The Washington Irrigator Newsletter

Vol. 3, Issue No. 2 **A WSU Cooperative Extension – Prosser Publication** October 1998

1998 SURVEY OF IRRIGATION SCHEDULING PROVIDERS

Ag. consultants that provide irrigation scheduling services participated in a telephone survey prior to the 1998 growing season. In Washington, nine consultants responded to the survey that required 45 minutes of phone time; however, most spent about two hours talking about their business. The combined effort from these nine firms resulted in over 1000 clients and nearly 300,000 acres contracted for irrigation scheduling. This acreage represents 13.7% of Washington's 2,120,000 irrigated acres.

1998 SURVEY OF IRRIGATION SCHEDULING SERVICE PROVIDERS

- 9 Consultants
- 1015 Clients
- 290,756 acres contracted for Irrigation. Scheduling out of 2,120,000 irrigated acres in Washington (13.7%)

Potatoes were the crop most likely to be scheduled by a professional service and tree fruit was the next highest. Together they account for more than half the acreage scheduled professionally. Alfalfa, sweet corn, grain corn, and onions were scheduled at between 25,000 to 15,000 acres each. From 15,000 to 4,000 acres each of sugar beets, grass seed, beans, small grain, peas, wine grapes, and poplars were being scheduled. Very little professional irrigation scheduling is being performed on hops, concord grapes, and carrots.

CONTRACT ACRES BY CROP

- 120,000 ac - Potatoes
- 32,600 ac - Tree Fruit
- 25,000 to 15,000 ac - Alfalfa (seed also), Sweet Corn, Grain Corn, and Onions
- 15,000 to 4000 ac - Sugar Beets, Grass Seed, Beans, Small Grain, Peas, Wine Grapes, and Poplars
- < 500 ac - Hops, Concord Grapes, Carrots

Center-pivot irrigation systems were the most likely to be contracted for irrigation scheduling at 217,000 acres. Solid set and drip (includes micro spray) were the next largest group at 30,000 acres each, while very little irrigation was being scheduled professionally under furrow and set move systems. These survey results were also compared to the irrigation system acreage in Washington State as reported in the Irrigation Journal. Nearly, fifty percent of center-pivot acreage was being scheduled by professional services. This seemed unduly high and perhaps the total center pivot acreage is under reported. However, center-pivots are predominantly used to grow potatoes, the most scheduled crop, and water application can be easily controlled under center-pivot irrigation. Both solid-set sprinkler and drip irrigation had a higher percentage of professional irrigation scheduling than furrow and set-move sprinklers, possibly because they are extensively used on high-value crops such as vines and tree fruit and they are also easy to automate.

CONTRACT ACRES BY IRRIGATION SYSTEM

	Furrow	Set Move	Solid Set	Pivot	Drip
Survey					
	9850	3900	30,601	216,905	29,300
State					
	510,00	800,000	200,000	475,000	100,000
	1.9%	0.5%	12.2%	45.7%	29.3%

Most irrigation-scheduling consultants use the hand/feel method to compare with their soil moisture monitoring devices. The most prevalent monitoring device was the neutron probe, used by five of the nine consultants. Three of the consultants used gravimetric sampling in shallow rooted crops where a neutron probe might not be as effective. In addition, several consultants were promoting one of the less conventional methods of soil-moisture monitoring: Aqua-Flex, Aqua-Tel, Time Domain Reflectometry (TDR), and Frequency Domain Reflectometry (FDR).

SOIL MOISTURE MONITORING

Hand/Feel	9 out of 9
Neutron Probe	5 out of 9
Gravimetric	3 out of 9
Aqua-Flex	1 out of 9
Aqua-Tel	1 out of 9
TDR	1 out of 9
FDR Troxler Sentry	1 out of 9

Most irrigation scheduling providers rely on a combination of PAWS and AGRIMET weather stations to estimate crop ET. Two of the consultants set up on-site weather stations for clients to calculate ET right on their property. Two consultants indicated that they used the change in water content measured at their soil moisture monitoring sites to adjust predicted ET rates. Seven out of nine consultants use a combination of present soil moisture status and predicted ET to calculate operation times for clients' irrigation systems.

EVAPOTRANSPIRATION

On-site Weather Station	2 out of 9
PAWS Weather Station	8 out of 9
AGRIMET Weather Station	6 out of 9
Historical	2 out of 9
Change in Soil Moisture	2 out of 9

Irrigation scheduling is beneficial in many ways, but consultants were asked which benefits motivated clients to pay for their services. When clients were pumping from deep wells or lifting water long distances from rivers, water and energy conservation were important because operating expenses could be lowered significantly. Another key reason to pay for irrigation scheduling was improved crop quality. For many high-value crops, quality is the key to better price and proper irrigation is an important factor in maintaining high quality. Pressure to reduce agricultural pollutants was not described as an important reason to pay for irrigation scheduling even though environmental issues are becoming more prevalent.

KEY REASONS CLIENTS PAY FOR IRRIGATION SCHEDULING

Short of Water	1 out of 9
Save Water	3 out of 9
Save Energy	4 out of 9
Reduce Pollutants	1 out of 9
High Yields	3 out of 9
Crop Quality	7 out of 9
Save Fertilizer	2 out of 9
Size of Farm	1 out of 9
Crop Value	2 out of 9
Reduce Agronomic Problems	0 out of 9

Seven of the irrigation scheduling providers said their business was expanding slightly to moderately and those who said their business was not growing wanted to keep the business at its present size but felt they could expand if they desired. In addition to this favorable business climate among existing consultants, new irrigation scheduling ventures are getting started that utilize some of the newer soil-moisture measuring technology.

THE BUSINESS CLIMATE

- Growth of business - 7 out of 9 expanding
- Identified 3 new firms offering irrigation scheduling
- A 1 to 1 benefit ratio to non contracted acreage

Most of the consultants felt clients used information from contracted fields to help manage non-contracted fields. On tree fruit, some consultants reported a 3 to 1 benefit ratio of contracted to non-contracted acreage, while potato irrigation schedules were mostly thought to be useful on contracted fields only. Overall, consultants felt an additional acre benefited from every acre under contract.

This survey gives a picture of irrigation scheduling in Washington State from the consultants' perspective. Future issues will reveal how individual growers and other organizations implement Scientific Irrigation Scheduling.

Brian G. Leib
WSU Extension Irrigation Specialist
The Survey was conducted with support from the Northwest Energy Efficiency Alliance

SOIL MOISTURE MONITORING IN FURROW AND DRIP IRRIGATED ONIONS

Managing soil moisture is an important component to producing an irrigated onion crop with the highest yield and quality. Optimum onion growth is achieved when the soil moisture is maintained near 85 percent of field capacity. However, onions are considered to be a shallow rooted crop (14 to 18 inches) which limits the amount of available soil moisture. Therefore, onion irrigation must be fairly frequent, accurate, and uniform to prevent crop-moisture stress and reduce waste of water and fertilizer.

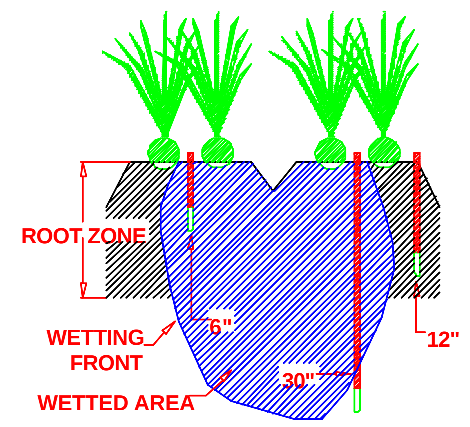
Furrow irrigation (also called rill irrigation) and an increasing number of drip irrigation systems make up a large portion of the onion acreage in Washington and the western United States. In contrast to sprinkler irrigation, furrow and drip irrigation require lateral soil moisture movement to refill the onion root zone. These two irrigation methods will be the focus of this article.

Soil-moisture sensors can help the onion irrigator supply the correct amount of water at the correct time. There are a number of methods available to measure soil moisture but Watermark sensors (a resistance block surrounded by a granular matrix) are an inexpensive means by which growers can schedule irrigation. These sensors are read in terms of centibars of tension, with lower tension readings representing higher soil moisture. For most mineral soils, 15 to 25 centibars indicates adequate available moisture for onion production which is roughly 85% of field capacity (adapted from Shock et al., 1994).

Placement of soil-moisture sensors is determined by the configuration of the onion bed in relationship to the water source. For furrow irrigated onions, crop bed spacing is typically 34 or 44 inches with two double rows per bed. For drip irrigated onions, crop bed spacing ranges from 34 to 88 inches with two or six double rows per bed. Figure 1 shows sensor placement within an onion bed. The reasons for these placement locations are as follows:

- 6-inch depth between double row — this location yields information on the soil moisture that the majority of the onion roots "feel."
- 12 inch depth at crop bed shoulder — this location yields information on the lateral movement of moisture from the water source. Observable trends at this location show whether the "wetted area" is increasing, decreasing or staying the same.
- 30-inch depth — this location yields information on the extent of deep percolation or "leaching" that occurs in order to move the moisture across the crop bed.

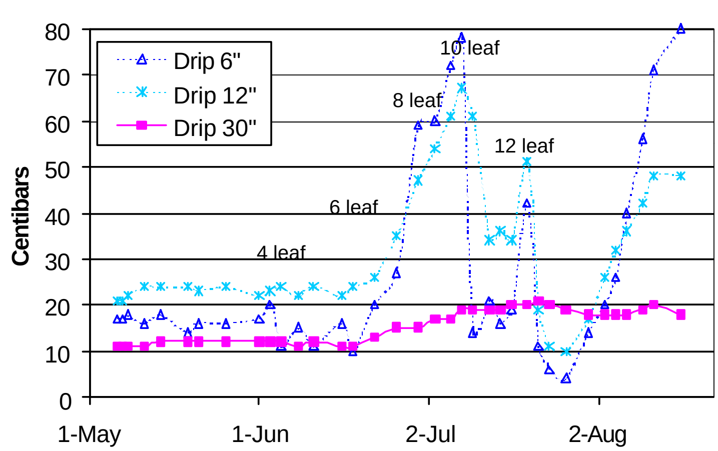
Figure 1:



Watermark sensors were placed at the above locations for both a furrow and drip irrigated field. In these trials, the sensors were only used to monitor trends in soil moisture and were not used to adjust the irrigation. The resulting trends in soil moisture are shown in Figures 2 & 3.

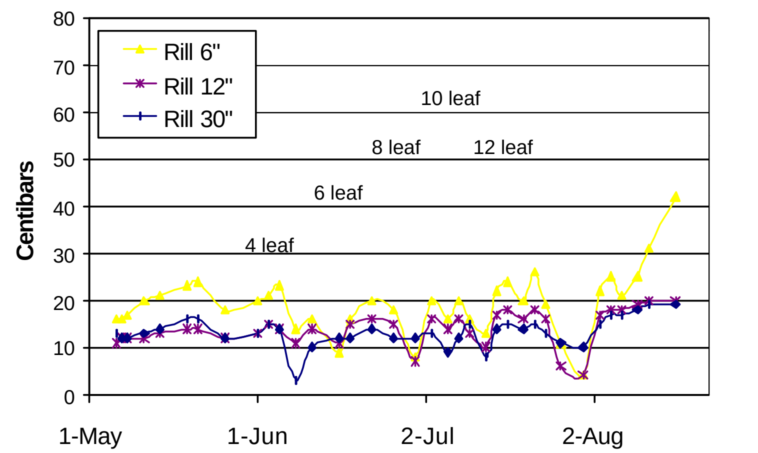
During drip irrigation, the 6" and 12" sensors revealed high soil moisture until early July when soil tension reached 70 centibars: a very dry condition for onions. This does not mean that drip irrigation is unable to meet the water requirements of onions but rather that the producer was not immediately aware that soil moisture was falling behind as onion water use increased. Peak water use (ET) can be as high as 0.30 inches per day. Inadequate irrigation during peak water use caused the soil moisture at the 6" and 12" sensors to drop rapidly because available moisture was quickly depleted within the shallow onion root zone. At the 30" sensor, there was minimal drying during peak water use and no indication that over-irrigation increased soil moisture below the root zone.

Figure 2: WaterMarks in Drip Irrigated Onions



During rill irrigation, soil moisture was consistently high throughout the growing season. The 12” sensor indicated that the wetting fronts from each irrigated furrow “met” in the soil profile and allowed sufficient reserve moisture so that crop moisture stress did not occur. However, in examining the trend of the 30” sensor, spikes of nearly zero tension were observed, indicating a saturated profile and percolation of water past the onion root zone. Perhaps, less frequent or lighter irrigation could have maintained the same high soil moisture with less deep percolation of water and leaching of fertilizer.

Figure 3: WaterMarks in Rill Irrigated Onions



In summary, there are two important factors that determine the performance of furrow and drip irrigation systems: 1) soil texture and 2) spacing between irrigated furrows or drip tape laterals. Soils that contain a high percentage of sand, known as “light” soils, do not allow the lateral moisture movement to the extent that “heavier,” fine textured soils allow. To move the wetting front laterally in sandy soils, longer set times are necessary, resulting in lower irrigation efficiencies and poor uniformity in the case of furrow irrigation. The Watermark sensor is one of the tools that the onion grower can use to monitor not only root-zone soil moisture, but also the width and depth of the “wetted” area in the soil profile to improve irrigation performance.

Literature Sited:

Shock, C.C., E.B.G. Feibert, L.D. Saunders. 1994. Soil water potential criteria for onion irrigation, 1994 trial. Malheur County Crop Research Annual Report, 1994. Oregon State University Agricultural Experiment Station Special Report 947: 68-78.

Article contributed by:

Bob Mittelstadt, Conservation Districts Partnership, Othello, WA

Brian Leib, Extension Irrigation Specialist, Washington State University, Prosser, WA

Gary Pelter, Area Extension Agent, Washington State University, Ephrata, WA.

CHEMIGATION AND FERTIGATION TECHNICAL ASSISTANCE PROGRAM

The advantages associated with injecting a pesticide or fertilizer into an irrigation system has been known for nearly three decades. However, in addition to the benefits, the risks inherent to these practices must also be considered.

In Washington State, chemigation is a practice of applying a pesticide through an irrigation system while fertigation involves injecting a fertilizer product. One of the functions of the Washington State Department of Agriculture (WSDA) is to help protect Washington’s water resources from pesticide or fertilizer contamination risk, whether that risk may be to a pond, irrigation or drainage ditch, stream, river, or well. To protect the state’s water resources, the irrigation system must be equipped with appropriate backflow protection devices. Washington’s chemigation and fertigation laws specify that safety devices must be in place (and properly operating) prior to a chemigation or fertigation operation. Without appropriate and functional safety devices, the application of a product is deemed inconsistent with its labeling and therefore in violation of state laws.

WSDA recently initiated a Chemigation and Fertigation Technical Assistance Program to enhance operator awareness and to assist operators in implementing measures to minimize contamination risk. The new program is located in the Moses Lake field office. The program is staffed by Byron Fitch, Chemigation Compliance Specialist, and by Tom Hoffmann, Chemigation/Fertigation Technical Systems Specialist.

WSDA hopes to achieve the ultimate goal of protecting Washington’s water resources through voluntary compliance. To that end, WSDA staff will:

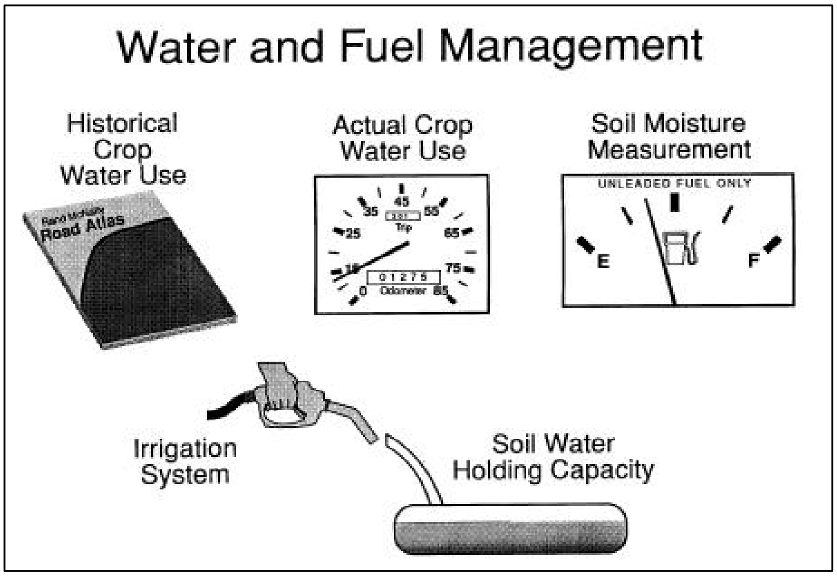
- generate and distribute reference material,
- conduct training programs and demonstrations,
- provide individual consultation, and
- perform on-site visits.

To find out more about the WSDA Chemigation and Fertigation Technical Assistance Program, contact either Byron Fitch at 509-766-2575 or Tom Hoffmann, 509-766-2574.

SIS, HOW HARD CAN IT BE?

Scientific Irrigation Scheduling (SIS) sounds pretty complicated and much of the equipment used is of a technical nature; however in reality, the concepts that govern SIS are very simple. In fact, most of us use the concepts involved in SIS on a daily basis without really thinking about it. For example, why do most of us keep track of the gasoline in our cars? The self-evident answer is that most of us do not want to run out of gas and be stranded. Similarly, we irrigate so our crops do not run out of water and strand us with less than desirable yields. Let's take the analogy of irrigation management and fuel management a little further.

Just as gas tanks are limited in the amount of fuel they can store (12, 16, 20 gallons depending on the vehicle), soils are likewise limited (0.8 to 2.3 inches of water per foot of soil depending on texture, sand to clay, respectively). The rooting depth also limits water storage. A crop with four foot roots in a silt loam soil that has a water holding capacity of 2in/ft will be able to store eight inches of water for the plant to use (2in/ft x 4ft = 8 inches). In irrigated agriculture, it is not advisable to allow the crop to use all the available moisture (8 inches in this example) before irrigating because the crop would be severely stressed.



I have already mentioned the consequences of failing to refill fuel tanks and soil moisture in a timely manner, but what happens if we exceed limited storage capacity. In the case of refueling, gas shoots out of the tank, onto the ground, and possibly onto ourselves. I for one do not like wasting gas that has been paid for, unnecessary degradation of the environment, and reeking with the smell of gasoline. The effects of over-irrigation are similar, if not as dramatic. Over irrigation can result in run-off and soil erosion that carries sediment and soil adsorbed ag chemicals into waterways. Over irrigation also can cause deep percolation, which leaches soluble ag chemicals out of the crop-root zone and into groundwater. In either case, water and ag chemicals that you pay for are wasted. This waste can also be harmful to the environment.

Planning a trip by car can also be compared to growing an irrigated crop. If I wanted to drive to Denver from Eastern Washington, I could look up the mileage in a road atlas and find out it is approximately 1000 miles. Since my truck gets 25 mph and I want to refill my tank after 10 gallons are used from the 16 gallon tank, I will have to refill 4 times (10 gal x 25 mpg x 4 refills = 1000 miles). Similarly, I can look up the historical crop water use of alfalfa for Prosser in the "State of Washington Irrigation Guide" as 36 inches of irrigation required. If my irrigation system applies 4 inches per application, then on average I will need to irrigate 9 times during the growing season.

Many of us zero the trip odometer after refueling to estimate gas mileage. We can also use the trip odometer to estimate gas usage. If my trip odometer reads 125 miles since refueling and my truck gets 25 mpg, then I have used 5 gallons of gas and could add 5 gallons at the pump. In this scenario, I am keeping track of actual usage because real trips do not always turn out the way they are planned. Actual crop water use can be tracked in a similar manner. For example, the weather has been extremely hot, dry and windy, and I am afraid I might not be keeping up with my crop's water use. I access the Public Agricultural Weather System (PAWS) on the Internet and look up my crop's evapotranspiration (ET) of .35 inches/per day over the last three days at Prosser. If I want to keep up with actual crop-water use, I need a net application of 0.35 inches per day, 1.05" in three days or 2.45" in a week.

Of course, one of the most popular methods of tracking your fuel supply is via direct measurement with the gas gauge. Soil moisture can also be directly measured. In fact, there are more than ten different soil-moisture sensors being marketed in Washington at this time. Space will not permit a discussion of each sensor. Perhaps an upcoming issue of the newsletter will cover soil-moisture monitoring methods more completely. For now, I will just remind you of the various cars you have driven or owned in the past. The gas gauge on one car will read "E" and mean you can safely drive another 75 miles. Another car's gauge will read "E" and you better head to the nearest gas station. Soil moisture sensors also have different characteristics and costs. You will need to chose between the different sensor and spend time becoming familiar with the sensor you chose.

Finally, a gas pump can be compared with an irrigation system. A gas pump meters fuel into the tank as an irrigation system delivers water to the soil at a known rate. However, gas pumps are fairly universal and there are many distinct types of irrigation. As most analogies are imperfect, this one seems to diverge at this point. Some irrigation systems force the soil moisture storage tank to be very small (drip irrigation). Other irrigation systems apply water very lightly and frequently similar to buying a gallon's worth of gas every day (center pivot irrigation). Very few irrigation systems have been successfully engineered to turn-off automatically when soil moisture has been completely refilled, as gas pumps do when the tank is full. Therefore you the irrigator still control how much water is applied to the soil with all its benefits and consequences. Future issues of the Washington Irrigator Newsletter will show how to calculate the application rate of your irrigation system.

- For information on connecting to PAWS call -- (509) 786-9367 or WWW -- http://frost.prosser.wsu.edu
- For help with Scientific Irrigation Scheduling call – (509) 786-9203

Brian G. Leib
WSU Extension Irrigation Specialist

SPONSORED BY

NORTHWEST ENERGY EFFICIENCY ALLIANCE

Brian G. Leib, Extension Irrigation Specialist
Biological Systems Engineering Department
Washington State University
Irrigated Agricultural Research and Extension Center
24106 North Bunn Road
Prosser, WA 99350