J Frank Schmidt & Son Co.: Using Drip Irrigation to Save Money and Resources

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Water, labor and energy all play a role in nursery irrigation. J Frank Schmidt & Son Co. (JFS) took progressive measures to install underground drip irrigation at two of their farms, and by so doing, harvest savings and time benefits. The installation of drip irrigation offered an additional opportunity - drip fertigation – which reduced another costly input and diminished the chance for fertilizer to leach out of their farm and into water systems.

When I stopped by the JFS Canby, OR site one very rainy day in May 2010 to talk to Sam Doane, Production Horticulturist, I thought it would take an hour to talk about the system, a few minutes to take pictures and then back on the road. Like many systems in a large organization it turned out to have more depth than I anticipated. This case study is far from comprehensive; establishing reliable and trusted drip irrigation and fertigation took many years, diligence, research and patience, and the farm is still working on system improvements. This is an introduction with more in-depth information following in future case studies.

J Frank Schmidt & Son Co. (JFS) has operated in Oregon for over 60 years, growing more than 500 varieties and cultivars of deciduous trees.

PART 1: UNDERGROUND DRIP IRRIGATION

Water, labor and energy all play a role in nursery irrigation, but it was the second variable – labor – that compelled JFS to proceed with an underground drip irrigation project. JFS had already used many techniques to mitigate irrigation costs: comprehensive schedules and field methods like soil monitoring to water on an as-needed basis, and installing a more efficient and effective system was the next logical step. In 2000 when Sam Doane was transferred from JFS's farm in Independence to manage the farm in Canby, the minimum wage was rising and Oregon was already above the national average. (In 1997 lawmakers increased the federal minimum wage to $5.15/hour; in 2007 this was raised again to $7.25/hour. By comparison, in 1997 Oregon's minimum wage was $5.50/hour and by 2007 Oregon's minimum wage had risen to $7.80/hour, [Doane] "We were paying a lot of overtime for workers to move irrigation pipe and finding a way to mitigate this rising expense was a key priority. Above-ground irrigation is incredibly labor intensive, we were often operating from 5 am to 9 pm."

Doane looked into underground drip irrigation and created a labor savings analysis that captivated JFS owners. [Doane] "The ROI (return on investment) for the infrastructure costs was two years: three workers could do the work that a crew of up to sixteen did before, and there was a 30 percent reduction in water use at the end of the third year when the system was fully fleshed out."

With this type of ROI analysis Doane received permission to start a pilot project at the Canby, OR facility – a 1,200-acre bare-root shade and flowering tree farm. The project was implemented over a five year period. All of the mainline and filtration systems were installed in the first and second years. With each planting cycle JFS converted more acreage to drip irrigation until the entire farm was done.

Installation of the system was only the beginning of this project. The next step was to develop an irrigation schedule which would take into account soil type, root patterns, crop type, desired water cycle and age of plant. [Doane] "We started out using soil moisture-sensing technology, and in conjunction with this completed a two-year study with Rich Regan at Oregon State University to develop crop coefficients applicable to our diverse group of crops." The crop coefficients help refine data from the AgriMet stations; a subset of an overall satellite network of automatic agricultural weather stations which provides information for near-real-time management of water operations in the Pacific Northwest.

A variety of filtration technologies are employed to remove contaminants unique to each water source. [Doane] "Our largest filter station is connected to a central pond that holds water from a well. Water is pumped from the pond, treated for algae by injecting a low concentration of chlorine, mechanically scrubbed to remove particulates, and then finally distributed to mainline at rates that can reach 2,000 gallons a minute at peak flow."

Any nursery operation considering drip irrigation needs to expect adjustments to expectations and operations. [Doane] "The fields look different with drip irrigation - they are dry. This was a major adjustment for everyone in the operation as we were used to seeing wet soil, and with that, came knowledge that the plants had enough water for the near future. When we installed the first 220 acres we think we actually used more water than before. The overhead system was limited by hours in the day, pump flow, and the amount of handline that we had available. The new drip irrigation system made completing our irrigation schedule an easy task, and because we were still building system confidence we ran the drip irrigation until we saw water on the surface. After reviewing many soil moisture charts we discovered that this was applying more water than is necessary and it defeated one of our goals – to reduce water use." JFS had been using gypsum blocks for decades to help schedule irrigation. With the change to drip irrigation, new irrigation feedback mechanisms needed to be implemented to ensure this task was completed accurately and effectively. JFS first used electrical sensors that uploaded data to a PC and provided instant feedback – 24/7. The instant feedback helped support the management team's contention that they were applying enough water. The monitoring device they elected to use after gaining a few years of watering confidence was the portable 'Diviner,' which can be taken to all access points at the facility; JFS transitioned from 24/7 monitoring to measuring soil moisture content at a point in time three

times a week. [Doane] “That level of information – three data points a week - took time to get comfortable with. Nursery owners and managers need to experiment with different feedback devices and levels of detail that allow them to run their operations effectively.”

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This case study is very brief in relation to the effort that went into creating a system that delivers drip irrigation accurately and consistently. Before any operation considers drip irrigation there are some items to consider:

1. Hire an experienced engineer. Pay an expert to complete an analysis of the entire system. Everything from mainlines to filtration to flow and pressure, otherwise you could build a system that will not work the way it’s intended. The goals are to save water, increase uniformity and efficiency, and make irrigation less burdensome – poorly designed systems won’t help you achieve these goals.
2. Management commitment. The managers at JFS were excited about the prospect to reduce labor costs, however, without their forward thinking and commitment to the long-term profitability of the operation this project would have failed. There are many adjustments required for this type of change and management needs to buy in 100%.
3. Confidence comes with time and experience. There will be many hurdles when installing and perfecting a system like this. If you are going to use a soil moisture monitoring system, make sure you have a staff member who can interpret and evaluate complex graphs and data that come with the system, and someone familiar with the irrigation requirements of your crops. Simple, non-technical solutions are available for evaluating soil moisture as well; these can be a good option during the learning process.
4. Fit the project with the property. JFS doesn’t plan to use underground drip irrigation at their Monmouth farm because they’ve experienced problems with voles in the past. (Voles and other rodents can chew into drip systems, resulting in wasted water and excessive maintenance costs). Also, there are some crops which need the evaporative cooling of overhead watering (ash trees for example), so these types of crops may not be best suited for “drip only” irrigation.

[Doane] “The end product has been worth the effort; our operational efficiency has increased through reduced labor costs and water use, we are able to work and cultivate in a field while irrigating, and we have reduced weed growth by limiting surface water. Our owners are happy and we are taking steps to ensure our competitive advantage and future success.”

PART 2: REDUCED FERTIGATION THROUGH DRIP IRRIGATION

World fertilizer prices started rising in 2002 and reached historic rate increases in 2008. During the 12 months ending in April 2008, nitrogen prices increased 32 percent, phosphate prices 93 percent, and potash prices 100 percent. This price surge in 2008 was due to strong domestic and global demand for fertilizers, increased energy and freight prices, higher demand for grain-fed meat in emerging countries and low fertilizer inventories.

Rising fertilizer prices and changing perceptions about plant fertilizer needs compelled JFS to look into new and more efficient fertilizer application opportunities. [Doane] "We had already moved from broadcast to band application to reduce fertilizer use, but we couldn't water in granular fertilizer with drip irrigation. Injecting fertilizer, or fertigating, into drip irrigation provided us with an opportunity to utilize the system to deliver fertilizer directly to the root zone. By fertilizing and watering at the same time, we reduced overall fertilizer use by 30 percent. The ROI on this project and system infrastructure was less than a year."

Doane said system set-up and design were pretty simple. [Doane] "We do manifold level injection 2 ½ to 5 acres at a time for our drip irrigation fields. The hardest part of the system was making sure we had the right dilution factor and keep salt levels where we were comfortable. We use a proportional injector to measure the amount of liquid fertilizer we are injecting; to help keep costs low, we installed this as a bypass on the manifold (about 10 percent of the water goes through the injector). We use a simple flow meter and a series of valves to set the flow at our desired level. We wrote an Excel calculator that allows the irrigation crew to input a number of variables, like row length and total flow per manifold, to ensure that injection rates remain at a safe level."

"We've reduced overall fertilizer use by 30 percent which is a win for everyone. Our operational costs are lower and we are responsible for fewer GHG (greenhouse gas) emissions normally attributed to nitrous oxide emissions. If anyone decides to implement a drip irrigation system, this is a natural next step to investigate."

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