

Early Season Water Management

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How do I irrigate?



When do I start?

How much do I irrigate?

How do I know it's working?

When do we start irrigating?



“Short answer: wait for the tree to tell you when it needs water.”

-Ken Shackel

Stem Water Potential



Pressure Chamber



Measures Tree Stress

Read between 1 and 3 pm

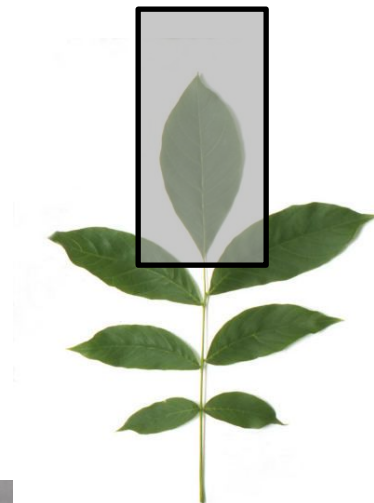
Based on baseline values for
each crop

Dependent on temperature and
relative humidity

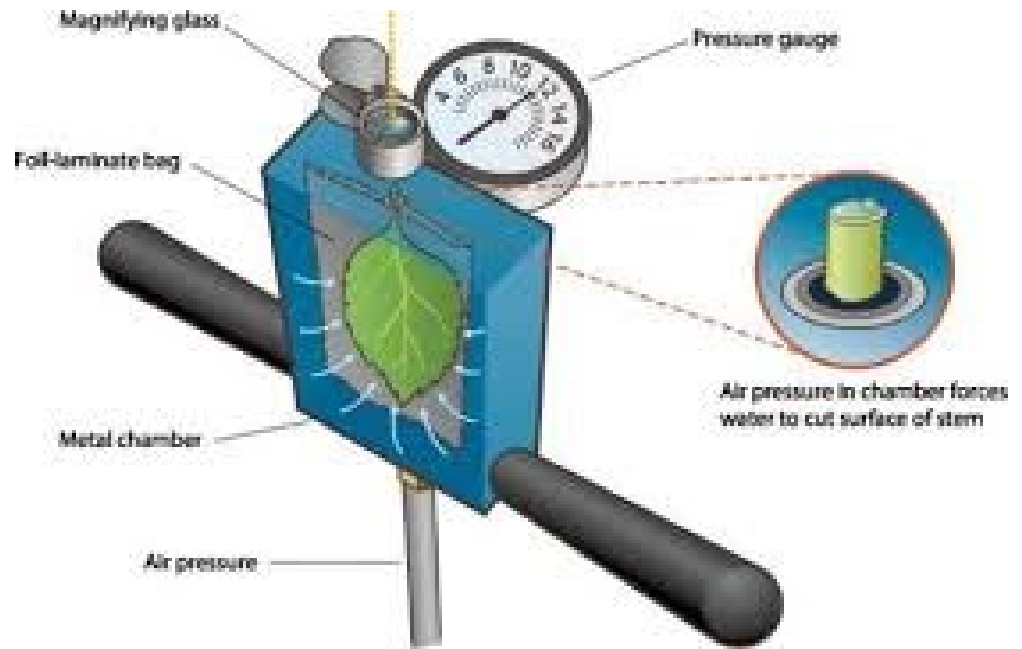
How do I work this thing?



Figure 3. Choose terminal leaflets that are in the lower canopy, nearest the trunk of the tree and bag for SWP measurement.



Stem Water Potential



<http://www.sacvalleyorchards.com>



Video courtesy of Cameron Zuber, UCCE

“Baseline”

UCCE University of California **AR** UNIVERSITY OF CALIFORNIA

Table 1. Values of midday stem water potential (SWP in Bars tension) to expect for fully irrigated walnut trees under different conditions of air temperature and relative humidity
(Table courtesy of Ken Shackel, Department of Pomology, University of California Davis)

Air Temp (F)	Air Relative Humidity															
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
60	-3.8	-3.7	-3.7	-3.6	-3.6	-3.5	-3.5	-3.4	-3.3	-3.3	-3.2	-3.2	-3.1	-3.1	-3.0	-2.9
62	-3.9	-3.8	-3.8	-3.7	-3.6	-3.6	-3.5	-3.4	-3.4	-3.3	-3.3	-3.2	-3.1	-3.1	-3.0	-3.0
64	-4.0	-3.9	-3.8	-3.8	-3.7	-3.6	-3.6	-3.5	-3.4	-3.4	-3.3	-3.2	-3.2	-3.1	-3.0	-3.0
66	-4.0	-4.0	-3.9	-3.8	-3.8	-3.7	-3.6	-3.5	-3.5	-3.4	-3.3	-3.3	-3.2	-3.1	-3.1	-3.0
68	-4.1	-4.1	-4.0	-3.9	-3.8	-3.8	-3.7	-3.6	-3.5	-3.5	-3.4	-3.3	-3.2	-3.2	-3.1	-3.0
70	-4.2	-4.1	-4.1	-4.0	-3.9	-3.8	-3.7	-3.7	-3.6	-3.5	-3.4	-3.3	-3.3	-3.2	-3.1	-3.0
72	-4.3	-4.2	-4.2	-4.1	-4.0	-3.9	-3.8	-3.7	-3.6	-3.6	-3.5	-3.4	-3.3	-3.2	-3.1	-3.0
74	-4.4	-4.3	-4.2	-4.2	-4.1	-4.0	-3.9	-3.8	-3.7	-3.6	-3.5	-3.4	-3.3	-3.2	-3.1	-3.1
76	-4.5	-4.4	-4.3	-4.3	-4.2	-4.1	-4.0	-3.9	-3.8	-3.7	-3.6	-3.5	-3.4	-3.3	-3.2	-3.1
78	-4.7	-4.6	-4.5	-4.4	-4.2	-4.1	-4.0	-3.9	-3.8	-3.7	-3.6	-3.5	-3.4	-3.3	-3.2	-3.1
80	-4.8	-4.7	-4.6	-4.5	-4.3	-4.2	-4.1	-4.0	-3.9	-3.8	-3.7	-3.6	-3.5	-3.3	-3.2	-3.1
82	-4.9	-4.8	-4.7	-4.6	-4.5	-4.3	-4.2	-4.1	-4.0	-3.9	-3.7	-3.6	-3.5	-3.4	-3.3	-3.1
84	-5.1	-4.9	-4.8	-4.7	-4.6	-4.4	-4.3	-4.2	-4.1	-3.9	-3.8	-3.7	-3.5	-3.4	-3.3	-3.2
86	-5.2	-5.1	-5.0	-4.8	-4.7	-4.5	-4.4	-4.3	-4.1	-4.0	-3.9	-3.7	-3.6	-3.5	-3.3	-3.2
88	-5.4	-5.2	-5.1	-4.9	-4.8	-4.7	-4.5	-4.4	-4.2	-4.1	-3.9	-3.8	-3.6	-3.5	-3.4	-3.2
90	-5.6	-5.4	-5.2	-5.1	-4.9	-4.8	-4.6	-4.5	-4.3	-4.2	-4.0	-3.9	-3.7	-3.6	-3.4	-3.2
92	-5.7	-5.6	-5.4	-5.2	-5.1	-4.9	-4.7	-4.6	-4.4	-4.3	-4.1	-3.9	-3.8	-3.6	-3.4	-3.3
94	-5.9	-5.7	-5.6	-5.4	-5.2	-5.0	-4.9	-4.7	-4.5	-4.4	-4.2	-4.0	-3.8	-3.7	-3.5	-3.3
96	-6.1	-5.9	-5.7	-5.6	-5.4	-5.2	-5.0	-4.8	-4.6	-4.4	-4.3	-4.1	-3.9	-3.7	-3.5	-3.3
98	-6.3	-6.1	-5.9	-5.7	-5.5	-5.3	-5.1	-4.9	-4.8	-4.6	-4.4	-4.2	-4.0	-3.8	-3.6	-3.4
100	-6.5	-6.3	-6.1	-5.9	-5.7	-5.5	-5.3	-5.1	-4.9	-4.7	-4.5	-4.2	-4.0	-3.8	-3.6	-3.4
102	-6.8	-6.6	-6.3	-6.1	-5.9	-5.7	-5.4	-5.2	-5.0	-4.8	-4.6	-4.3	-4.1	-3.9	-3.7	-3.4
104	-7.0	-6.8	-6.6	-6.3	-6.1	-5.8	-5.6	-5.4	-5.1	-4.9	-4.7	-4.4	-4.2	-4.0	-3.7	-3.5
106	-7.3	-7.0	-6.8	-6.5	-6.3	-6.0	-5.8	-5.5	-5.3	-5.0	-4.8	-4.5	-4.3	-4.0	-3.8	-3.5
108	-7.6	-7.3	-7.0	-6.8	-6.5	-6.2	-6.0	-5.7	-5.4	-5.2	-4.9	-4.6	-4.4	-4.1	-3.8	-3.6
110	-7.8	-7.6	-7.3	-7.0	-6.7	-6.4	-6.2	-5.9	-5.6	-5.3	-5.0	-4.7	-4.5	-4.2	-3.9	-3.6
112	-8.1	-7.8	-7.5	-7.2	-7.0	-6.7	-6.4	-6.1	-5.8	-5.5	-5.2	-4.9	-4.6	-4.3	-4.0	-3.7
114	-8.5	-8.1	-7.8	-7.5	-7.2	-6.9	-6.6	-6.3	-5.9	-5.6	-5.3	-5.0	-4.7	-4.4	-4.0	-3.7
116	-8.8	-8.5	-8.1	-7.8	-7.5	-7.1	-6.8	-6.5	-6.1	-5.8	-5.5	-5.1	-4.8	-4.4	-4.1	-3.8
118	-9.1	-8.8	-8.4	-8.1	-7.7	-7.4	-7.0	-6.7	-6.3	-6.0	-5.6	-5.3	-4.9	-4.5	-4.2	-3.8
120	-9.5	-9.1	-8.8	-8.4	-8.0	-7.6	-7.3	-6.9	-6.5	-6.1	-5.8	-5.4	-5.0	-4.6	-4.3	-3.9

Finding Baseline



Table 1. Values of midday stem water potential (SWP in Bars tension) to expect for fully irrigated walnut trees under different conditions of air temperature and relative humidity
 (Table courtesy of Ken Shackel, Department of Pomology, University of California Davis)

Air	Air Temperature (F)						Air Relative Humidity (%)						Air Temperature (F)					
Temp (F)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85		
60	-3.8	-3.7	-3.7	-3.6	-3.6	-3.5	-3.5	-3.4	-3.3	-3.3	-3.2	-3.2	-3.1	-3.1	-3.0	-2.9		
62	-3.9	-3.8	-3.8	-3.7	-3.6	-3.6	-3.5	-3.4	-3.4	-3.3	-3.3	-3.2	-3.1	-3.1	-3.0	-3.0		
64	-4.0	-3.9	-3.8	-3.8	-3.7	-3.6	-3.6	-3.5	-3.4	-3.4	-3.3	-3.2	-3.2	-3.1	-3.0	-3.0		
66	-4.0	-4.0	-3.9	-3.8	-3.8	-3.7	-3.6	-3.5	-3.5	-3.4	-3.3	-3.3	-3.2	-3.1	-3.1	-3.0		
68	-4.1	-4.1	-4.0	-3.9	-3.8	-3.8	-3.7	-3.6	-3.5	-3.5	-3.4	-3.3	-3.2	-3.2	-3.1	-3.0		
70	-4.2	-4.1	-4.1	-4.0	-3.9	-3.8	-3.7	-3.6	-3.5	-3.5	-3.4	-3.3	-3.3	-3.2	-3.1	-3.0		
72	-4.3	-4.2	-4.2	-4.1	-4.0	-3.9	-3.8	-3.7	-3.6	-3.6	-3.5	-3.4	-3.3	-3.2	-3.1	-3.0		
74	-4.4	-4.3	-4.3	-4.2	-4.1	-4.0	-3.9	-3.8	-3.7	-3.6	-3.5	-3.4	-3.3	-3.2	-3.1	-3.1		
76	-4.5	-4.4	-4.3	-4.3	-4.2	-4.1	-4.0	-3.9	-3.8	-3.7	-3.6	-3.5	-3.4	-3.3	-3.2	-3.1		
78	-4.7	-4.6	-4.5	-4.4	-4.2	-4.1	-4.0	-3.9	-3.8	-3.7	-3.6	-3.5	-3.4	-3.3	-3.2	-3.1		

Example: Day temperature is 74 degrees F, relative humidity is 40%

Ok, now what?

- 1 to 2 bars below baseline

- Previous studies have shown:
 - Walnut trees behave better when below baseline (more negative)
 - No significant differences in yield up to 2 bars below baseline

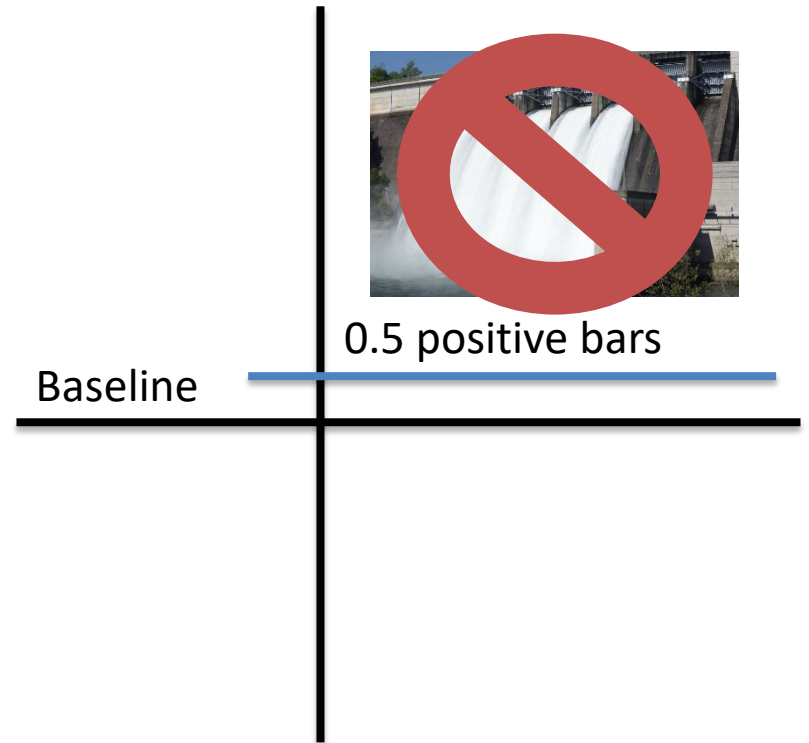


Example:

- Pressure chamber gauge reads -4.5 bars
- Baseline for given temp and RH is -4.0 bars
 - Do I irrigate or do I wait?

You Wait!

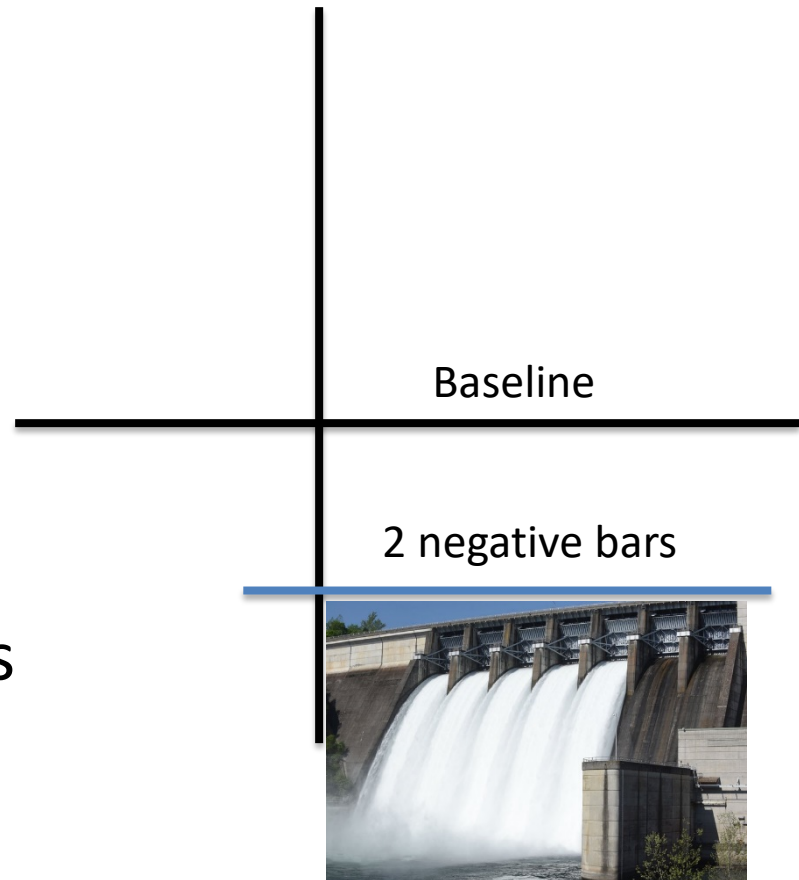
- $-4.5 - (-4.0) = (-0.5)$ bars from baseline



Come back to recheck....

- Pressure chamber gauge reads -6.5 bars
- Baseline for given temp and RH is -4.5 bars

$-6.5 - (-4.5) = (-2.0)$ bars
from baseline



How much water?

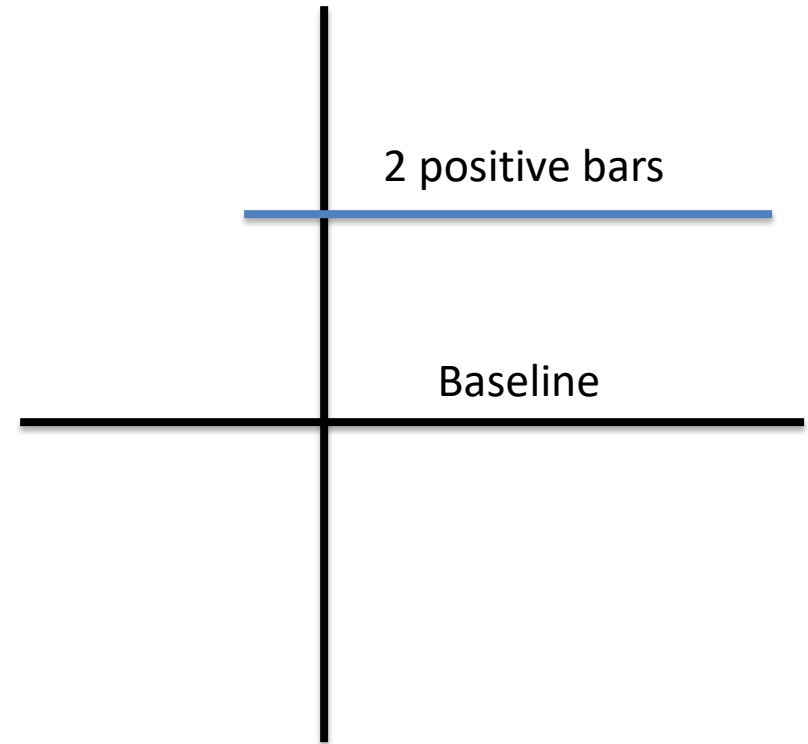
- Evapotranspiration estimates
- Weekly emails via UCCE
- Calculations provided by the Department of Water regulations (DWR)
- Use as a guide, not gospel
- Follow up with SWP measurements



WEEKLY CROP WATER USE - Based on local CIMIS Weather Stations (in inches) (Estimated Crop Evapotranspiration or ETC) 09/04/20 through 09/10/20									
Crops (Leafout Date)	#70 Manteca			#194 Oakdale			#206 Denair II		
	9/4-9/10 Water Use	Accum'd Seasonal Water Use	9/11-9/17 Estimated ETc	9/4-9/10 Water Use	Accum'd Seasonal Water Use	9/11-9/17 Estimated ETc	9/4-9/10 Water Use	Accum'd Seasonal Water Use	9/11-9/17 Estimated ETc
Almonds (3/1) *	1.37	39.37	1.27	1.40	38.35	1.34	1.49	39.95	1.32
Peaches (3/10) *	1.43	32.59	1.34	1.46	31.91	1.41	1.55	33.11	1.39
Walnuts (5/7) *	1.49	28.33	1.34	1.52	28.05	1.44	1.61	28.96	1.42
Vineyard Established (4/10)	1.24	27.69	1.13	1.27	27.31	1.20	1.34	28.28	1.18
Alfalfa (2/1)	1.25	42.84	1.20	1.28	41.41	1.27	1.36	43.11	1.25
Pasture (2/1)	1.30	44.26	1.20	1.33	42.76	1.27	1.41	44.54	1.25
Past 7 days precipitation (inches)		0.01		0.00			0.00		
Accumulated precipitation (inches)	(1/1/2020)	4.12		5.01			4.52		
Accumulations started on February 1, 2020 or on the approximate leafout date for a specific crop as indicated in parentheses. Criteria for beginning this report are based on the season's last significant rainfall event where the soil moisture profile is estimated to be near its highest level for the new season. * Estimates are for orchard/vineyard floor conditions where vegetation is managed by some combination of strip applications of herbicides, frequent mowing or tillage, and by mid and late season shading. Weekly estimates of soil moisture loss can be as much as 25 percent higher in orchards where cover crops are planted and managed more intensively for maximum growth.									
PAST WEEKLY APPLIED WATER IN INCHES, ADJUSTED FOR EFFICIENCY ¹									
Crops	#70 Manteca			#194 Oakdale			#206 Denair II		
	75%	85%	95%	75%	85%	95%	75%	85%	95%
System Efficiency >>	1.8	1.6	1.4	1.9	1.6	1.5	2.0	1.8	1.6
Almonds (3/1)	1.9	1.7	1.5	1.9	1.7	1.5	2.1	1.8	1.6
Peaches (3/10)	2.0	1.8	1.6	2.0	1.8	1.6	2.1	1.9	1.7
Walnuts (5/7)	1.7	1.5	1.3	1.7	1.5	1.3	1.8	1.6	1.4
Vineyard Established (4/10)	1.7	1.5	1.3	1.7	1.5	1.3	1.8	1.6	1.4
Alfalfa (2/1)	1.7	1.5	1.3	1.7	1.5	1.3	1.8	1.6	1.4
¹ The amount of water required by a specific irrigation system to satisfy evapotranspiration. Typical ranges in irrigation system efficiency are: Drip, 80%-95%; Micro-sprinkler, 80%-90%; Sprinkler, 70%-85%; and Flood, 50%-75%. For further information concerning this report, contact the University of California Cooperative Extension office in Stanislaus County at (209) 525-6800.									

Was the irrigation effective?

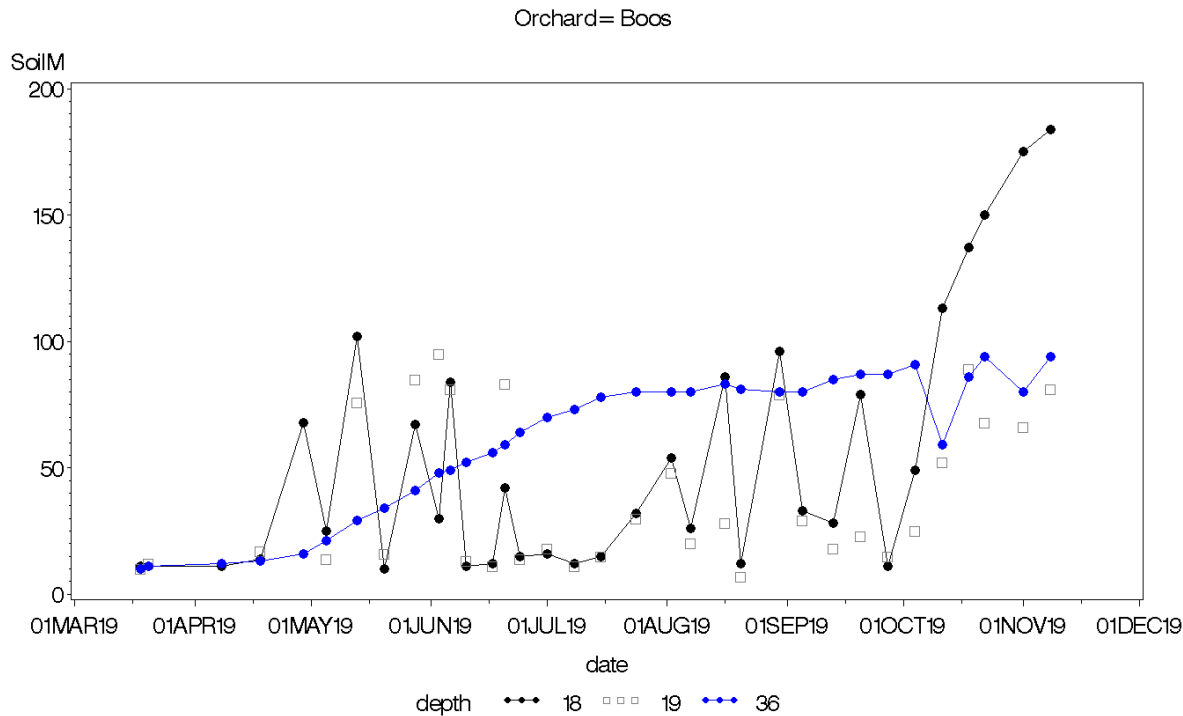
- Take SWP again
 - Example:
 - Pressure chamber gauge reads -2.5 bars
 - Baseline for given temp and RH is -4.5 bars
- $(-2.5) - (-4.5) = 2.0$ bars from baseline



What about Soil Sensors?

Tell you what's happening to the moisture....

....but not necessarily how/when to irrigate





2018



2019



2020



Delayed irrigation treatment

Thanks for your
support and
attention!



TM