IRRIGATION

Micro Sprinkler Irrigation for Orchards

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Quick Facts…

Micro irrigation is a low pressure, low volume irrigation system suitable for high value crops such as fruit trees.

When correctly managed, micro-sprinkler irrigation can increase yields and decrease water, fertilizer and labor requirements over flood irrigation.

Micro sprinkler irrigation has great potential to increase application efficiency and enhance water distribution uniformity. Micro sprinkler irrigation can increase irrigation efficiency by approximately 30 percent versus furrow irrigation.

Micro sprinkler irrigation has gained attention during recent years because of its potential to increase yields and decrease water use, fertilizer, and labor requirements. Micro sprinkler irrigation applies water directly to the soil surface area allowing water to dissipate under low pressure in a wetted profile that uniformly meets water demand throughout the orchard block. Compared to gated pipe/furrow irrigation, water use on orchards with micro sprinklers is typically 30 percent less, and as much as 50 percent less.

Some of the additional advantages of micro sprinkler irrigation systems are: the potential for controlling frost, greater control over water application, and lower susceptibility to clogging due to larger orifice sizes when compared to drip systems. Orchard micro sprinkler irrigation systems also operate under low pressure (typically 20 to 35 psi) with small-sized wetting patterns (10 to 30 ft) and a variety of discharge flows (8 to 90 gph) matched to fit orchard size, tree maturity and spacing.

System Layout and Equipment

Micro irrigation systems consist of a system "head" and a distribution network. A pump, filter, flow meter (optional), pressure gauge, fertilizer injector (optional), pressure regulator, and controller (optional for manual systems) generally make up a system head (Figure 1). The flow meter and acid injector are optional equipment but highly desirable because they help monitor system performance (flow meter) and add flexibility to the system (injector). The distribution network consists of pipes usually made of polyethylene (PE), pipe fittings, sprinklers, and valves. Valves can be actuated electrically by a controller connected to a solenoid valve in the case of an automated system or manually.

When sediment can be found in irrigation, water filtration is essential for protecting sprinkler nozzles. Two basic types of filters are graduated sand filters and screen filters. At least one stage of filtration is needed for micro irrigation systems, though micro irrigation sprinkler systems usually require less filtration than drip irrigation systems. The required screen size or sand filter size is determined by the sprinkler type, orifice size, and amount of contaminants in the water source. Sprinkler manufacturers specify minimum mesh size or filtration needed for each of their particular sprinklers. The type of sprinkler used affects the level of required filtration. The bigger the orifice of the sprinkler, the less filtration is needed. Filters require periodic back flushing to remove contaminants from the filter system, back flushing intervals depend on the amount of contaminates in the water source. Back flushing can be done manually, however most new filter systems incorporate an automatic back flush feature that can reduce labor substantially, especially early in the growing season when surface water typically has heavy sediment loads from winter runoff.

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Micro sprinkler irrigation systems operate at relatively low pressure compared to large sprinkler irrigation systems (e.g. handset sprinklers). For this reason, pumping costs are substantially less. A pressure regulator is used to control the line pressure as sprinklers have a maximum operating pressure for optimal efficiency. Multiple pressure regulators may be desirable for locations with large elevation changes, with pressure reduction occurring as elevation drops. Small diameter polyethylene pipe (1/2 to 1 inch) is generally used for the in-row laterals that are laid on the soil surface (risers) or suspended on wire in the tree row (drop down). Irrigation lines are buried between rows to facilitate tractor operations. The lateral is connected to a manifold that is supplied with water through a main and/or sub-main connection. Manifolds, submains and mains are usually buried with control valves above ground.

The purpose of the lateral is to supply water to sprinklers located in the tree row and the lateral should be sized for the maximum flow--rate of water application. Sprinklers are chosen for flow rate at the tree but are dependent on lateral pressure to perform correctly. Sprinkler manufacturers specify minimum and maximum pressure ranges to maximize system efficiency for each sprinkler head. Once sprinklers are selected and installed, lateral pressure is controlled by a pressure regulator valve to match sprinkler size and capacity. It is important that all sprinklers being fed from a common lateral are selected for the same pressure.

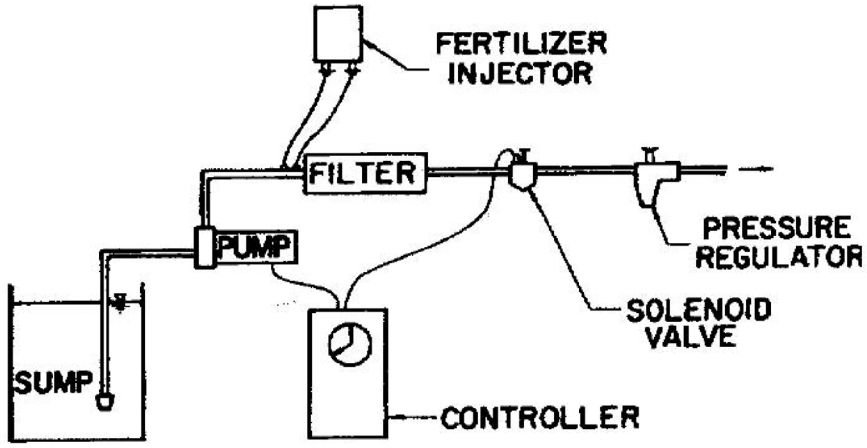

Figure 1: Typical micro sprinkler irrigation system “head.”

There are a wide range of micro sprinkler sizes and types available that vary in irrigated diameter size, and cost. Information can be found on irrigation equipment or irrigation manufacturer or irrigation sales company websites. The necessary initial investment will vary due to water source, water quality, filtration requirements, sprinkler size, tree type and spacing, soil texture and degree of automation. In general, the more automation the higher the costs. The operating cost of micro-irrigation systems varies widely depending on acreage, filter requirements, pump sizes and required water output needed to irrigate orchard blocks. Your local irrigation company, Conservation District or Natural Resource Conservation Service office can help design and size the correct micro-irrigation system for your new orchard blocks.

When converting old or existing orchards from furrow irrigation to micro sprinklers it is best to do so when new trees are planted. The root zone shape and size of older, furrow irrigated trees is generally very different from micro sprinkler wetting patterns and conversion with established trees from furrow to sprinkler could result in reduced orchard production or even loss of trees. Your local orchard expert or Extension office should be consulted before attempting to convert established furrow irrigated orchards from furrow irrigation to micro-sprinkler irrigation.

System Management

Micro sprinkler irrigation can be configured in one of two ways, with either drop down sprinklers from suspended irrigation lines or riser mounted from surface irrigation lines. Both methods connect sprinklers to in-row surface irrigation lines with 'spaghetti' tubing. Drop down sprinklers allow for mowing between trees since no moving of sprinklers is required to mow, unlike with riser mounted sprinklers. Micro irrigation systems are also useful and suitable for sloping or irregularly shaped pieces of land that are otherwise impractical to furrow irrigate.

Micro sprinkler systems usually have a sprinkler between every other tree and are staggered (offset by one tree) in adjoining tree rows to maximize irrigation coverage and efficiency, and minimize costs. The size of the sprinkler emitter, or orifice, determines application rate and pressure. Maximum application rates are in turn dependent on soil characteristics and soil texture so as not to apply water at a faster rate than the soil can absorb in a given time. When irrigation water contains sediment, typically ditch or reservoir water, micro sprinkler systems usually make use of an in-line filter system to prevent emitter clogging.

Micro irrigation systems can apply water on a short-set, high-frequency basis, providing a more consistent and optimal soil moisture environment for trees. Soil moisture monitoring devices, such as composite gypsum blocks or Watermark™ sensors, can help improve overall irrigation system performance by allowing irrigators to monitor and manage soil moisture more conveniently and accurately. Consult with your local Extension office for guidance on reading soil moisture sensors for your soil type; typically maximum soil moisture depletion for fruit trees is 30 to 40 kPa[2] of soil vacuum during flowering and 50 to 60 kPa post flowering. Where uninterrupted water delivery is available, micro-sprinkler systems can be setup to operate irrigations automatically, triggered by the same soil moisture monitoring devices.

Since micro- sprinkler irrigation systems apply water in a manner that can be very precise at meeting your crops water needs, it is recommended that irrigators practice water balance approach regardless of irrigation frequency. The water balance approach involves calculating the daily water use by the crop (ET) and replenishing it on an as needed basis depending on soil water holding capacity and the orchard's age and rooting depth. Even if soil moisture sensors are in place, the water balance approach is a good tool for monitoring the health of the orchard and the accuracy of sensors. The water balance approach is described in Extension fact sheet 4.707, *Irrigation Scheduling: The Water Balance Approach.* The crop (ET) concept is described in fact sheet 4.715, *Crop Water Use and Growth Stages.* Different water management methods are also described in fact sheet 4.708, *Irrigation Scheduling*.

Soil and Water Quality

If your orchard has been diagnosed with high salt levels, this can be mitigated by applying a leaching fraction i.e. extended irrigation, to trees, pushing salts below the root zone. Irrigation water with high pH impairs trees' ability to absorb key micro-nutrients such as iron but can be neutralized by the injection of acids into the irrigation water. In high salinity areas such as Palisade, there may also be cost-sharing money available to install a micro-sprinkler irrigation system (consult with your local NRCS or Conservation District staff). More on irrigation water quality is described in Extension fact sheet 0.506, *Irrigation Water Quality Criteria* and on salinity in Extension fact sheet 0.521, *Diagnosing Saline and Sodic Soil Problems.*

[2] *1 kilopascal (kPa) = 1 centi-bar (cbar)* ≅ 0.145 pounds-per-square inch (psi) ≅ 0.01 atmospheres (atm)

Fertilizer injection or "fertigation" is also possible with micro-sprinklers but is highly dependent on soil type and if cover crops are already providing some of the tree nutrients. Cover crops grown in the orchard alleyways have the potential to reduce erosion and supply much of the orchard's required fertility.

Healthy soil and good water quality is an integral part of successful micro-sprinkler irrigation management. Soil and water testing is the best tool for determining if there are salinity, pH or nutrient problems present in your orchard's soil or irrigation water. For more information on soil and water testing refer to Extension fact sheet 0.520, *Selecting an Analytical Laboratory.*

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