

How can a sensor network save me money?

There are a number of ways that we have found that sensor systems can save you money. Where you save money, and how much, depends on a number of factors. We will discuss some of these examples in the following sections. The next learning module ([return on investment](#)) will look at overall payback, and allows you to enter specific information for your operation, using a spreadsheet file that you can download.

Some of the biggest savings that we have seen related to more timely irrigation decisions is tied to irrigating plants exactly when they need it, and reducing over-irrigation (reducing nutrient loss, and disease incidence).

For maintaining optimum plant growth, a good analogy to think of is driving a car on the highway. If you are using cruise control at 65mph, the car continues to move at a steady speed, minimizing fuel consumption. This is like irrigating your plants exactly as much as they need, when they need it. They can continue to grow at maximum speed. Now imagine you are driving along the highway and you keep stepping on the brake, or taking your foot off of the gas. Since you can't go any faster than the speed limit (maximum plant growth), you are lengthening the time it takes you to get to your destination (saleable size). If you are letting plants get too dry, or keeping them too wet, it is like you are stepping on the brake. It takes plants time to adjust to changing conditions, so they are not growing at maximum speed. Sensors help plants achieve maximum growth rate by providing them with ideal moisture conditions (assuming the set points are correct, which you can learn about in other modules).

To illustrate this point, a grower involved with our project was having a difficult time growing Gardenias (*Gardenia jasminoides*). Their typical production time was 14 months. They installed a sensor system, and production time was reduced to 9 months.

The experiment was run a second time, but with very different results. Instead of 9 months, the plants were ready to sell after only 5 months, as they started this crop in the spring instead of the previous fall (Figure 6).

The best part is these results were achieved by using LESS water! More details and a discussion of the analysis can be found under additional resources at the end of this module.



Figure 6. Actual plant sales vs forecasted plant sales for Gardenias. Plants were ready to be sold in 5 months using sensor networks, as opposed to the typical 14 months for this operation.

Energy / water / fertilizer costs-savings

We have found that most ornamental greenhouse and container-nursery growers tend to over water plants. This makes sense because containers can dry out very quickly, so making sure that plants have enough water to make it until the next irrigation cycle is important. It is also very difficult to adjust plant water needs when weather (especially temperature and wind) conditions change every day. Ideally, applied water will just start to leach out the bottom of the container when the irrigation is turned off, and the root zone is fully wetted. The reality is that containers are most often over irrigated to make sure they have reached container capacity. By cutting back on irrigation, there are a number of benefits (besides the increased growth rates discussed above).



Using your irrigation pumps less keeps more water in the ground or in your pond and lowers your water utility bills. This also helps your pump last longer, and require less maintenance. Additionally, it saves on electricity and/or diesel costs. This impacts your bottom line, and the environment.

Figure 7. Sensor networks can conserve water resources.

Reducing leaching also helps stretch your fertilizer dollars. It doesn't matter if you are using soluble or slow release (also called controlled release) fertilizers. Keeping water in the root zone, without leaching it, also keeps the fertilizer in the root zone. The bottom line is that the longer water and fertilizer stays in the root zone, the more of it is available for plant uptake and growth. If you fertigate, it is possible that you can cut down on your fertigation frequency or application rate, or typically both. Increased fertilizer use efficiency (the percent of fertilizer taken up by the plant) also reduces your impact on the environment (both groundwater leaching and runoff) and most importantly saves considerable amounts of money.



Figure 8. Sensor networks can reduce fertilizer costs.

Increasing Land Area under Production / Increasing Efficiency / Troubleshooting Issues

Saving water may also mean that you can expand your operation. If you can reduce your irrigation volumes by 50% or more (which we have seen in many of the operations that we have wireless sensor networks installed), you can then use that water for other things, including expanding your operation if you are water limited, or avoiding the expense of drilling another well.

Instead of traveling to each irrigation block to determine irrigation needs, real-time soil moisture can be checked from an office computer, or remotely with a smart phone at any time. This saves time, and increases operational efficiency. The software can also be easily configured to send out alerts if there is a problem (bad sensor, low soil moisture, irrigation was not triggered etc.).

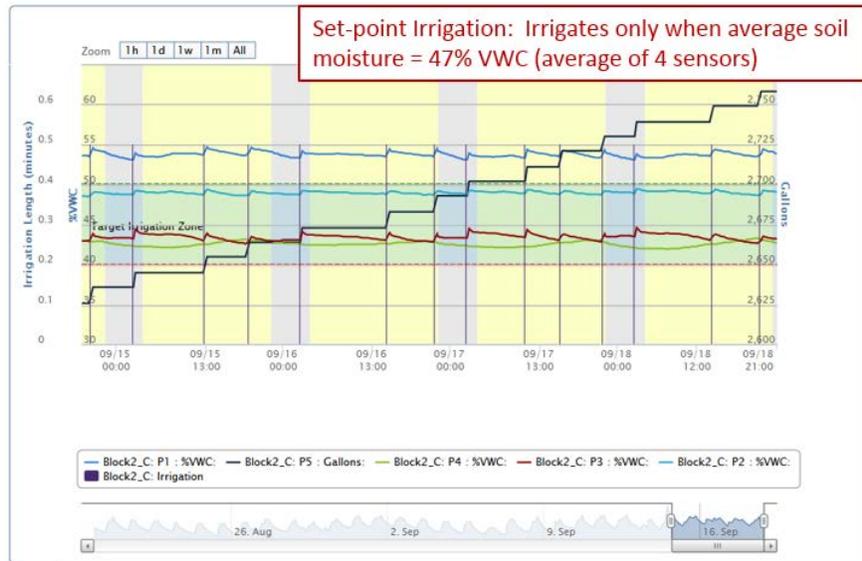


Figure 9. Software provides real-time data from sensors.

Further increasing operational efficiency, control nodes are available that can not only monitor and alert you to specific soil moisture conditions or equipment problems, but also turn irrigation on and off as needed, using average soil moisture data, as described above. You determine the set point (volumetric water content or VWC) that the irrigation is triggered, and when the average sensor reading is brought back above that threshold, the irrigation solenoid is automatically switched off by the control node.

Sensors can also help troubleshoot problems at your operation, further saving you time. If there is a particular plant that is difficult to grow, or a particular location that is challenging to grow plants in, (Ex. sensitive to overwatering, or a soil is particularly sandy) sensors have been found to be an effective way to help diagnose and fix the problem. For example, by placing moisture sensors in areas of a field which are sandier and prone to leaching, irrigation can be correctly determined and applied to that area.