C R O P S E R I E S

# IRRIGATION

## Microirrigation for Orchard and Row Crops no. 4.703

*by I. Broner* [1]

### Quick Facts...

Microirrigation is a low pressure, low volume irrigation system suitable for high-return value crops like fruit and vegetables.

If managed properly, micro-irrigation can increase yields and decrease water, fertilizer and labor requirements.

Microirrigation applies the water only to the plant's root zone and saves water because of the high application efficiency and high water distribution uniformity.

Any water-soluble fertilizer may be injected through a micro-irrigation system.

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Microirrigation is a system that operates under low pressure with small-sized wetting patterns and low discharges. Microirrigation systems can apply water and fertilizer directly to individual plants or trees, reducing the wetted area by wetting only a fraction of the soil surface; thus, water is applied directly to the root zone. Some microirrigation systems are capable of wetting only a fraction of the root zone while supplying adequate water to satisfy crop water requirements.

Microirrigation has gained attention during recent years because of its potential to increase yields and decrease water, fertilizer, and labor requirements if managed properly.

Microirrigation systems include low pressure, low volume irrigation systems and can be subdivided into four main methods according to pressure and volume (Table 1). Drip irrigation applies water directly to the soil surface or subsurface and allows the water to dissipate under low pressure in a predetermined pattern. A wetted profile develops in the plant's root zone beneath each dripper. The shape depends on soil characteristics, but often it is onion-shaped as shown in Figure 1. Ideally, the area between rows or individual plants remains dry and receives moisture only from incidental rainfall.

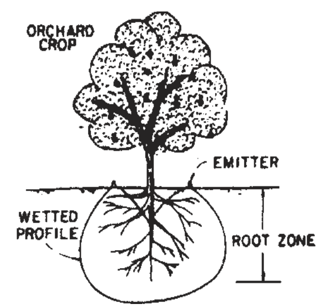


Figure 1: A wetted profile develops in a root zone below each "dripper."

The other three methods that convey water through the air can be termed microsprinkler systems. However, because of the low pressure and low volume, the wetted diameter is relatively small. The emitters are small and usually placed on short risers. Consequently, the water droplet has a short distance to travel before it reaches the soil surface. The wetted area of these emitters is small, can be controlled fairly easily, and has different shapes to match the desired distribution patterns.

The advantages of microsprinkler irrigation systems are the potential for controlling frost, greater flexibility in applying water, and lower susceptibility to clogging. The advantages of drip systems are that the water is applied directly to the soil in a smaller wetted area reducing evaporation and water consumption by weeds while operating at a lower pressure. Fertilizer injection can be done with both systems; however, with drip systems, placement of fertilizer is more accurate. Weed and pest control cannot be accomplished with drip irrigation systems.

Microirrigation systems apply water on a high-frequency basis and create a near optimal soil moisture environment for the crop. Under proper

**Table 1: Characteristics of various microirrigation systems.**

| | Pressure PSI | Volume gal/hr |
|---|---|---|
| Drip | 15 | 0.5 - 2 |
| Misters | 15 | 2.0 - 5 |
| Sprayers | 25 | 5.0 - 20 |
| Mini-sprayers | 25-35 | 10 - 50 |

management, microirrigation saves water because only the plant's root zone is supplied with water and little, if any, is lost to deep percolation, consumption by nonbeneficial plants, or soil surface evaporation. Some movement of moisture below the crop roots is necessary to prevent excessive salt buildup in the root zone.

Microirrigation systems are useful and suitable for sloping or irregularly-shaped pieces of land that are impossible to flood or sprinkler irrigate. A relatively small elevation drop is enough to operate a microirrigation system on gravity pressure.

## System Layout and Equipment

Microirrigation systems consist of a system "head" and a distribution network. A pump, filter, flow meter, pressure gauges, fertilizer injector, pressure regulator, and controller generally make up a system head (Figure 2). The flow meter and fertilizer injector are optional equipment but highly desirable. A controller is necessary only if the system is automated.

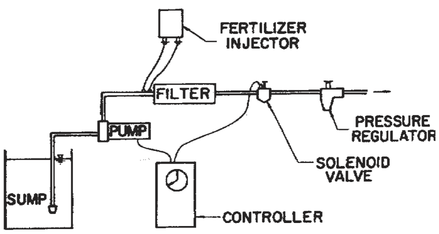


Figure 2: Typical trickle system "head."

The distribution network consists of pipes usually made of polyethylene (PE), pipe fittings, drippers or emitters, and valves. Valves are actuated electrically by a solenoid in the case of an automated system.

Filtration is a must in microirrigation systems because of the narrow passages of the drippers and emitters. Two basic types of filters are graduated sand filters and screen filters. At least one stage of filtration is needed for microirrigation systems. Drip irrigation systems usually require more filtration than microsprinklers. If the water source is surface water (ditch, reservoir), both filtration stages should be used. The required screen size or sand filter size is determined by the type, size, and concentration of contaminants in the water source, required quality of filtered water, flow rate, and cost analysis.

The type of drippers or emitters also affects the level of required filtration. The bigger the passages of the dripper/emitter, the less filtration needed. Filters require periodic backflushing depending on the amount of contamination in the water. Backflushing can be done manually or automatically.

Any water-soluble fertilizer may be injected through a microirrigation system. A pressure differential can be used to cause flow through a tank as shown in Figure 2, or a nutrient metering pump can be used to carefully control fertilizer application. In either case, inject fertilizer in advance of the filter to remove undissolved chemicals.

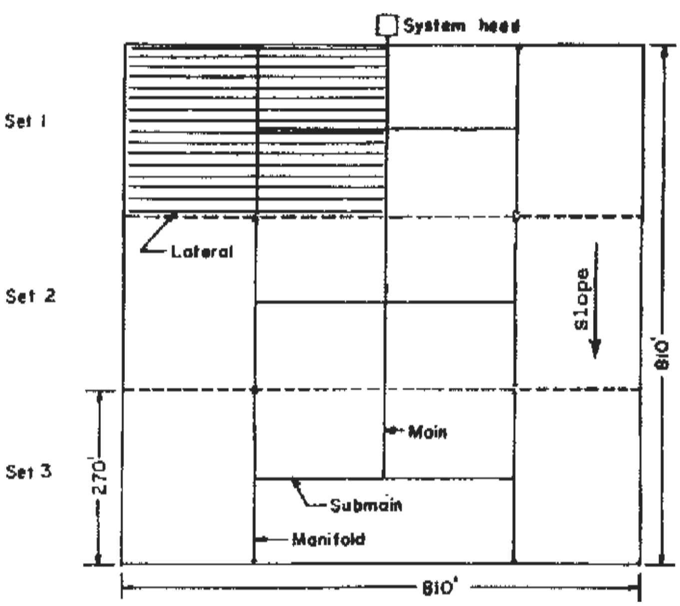


Figure 3: A typical 15-acre (6-hectare) system layout showing various system components.

Microirrigation systems operate at relatively low pressure compared to sprinkler irrigation. For this reason, pumping costs are substantially less than sprinkler systems. A pressure regulator is used to control the lateral line pressure. Multiple pressure regulators may be desirable for locations with large elevation changes. However, if pressure-compensated drippers/emitters are used, less pressure regulation at the laterals is needed.

Small diameter polyethylene pipe generally is used for the system laterals that are laid on the soil surface along each row or are buried to facilitate tillage operations. The lateral is connected to a manifold that is supplied with water through a submain and main. A typical 15-acre layout is illustrated in Figure 3. Manifolds, submains and mains usually are buried.

The purpose of the lateral is to supply water to drippers or emitters located at each tree or along plant rows. In orchards, one emitter may be adequate for newly planted trees with additional emitters added as the trees mature. However, the lateral should be sized for the maximum water application.

The dripper causes a large pressure drop so that a small flow of water is able to pass through. A microsprinkler uses the pressure to spray water over a larger area. The discharge of a particular dripper/emitter is primarily dependent on lateral pressure and the type of emitter or dripper.

Different types of drippers and microsprinkler emitters are available and vary in purpose and cost. In-line drippers are suitable for densely planted row crops while on-line drippers are more suitable for tree crops or sparsely planted row crops. Pressure-compensated drippers or emitters are suitable for sloping terrain where they allow extension of laterals and save on pressure regulators. Misters and microsprinklers often are used in greenhouses to increase humidity. Sprayer microsprinklers are used for light applications of water and controlled shapes of wetted area, while microsprinklers are used to apply larger volumes under relatively low pressure and to cover larger areas. In addition to frost control, mini-sprinklers and sprayers are used for evaporative cooling in western Colorado to reduce sunburn to apples.

The necessary initial investment will vary due to water source, water quality, filtration requirements, emitter choice, crop type, soil characteristics and degree of automation. A manual system could range in price from $800 to $1,200 per acre, and an automated system could range from $900 to $1,500 per acre. This includes installation costs.

## System Management

Microirrigation systems offer flexibility in water management. One of the main advantages of microirrigation systems is the ability to apply frequent light irrigations. Different water management methods are described in fact sheet 4.708, *Irrigation Scheduling*. However, because microirrigation systems can apply water daily, it is desirable to use the water balance approach. This involves calculating the daily water use by the crop (ET) and replenishing it on a daily basis. The water balance approach is described in 4.707, *Irrigation Scheduling: The Water Balance Approach.* The crop (ET) concept is described in 4.715, *Crop Water Use and Growth Stages.*

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