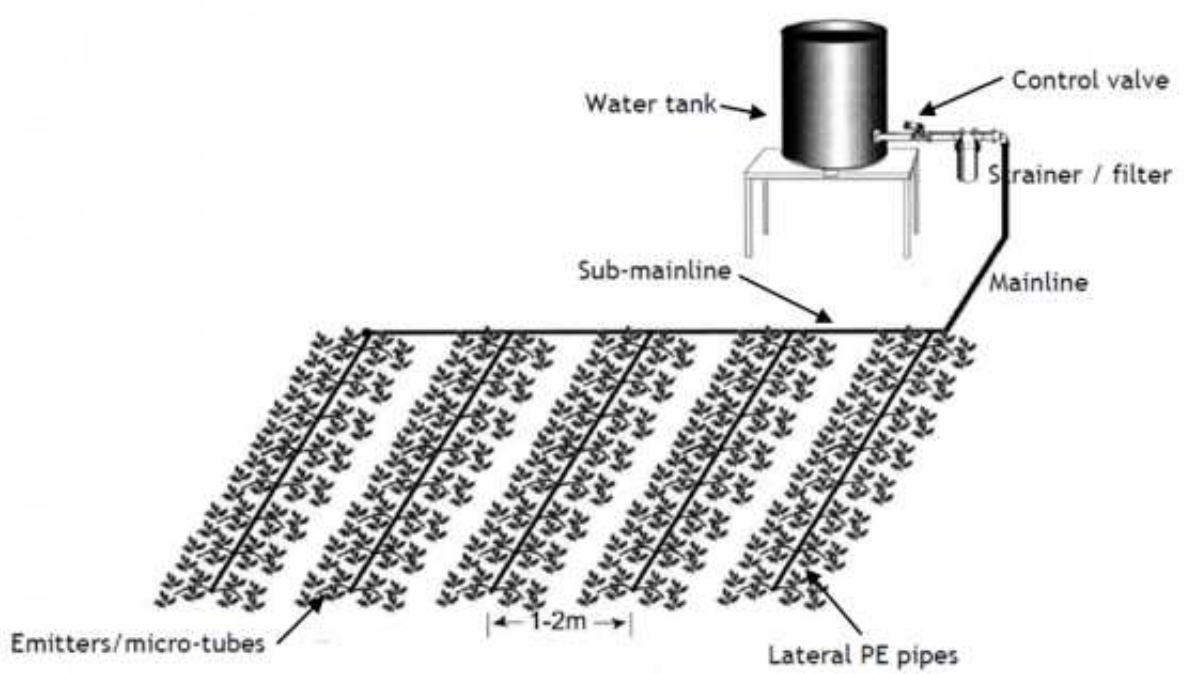
A self-made irrigation system in Africa with a bucket as a water reservoir and simple plastic hoses for the distribution. If bamboo is available, it can be used as distribution pipes. Source: STANDISH (2009) and INFONET-BIOVISION (2010)

For a relatively low initial investment a small-scale farmer can buy and set up a drip-irrigation system. If used to grow crops for market, this investment will pay itself within the first season and lead to increased household food production, especially during extended dry periods (INFONET-BIOVISION 2010). Apply correct design (that might need training of the farmers), very simple drip systems can be built with local available material. Using buckets or barrels as water reservoir and bamboo or PVC tubes as distribution pipes, everyone can construct a very efficient irrigation system. If wastewater is used, a filtration unit after the treatment plant is recommended to avoid clogging of the emitters. Read more about simple manual irrigation methods here.

Design of a Simple Drip Irrigation System

A simple drip can consist of a 20 litre bucket with 30 metres (100 feet) of hose or drip tape connected to the bottom of the tank. The bucket is placed at least 1 metre (3 feet) above the ground so that gravity provides sufficient water pressure to ensure even watering for the entire crop. Clean water is poured into the bucket daily through a filter/ strainer. The water in the bucket fills the drip tape and is evenly distributed to 100

watering points. A multi-chambered plastic drip tape is engineered to dispense water through openings spaced at 30cm (12 inches). The bucket kit is the smallest type of drip irrigation technique (Adapted from RCSD 2008). A filter after the control valve can be installed, to prevent blockages (e.g. a screen) or an even more developed filter to improve the water quality.



Schematic design of a low-cost drip irrigation system. Source: (RCSD 2008)

Costs considerations

As already mentioned, commercial systems for industrial production are very expensive. Small scale farmers can buy a drip irrigation system for relatively low initial costs (US$15 to $85) or construct it with local available material (buckets, bamboo or plastic pips)(INFONET-BIOVISION 2010). In general, it is more costly than manual irrigation, but has improved yields and decreased water/ operating costs.

Operation and Maintenance

For perennial crops, the drip hose should be lifted periodically if a drip hose system is used on the soil surface, so that leaves, soil, and debris do not cover the hose. If the drip hose is not lifted, roots can grow over the hose, anchor it to the ground, and eventually pinch off the flow of water. Leaks can occur unexpectedly as a result of damage by insects, animals, or farming tools. Systematically monitor the lines for physical damage. It is important to fix holes as soon as possible to prevent uneven irrigation. If the rate of water flow progressively declines during the season, the tubes or tape may be slowly plugging, resulting in severe damage to the crop. Once a month, flush the drip lines by opening the far ends of a portion of the tubes at a time and allowing the higher velocity water to flush out the sediment (INFONET-BIOVISION 2010). If poorly treated wastewater is used, soil quality can be degraded over time (e.g. accumulation of salts) (TILLEY at al. 2008).

Health Aspects

(Adapted from TILLEY et al. 2008)

If wastewater is used for the irrigation process, there are potential health risks if water is not properly pre-treated (i.e. inadequate pathogen reduction). If poorly treated wastewater is applied. Appropriate pre-treatment should precede any irrigation scheme to limit health risks to those who come in contact with the water. As well, depending on the degree of treatment that the effluent has undergone, it may be contaminated with the different chemicals that are discharged into the system. When effluent is used for irrigation, households and industries connected to the system should be made aware of the products that are and are not appropriate for discharging into the system. Drip irrigation is the only type of irrigation that should be used with edible crops, and even then, care should be taken to prevent workers and harvested

crops from coming in contact with the treated effluent. Despite safety concerns, irrigation with effluent is an effective way to recycle nutrients and water (see also waterborne diseases pathogens and contaminants).

At a Glance

Working Principle	With drip irrigation, water is conveyed under pressure through a pipe system to the fields, where it drips slowly onto the soil through emitters or drippers, which are located close to the plants.
Capacity/Adequacy	It is applicable to almost every crop prediction, especially in arid, dry areas.
Performance	High
Costs	Commercial system for industrial production is very expensive. Small-scale or self-made systems are inexpensive
Self-help Compatibility	Expert design is required for commercial systems. Small-scale drip systems can be operated by trained farmers.
O&M	Flush piping system once a month to prevent clogging and check if the pipes are not covered by soil/foliage or damaged.
Reliability	Very reliable if operated and maintained well.
Main strength	High water application efficiency.
Main weakness	Water must be well settled and particle-free because of the high risk of clogging.

Applicability

Generally, drip irrigation is the most appropriate irrigation method; it is especially good for arid and drought prone areas. Drip and subsurface drip irrigation is used almost exclusively when using recycled municipal wastewater. Regulations typically do not permit spraying water through the air that has not been fully treated to potable water standards (WIKIPEDIA 2011). Furthermore, this system can be very technical for industrial crop production but also a simple small-scale irrigation method, which farmers can construct by themselves.

Advantages

- High water application efficiency and lower labour costs
- Minimised fertiliser/nutrient loss due to localised application and reduced leaching
- Ability to irrigate irregular shaped fields. Levelling of the field not necessary
- Allows safe use of recycled (waste-) water
- Moisture within the root zone can be maintained at field capacity and minimised soil erosion
- Soil type plays less important role in frequency of irrigation
- Highly uniform distribution of water i.e., controlled by output of each nozzle
- Usually operated at lower pressure than other types of pressurised irrigation, reducing energy costs

Disadvantages

- Expensive initial cost can be more than overhead systems (commercial system)
- The sun can affect the tubes used for drip irrigation, shortening their usable life
- If the water is not properly filtered and the equipment not properly maintained, it can result in clogging
- Drip irrigation might be unsatisfactory if herbicides or top dressed fertilisers need sprinkler irrigation for activation
- Waste of water, time & harvest, if not installed properly
- Systems require careful study of all the relevant factors like land topography, soil, water, crop and agro-climatic conditions, and suitability of drip irrigation system and its components
- Without sufficient leaching (most drip systems are designed for high efficiency, meaning little or

no leaching fraction), salts applied with the irrigation water may build up in the root zone

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See document in FRENCH

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For further readings, case studies, awareness raising material, training material, important weblinks or the related powerpoint presentation, see www.sswm.info/category/implementation-tools/water-use/hardware/optimisation-water-use-agriculture/drip-irrigation