# MICRO IRRIGATION SYSTEMS



## INTRODUCTION

Sprinkler and drip systems have sometimes been categorized as pressurized systems, closed systems, or mechanical systems. Instead of distributing water over a field by allowing it to flow freely across graded land, the water is piped to specific locations and then sprayed or dripped onto the field. In contrast to flood irrigation system types (furrow, border, level basins), the amount of water soaking into the soil with a pressurized system (field sprinklers, drip, spitter, over/under tree sprinklers) depends on two different factors . . .

- The set time.
- The application rate of the system, assuming that the application rate of the system is less than the infiltration rate of the soil.

The system application rate is a measure of how fast water is being applied to the soil. For micro-irrigation systems it is usually measured as a volume of water applied per hour (gallons/hour). With pressurized systems you should know the application rate of the system. This is how fast water is being applied. Then, also knowing the soil moisture depletion, it is a simple matter to calculate required set times.

The soil's infiltration rate, IR, is a measure of how fast water is soaking into the soil. Infiltration rates are described in terms of inches/hour. The application rate for the system (gallons/hour) must be divided by the wetted surface area to determine the infiltration rate for a micro system to make the comparison to the soil infiltration rate.

Runoff with micro-irrigation systems may be due to an excessive application rate. Many times it is due to surface sealing due to chemical reactions or an algae buildup. Chemical amendments are often necessary with micro systems because of the slow, frequent nature of water applications.

With sprinklers and drip systems, the keys to distribution uniformity are pressure uniformity and device uniformity. Pressures in the system should not vary more than 20 percent. Because of energy and water economics, many engineers are shooting for 10 percent variance. Always have your systems designed and laid out by qualified engineers.

For trickle systems, each plant should have the same emitter configuration. That is, you may put more than one type of emitter in the field as long as each plant as one of each. Also, all emitters should have about the same operating pressure range.

In micro-irrigation systems there is generally no overlap. The important uniformity considerations are pressure and device.

Device uniformity is especially important with micro-irrigation systems because of the small flows and small passages. Correct filtration, chemical treatment, and periodic line flushing are essential for keeping micro-irrigation systems clean.

Also, make sure all devices are the same. Many times, especially with trickle systems in orchards, emitters are added as the trees mature. Don't make the mistake of adding different types of emitters unless the recommended operating pressure ranges are similar.

Install pressure gauges or pressure taps (Schraeder valves work well if shielded) at the head of any pipe with pressure controls. Make sure all personnel know the correct operating pressure.

Preventive maintenance is a must with drip, spitter, and micro-sprinkler systems. Make sure that the level of filtration is matched to the flow, water quality, and device type. Make sure your designer/installer knows when to use sand separators, media tanks, and screen filters. Flush the filters as directed. Use chemical treatments as needed to prevent algae growth.

Once a micro system is clogged it is usually very expensive to unclog it. And, you run the risk of loosing all or part of your crop as well as a significant portion of your capital investment.

See this link to another site for a list of pros and cons for drip irrigation systems.

## CONTROLLING TOTAL APPLICATIONS WITH DRIP SYSTEMS

Since the total field is covered with field sprinkler systems the application rate can be compared to the soil moisture depletion to determine how long to run the system. With trickle, micro-sprinkler, or spitter systems all the field is not covered.

Also, these systems are operated frequently. Many times the gallons per hour per tree/vine of the system design is compared to the daily water use of the crop (evapotranspiration, ETc) to determine required set times. The equation to convert daily ET to hours of system operation is as follows . . .

HR = ETc * AREA / (GPH * AE * 1.605)

where:
HR = daily hours of system operation
ETc = daily crop water use in inches/day
GPH = total flow to each plant in gallons per hour
AE = system efficiency as a decimal, 0 - 1.0

For example, there is a grape vineyard with two 1-gallon per hour emitters per vine. The vines are spaced 8 by 12. The estimated system efficiency is 80 percent (.8 as a decimal) and the current daily crop water use is estimated at .25 inches/day. Then . . .

HR = ETc * AREA / (GPH * AE * 1.605)

HR = .25 * (8 * 12) / (2 * .8 * 1.605)

HR = 9 hours of operation per day

With high frequency systems you should be using a soil moisture measuring device such as a tensiometer or gypsum blocks. Watch the trend in moisture measurements. If the trend is towards higher readings, increase the daily system operating time--if lower, decrease. Refer to the "Irrigation Scheduling" section of this handbook for more on planning irrigations.

You can use the same equation with "drip-tape" systems. Assume you have a drip-tape system on fresh tomatoes with a bed spacing of 60 inches (five feet). The tape is rated at 12 gallons/hour per 100 feet of tape. The crop is using water at the rate of .25 inches/day (ETc = .25 in/day). With an 80 percent efficiency . . .

HR = ETc * AREA / (GPH * AE * 1.605)

HR = .25 * (5 * 100) / (12 * .8 * 1.605)

HR = 8 hours of operation per day

## MICRO-SYSTEM EVALUATIONS AND TYPICAL RECOMMENDATIONS

Many of the recommendations on the sprinkler system pertain to micro irrigation systems also.

Explaining them as they are applied to micro-irrigation . . .

- 1. Replace gaskets on the lateral/main pipes - Many micro systems use underground piping. However, some portable drip tape systems will use surface transfer or "layflat" tubing. Pipe leakage in fields can be significant and easy to fix. Leakage reduces the irrigation efficiency. It can also lead to poor pressure uniformity in the field.
- 2. The gross application is much greater than the net required - As previously seen, each system configuration applies water at a specific application rate. This application rate should be compared to the soil moisture depletion at irrigation to determine the set time. With high frequency micro irrigation systems, it is best to balance set times with daily ETc's. Refer to the previous example on preplanning an irrigation. Excessive set times result in excessive deep percolation and/or surface runoff.
- 3. The flow rate through a valve opener is too high resulting in excess head loss - This may be applicable to field drip-tape systems and may or may not lead to poor field pressure uniformity. It is certainly costing you money as the head loss is energy that you paid for (through pump and power costs) and did not use.
- 4. Need for more laterals - Micro irrigation systems should only be designed and installed by qualified engineers. Because of the piping, filtration, and pump expense, they will design a system with sufficient but not excessive capacity. A poorly designed system with insufficient capacity is usually difficult and expensive to retrofit.
- 5. There is runoff from the field - If there is runoff with a micro system it usually means there is a sealing over of the surface soil due to chemical interactions. Investigate the need for chemical amendments.

For Flow Rate Uniformity (these comments address pressure and device uniformity at the same time) . . .

- 1. Two or more different nozzle (emitter) sizes in the field - During routine system maintenance, or additions to a system on a growing orchard/vineyard, different types of emitters may be installed in the same field. This is not bad if the emitters are supposed to work at the same pressures and the addition is even. That is, one emitter of type A and one of type B per plant, not two type A's on one plant and two type B's on another.
- 2. Sand wear in the nozzles (emitters) - This reduces flow uniformity because the emitters may not wear at the same rate. Plugging may be catastrophic to the plant. If sand wear or plugging is a constant problem check to make sure that your filtration system is sufficient.

- 3. Poor pressure uniformity - Poor pressure uniformity can be fixed in a number of ways. It is very expensive to switch underground piping. It may be a matter of installing/resetting pressure regulators in the system and/or using a different pump. It is always best to consult a qualified agricultural engineer for a micro irrigation system design and installation.
- 4. Plugged nozzles (emitters) - This is an obvious problem. Make sure that the filter system is matched to the water quality/emitter type combination.

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Further reading, FAO Irrigation Methods, IWTM 5 (http://www.fao.org/docrep/S8684E/s8684e00.htm), NRCS Irrigation Water Management, (ftp://ftp-nhq.sc.egov.usda.gov/NHQ /pub/outgoing/jbernard/CED-Directives/neh-2of2/neh15/neh-15.htm) National Engineering Handbook. See the following link for information of selecting an irrigation method --a large download--(http://www.wcc.nrcs.usda.gov/nrcsirrig/irrig-handbooks-part652-chapter5.html) National Engineering Handbook, Part 652.