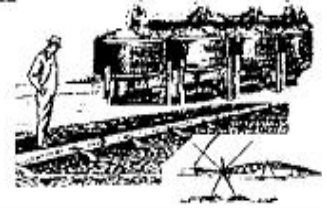




University of California Cooperative Extension

KERN SOIL AND WATER



Kern County • 1031 S. Mt. Vernon Ave • Bakersfield CA 93307 • Telephone: (661) 868-6218

Kern Irrigation Workshop

April 8, 2010

**IRRIGATION SCHEDULING in PERMANENT CROPS:
PROCESS, PLANNING, PROGRAMS & PRESSURE BOMB**

**UCCE Conference Room, 1031 S. Mt. Vernon Ave., Bakersfield 93307
(Just south of the Ag Commissioner's Office)**

Co-sponsored by North-West Kern RCD Mobile Irrigation Lab

Join Blake Sanden, Kern County UC Irrigation/Soils Advisor, Ken Shackel, Pomology UC Davis and the master of the pressure chamber, Brian Hockett, NW Kern RCD Mobile Irrigation Lab and some of the best farm/irrigation managers in Kern County to discuss the possibilities and pitfalls of irrigation scheduling in permanent crops. A variety of handouts will be provided, including weekly "normal year" crop water use for permanent crops, estimating soil moisture and plant stress (stem water potential, SWP) guidelines.

IRRIGATION SCHEDULING ESSENTIALS (Blake Sanden, Brian Hockett, Kern Growers, Industry Service Providers): 8:30 to 10:45 AM

- **Process:** Essential steps for implementing "scientific irrigation scheduling".
- **Planning:** Laying the foundation blocks and securing the information needed – soils, weather (CIMIS), crop coefficients, irrigation system components, monitoring ... the water budget. Getting the most efficiency out of your irrigation system.
- **Programs:** Spreadsheets, WaterRight, Oregon State Irrigation Management On-Line, PureSense. Most of the time will be spent looking at these programs and Kern County examples – from the simple to integrated whole farm "expert systems". Brief explanation of Irrigation Scheduling Products and Services by various commercial providers.
- **People:** What are Kern growers using? Why? Is the perfect system out there?

BREAK 10:45 – 11:00

USING THE PRESSURE BOMB FOR IRRIGATION SCHEDULING (Ken Shackel): 11:00 to 12:30

- **Principle:** What does the pressure bomb tell you? Factors causing plant water stress.
- **Premise:** Advantages and disadvantages of plant stress measurements compared to measurements of soil moisture. Should you use both, when?
- **Practice using the pressure bomb:** we will have 4 pressure bombs with gas tanks and at least 1 "hand pump" pressure chamber for you to practice your technique.

At first thought this sounds like a dumb question. Of course we need to schedule irrigations ... just like we schedule lunch; we get hungry, plants get thirsty. End of story. But how many of you skip lunch, or delay it? How often? If you're like some of us old agronomists that can't jump across the head ditch as easily as we used to and you look down and can't see as much of your feet as you did when you were 25 then you think, "Probably better if I skipped lunch anyway." Then you think on this idea even more and you say, "Well, I just aint gonna eat anything until I see this gut disappear." But we all know this is bad idea as we still need balanced nutrition regularly even if we do have some extra weight.

So before you think I'm completely out to lunch – here's the connection: if you don't irrigate until you see the crop stress you've waited too long. If you just keep irrigating every three days with microsprinklers (Hey, that's a schedule, right!?) from May to August without checking the soil/plant water status it's like eating that foot long sub sandwich every day for lunch and never stepping on the scale! Neither extreme is healthy for you or the crop.

In many ways the San Joaquin Valley has already been placed on a forced diet. A combination of hydrologic and "judicial" drought (The latter being restrictions of State and Federal Project pumping out of the Delta due to Endangered Species Act listing of the Delta Smelt.) has drastically cut the import of fresh water to the SJV over the last 3 to 5 years. Growers and water districts have responded by pumping more groundwater, buying "emergency pool" water and other market trades, improving field irrigation efficiency where possible and finally reducing applied water when they just don't have enough. Now, more than ever we need to know how to use available information and technology for optimal water use.

Process & Planning

Okay, so I need more than just a calendar to do the best job of irrigation. But what's this "scientific" thing? Does that mean I have to have a bunch of sensors, loggers and all that stuff? Not at all. In fact, the dictionary meaning of **science** is NOT 'using a bunch of gizmos/technology' but defined as: "**systematic knowledge of the physical or material world gained through observation and experimentation.**" Wow, sounds pretty close to the definition of a good farmer! Being **scientific** simply means being consistent in how you record and analyze your observations so that you can develop a system for making the best decisions. This is where gizmos/technology are helpful, as they are tools to collect and analyze data/observations. Some of the most useful gizmos are strictly mechanical.

You can actually do scientific scheduling with no electronics at all; just your hands, a soil probe/auger, regular walks through the field, a notebook and a flometer or weir to record your actual applied water. This was all we had 40 years ago. You don't even need a computer in the office! But most of us are farming too much acreage to know each field this intimately and we get tired of pounding/twisting soil probes and augers down to 5 feet. This is where electronic sensors, loggers and automated computer programs are helpful. These devices will automatically collect the data and can do the number crunching that saves you a lot of hand calculation. The only problem is that they're

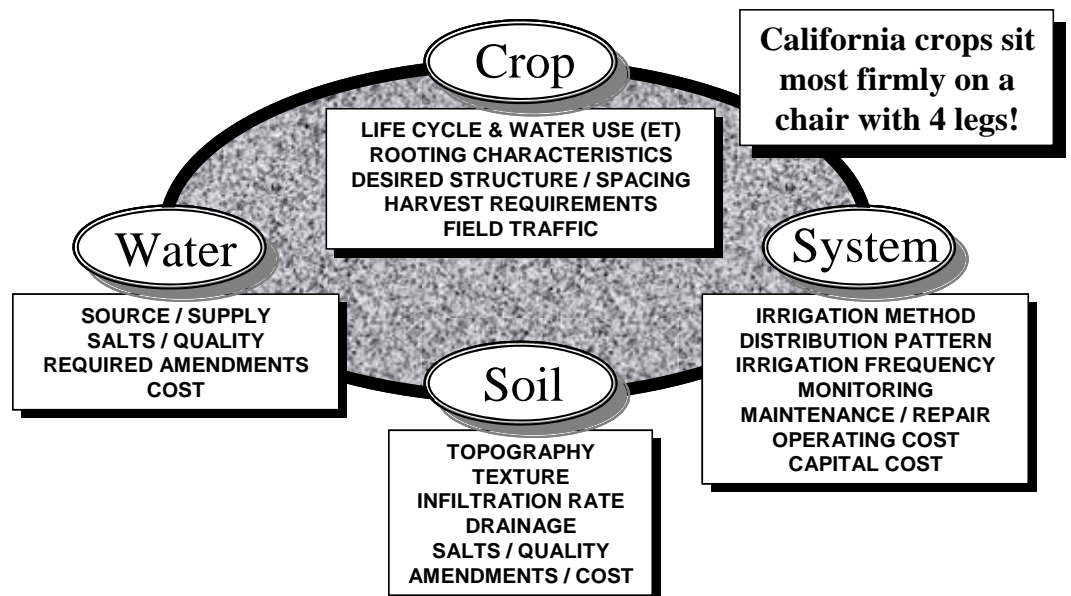


Fig. 1. Factors impacting crop production and irrigation scheduling / management.

dumb. They don't think, they're usually stuck in one location without the ability to "look around" at the rest of the block. Thus, it's possible to do "technified" irrigation scheduling (this is the term they like in South America) with all this technology without it being truly "scientific". In other words, you can collect a whole bunch of numbers but it's still up to the grower/manager to take those numbers and trends and turn it into systematic knowledge for truly optimal scheduling.

Figure 1 shows the multiple factors that need to be accounted for if you are going for top field performance. This looks complicated, but in reality most of these are fixed at the time you plant the orchard. Once you determine your soil water holding capacity and irrigation system design application rate, these will be fairly constant. Then the only in-season things that may vary and should be monitored are salinity in the rootzone and irrigation water (How good or bad is it?), soil/rootzone water content (How much is available, how fast are the plants using it?), irrigation frequency (How often?) and system uniformity (How even are my pressures, how often to flush hoses?) The salinity/quality factors are usually tested/treated once a year, unless you're injecting gypsum and/or acid. So once you've processed this data and planned the likely field logistics (i.e. vary irrigation hours to match daily/weekly need or vary onset of irrigation to match a set application say over 24 hours) it's just a matter of matching the volume water balance pieces together so you can ...

Program

These data can be put into a table such as shown in Table 1 or even one line of an Excel spreadsheet. You wouldn't think of buying a booster motor for your pump that didn't have the boiler plate specs on the casing. (Very similar to the 'boiler plate' of this Field 12-2.) But after 23 years of tromping the fields of Kern County I am still surprised by the number of growers and fields that don't have this simple yet critical information ready and easily accessible.

Table 1. Soil and irrigation system characteristics necessary for scheduling irrigations in mature almonds with 2, A-40 Fanjets per tree.

FIELD:	12-2		
SOIL TYPE:	Milham/Panoche sandy clay loam		
FIELD CAPACITY (in/ft):	2.4		
REFILL POINT (in/ft):	0.9	Total Avail @ 100% (in):	9
ROOTING DEPTH (ft):	6	AREA/TREE (sq ft):	504
ROW SPACING:	21' x 24'	DESIGN FLOW (gph/tree):	21.6
IRRIGATION SYSTEM:	2, 10.7 gph Fanjets	WET AREA APPLIC (in):	3.30
NORMAL RUN TIME (hrs):	24	NUMBER of SETS:	3
WETTED VOLUME (%):	50%	TOTAL AREA APPLIC (in):	1.65

Using this information along with expected "normal year" ET it's relatively straightforward to construct a simple water balance checkbook like the one below (which will be available at the workshop):

	FIELD CAPACITY (in/ft):	REFILL POINT (in/ft):	ROOTING DEPTH (ft):	ROW SPACING:	IRRIG. SYSTEM:	NORMAL RUN TIME (hrs):	WETTED VOLUME (%):	Total Avail @ 100% (in):	AREA/TREE (sq ft):	DESIGN FLOW (gph/tree):	WET AREA APPLIC (in):	NUMBER of SETS:	TOTAL AREA APPLIC (in):
Milham/Panoche sandy clay loam	2.6	0.9	6	21' x 24'	2, 10.7 gph Fanjets	24	50%	10.2	504	21.4	3.27	3	1.63
Week Ending:	6/15	6/22	6/29	7/6	7/13	7/20	7/27	8/3	8/10	8/17	8/24	8/31	9/7
"Avg" Almond ET:	1.99	2.09	2.11	2.14	2.14	2.06	2.05	1.97	1.95	1.87	1.79	1.71	1.60
Run Time to Refill for Week (hrs):	29.2	30.6	31.0	31.4	31.4	30.2	30.1	28.9	28.6	27.5	26.3	25.1	23.5
Actual Run Time (hrs):	24	24	24	48	24	36	Harvest	48	48	Harvest	24	24	24
Cumulative Surplus or Deficit (hrs):	-5.2	-11.8	-18.8	-2.2	-9.5	-3.7	-33.8	-62.7	-43.3	-22.8	-49.1	-50.2	-49.7
Estimated Soil Moisture Depletion (inches):	0.71	1.61	2.56	0.30	1.30	0.51	4.60	8.55	5.90	3.11	6.69	6.84	6.77
Estimated Soil Moisture (% available):	93%	84%	75%	97%	87%	95%	55%	16%	42%	70%	34%	33%	34%

There are plenty of irrigation scheduling aids/programs on-line. A Google search of “free irrigation scheduling programs” returns more than 80,000 hits. The list will make your head hurt – even before you start to use them. Links to a few of these sites that I have looked at and can recommend as completely free and sponsored by worthy organizations are below:

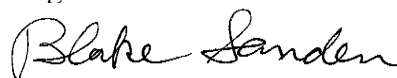
<http://www.cimis.water.ca.gov/cimis/infoIrrSoftware.jsp> Concise list of free and pay-for scheduling software. Some tutorials on basic scheduling. State of CA, Sacramento.

<http://www.wateright.org/> Checkbook type schedule, all on-line, mostly crop water demand based on CIMIS weather and standard crop coefficients. Cal State Fresno, CATI,

http://biomet.ucdavis.edu/irrigation_scheduling/bis/BIS.htm Multi-worksheet Excel file, completely downloadable, soil moisture estimation but no feedback adjustment. Most comprehensive list of crop coefficients. Calculator for estimating daily crop coefficients. Rick Snyder, UC Davis

<http://cesanjoaquin.ucdavis.edu/files/14724.xls> Simple one-page worksheet checkbook for winegrape irrigation scheduling.

<http://oiso.bioe.orst.edu/RealtimeIrrigationSchedule/index.aspx> Most complex of the extension type web-based scheduling programs. Has the capacity to create integrated whole ranch schedules. Difficult to use, but with some of the best “feedback” calculations.



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