Driving Down Irrigation Costs – Part II

Jerry Faulring

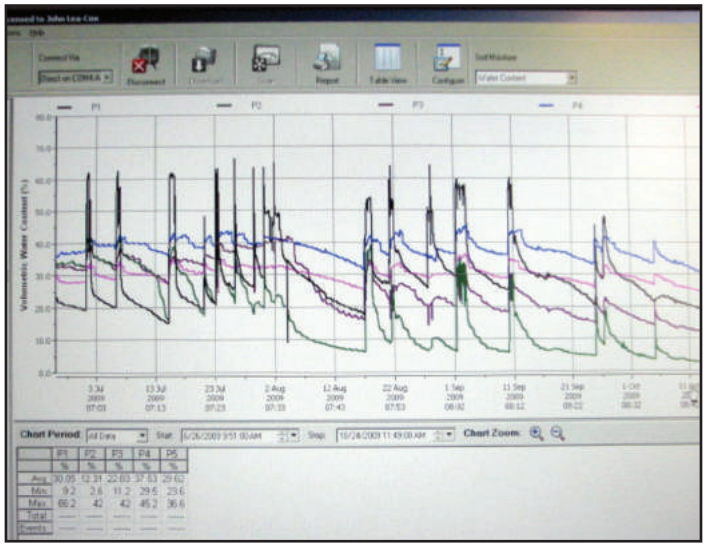
As I have reported previously, we have been engaged in automated soil moisture monitoring for many years.

First, I'll give a brief recap and then the latest and truly astonishing development.

All the work has been done collaboratively with Dr. John Lea-Cox and his team under USDA grants that grew to an ambitious national project engaging scientists from across the country. Unfortunately, the grants may not be renewed for 2015.

The website, http://smart-farms.org/ will bring you to the Knowledge Center that reports this work, and contains a vast amount of information related to the effort. There is also a tab listing the for-profit cooperators. Waverly Farm along with seven other businesses participates in the Smart-Farms organization.

Initially we installed soil moisture sensing stations with the goal of better understanding what the soil moisture conditions actually were, and therefore a tool to drive our irrigation management decision making. This system allowed me to watch data on my office computer that revealed, among many environmental factors, the volumetric water contained within the growing zone at any given minute of the day, year round.



Based on the data and additional monitoring of soil moisture with hand held probes, I quickly determined that we had been over irrigating since the beginning. During that first year of monitoring and subsequent years, we gradually reduced irrigation events by over one half. The amount of water used back in those days was based on pump run time which can be only loosely accurate because pump output is a function of age and wear. A submersible deep well pump will produce more than it is rated for when installed and less than its rating when nearing the end of its useful life. Given that we have several pumps of differing age, the average output may have been near expectation but I could not know for sure.

As you may know, every consumer of water in the State using more than an average of 10,000 gallons per day or an annual total of 3,650,000 gallons per year is required to obtain a water appropriation permit from MDE and report usage annually. The actual rules are just a bit more complicated but the summary above gets us in the ballpark. Our permit allows for 24,000,000 gallons annually and I am confident that we used all of it before the enlightenment.

In 2013 a new experiment was installed to allow for

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precision irrigation based on the plants' actual need. We don't actually know what a given plant requires but that is a large part of ongoing research. The new system is computer controlled such that we can set the amount of soil moisture that will be constantly maintained. Without understanding how much a plant actually needs and based on prior year's findings, we set the system to maintain soil moisture at 40% of its volumetric capacity in the root zone. Field capacity or fully saturated is referred to as 100% volumetric capacity.

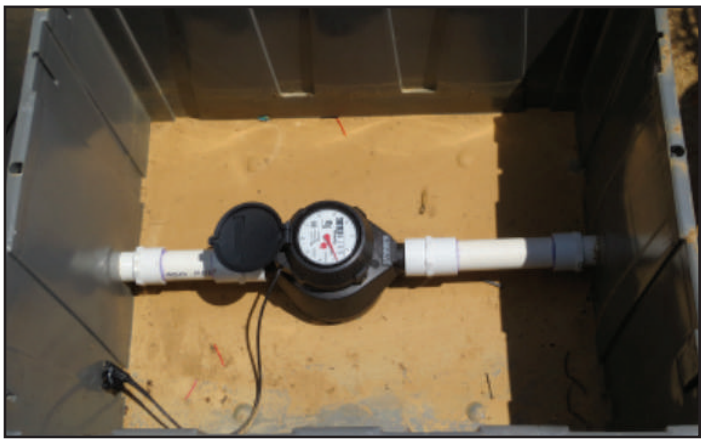
The 2013 implementation engaged first year plantings of Syringa and Cornus. I chose Syringa as a relatively fast growing genus and Cornus to represent a slow growing genus. The photo below shows the Syringa block one year after planting. The picture does not show clearly the outcome but I think one can see the row on the right is larger and fuller than the row on the left.

Each row of plants, shown above, has a flow meter as seen within the boxes, shown below. The right hand row and box also have a solenoid valve that is opened and closed by the soil moisture monitoring unit located half way up the row.

The left row of plants was irrigated by implementing our old method for first year plantings, which is a 24 hour irrigation event weekly in the absence of a good rain, about one inch. The row on the right was irrigated automatically based on the 40% demand setting.

NOW FOR THE REVELATION!

I was told not to look at the flow meters during the year for fear of manipulating our manual practices of irrigation which could have invalidated the research results. Of course, I cheated and watched closely as the year progressed. But, I did not tell the irrigation crew anything and let them pursue normal methodology.



The left row consumed 11,000 gallons.

The right hand row of plants (larger, fuller) consumed in round numbers 3,000 gallons of water. Even if the plants were equal in growth, I would have to be pleased with the reduced water consumption.

My first reaction is to be shocked that a single 500 foot row would consume 11,000 gallons. I have never calculated how much a first year planting used. Of course the second shock was the significantly better growth outcome using 266% less water for the right row.

The results may seem counter intuitive. It might make sense that more water would be better. The answer has to be that less water made available precisely when the plant needs it produces a better plant. Visual observation during the growing season shows that the soil surface in the automated row is almost always moist while the manually controlled row is dry two days after irrigation. It is probably true that most of the manual water moves past the root zone and only partially migrates upward when the surface soil dries. It may also be true that the excess water forces oxygen out of the soil during and after the irrigation event. I am less concerned with why the lesser row did poorly than to know less water delivered exactly when needed produces the better outcome.

The joke is on me! Steve Black, my neighbor and mentor for all things science, has been part of the Smart-Farms program from the beginning. Even before involvement, his irrigation philosophy was to irrigate for short cycles frequently while I always believed we should irrigate deep and infrequent. Dr. Lea-Cox also encouraged me to follow Steve's lead but I knew better. My theory is appropriate for large established plants but is obviously wasteful for small root systems growing near the surface. Now, it's a point of humor and humility for me to know I should develop better listening and understanding skills.

As a footnote, four years ago we installed water meters on all our water lines, shown above, a total of 4. Over that period, and after learning from the initial research, we used only 12,000,000 gallons each in 2011 and 2012 and 9,000,000 gallons in 2013 compared to my previously calculated 24,000,000 gallon per year consumption. The financial outcome is to double the life expectancy of our pumps from an average of 7-8 years to possibly 14 years, a reduction of electricity consumption, and reduced labor.

Dr. Andrew Ristvey, a participant in the Smart-Farms research and a University of Maryland Extension Specialist, once told me he had seen a 90% reduction in irrigation for container crops resulting in faster growing, healthier plants when the irrigation was controlled by a similar system.

The Cornus block, seen on the next page, has not yet revealed such differences in growth but had similar water usage. It is anticipated that any changes in growth rate will appear in year three. Water consumption for 2014 has been about the same as in 2013 for the automated rows. Our manual irrigation has declined significantly.

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The next step:

Our goal is to expand the system to include more of the new plantings starting in 2015. This will be a bit complicated because we will have to modify the current irrigation infrastructure to accommodate the solenoid set up. Water consumption should decline significantly. We have always operated our irrigation manually because I did not trust automation on new plantings. That will change because I can now visually watch irrigation from my computer by way of wireless communication from the field equipment. I'll still insist on regular 'drive by' inspection to make sure all is in order. The cost of labor to run the system will decline dramatically.

We all seek improvement in our operations for dozens of activities to improve productivity, reduce costs and to grow better plants more efficiently.

The objective is to seek incremental gains everywhere on a regular basis. Precision delivery of irrigation water based on a plant's need is a big step forward.

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