

An Irrigation Crash Course: How to Calculate Your Orchard's Water Needs

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1-19-2011

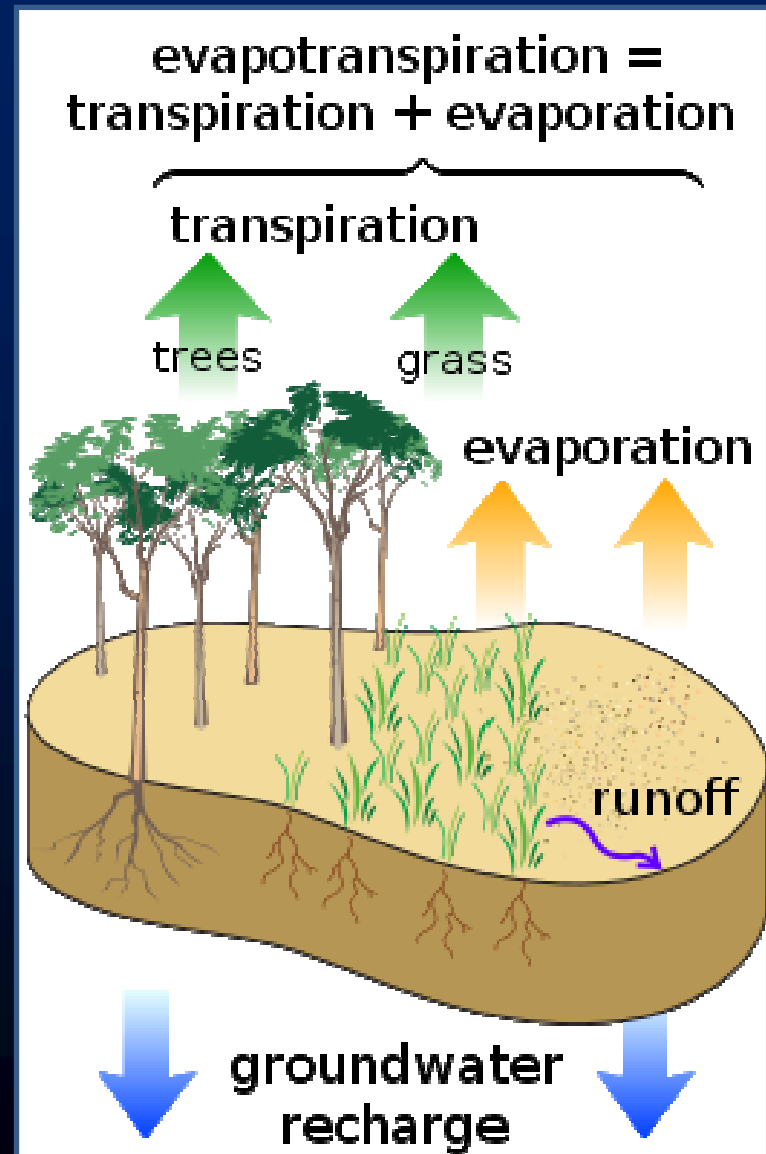
North San Joaquin Valley Almond Day

Oh No, another irrigation sermon...

- Increases Crop Yield, reduces shrivels
- Help ease harvest and reduce damage to trees
- Doesn't waste energy (Why pay PG&E more than we have too?)

Water Export of the Orchard

- Transpiration – needed for plant growth
- Evaporation – Due to environmental conditions
- Runoff/ Groundwater Recharge – Due to over-application



Two (official) ways to schedule irrigation

Apply water in an estimate to meet demand

1. Can use historical ET values for the San Joaquin Valley
2. Needs to be adjusted if under-applied
3. Over-application may be lost to deep percolation

Apply water to replace water used that week

1. Can use real time CIMIS ET values and calculate crop use
2. Can use historical ET values for the San Joaquin Valley
3. Over application may be lost to deep percolation

How do we calculate water use?

Evapo-transpiration of the reference crop (grass) **Known, Variable**



$$ET_c = ET_o \times k_c$$



Evapo-transpiration of the Crop of Interest (almonds)

Unknown

Crop Coefficient – ratio of water need of crop v/s water need of grass

Known, Fixed

How do we figure out Eto?

1). CIMIS

The screenshot shows a web browser window displaying the CIMIS (California Irrigation Management Information System) website. The browser's address bar shows the URL www.cimis.water.ca.gov/cimis/welcome.jsp. The website header features the California state logo and the text "CALIFORNIA THE GOLDEN STATE". Below this, the CIMIS logo is prominently displayed, along with the text "CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM" and "DEPARTMENT OF WATER RESOURCES OFFICE OF WATER USE EFFICIENCY".

The website has a navigation menu with the following items: WELCOME, INFO CENTER, CIMIS DATA, RESOURCE CENTER, MY CIMIS, and SPATIAL CIMIS. The main content area is divided into several sections:

- General:** Includes links for Events, System News, FAQs, and CIMIS Staff.
- Upcoming Events:** Lists events such as "CIMIS computer down", "New Feature - Email Scheduler", and "Non-ideal site study update".
- Current System News:** Reports on issues like "Station #123 Suisun Valley Removed", "Station #61 Orland Removed from Service", "Stn 159 Monrovia Communication Problem", and "Stn 186 UC San Luis Communication Problem".
- Sample FAQ:** Addresses questions like "What is CIMIS?" and "How does CIMIS work?".
- Welcome Section:** Provides a "CIMIS Overview" explaining that CIMIS is a program in the Office of Water Use Efficiency (OWUE) that manages a network of over 120 automated weather stations. It also lists "CIMIS Data Uses" and an "ET Overview" (Evapotranspiration).
- Right Side:** Features an advertisement "Irrigate like a Pro" with an image of apples, a "CIMIS System Status" section indicating a maintenance window on Wednesday from 02:00 to 04:00 PM, and a "REGISTER" section for "instant weather data access".

The browser's taskbar at the bottom shows several open applications, including Calculator, Microsoft Excel, and Mozilla Firefox. The system clock in the bottom right corner displays the time as 6:03 PM.

How do we figure out Eto?

1). CIMIS

The screenshot shows a web browser window displaying the CIMIS website. The browser's address bar shows the URL: www.cimis.water.ca.gov/cimis/frontDailyEToReport.do. The website header includes the California state logo and the text "CALIFORNIA THE GOLDEN STATE" and "CIMIS CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM DEPARTMENT OF WATER RESOURCES OFFICE OF WATER USE EFFICIENCY".

The main content area is titled "Daily ETo Variance" and includes a navigation menu on the left with sections: "Welcome Back David", "Quality Control", and "More Info". The "Daily ETo Variance" section contains a description: "The Daily ETo Variance provides a comparative report of ETo variance for selected station(s) and date range specified." and a "Note: Multiple selections can be made by holding down the 'Ctrl' or 'Shift' keys while making selections."

Under the "Stations" section, there are instructions: "Select a station(s) from the following categories. By default, only the checkbox for Active Stations is checked. Click on the checkboxes for Inactive Stations, Region, County, and Zip Code to see their respective selection boxes. Selecting a station(s) from these lists produces standard reports." Below this, there are checkboxes for "Active Stations" (checked), "Inactive Stations", "Stations by Region", "Stations by County", and "Stations by Zip Code".

A "Station List:" dropdown menu is open, showing a list of stations with their respective start dates:

- 2 - FivePoints, Since Jun/1982
- 5 - Shafter/USDA, Since Jun/1982
- 6 - Davis, Since Jul/1982
- 7 - Firebaugh/Telles, Since Sep/1982
- 8 - Gerber, Since Sep/1982
- 12 - Durham, Since Oct/1982
- 13 - Camino, Since Oct/1982
- 15 - Stratford, Since Oct/1982

The Windows taskbar at the bottom shows the Start button and several open applications: Calculator, CIMIS - [Dai..., Microsoft Ex..., Salt intro an..., Presentation2, Inbox - Mozill..., almond11 wit..., Doll Irrigatio..., and the system clock showing 6:05 PM.

What about the crop coefficient?

- Research has been done to determine this:

Almond Orchard Kc by Month	Dec/ Jan	Feb	Mar	Apr	May	June/Jul y/Aug	Sept	Oct	Nov
With cover Crop	0.85	0.85	0.85	0.95	1.05	1.15	1.10	0.90	0.85
Without Cover Crop	0	0	0.50	0.70	0.85	0.90	0.80	0.75	0.65

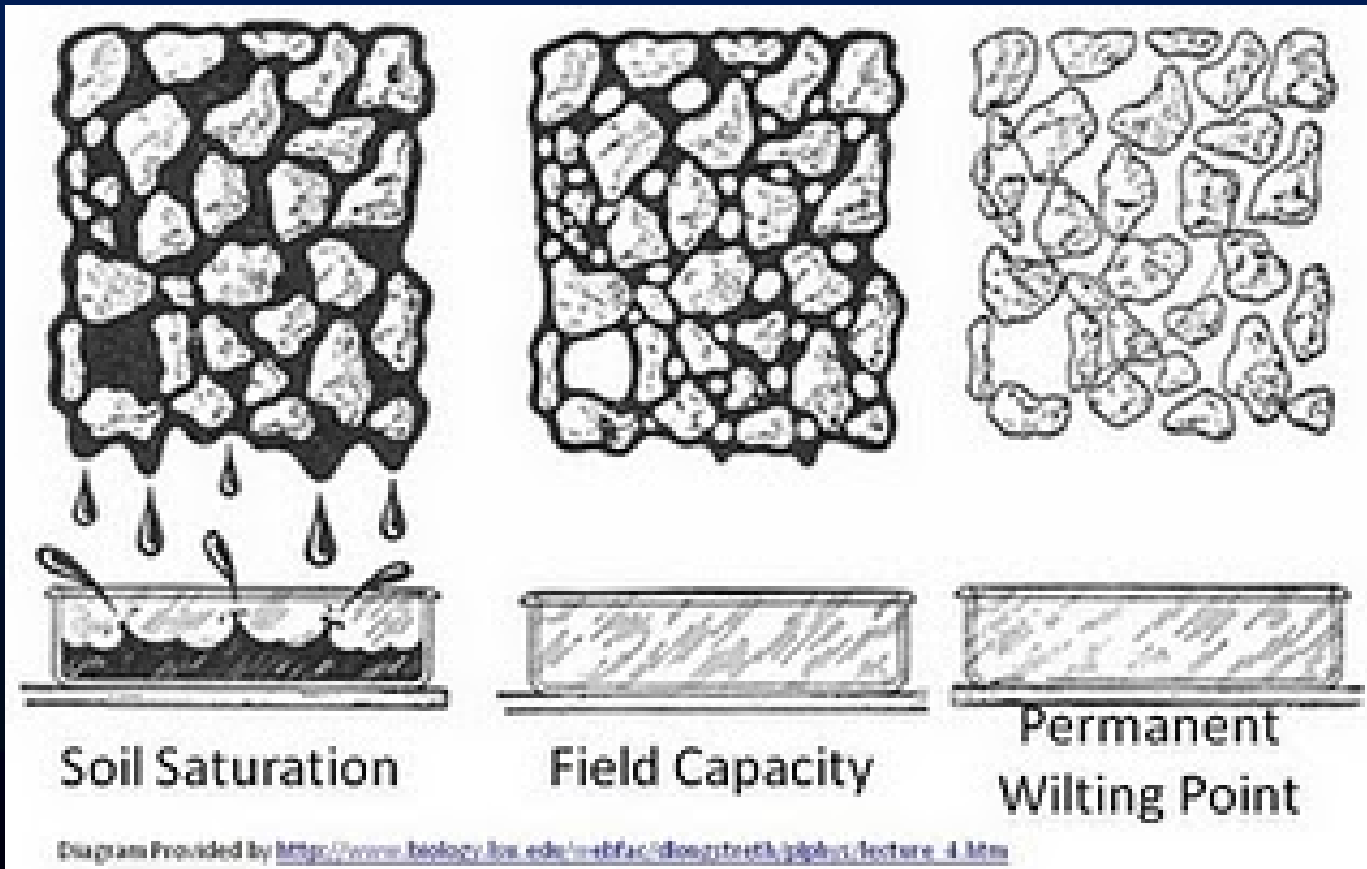
The Almond Production Manual, handout in the back

Calculating Orchard Water Use

Week	ETo for the week (Grass water use) provided by CIMIS	Almond Kc for the month of May (from table 1)	ETc for the week (water lost from the orchard)	Cumulative total of water use by the Almond Orchard w/ cover crop
May 1st-7th	1.65	1.05	1.74	1.74
8th - 14th	1.20	1.05	1.26	1.26 + 1.74 = 3
15th- 21st	1.39	1.05	1.46	3 + 1.46 = 4.46
22nd-28th	1.19	1.05	1.25	4.46 + 1.25 = 5.71
29th- 31st	0.72	1.05	0.76	5.71 + 0.76 = 6.47

That's it? Well...No

- Take into account water holding capacity



Water Holding Capacity

Type of Soil	Range (in/ft)	Average (in/ft)
Coarse (S /LS)	0.6-1.00	0.75
Sandy (LS /SL / L)	1.00-1.50	1.25
Medium (L /SCL)	1.25-2.2	1.50
Fine (SiL /SiCL / CL / SIC)	1.7-2.4	2.00

Importance of determining ROOTING PROFILE

Find info at: Local NRCS office, Online soil survey

Water Holding Capacity

Soil Surface	Soil Texture	Depth in Feet	Available Water Holding Capacity (From Table 3)	Available water in each soil layer (in)
1"-12"	Sand	1	0.6	0.6
13"-24"	Loamy Sand	1	0.8	0.8
25-42"	Sandy Loam	1.5	1.0	1.5
			Total:	2.9

Needs to be determined once in orchards life.


So, That has to be it? Well...No

- Take into irrigation system inefficiency

<u>System</u>	<u>Ea (%)</u>
Basin/Flood	65 - 80
Furrow	65-75
Solid Set Sprinkler	75-85
Micro-sprinkler	85-90
Drip	90-95

Slightly more water will be needed to ensure that the trees

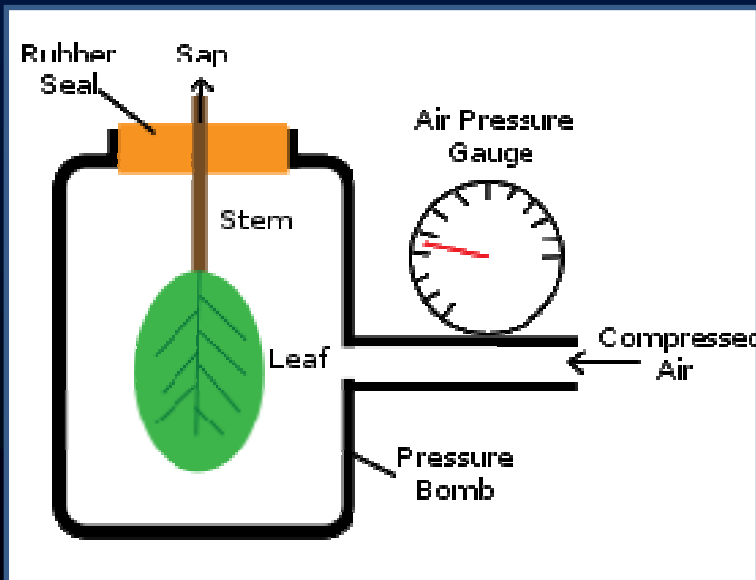
How do we calculate water use?

$$ET_c = \frac{ET_o \times k_c}{E_a}$$


If total more than WHC, than irrigate more frequently to match water applied with WHC

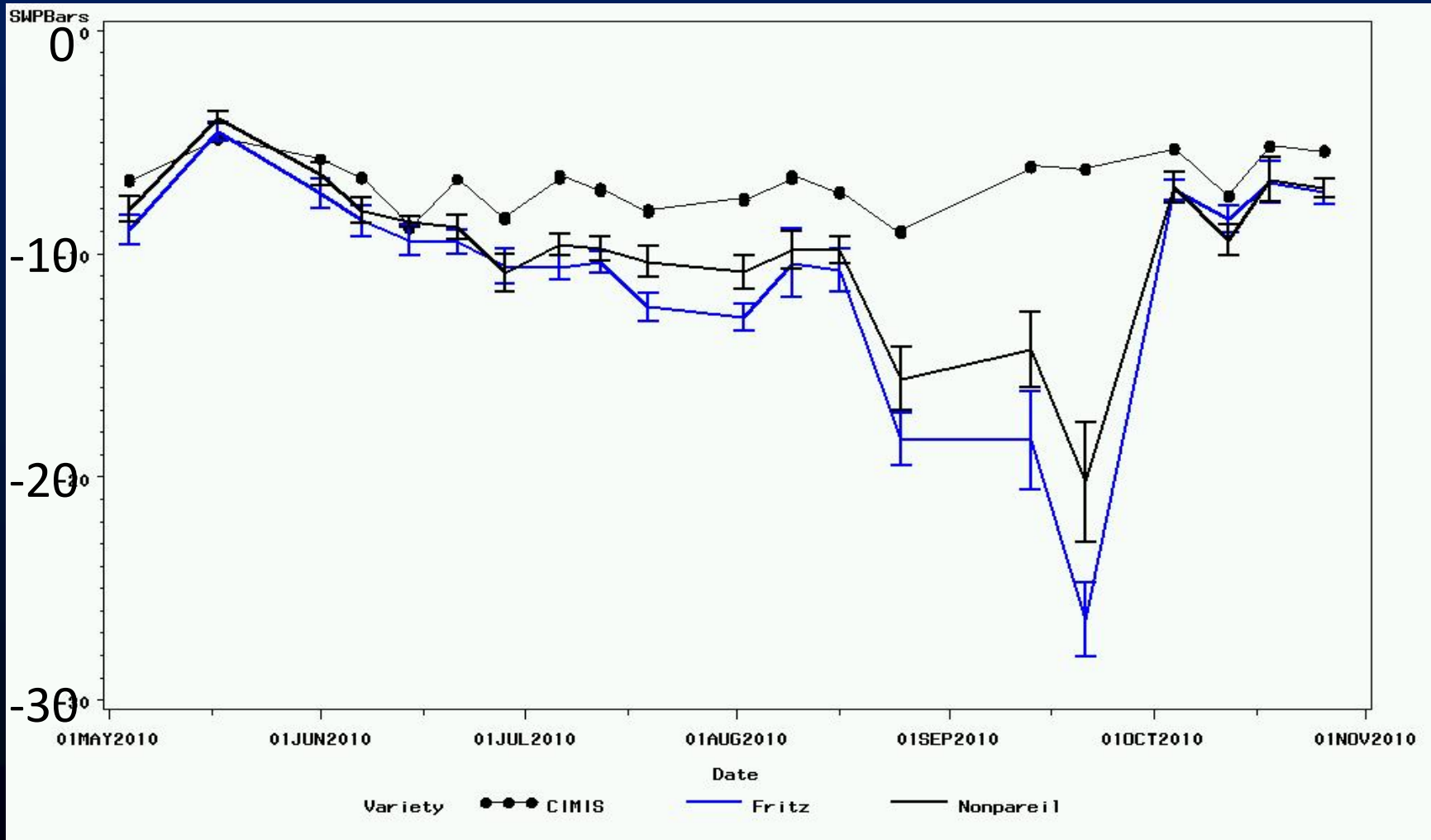
How much water should I be using?

- Use of pressure chamber
- Measured stem water potential

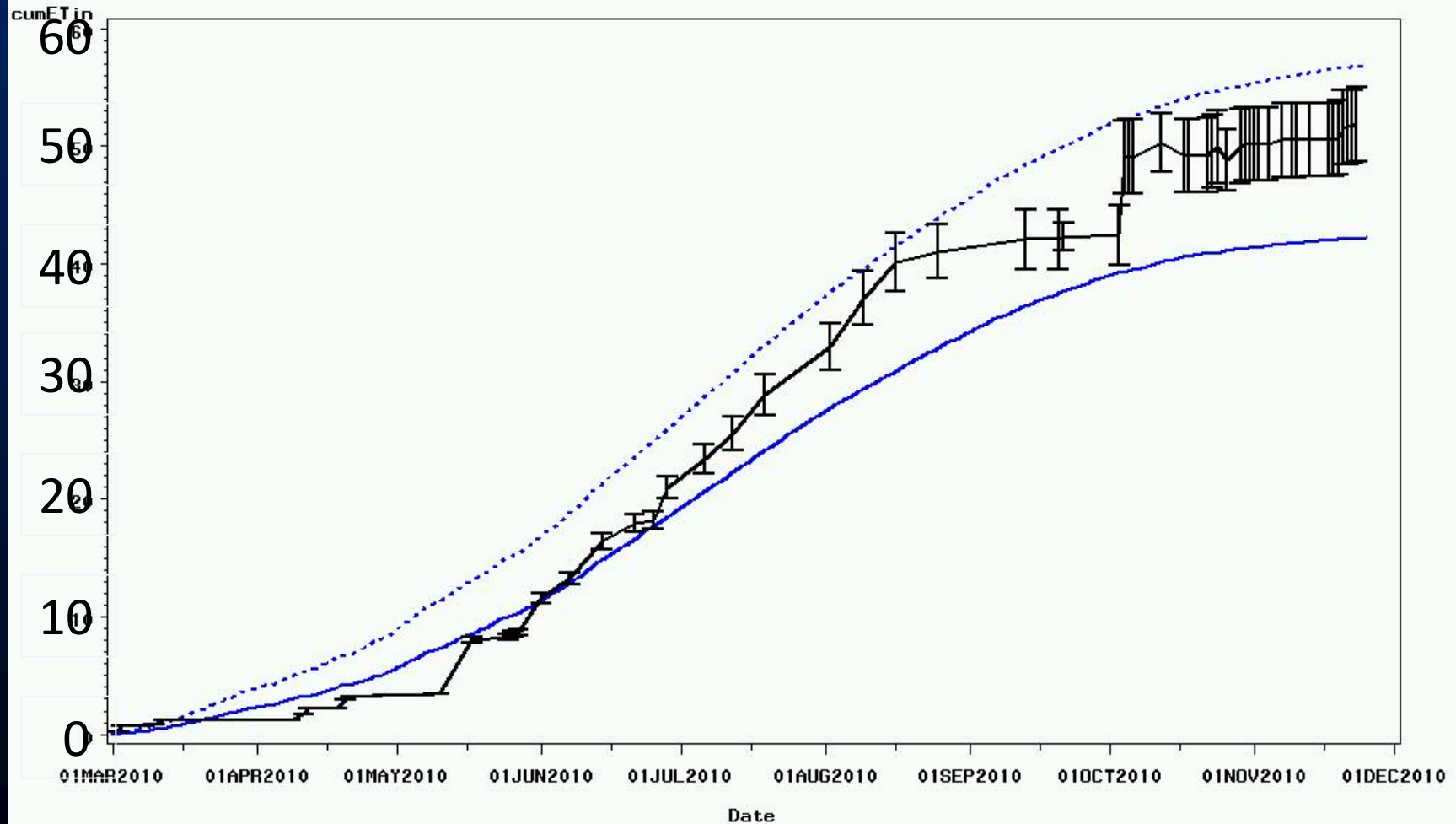


UC Recommendation: Irrigate when 2-3 bars below baseline

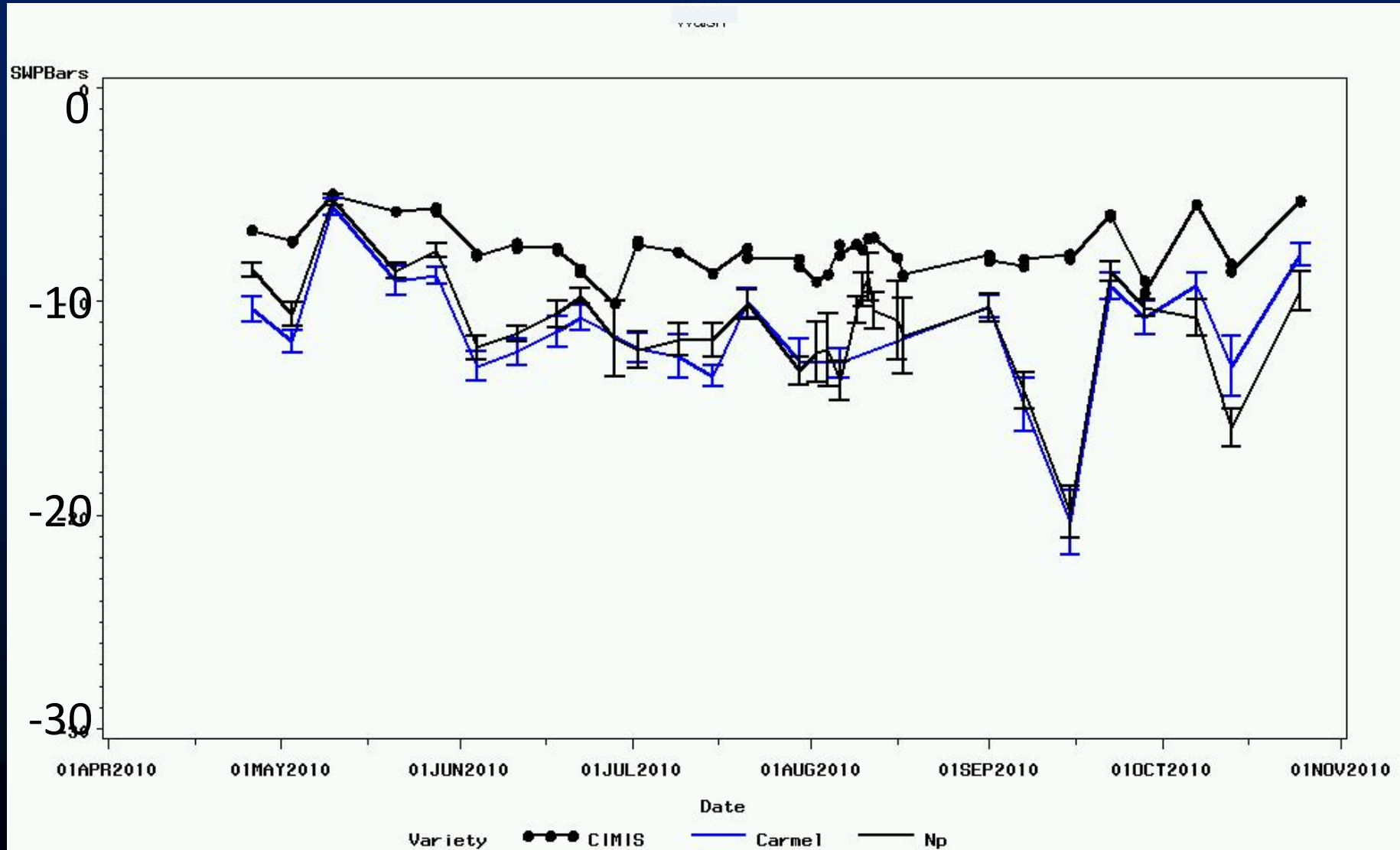
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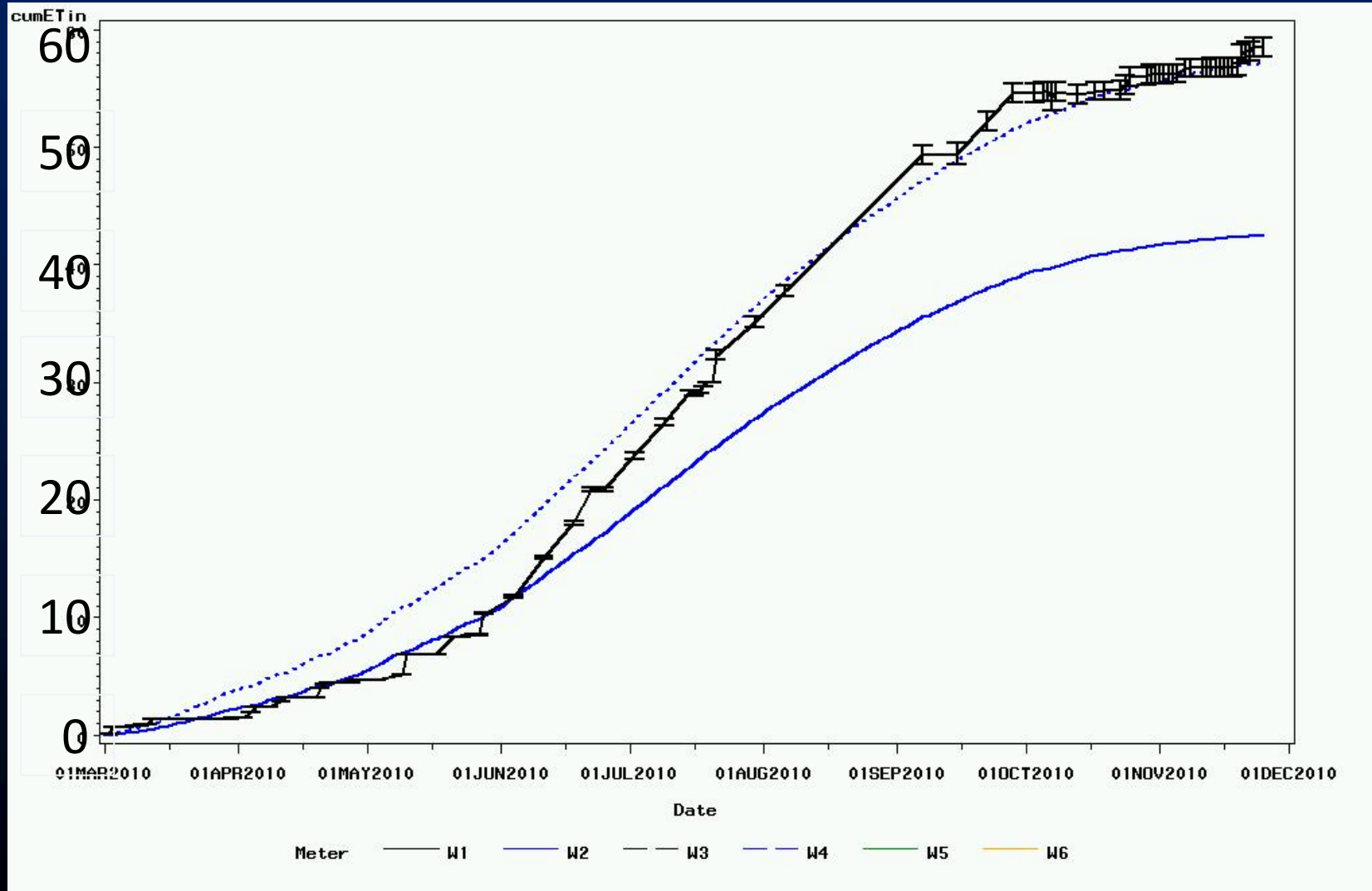
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How much water should I be using?



How much water should I be using?



Conclusions

- Remember: $E_{tc} = (E_{to} \times K_c) * E_a$
- Keep in mind your holding capacity of your soil
- Previously thought that trees only needed around 48 inches of water, looks like we need a little more
 - Following orchards with a pressure bomb indicated that this may not be true
 - Possibly due to larger crops, more vigorous trees
 - Research will determine if crop coefficients need to be updated

Handouts explaining the calculations are available on the table.

Questions?

Weekly almond update at

www.thealmonddoctor.com

Or just search: “The Almond Doctor”