# The Washington Irrigator Newsletter

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## WISE TABLES, AN IRRIGATION SCHEDULING TOOL WITHOUT THE COMPUTER

Most irrigation scheduling tools being marketed in Washington at present are of the high tech variety. In fact, the last issue of The Washington Irrigator Newsletter announced the release of WSU's high tech scheduling tool, the Washington Irrigation Scheduling Expert (WISE) software. The use of irrigation scheduling software may not fit well into every farming operation so WSU has also released WISE Tables in addition to the software. Once printed, WISE Tables for your individual irrigation systems can be kept in a notebook and transported in your farm vehicle or they could be laminated and mounted near your irrigation system controls. A computer is not needed to produce schedules from the Tables.

An example WISE Table for center pivot irrigated sweet corn is printed in the middle section of this newsletter. The procedure to determine a weekly schedule for a center pivot that delivers 7.5 gpm per acre at 85% is as follows: 1) determine your crop ET (0.18 in/day, five weeks after emergence) and locate this value in the far-left column, 2) move one column to your right and determine the weekly application needed to replace the expected crop-water use (1.26 inches). Your weekly application can be adjusted by moving up and down this column. If your soil moisture is higher than desired or you had unaccounted for rainfall during the previous week, subtract water from the schedule and move up this column to the appropriate value. If soil moisture is below the level you desire, add water to the schedule and move down this column to the appropriate value. In this example we will assume that the schedule will not need to be adjusted for either rainfall or soil-moisture conditions. 3) move one column to your right and determine the total irrigation time required for the upcoming week's schedule (89 hours based on the irrigation system's net application rate). 4) move right until you come to the column that matches your desired revolution speed (32 hours per revolution) to determine the number of revolutions for the upcoming week (2.8 or approximately 3 revolutions). So in four easy steps, a schedule of 3 revolutions at 32 hours per revolution was determined.

On the reverse side of the WISE Table you will find an irrigation log that can be used with the WISE Table. The log is not required to use the WISE Table but it is included to facilitate your record keeping of irrigation decisions. The irrigation decisions for the sweet corn example are hand recorded on the log from emergence on May 29 to July 3 (when article was written). Note that the log contains adjustments for unexpected rainfall. Also, WISE Tables are not limited to center-pivot irrigation. Tables can be generated for set sprinklers, drip tape, and drip emitters.

Well it is time for some true confessions, WISE Tables are not completely computer free. The tables are printed Excel spreadsheets that are accessed from the SIS webpage (http://sis.prosser.wsu.edu). When your irrigation system information is entered into the spreadsheet, the table recalculates and is ready to be printed out. Also, the crop-water use values used in the sweet corn example came from the PAWS webpage (http://index.prosser.wsu.edu) and the WISE water use model. Once your Tables are printed and if your source of crop-water use data does not require a computer, WISE Tables become a computer free irrigation scheduling tool. I look forward to seeing how Washington irrigators apply this low-tech tool.

*Brian G. Leib, WSU Extension Irrigation Specialist*

The Washington Scientific Irrigation Scheduling Project is funded by the Northwest Energy Efficiency Alliance.

**WASHINGTON IRRIGATION SCHEDULING EXPERT TABLES**

Washington State University
IAREC. 24106 N. Bunn Road
Prosser, WA 99350-9687
Brian G. Leib

**CENTER PIVOT** **FIELD NAME:** Sweet Corn - 2000

Steps From Article

**7.5 gpm ~1 acre 85% Eff.**

**NUMBER OF IRRIGATIONS PER WEEK**

| CROP ET in/day | APPLY in/wk | TIME hr/wk | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 | 64 | 68 | 72 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.02 | 0.14 | 9.9 | 1.2 | 0.8 | 0.6 | 0.5 | 0.4 | 0.4 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 |
| 0.04 | 0.28 | 19.9 | 2.5 | 1.7 | 1.2 | 1.0 | 0.8 | 0.7 | 0.6 | 0.6 | 0.5 | 0.5 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 |
| 0.06 | 0.42 | 29.8 | 3.7 | 2.5 | 1.9 | 1.5 | 1.2 | 1.1 | 0.9 | 0.8 | 0.7 | 0.7 | 0.6 | 0.6 | 0.5 | 0.5 | 0.5 | 0.4 | 0.4 |
| 0.08 | 0.56 | 39.7 | 5.0 | 3.3 | 2.5 | 2.0 | 1.7 | 1.4 | 1.2 | 1.1 | 1.0 | 0.9 | 0.8 | 0.8 | 0.7 | 0.7 | 0.6 | 0.6 | 0.6 |
| 0.10 | 0.70 | 49.7 | 6.2 | 4.1 | 3.1 | 2.5 | 2.1 | 1.8 | 1.6 | 1.4 | 1.2 | 1.1 | 1.0 | 1.0 | 0.9 | 0.8 | 0.8 | 0.7 | 0.7 |
| 0.12 | 0.84 | 59.6 | 7.5 | 5.0 | 3.7 | 3.0 | 2.5 | 2.1 | 1.9 | 1.7 | 1.5 | 1.4 | 1.2 | 1.1 | 1.1 | 1.0 | 0.9 | 0.9 | 0.8 |
| 0.14 | 0.98 | 69.5 | 8.7 | 5.8 | 4.3 | 3.5 | 2.9 | 2.5 | 2.2 | 1.9 | 1.7 | 1.6 | 1.4 | 1.3 | 1.2 | 1.2 | 1.1 | 1.0 | 1.0 |
| 0.16 | 1.12 | 79.5 | 9.9 | 6.6 | 5.0 | 4.0 | 3.3 | 2.8 | 2.5 | 2.2 | 2.0 | 1.8 | 1.7 | 1.5 | 1.4 | 1.3 | 1.2 | 1.2 | 1.1 |
| 0.18 | 1.26 | 89.4 | 11.2 | 7.5 | 5.6 | 4.5 | 3.7 | 3.2 | 2.8 | 2.5 | 2.2 | 2.0 | 1.9 | 1.7 | 1.6 | 1.5 | 1.4 | 1.3 | 1.2 |
| 0.20 | 1.40 | 99.3 | 12.4 | 8.3 | 6.2 | 5.0 | 4.1 | 3.5 | 3.1 | 2.8 | 2.5 | 2.3 | 2.1 | 1.9 | 1.8 | 1.7 | 1.6 | 1.5 | 1.4 |
| 0.22 | 1.54 | 109.3 | 13.7 | 9.1 | 6.8 | 5.5 | 4.6 | 3.9 | 3.4 | 3.0 | 2.7 | 2.5 | 2.3 | 2.1 | 2.0 | 1.8 | 1.7 | 1.6 | 1.5 |
| 0.24 | 1.68 | 119.2 | 14.9 | 9.9 | 7.5 | 6.0 | 5.0 | 4.3 | 3.7 | 3.3 | 3.0 | 2.7 | 2.5 | 2.3 | 2.1 | 2.0 | 1.9 | 1.8 | 1.7 |
| 0.26 | 1.82 | 129.1 | 16.1 | 10.8 | 8.1 | 6.5 | 5.4 | 4.6 | 4.0 | 3.6 | 3.2 | 2.9 | 2.7 | 2.5 | 2.3 | 2.2 | 2.0 | 1.9 | 1.8 |
| 0.28 | 1.96 | 139.1 | 17.4 | 11.6 | 8.7 | 7.0 | 5.8 | 5.0 | 4.3 | 3.9 | 3.5 | 3.2 | 2.9 | 2.7 | 2.5 | 2.3 | 2.2 | 2.0 | 1.9 |
| 0.30 | 2.10 | 149.0 | 18.6 | 12.4 | 9.3 | 7.5 | 6.2 | 5.3 | 4.7 | 4.1 | 3.7 | 3.4 | 3.1 | 2.9 | 2.7 | 2.5 | 2.3 | 2.2 | 2.1 |
| 0.32 | 2.24 | 158.9 | 19.9 | 13.2 | 9.9 | 7.9 | 6.6 | 5.7 | 5.0 | 4.4 | 4.0 | 3.6 | 3.3 | 3.1 | 2.8 | 2.6 | 2.5 | 2.3 | 2.2 |
| 0.34 | 2.38 | C | 21.0 | 14.0 | 10.5 | 8.4 | 7.0 | 6.0 | 5.3 | 4.7 | 4.2 | 3.8 | 3.5 | 3.2 | 3.0 | 2.8 | 2.6 | 2.5 | 2.3 |
| 0.36 | 2.52 | C | 21.0 | 14.0 | 10.5 | 8.4 | 7.0 | 6.0 | 5.3 | 4.7 | 4.2 | 3.8 | 3.5 | 3.2 | 3.0 | 2.8 | 2.6 | 2.5 | 2.3 |
| 0.38 | 2.66 | C | 21.0 | 14.0 | 10.5 | 8.4 | 7.0 | 6.0 | 5.3 | 4.7 | 4.2 | 3.8 | 3.5 | 3.2 | 3.0 | 2.8 | 2.6 | 2.5 | 2.3 |
| 0.40 | 2.80 | C | 21.0 | 14.0 | 10.5 | 8.4 | 7.0 | 6.0 | 5.3 | 4.7 | 4.2 | 3.8 | 3.5 | 3.2 | 3.0 | 2.8 | 2.6 | 2.5 | 2.3 |

**HOURS PER REVOLUTION**

#1) #2) #3) #4)

Step 1: Determine your crop ET and enter the table on the left side.

Step 2: Move one column to the right to determine the weekly application needed to replace expected water use.

Step 3: Move up or down the Apply column to adjust for soil moisture monitoring.

Step 4: Move one column to the right to obtain weekly operation time.

Step 5: Move to the right to determine the number of revolutions at the desired speed (hours per revolution at bottom of the chart).

Note: High hours per revolution may cause excessive run-off and low hours per rev may not be possible at your machines fastest speed.

3 revs
@ 32 hrs/rev

EMERGENCE

**CENTER PIVOT** **FIELD NAME:** Sweet Corn - 2000

| | WEEK # | DATES to/from | CROP ET | SOIL MOIST. | APPLY | FORECAST # revs | FORECAST hrs/rev | ACTUAL # revs | ACTUAL hrs/rev | RAIN |
|---|---|---|---|---|---|---|---|---|---|---|
| MAY | 1 | 5/29-6/4 | .07 | OK | .49/.49 | 1 | 32 | 1 | | 0.61 |
| JUNE | 2 | 6/5-6/11 | .09 | LITTLE WET | .63/0 | 0 | 32 | 0 | | 0.31 |
| | 3 | 6/12-6/18 | .11 | OK | .77/.46 | 1 | 32 | 1 | | 0.18 |
| | 4 | 6/19-6/25 | .14 | OK | .98/.98 | 2.2 | 32 | 2 | | 0 |
| | 5 | 6/26-7/2 | .21 | OK | 1.47/1.47 | 3.1 | 32 | 3 | | 0 |
| JULY | 6 | 7/3-7/9 | .18 | OK | 1.26/1.26 | 2.8 | 32 | | | |
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# A DIRECT GRAPHIC INTERFACE (*DGI*) FOR A SOIL MOISTURE LOGGING DEVICE

A direct graphic interface (DGI) was developed for a soil moisture data logger by the M. K. Hansen Company with consultation from Washington State University's Scientific Irrigation Scheduling Project. The DGI concept increases the usefulness of continuously logged soil moisture by making the data instantaneously available to anyone who can touch a single button on the logger.

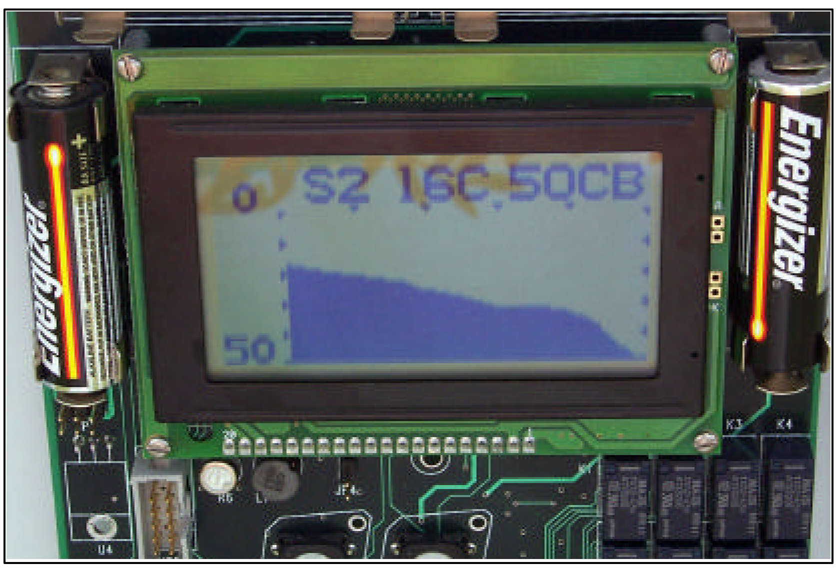
Figure 1 shows the AM 400 developed by the M. K. Hansen Company mounted in the indoor/outdoor enclosure with a see-through window for the DGI display. Up to six watermark sensors can be logged by a single AM 400 along with two temperature sensors (thermistors) used to measure soil temperature and to correct the soil moisture data. Soil moisture and temperature are logged three times per day, once every eight hours. By initially pressing the single button on the AM 400, the sensors are read and the display is activated. Each push of the button after activation separately displays the graph for each soil moisture sensor. The logger and the DGI display goes back into "sleep" mode after 30 seconds of inactivity.

Figure 2 shows the DGI display for a single watermark sensor. At the top of the screen going from left to right is the soil moisture sensor identifier (S2), the current soil temperature in centigrade associated with the sensor (16C), and the current sensor reading in centibars (50CB). Below this information, the graph shows soil moisture measurements taken every eight hours for the last five weeks. Each bar or column represents one measurement in centibars (scale shown on the left of graph). When the graph is updated every eight hours, the new data point is inserted at the right and all previous data points are shifted one to the left.

The data graphed in Figure 2 is from an alfalfa plot at the WSU-Prosser Research Station during late August and early September of 1999. On the left side of the graph, the soil moisture is declining due to intentional under irrigation. In the middle, the soil moisture is constant or level when the hay is first cut and the drop in soil moisture increases to the right as the alfalfa begins to grow again and no irrigation is applied. The AM 400 is also being tested by WSU in drip irrigated onions, solid-set irrigated apples, and center-pivot irrigated carrots through funding from the Northwest Energy Efficiency Alliance for the Scientific Irrigation Scheduling Project.

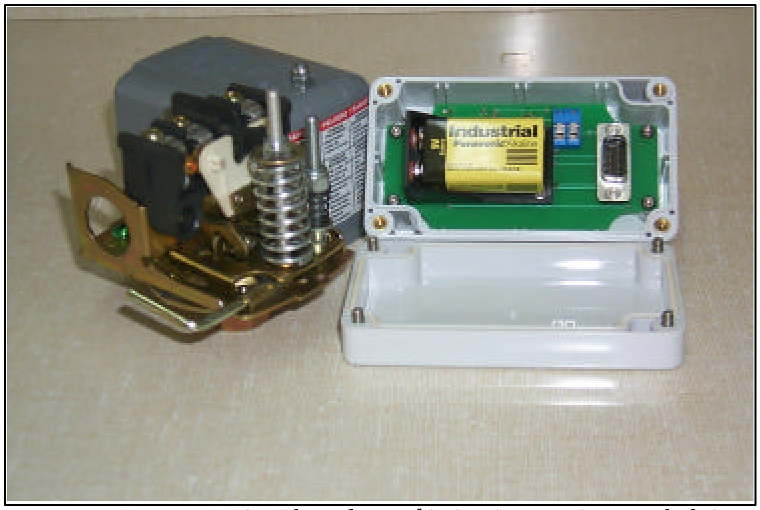
The DGI concept has been applied to the AM 400 with a low cost micro-logger and LCD display (around $270). The cost of a data shuttle or laptop to download data can be avoided. However, data can be downloaded via the RS232 port including telemetry methods. There is also a low power requirement: two AA batteries will last through a calendar year. The DGI concept should be considered for all types of soil-moisture monitoring systems. For more information on the AM 400 contact:

Mike Hansen
M. K. Hansen Company
2216 Fancher Boulevard
East Wenatchee, WA 98802
(509) 884-1396
www.mkhansen.com




*Brian G. Leib, WSU Extension Irrigation Specialist*

# MICRO-LOGGING IRRIGATION SYSTEM ON-TIME



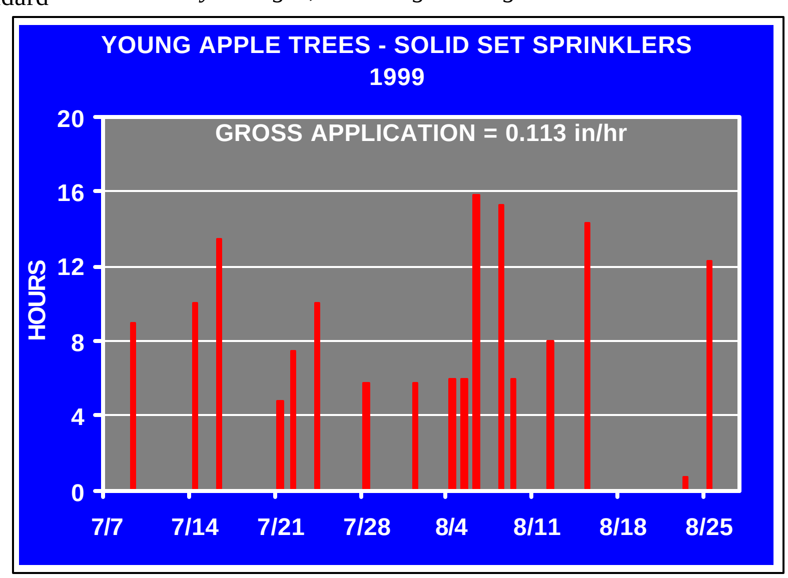
An inexpensive micro-processor and pressure switch ($125) were developed by Washington State University (WSU), Irrigated Agriculture Research and Extension Center to log the amount and frequency of irrigation (see Figure 1). Traditionally, irrigation is monitored with flow meters and raingages. However, flowmeters are expensive, intrusive, and require intense record keeping to detect the frequency of irrigation. Automated raingages can be data logged, and while they work well in many situations, they are limited in value when the crop canopy grows above the gage, fruit trees/weeds block the sprinkler pattern, and drip irrigation is used. Thus, the On-Time Micro-Logger was created to monitor irrigation improvements as part of the Scientific Irrigation Scheduling Project funded by the Northwest Energy Efficiency Alliance (NEEA).

The micro-logger consists of a custom designed printed circuit board, MICROCHIP (trade name) programmable CMOS 8 bit RISC micro-controller IC, real-time clock IC, RS232 communications IC, CMOS micro-power voltage regulator IC and 8k of non-volatile external ram. The logger is used in conjunction with a standard adjustable pressure switch, which is connected to the irrigation system as shown in Figure 2. The rise and fall of pressure in the irrigation system opens or closes the contacts of the pressure switch, which in turn generates an interrupt in the micro-logger. The interrupt is then date and time stamped and the logic transition (0 to 1 or 1 to 0) of the opening or closing contacts is recorded. The logger can store 250 irrigation events, and the expected life of the 9 volt battery is sixty days. The data can be downloaded via laptop with a terminal emulation program or with the user's preferred interface.

The On-Time Micro-Loggers were installed on 11 irrigation systems for producers who cooperated in the Scientific Irrigation Scheduling Venture. An example log is shown in Figure 3 for solid-set, irrigated apples grown at Olsen Brother's Orchard, Prosser, WA. These logs of irrigation on-time are helping WSU research and extension evaluate the usefulness of irrigation scheduling tools and the effectiveness of irrigation scheduling in conserving water, saving energy, increasing yield, improving crop quality, and reducing non-point pollution.

Even though the On-Time Micro-Logger was developed for use by WSU, it may also have some commercial applications. The On-Time Micro-Logger can be used like an inexpensive and easily installed flow meter to estimate the amount of water applied (multiply the logged hours of operation by the application rate). It can be used for water management to see how closely irrigation is matching crop-water use rates or to relate changes in soil moisture to application amounts. Finally, the On-Time Micro-Logger can verify the amount of water applied for cost sharing in the GWMA's Irrigation Scheduling Program or for meeting future environmental regulations.

*Brian G. Leib, WSU Extension Irrigation Specialist*
*Gary Matthews, WSU Engineering Tech*
*Marty Kroeger, WSU Engineering Tech*



## SOIL-MOISTURE SENSORS TO BE EXAMINED AT FIELD DAYS

Washington State University's Scientific Irrigation Scheduling Project has been comparing soil-moisture sensors in field trials over the last three growing seasons. The number of sensors being tested has grown as the number of sensors marketed in Washington increases. At present, we are working with tensiometers, Watermarks, CPN neutron probe, EnviroScan, Troxler Sentry 200, AquaFlex, Aqua-Tel, AquaPro, Grow-Point, Trime and Tektronix TDR. There will be several opportunities to see these sensors in Field Days around the State.

- The 28th International Carrot Conference, August 27 to 30, 2000. Contact Eric Sorenson, (509) 545-3511.
- Columbia Basin Onion Field Day, September 1, 2000. Contact Gary Pelter, (509) 754-2011.
- Yakima Tree Fruit Thinning and Water Management Field Tour, August 31, 2000. Contact Dana Faubion, (509) 574-1600.
- Mattawa Tree Fruit Variety and Water Management Tour, August ??, 2000. Contact Karen Lewis, (509) 346-1377.

You are invited to participate in the field days and increase your awareness of the soil-moisture monitoring systems available for your operation. Hope to see you at one of these events.

*Brian G. Leib, WSU Extension Irrigation Specialist*
*Gary Matthews, WSU Engineering Tech*

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