Irrigation Management for California Walnut Production

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Potential ET = 42 acre – inches

Little or no effective rainfall

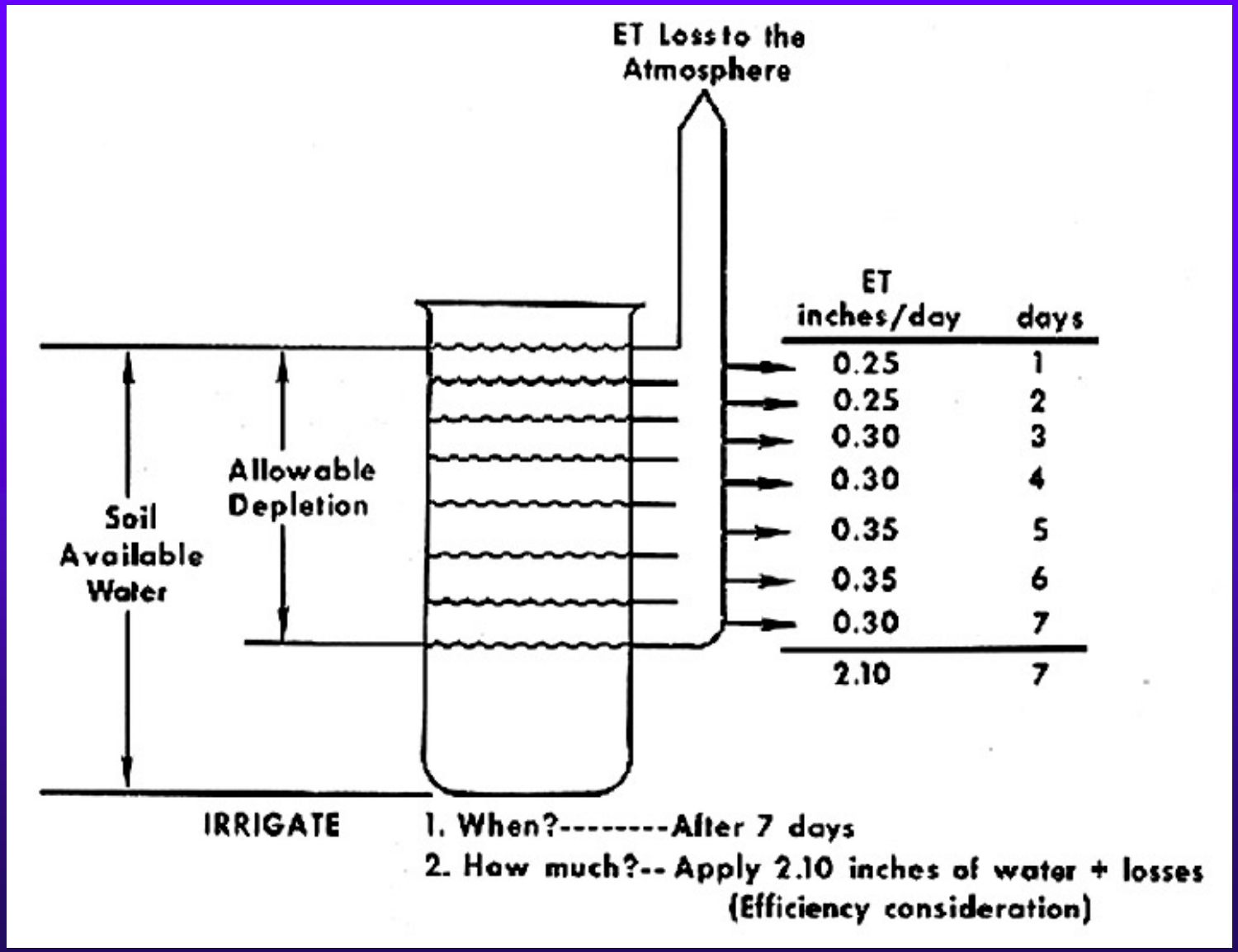
Nearly all California walnut acreage is irrigated

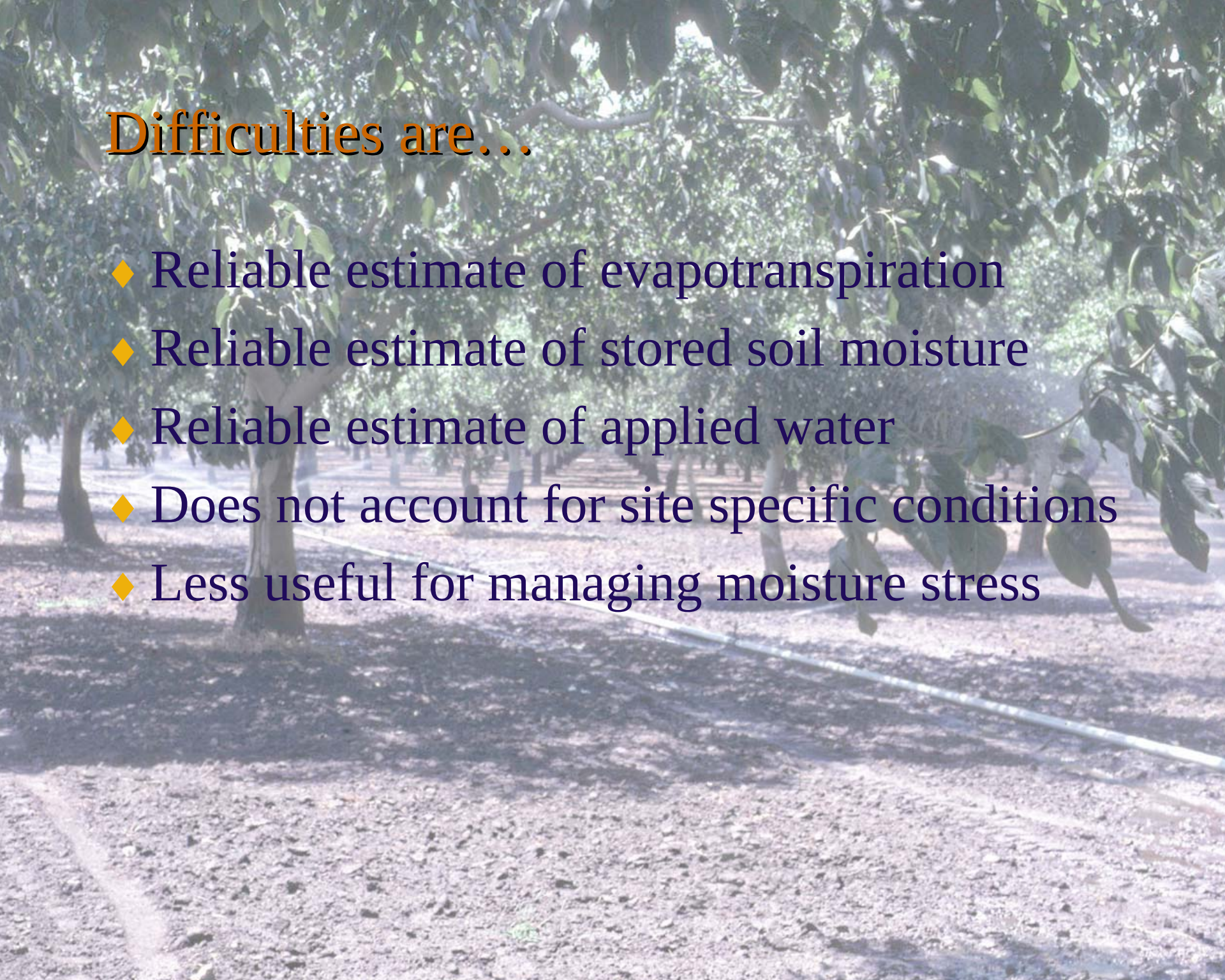
Soil Moisture Monitoring

Difficulties are…

- Measurement locations and depths are representative
- Correctly defining management thresholds
- Accurate equipment calibration

Water Balance or Budget Approach

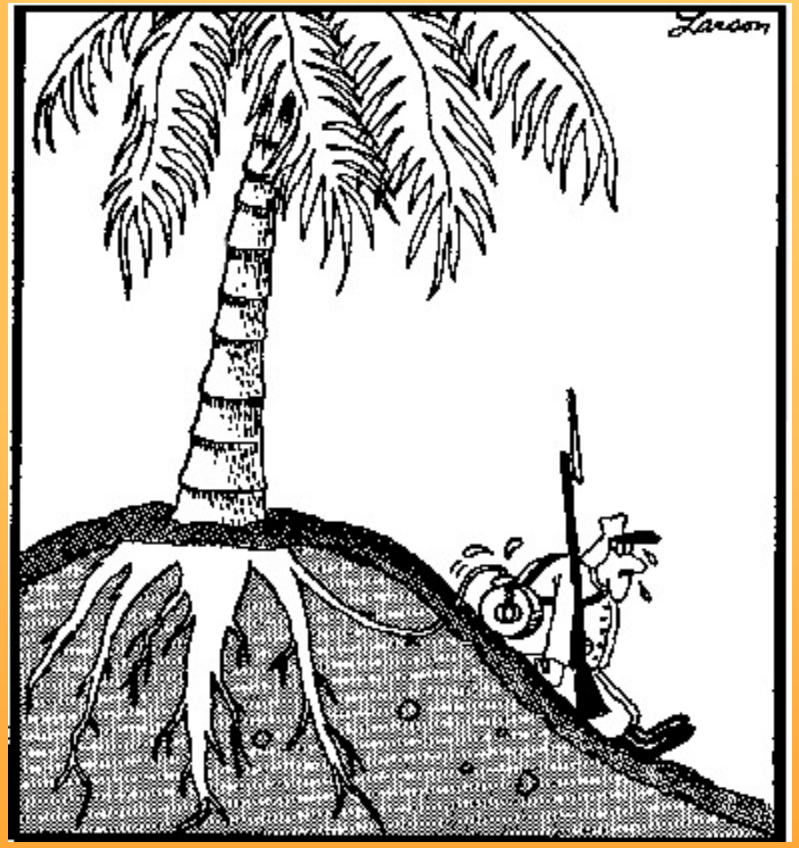




Difficulties are…

- Reliable estimate of evapotranspiration
- Reliable estimate of stored soil moisture
- Reliable estimate of applied water
- Does not account for site specific conditions
- Less useful for managing moisture stress

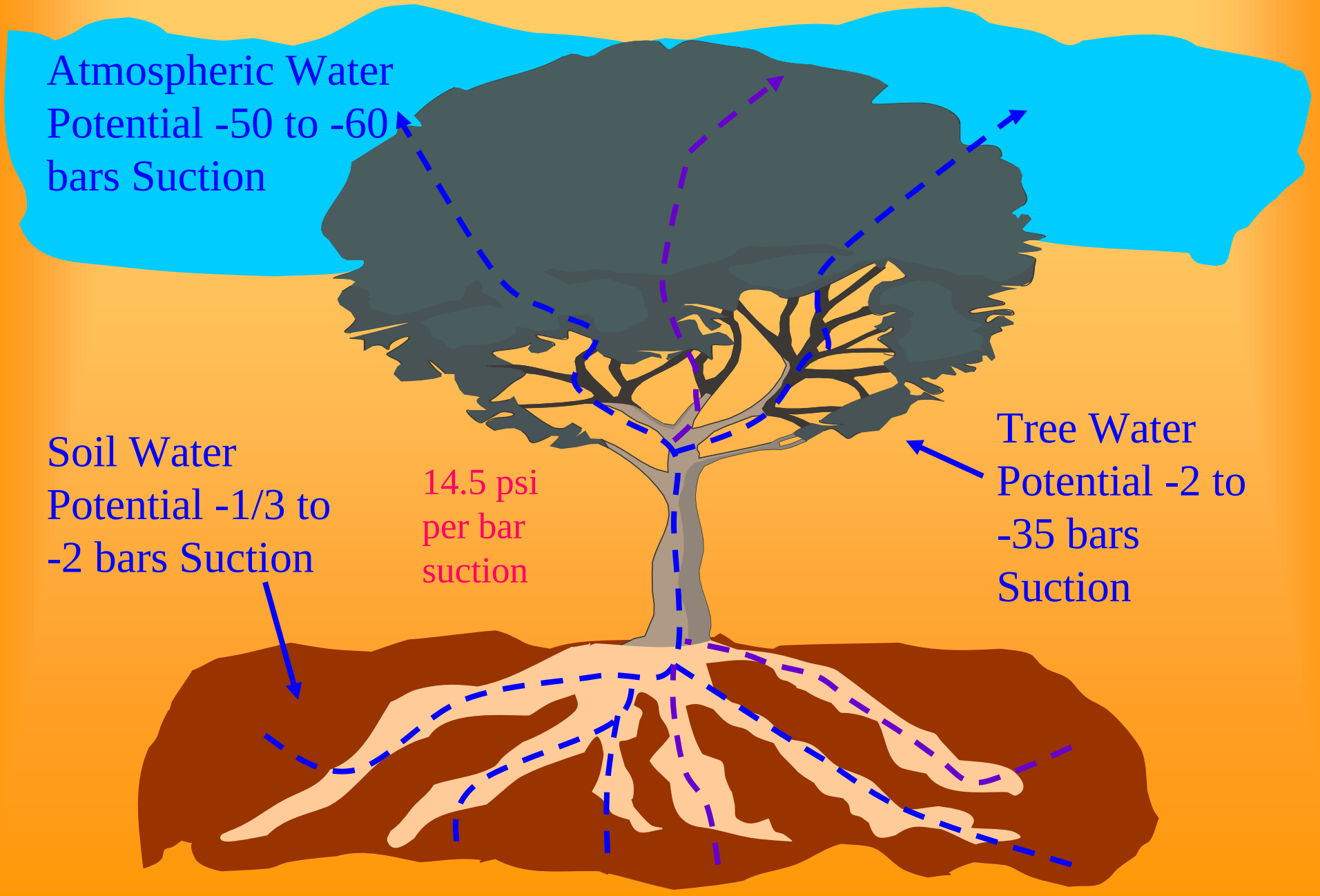
Why An Interest in SWP?



Where does a tree get its water and is all crop stress bad?

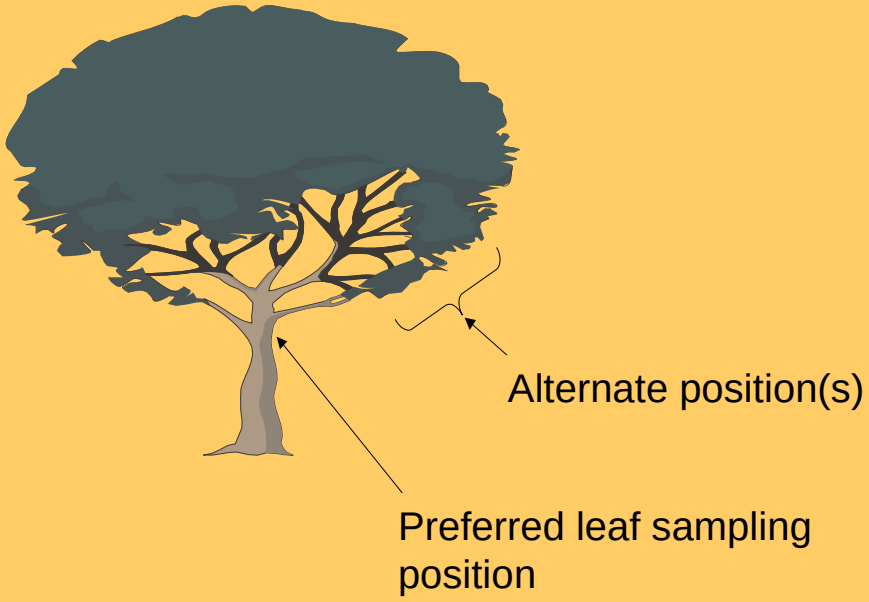
How well does regional weather and general estimates of crop ET fit specific orchard conditions? Is SWP an improvement?

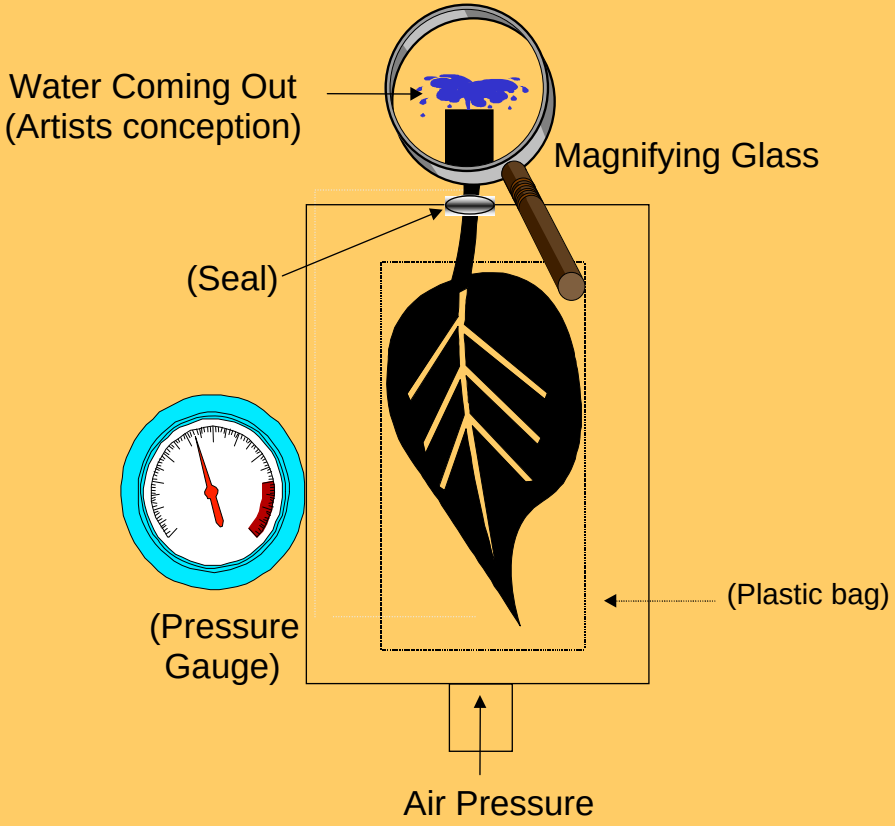
What is SWP Indicating?



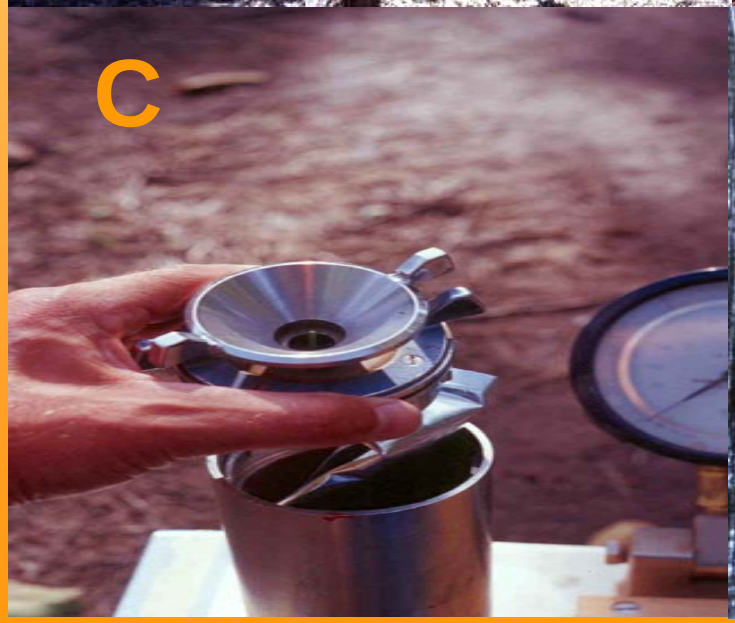
How is SWP Measured, Conceptually?

Plant based irrigation scheduling

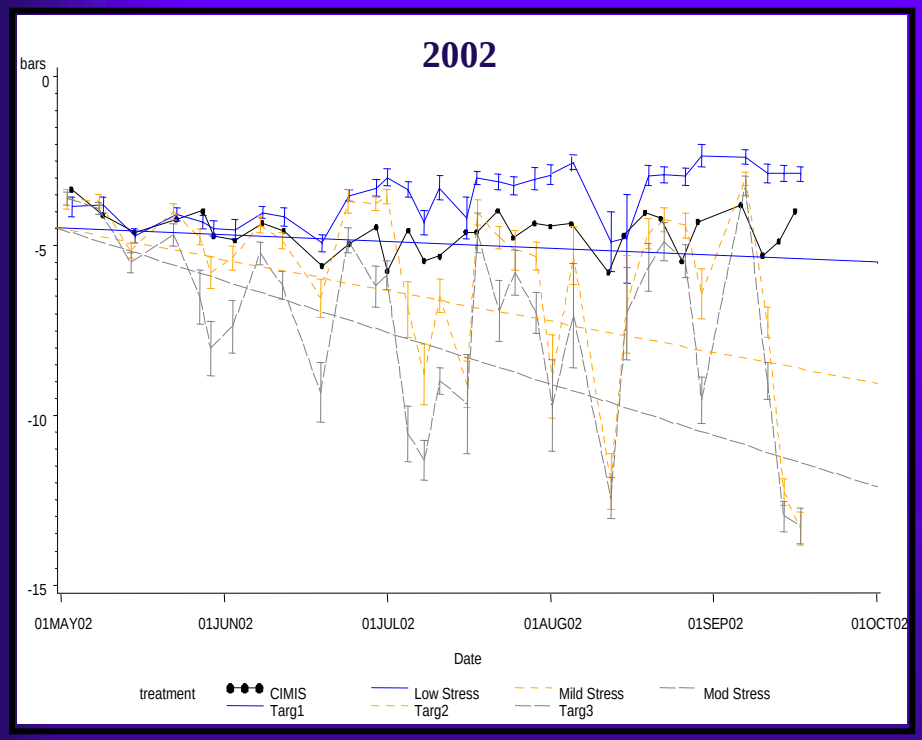


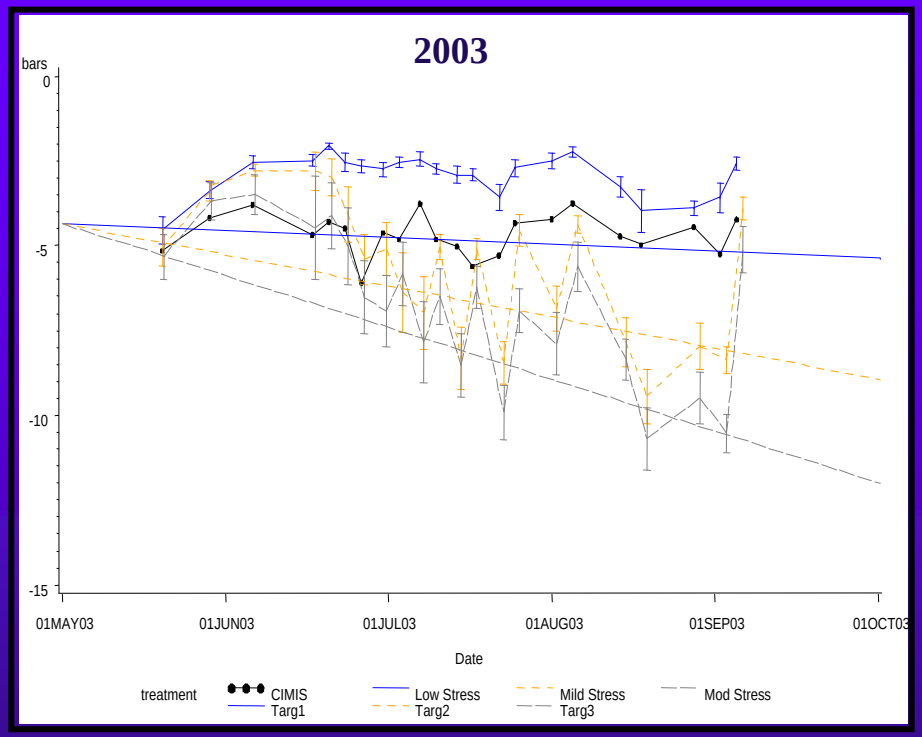


How is SWP Measured in the Field?

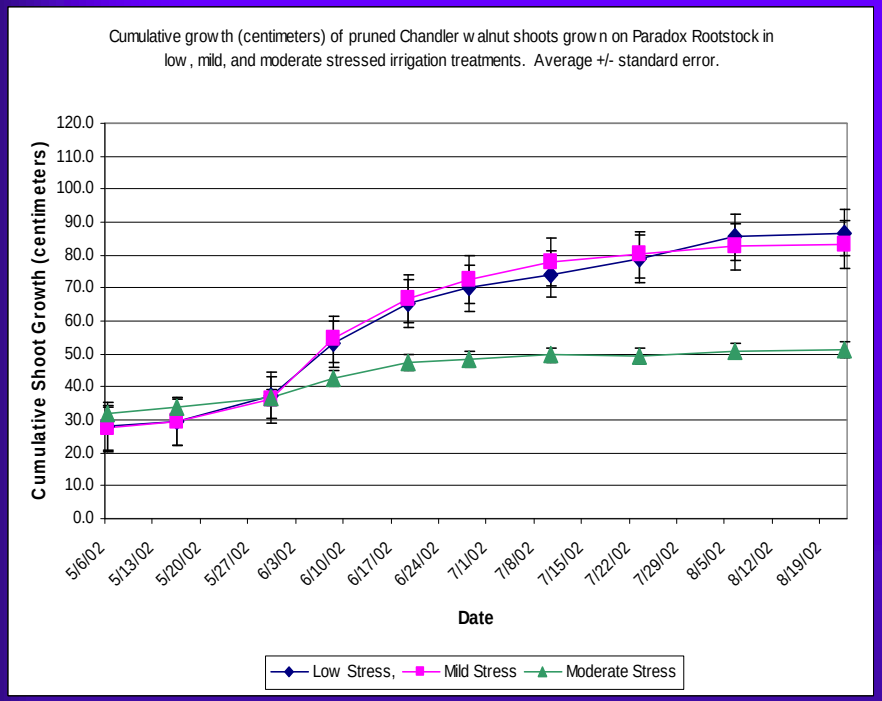


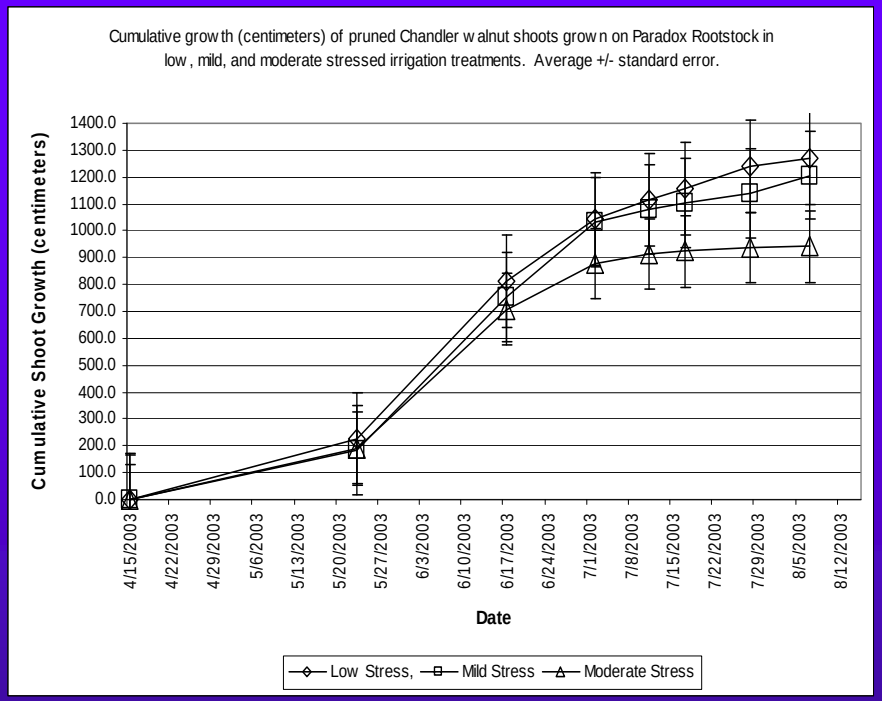
Black Butte Walnut Irrigation Trial



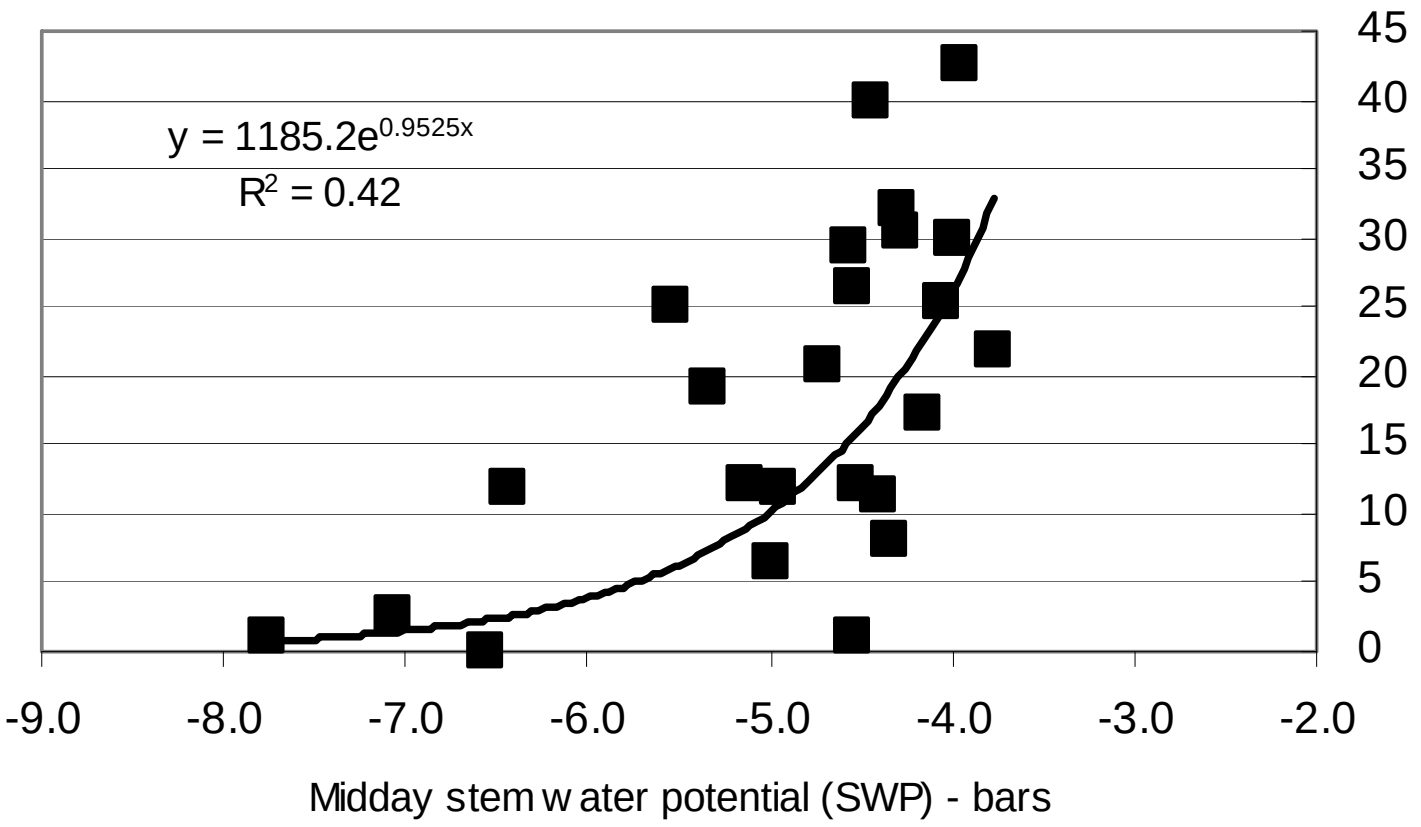


Shoot Growth

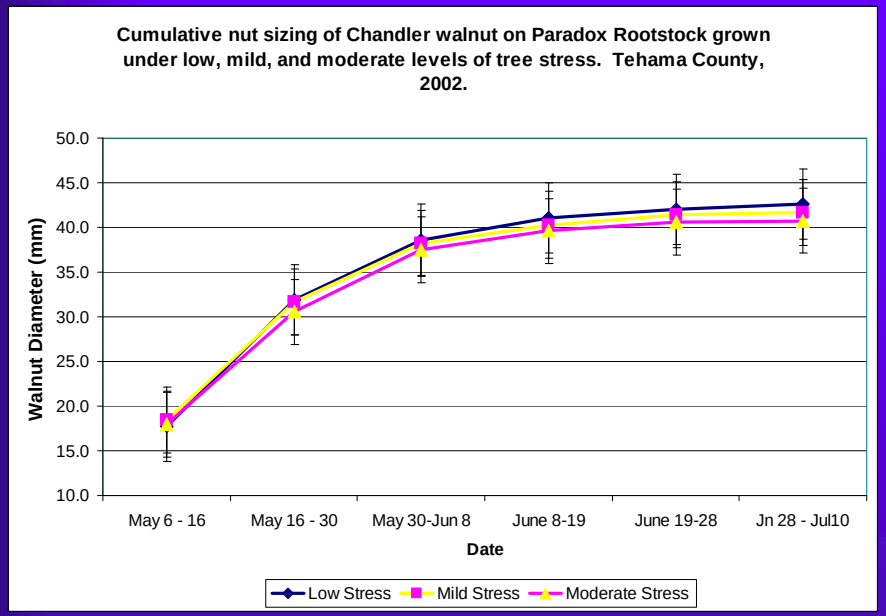


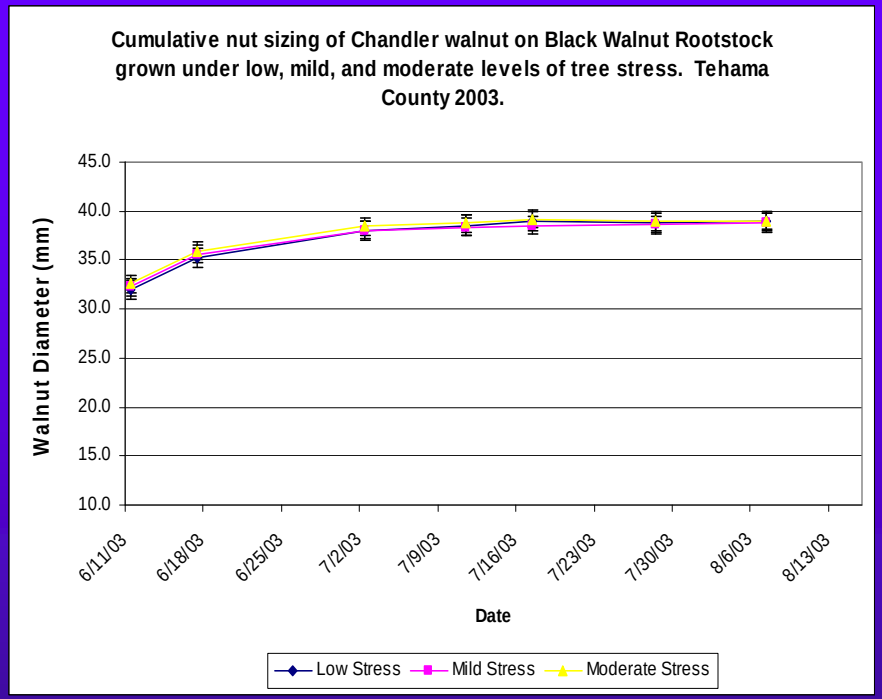


Correlation between shoot growth of pruned Chandler trees on Paradox rootstock and midday stem water potential



Nut Growth


Cumulative nut sizing of Chandler walnut on Paradox Rootstock grown under low, mild, and moderate levels of tree stress. Tehama County, 2002.
Walnut Diameter (mm)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
May 6 - 16
May 16 - 30
May 30-Jun 8
June 8-19
June 19-28
Jn 28 - Jul10
Date
Low Stress
Mild Stress
Moderate Stress


Cumulative nut sizing of Chandler walnut on Black Walnut Rootstock grown under low, mild, and moderate levels of tree stress. Tehama County 2003.
Walnut Diameter (mm)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
6/11/03
6/18/03
6/25/03
7/2/03
7/9/03
7/16/03
7/23/03
7/30/03
8/6/03
8/13/03
Date
Low Stress
Mild Stress
Moderate Stress

Tehama Quality and Yield

2002 Nut Quality and Yield for Stress Treatments

Treatment	% large	% mold	% insect	% shrivel	% adhering hull	RLI	Dry Wt. Yield (tons/ac)
Low	96.0 a	0.83 b	0.0 a	1.04 b	1.25 a	51.5 a	1.98 a
Mid	94.5 a	2.62 a	0.12 a	2.29 a	0.83 ab	51.3 a	1.84 a
Moderate	85.7 b	2.29 a	0.17 a	2.71 a	0.42 b	52.2 a	1.74 a
LSD	3.0	0.84	0.17	0.93	0.67	1.6	0.35

Reasons to Manage Stress in Walnut

- Sunburn/Shrivel
- Growth/Yield
- Frost Injury
- Tree Training
- Nut Size
- Pest Resistance
- Kernel Fill
- Kernel Color
- Black Husk/Mold
- Oil-less Nuts
- Codling Moth/ Husk Fly
- Mites

Interpreting SWP Measurements in Walnuts

SWP Reading (- bars)	
0 to –2.0	Not commonly observed
-2.0 to –4.0	Fully irrigated, low stress, commonly observed when orchards are irrigated according to estimates of real-time evapotranspiration (ETc), long term root and tree health may be a concern
-4.0 to –6.0	Low to mild stress, high rate of shoot growth visible, suggested level from leaf-out until mid June when nut sizing is completed
-6.0 to –8.0	Mild to moderate stress, shoot growth in non-bearing and bearing trees has been observed to decline especially with Black Walnut Rootstock. These levels do not appear to affect kernel development and may be appropriate during kernel development
-8.0 to –10.0	Moderate to high stress, shoot growth in non-bearing trees may stop, nut sizing may be reduced in bearing trees
-10.0 to –12.0	High stress, temporary wilting of leaves has been observed. New shoot growth may be sparse or absent and some defoliation may be evident. Nut size likely to be reduced.
-12.0 to –14.0	Relative high levels of stress, moderate to severe defoliation, should be avoided
-14.0 to –18.0	Severe defoliation, trees are likely dying