IRROMETERS IN MICRO-IRRIGATION

IRROMETERS are used with all methods of irrigation with very beneficial results to growers. However, in micro-irrigation they are absolutely essential if a grower expects to optimize his irrigation system to achieve full benefits and avoid problems. There are some special considerations which need to be taken into account when using IRROMETERS in conjunction with this method of irrigation.

Why are IRROMETERS so important in micro-irrigation?

To understand the answer to this question you must realize the basic "what" and "why" of micro-irrigation. The objective is to continuously supply each plant with readily available moisture to meet evapo-transpiration as it occurs, and to replace the moisture claimed by this process from the soil reservoir shortly after it has occurred. It is accomplished by supplying filtered water in frequent, slow applications through mechanical devices known as emitters, drippers, micro-sprinklers or sprays. One of the major problems faced in micro-irrigation is poor soil water distribution because a smaller surface area is often wetted. Distribution of the water into the effective crop root zone is dependent, to a large extent, on the soil and its ability to transmit water laterally. The lighter the soil, the bigger the problem. A designer must not only keep in mind the fact that the engineering may have to provide for future addition of more emission devices in permanent crops but that the number and placement of these must match the ability of the soil to move water laterally into the effective root zone desired. Roots will not grow into dry soil! In climates where seasonal rainfall causes extensive root development of tree crops, such as citrus in Florida or California, it must be recognized that the micro system must be capable of replacing soil water in the entire root system thus developed. During drought periods, trees can suffer stress if the entire root system is not adequately supplied with water.

In certain areas where salinity is a factor, the outward and down-ward wetting front serves to push salts away from the effective root zone. If this process is not continued, salts can readily move back into the root zone resulting in some rather severe cases of salt damage.

Another major fact about micro-irrigation is that the frequent, light applications of water are intended to keep the soil moisture reservoir at close to field capacity. You must optimize the amount of readily available water and this is accomplished by keeping things very close to field capacity.

So we have three basic facts to consider:

1. Lateral distribution of water in the soil.
2. Maintenance of soil moisture at or near field capacity.
3. Outward and downward movement of water to prevent salts

From accumulating in the root zone.

IRROMETERS are essential to monitor these key factors.

IRROMETERS to Monitor Water Distribution

IRROMETERS can effectively help you know if your system is accomplishing adequate distribution by their proper placement in areas where normal root development must take place. In tree crops, the most active roots will be located at or near the drip line of the tree so IRROMETERS must be located there. Also, the southwest side of the tree, in the Northern Hemisphere, receives the hot afternoon sun so this area would tend to be the quickest to dry. Thus the southwest side of the tree is the spot for the IRROMETERS. In row and vine crops, locate the instruments in the row between plants. A key factor to keep in mind on placement is that the sensing tips of the IRROMETERS must be in the area representatively wetted by the micro-irrigation system. With a true drip or trickle system, the emitter wets a very small surface area, with the subsurface moisture forming a "wetted onion" as the soil moves the water downward and outward. If the IRROMETER sensing tips are either too close or too far away from the emitter, you could be getting false readings on either the wet or dry side. What we suggest is that the instruments be placed 12"-18" from an

Emitter. In light soils, the “wetted onion” is more of a cone due to a lower lateral transmission of water in the soil. In this case you need to have instruments located 12”-14” from the emitter. In heavier soils, where lateral water transmission is better, locate instruments 16”-18” from the emitter. With micro sprinklers or sprays, a much larger surface area is wetted. Experience has shown that IRROMETERS be placed about 24”-36” from the micro sprinkler or spray. And, that no tree trunks or limbs interfere with the water pattern to the IRROMETER area. Of course, the basic rule still applies, and that is the instrument tips are in the active root system of the tree, vine or row crop.

Some growers, in addition to monitoring inside the “wetted onion”, have placed additional instruments to monitor the outside edge of this “wetted onion”. The idea here is that as water is depleted from the soil, this “wetted onion” begins to shrink, with the outside edge area giving an early warning from the increasing soil water suction readings on the IRROMETER.

With Subsurface Drip Irrigation (SDI), the water source could be 9”-18” below the soil surface, but you still may require adequate moisture to be maintained towards the soil surface in the most active portion of the crop root system. This upward movement of water can be monitored by placing IRROMETERS so the tips are closer to the soil surface.

With proper placement, as above, your IRROMETERS will allow you to accurately keep track of how the lateral movement of water is doing and can indicate how good the system is operating in terms of number and placement of emitters. You are looking for a nice continuous band of moisture down there in the soil in the plant, tree or vine row and IRROMETERS will help you accomplish this.

IRROMETERS to Maintain Field Capacity

This is probably the most important aspect of why IRROMETERS are so critical in micro-irrigation. In micro-irrigation, we really do not use the soil as a “reservoir” for water, as is the case with sprinkler and surface irrigation. The management objective is to never let the soil dry out very far beyond field capacity, which, in most soils, is somewhere in the 10-20 centibar range. We don’t want to keep the soil saturated at all times (below 10 cb), because this deprives the root system of its needed oxygen. But, if we let the soil dry out too much (i.e. 40-60 cb), we may never “catch up” with a micro system. At peak water use, usually the most critical time for the crop, we are near the upper threshold of the irrigation system capability in delivering water, unless the system has been grossly over designed.

Because the IRROMETER measures soil water suction directly, and because it is most accurate in the “wet” end of the soil water range (10-50 cb), it is by far the first choice in keeping track of available soil water in the “range” we are trying to maintain. Although our new WATERMARK sensor covers the 0-200 centibar area, the resolution of the readings in the 10-25 cb range is not as good as the IRROMETER. The WATERMARK however, among the many indirect methods of soil water measurement (gypsum blocks, neutron probes, etc.), is probably the closest in “tracking” an IRROMETER with accuracy. And it has many practical advantages in other situations.

But the major factor is this – there is no practical way of keeping track of soil moisture in the range we want to maintain, without doing soil moisture measurement. There is no way you can “feel” the difference between 10 and 25 centibars. This is why IRROMETERS are so important to good management of micro-irrigation.

New Model “LT” IRROMETER

For very coarse soils, or non-soil planting mixes, irrigation may have to be done in the 5-12 centibar range. For maximum precision, the new “LT” is worth considering. With a full scale of 0-40 centibars it is the ultimate in precision and the first of its kind. Some researchers in Florida, where there are a lot of very coarse soils, refer to the “LT” as the “Florida tensiometer”. Ask us for the product flyer (#55).

Automation of Micro Systems

The Model "RA" IRROMETER is gaining ever increasing use as growers learn the value of IRROMETERS and desire to automate their systems. Since micro systems are typically low volume you can use rather small valves (1"-3") to irrigate very large blocks. These valves are readily available with solenoid valves as their control. Most controllers, or time clocks, can be very simple But must be capable of being programmed with micro time (hours) rather than sprinkler time (minutes). In fact the Model "RA", without a controller, can be tied directly to the valve solenoid and can cause the valve to open and close based strictly on soil moisture conditions. However, controllers can be very valuable and in some cases essential, when there are several valves which must run sequentially due to the hydraulic design of the system. There are also new controllers on the market which can perform many other valuable functions such as fertilization cycles, emergency shut downs and keeping track of running time. However, the essence of using a controller, or timer, is that it gives you the opportunity to carefully control the length of running time on a given valve and thus putting the water at the exact depth desired. This is done by running short but repeated cycles and letting the IRROMETER permit as many of these cycles as needed to get the water to a specific depth.

Once that has been achieved, the IRROMETER prevents additional cycles not needed, even though they have been programmed.

The best way to use Model "RA" IRROMETERS in an automatic system is to wire them in to control individual valves rather than overriding the entire controller. Due to the fact that one valve could be irrigating 20-30 acres under a micro system, it is advisable to have more than one "location" of IRROMETERS to monitor the variables of soil type, topography and sun exposure as they may exist in that block. The instruments are wired in parallel, with "locations" wired in parallel, so that any single instrument which senses the need for water can call the system to run. Only needed irrigations will take place with unnecessary irrigations being eliminated.

When a controller or time clock, is used, it should be programmed so that the system has an "opportunity" to run every day. It is preferable to program station times to be short, but have the "opportunity" for repeats of these cycles. As an example, if it is necessary for a 6-hour run per day of a given valve to apply the peak consumptive use required, then you would program that valve to run for 2 hours at a time, but have an "opportunity" for this cycle to occur three times that day. Only the needed cycles would run since the IRROMETERS would override any cycle not needed. These shorter cycles also

Give water a chance to penetrate and move through the soil profile more efficiently. In some heavier soils, this "pulsing" method of micro irrigation systems has greatly aided in deeper penetration, where run off was occurring with longer cycles. One note of caution is in order when utilizing a controller. The controller resets itself every 24 hours and you can only control as much valve time as there are hours in a day. If your hydraulics dictate that only one valve can run at any given time the valves must run sequentially. If total time per valve per day had to allow for a maximum of eight hours of run time, you could only use three valves on that controller (8 hours x 3 valves = 24 hours).

Some very simple automatic systems have utilized a single valve with DC power to activate the valve solenoid. The IRROMETERS are wired in to interrupt the current to the valve. When the instrument calls for water, the IRROMETER switch closes allowing current to flow from the battery to the valve and the valve opens. Irrigation takes place until water penetrates to the sensing tip of the instrument calling for water, the switch opens and valve closes to terminate irrigation. One point here is that we need to know if you are going to use a DC current system, since our standard switch is AC. We can provide special DC switches when requested for battery controlled DC valves.

One final note of caution on our automatic switching type instruments (Model "RA", "LTA" and "TGA") is that our switch capacity is limited to 30 volts, 4 Amps. **DO NOT EXCEED THIS LIMITATION.**

Frequency of Monitoring Locations

The major variables which determine the number of monitoring locations are:

1. Soil Type
2. Topography
3. Sun Exposure

Remember that you are monitoring the soil moisture status for a given tree, vine or plant and using that as an "indictor" for a given area. Don't make a mistake by spreading your instruments over too large an area as this can do more harm than good. One extreme which can be cited would be some of the avocado plantings in North San Diego County in California. These situations have all the variables - soils, topography and sun exposure. In most cases, a monitoring location would be present every 1-2 acres in order to do an adequate job. Where soils are more uniform, topography level and sun exposure are the same, you could do nicely with a monitoring location every 10-15 acres. The point is this, don't skimp on such an important practice. It is far better to use a greater number of instruments on a smaller area and do a good job there, then add instruments and move locations as you begin to get a good control on this situation.

Typical Monitoring Location

It is important to note where in the root system a crop actually takes its moisture. The top 1/4 of the root system extracts 40% of the total moisture, second 1/4 extracts 30%, third 1/4 extracts 20% and the bottom 1/4 extracts 10%. Thus 70% of the total moisture is extracted in the upper 1/2 of the root system. It is for this reason that it is imperative to monitor soil moisture in at least two depths in the root horizon. The typical monitoring location with a micro system utilizes a 12" and 24" instrument, with a 36" additional setting for the deeper rooted tree and vine crops. With shallow rooted (<15") veg crops, one instrument 1/2 way down the root system is fine. In automatic systems, the 12" and 24" are the automatic Model "RA", with the 36" often being the manually read Model "R". Where a rising water table is a problem, the use of a 4' or 5' Model "R" can be helpful in keeping track of the water table, or in verifying that"leaching" type irrigation has driven any accumulated salts down below the active root system.

Fertigation

These days, most micro-irrigation systems are used to apply nutrients (principally nitrogen) in soluble form directly with irrigation events. We "spoon-feed" water and we "spoon-feed" nutrients. We can use the IRROMETER to keep track of our water, so why not measure our nutrients in the soil? We have a piece of technology here also - Model "SSAT" (Soil Solution Access Tube). Without going into further detail here, why not just ask us to send you the complete details on our Model "SSAT", if you feel this may be of interest in your operation.

Summary

Whether you automate or not, if you micro-irrigate, you really need to consider measuring your soil moisture if you expect to achieve top results from your irrigation system investment. Your "investment" in IRROMETERS is the least expensive insurance policy you could ever purchase.

The economics of your "investment" are rather simple ------- for example"

- 2 IRROMETERS every 10 Acres (Model "R")
- IRROMETER "life" of 5 years (Normal)

About $7.00/Ac./Year

IRROMETER IRRIGATION MANAGEMENT…….
TURNING WATER INTO PROFITS!!