Irrigation Management in the Imperial Valley

By
Alan Walters, AgriCast

I wrote a two-part article last year to describe the practical irrigation management system designed and manufactured by Automata. Part One (California Grower, April 2001) described the components of the Automata system: sensors, field stations, telemetry and software. Part Two (California Grower, May 2001) described how the system works using a weather station as the first example, then moved on to how valves, pumps, and a well can be controlled. This system is much more than a weather station!

Sure we use weather sensors where needed to feed data to various models such as evapotranspiration, degree-days, powdery mildew, pest models, frost warning, chilling hours, and so on. These models can be included or not depending upon the needs of a particular growing operation. However the inclusion of weather sensors is only incidental to the total capability of an Automata system for water management applications ranging from municipal water districts to farm irrigation. Remember, it is the same combination of sensors, field stations, telemetry and software that does all of this, not just one function exclusive of others.

Since my last articles, you have read in California Grower how Tom Stefanopoulos raises "4-bale" cotton using drip irrigation controlled by an Automata system, and how Tom Piper at Fetzer uses an Automata system for frost protection at the Manton and Hopland vineyards. So with this background, let's talk about a desert farm installation in the Imperial Valley, near Brawley, California; Jack Brothers, Inc.

Alex Jack is the managing partner of Jack Brothers. He is using Automata technology to conserve water, but more importantly, Alex is trying to lower his cost per unit, so he can stay ahead of global competition.

Jack Brothers operate a number of farms in the Imperial Valley. This particular farm of Jack Brothers consists of 230 acres, of which 90 acres is under micro sprinklers, irrigating various citrus crops. The balance of this ranch grows market onions, strawberries, romaine lettuce, honey dews melons, and cut flowers, all of which are irrigated with drip irrigation. A total of eight separate irrigation blocks, each controlled by a solenoid valve. Each solenoid controlled by a central computer, located 8.5 miles away, in Jack Brothers' main office in Brawley.

The communications challenge was to get a reliable radio signal from the east-side of Brawley, across buildings and treetops in town, then west to this Jack Brothers farm. To do this, we opted for five-watt UHF radios, operated on an assigned frequency, under license from the FCC instead of one-watt, license free spread spectrum radios. This wasn't a cost decision. Both are low cost radios to begin with; difference in cost between the two is negligible. It is simply a matter of choosing the best communication solution for the situation.

The base station uses a 40-foot high directional antenna. The field stations also use directional antennas, at about 20-foot above the ground. The overall result is exceptionally reliable communications between the base station computer and the field stations. Pictures of a typical field station installation are shown below. This location uses available AC power. The blow up to left shows the MINI enclosure housing the radio and processor board at top. Next is the

battery enclosure. A special housing for a 110/24VAC transformer and relay is located at the bottom of the stack.

	
Typical Field Station Installation	MINI with Battery and Relay Box

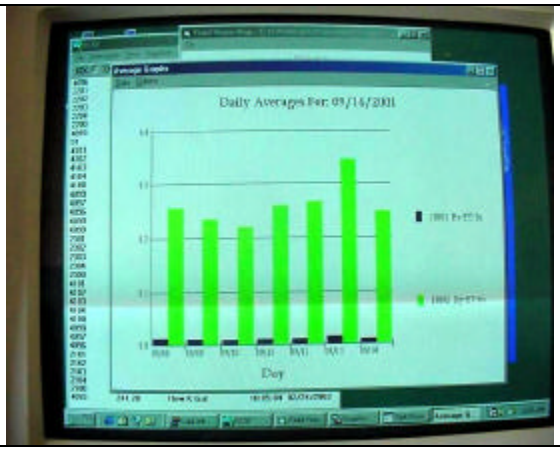
The Jack Brothers system was not installed all at once. The first installation included the software, the base station and four field stations. At the beginning, one field station was installed to control the boost pump, the fertilizer injector, monitor a flow meter reporting GPM and totaled flow from the canal, plus water pH. Three additional field stations were installed to control a solenoid-operated valve and monitor two soil moisture sensors in each of three blocks of citrus.

The next increment added four field stations for four blocks of rotational crops. Each field station controls an irrigation block valve, and reads two soil moisture sensors in each block. Additional booster pump capability was needed at this point. But we planned for this and configured the pump field station accordingly. When the second pump was installed, it was a simple matter to connect the spare control output to Pump Number 2-control relay. Software changes? Nothing more needed than a few clicks of the mouse to configure the software to include these new capabilities.

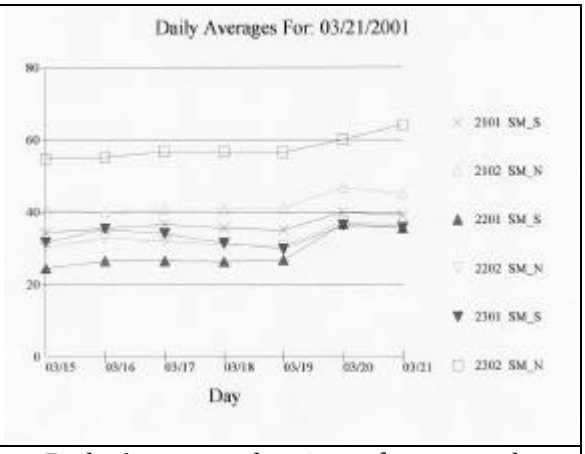
The last unit added to the system (now a total of eight field stations for the solenoid valves plus one for the pumps) is used control the solenoid valve to a field currently growing strawberries and read two soil moisture sensors in that field. More units are planned as more and more of this, and other farming locations are brought under drip irrigation. But here we see that one need not install an entire system at one time. Field stations and additional sensors may be installed incrementally as needed, at no cost penalty. In fact, as I pointed out in my May 2001 article, this is the most desirable way to proceed, because the grower has the opportunity to gain operating experience with a relatively simple installation.

Weather sensors? Yes, we have temperature, relative humidity, solar radiation and wind speed sensors installed at this farm to provide data inputs to the evapotranspiration model. The related field units collect these data and send the inputs to the central computer where the ET calculation is performed. At the same time however, you can see that these same field stations do much, much more. They collect soil moisture readings, salinity from the drain tiles, pH of the irrigation

water, and salinity of the pump back water, tabulating gallons per minute and total gallons applied from system and pump-back booster pumps. All the while reacting to valve on-off, booster pump on-off, and injector pump on-off commands controlled by the irrigation schedule.



Hourly and daily ET for one week



Daily Average soil moisture for one week

There are three important factors in using the system: 1) extensive farming experience, 2) data from the sensors, 3) and most important, a willingness to believe the data and make changes. Alex uses the Automata system to monitor ET at the farm and soil moisture sensors in each irrigation block. Observing the data, he has systematically moved away from long duration water applications during a week, toward shorter duration water applications each day of the week. Alex accomplished this change over time by making slow changes in the irrigation schedule, and then observing the affect of this change by watching average soil moisture levels over a period of weeks. Alex also learned to put different flow rate drip tape and micro sprinklers in different parts of the field, all due to being able to watch soil moisture readouts. These changes result in a better balance in the moisture to oxygen ratio at the root zone, which intern leads to better growth, less crop stress, and more production.

Can one do this without the ability to schedule the valves? Sorry, but I don't believe so. As you know, I think a system approach is necessary. It is one thing to use expensive three-level soil moisture sensors, and it is another thing to use the services of an irrigation schedule consultant. But, I think computer control of the irrigation valves is necessary if you wish to make full advantage of the costs involved. The similarity between your schedule and the time the irrigator actually turns valves on and off would be coincidental at best! Furthermore, I don't see how can anyone confidently correlate a manually controlled schedule change with results observed in the soil moisture data. Alex could do this because he was confident of the schedule and thus confident that the data changes he observed were a result of the changes he made in the schedule.

I mentioned in the introduction that Jack Brothers are saving water. How are they doing this? The "hot button" in the Imperial Valley is water conservation using reclaimed water. That is, the re-use of run-off tail water, and water from a drain tile system beneath a field. Alex Jack is leading the way with the Imperial Irrigation District (IID) to show that the use of reclaimed water is feasible in the Imperial Valley. He has added a lift pump to return water from a section of his drain tile system into the pressurized system immediately before his filters. We installed a flow meter and an EC sensor in this return line and connected the inputs to the same field station controlling the two booster pumps, the fertilizer injector and which reads the pH sensor. Now the same field station is used to control two pumps, one injector pump, read pH, flow rate and total

amount of unused water used from the canal, plus salinity, gallons per minute and total acre feet of tile water returned to the system.

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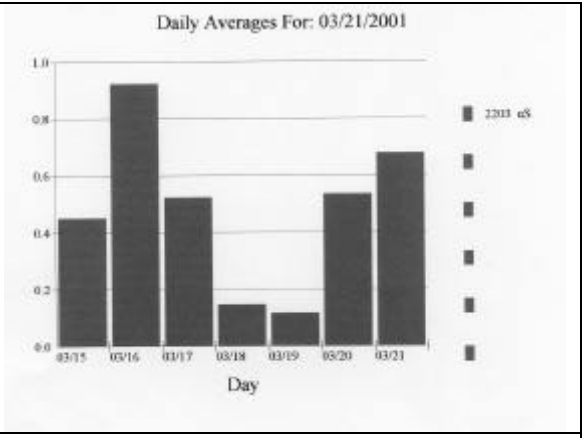
Pump back to canal and direct into filters



Salinity of drain tile water

In addition, the system now records the flow rate and total amount of tile water reused for irrigation (measured in acre feet), plus the salinity of the tile water from the tile system. With these data Alex can monitor the return water and pump directly back into the pressurized system or blend tile water with canal as needed. The result? A farmer trying to be on the leading edge of technology, maximizing production, and being environmentally friendly.

Alex Jack and Sharon Mousel from IID

Ron Owens monitoring conditions in the field

I occasionally hear some opine that farming by computer detracts from the hands-on attention required to raise top quality crops. Not so at Jack Brothers! Alex and his farm manger, Ron Owens, are so hands-on that both use laptops connected to a mobile base station installed in their pick-ups. This arrangement allows them to continually monitor growing conditions throughout the day while in the field. Watching hourly ET and soil moisture, plus inspecting crop foliage for any sign of stress (particularly on the hot, dry, windy days common to the desert) Alex and Ron are able to add or reduce water by telemetry command, or call farm headquarters and have Lori to tweak the master irrigation schedule for the next day. It is this continuous, reliable availability of accurate field data that brings new meaning to the idea of hands-on farming. And it is the full range of Automata sensors, field stations, telemetry and software that makes all of this possible.

Sidebar

Al Walters became interested in irrigation management while trying to grow avocados in one of California's most expensive water districts. He has been involved in both the software and hardware side of irrigation control for 20 years, and is currently the Southern California distributor for Automata, Inc. located in Nevada City. Additionally, he is distributor for Space Imaging, OrbImage and Earthscan and specializes in image processing for agricultural and other land-use applications. See www.agricast.com and www.swgeo.com for more information about these activities. He spent 32 years in the Air Force managing high-technology programs when not flying airplanes. He is also an avid amateur radio operator (K6NOF), a frequent contributor to California Grower, and can always be counted on for spirited presentations at Farm Tech.