Water Management in Walnuts: Spotlight on Early Season

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Why spotlight early season water management?

Long term root and tree health

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Assortment of Leaf Symptoms Associated with Too Much Water

Photos courtesy of Bruce Lampinen, UC Statewide Orchard Systems Specialist

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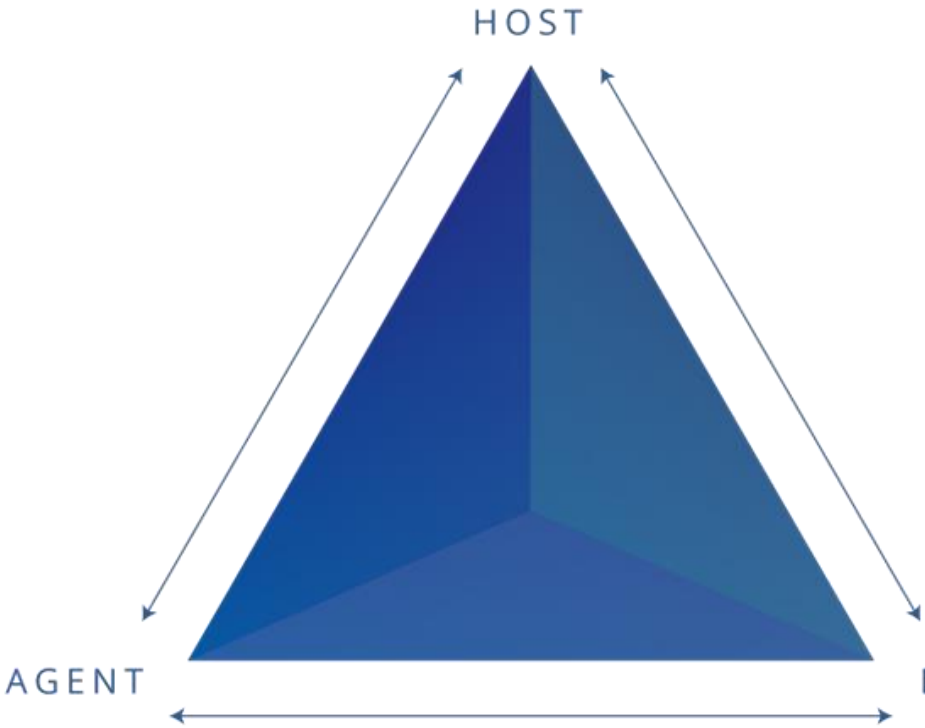
DISEASE TRIANGLE



Early Season Water Management

Influences Oxygen Levels and Soil Temperature in Root Zone

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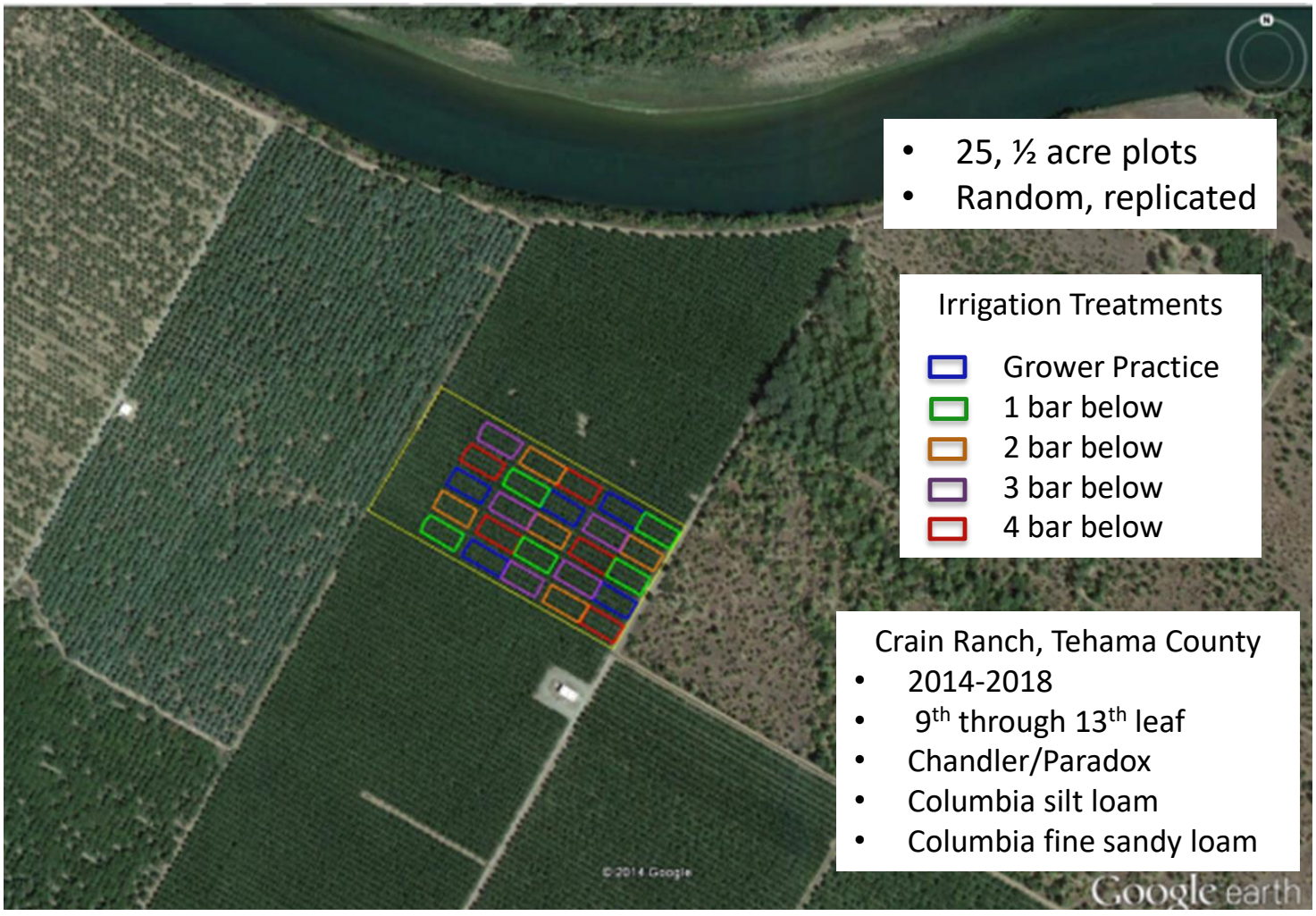
Project team

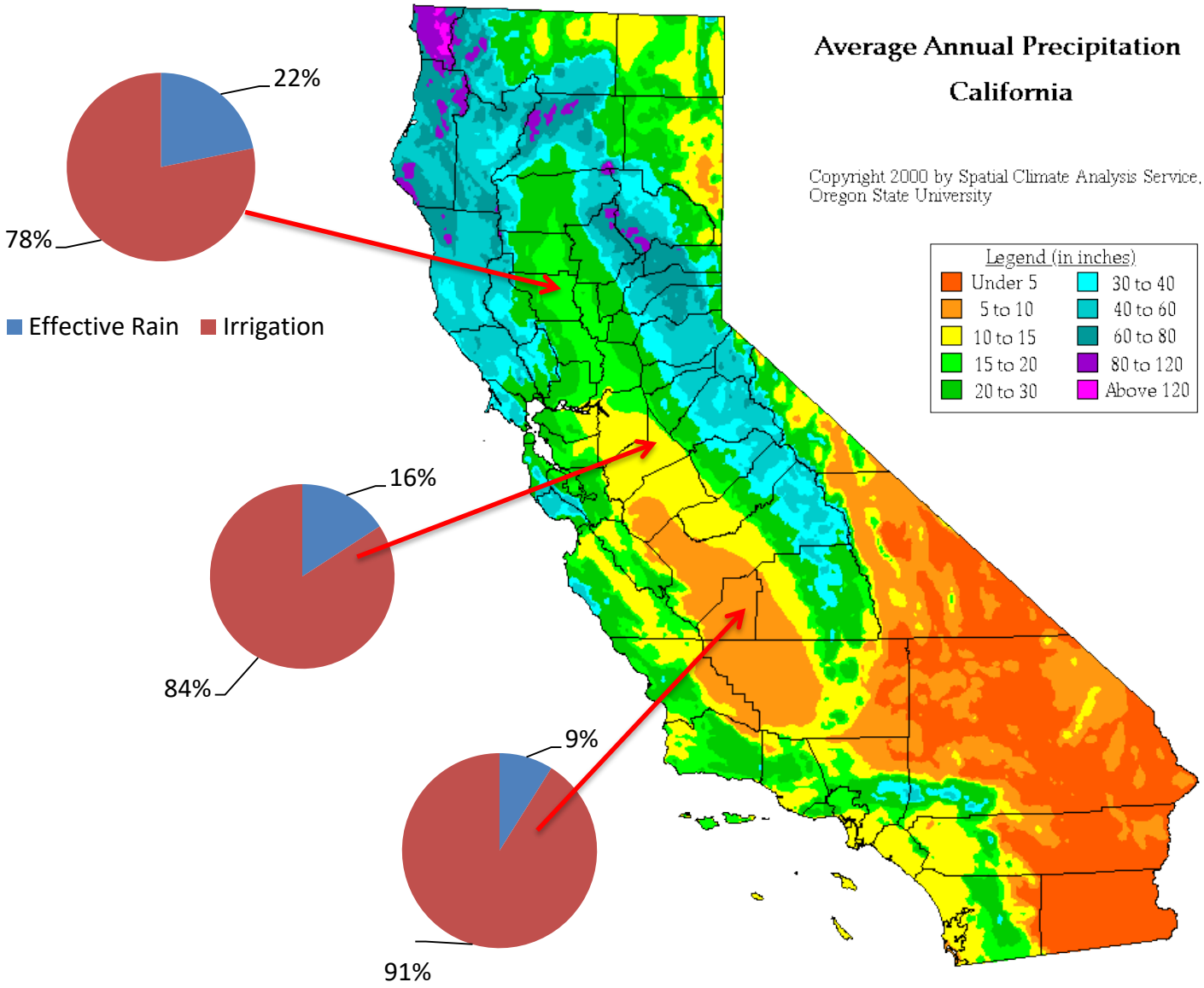
- Hal Crain, Crain Ranch
- Allan Fulton, UCCE, Tehama County
- Carol Haynes, UCCE, Tehama County
- Bruce Lampinen, UCCE, Davis
- Bob Mahoney, UCCE, Tehama County
- Sam Metcalf, UC Davis, Plant Sciences
- Ken Shackel, UC Davis, Plant Sciences

- Funded by California Walnut Research Board!

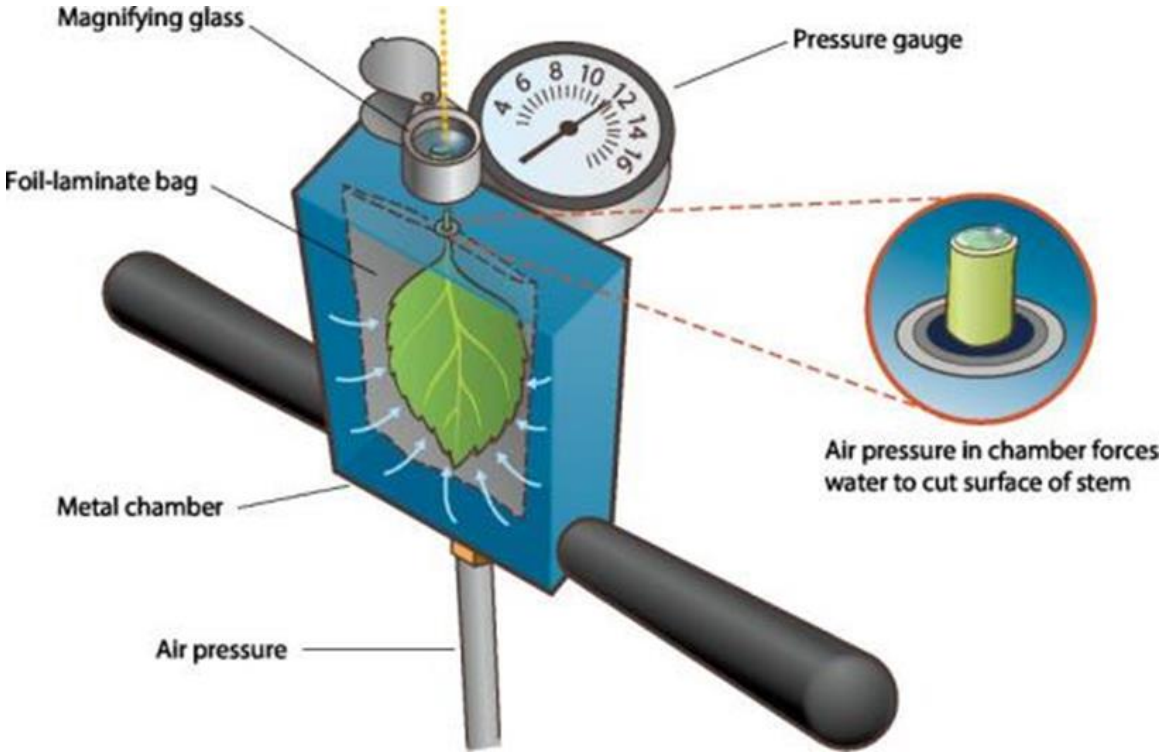
Field experimentation – maneuvering the start of irrigation season to learn about impacts



Amount and Timing of Winter Rainfall Influences Early Season Irrigation Decisions



Monitored tree water stress with a pressure chamber



Baseline SWP (bars) to expect for fully irrigated walnut trees under different conditions of air temperature and relative humidity.

Tempera -ture (°F)	Air relative humidity (RH, %)						
	10	20	30	40	50	60	70
75	-4.5	-4.3	-4.2	-4.0	-3.8	-3.6	-3.4
80	-4.8	-4.6	-4.3	-4.1	-3.9	-3.7	-3.5
85	-5.2	-5.0	-4.7	-4.4	-4.1	-3.9	-3.6
90	-5.6	-5.2	-4.9	-4.6	-4.3	-4.0	-3.7
95	-6.0	-5.7	-5.3	-5.0	-4.6	-4.3	-3.9
100	-6.5	-6.1	-5.7	-5.3	-4.9	-4.5	-4.0
105	-7.2	-6.7	-6.2	-5.7	-5.2	-4.8	-4.3
110	-7.8	-7.3	-6.7	-6.2	-5.6	-5.0	-4.5
115	-8.7	-8.0	-7.4	-6.7	-6.0	-5.4	-4.8

http://informatics.plantsciences.ucdavis.edu/Brooke_Jacobs/introduction.html

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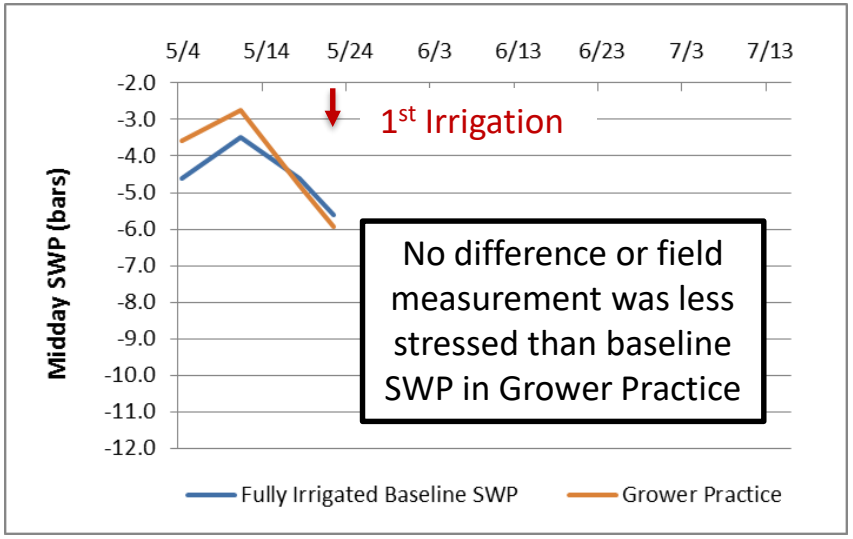
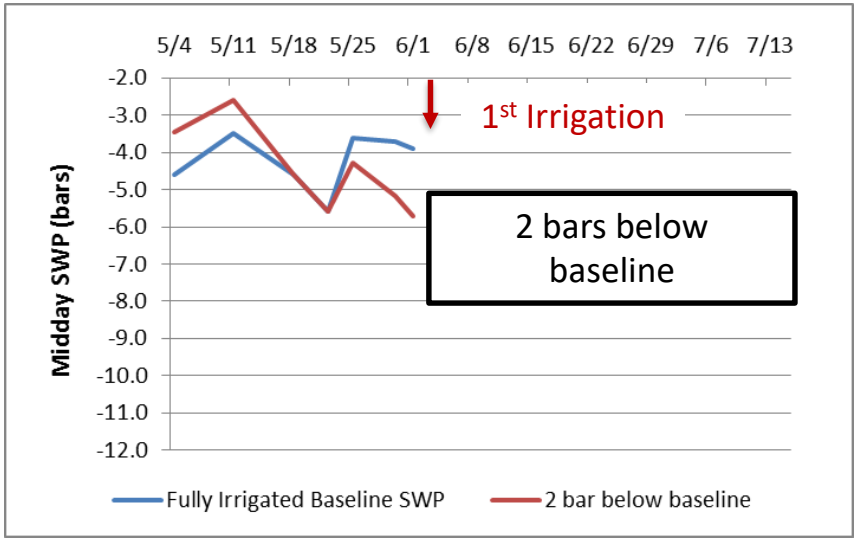
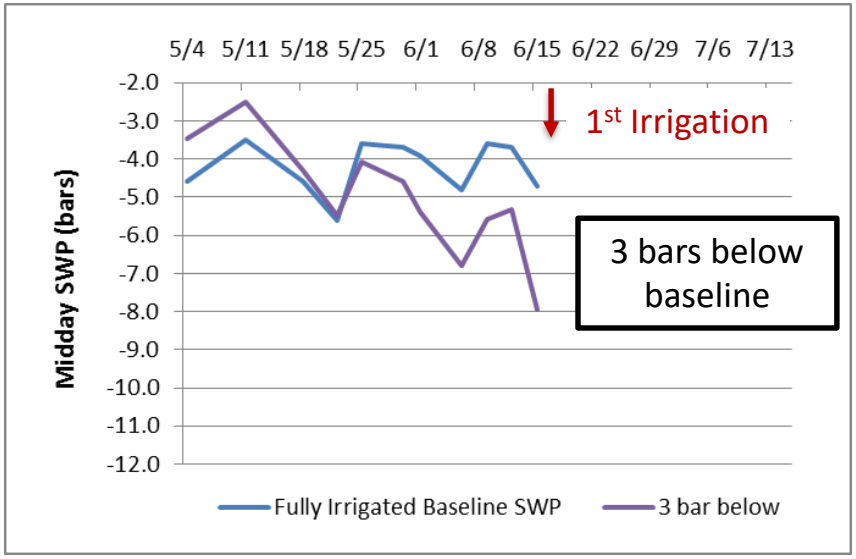
Interpretation of midday SWP levels with consideration to fully irrigated baseline and walnut water stress symptoms.

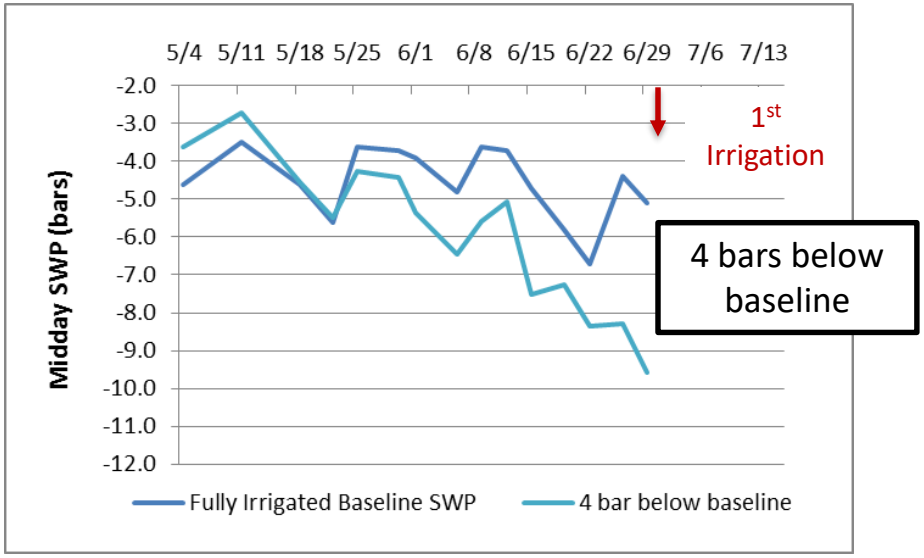
SWP range (bars)	General Water Stress Level	Baseline Consideration	Water Stress Symptoms in Walnut
Higher than -2	None	Likely above fully irrigated baseline	Levels uncommon. Indicates waterlogged conditions conducive to unhealthy roots and trees.
-2 to -4	None	At or above fully irrigated baseline	Fully irrigated conditions. Commonly observed when orchards are irrigated according to estimates of real-time ET without adjusting for soil water storage. If sustained, long term root and tree health may be of concern, especially on California Black rootstock.
-4 to -6	Minimal	May equal baseline on warmer days or be 2 bars below baseline under normal or cool weather	High rate of shoot growth visible. Promotes nut sizing. Irrigation is not yet necessary.
-6 to -8	Mild	May equal baseline on hot, dry days or be 2 to 4 bars below baseline under normal or cool weather	Rate of shoot growth and nut sizing may begin to slow down. These levels do not appear to affect kernel development or quality. Approaching threshold to trigger irrigation.
-8 to -10	Moderate	May be 1 to 3 bars below baseline on hot, dry days or be 3 to 6 bars below baseline under normal or cool weather	Shoot growth in non-bearing trees may stop. Nut size and weight may be reduced. Bud development for next season may be negatively affected. May be slightly past threshold to trigger an irrigation.
-10 to -12	High	Likely to be 3 to 4 bars below baseline on hot, dry days or 4 to 8 bars below baseline on under normal or cool weather	Temporary wilting of leaves and shriveling of hulls has been observed. New shoot growth is likely sparse or absent. If sustained nut size will be reduced and darker kernels are more likely. Past threshold and late with irrigation.

How the pressure chamber was used to guide irrigation start date, 2017 example





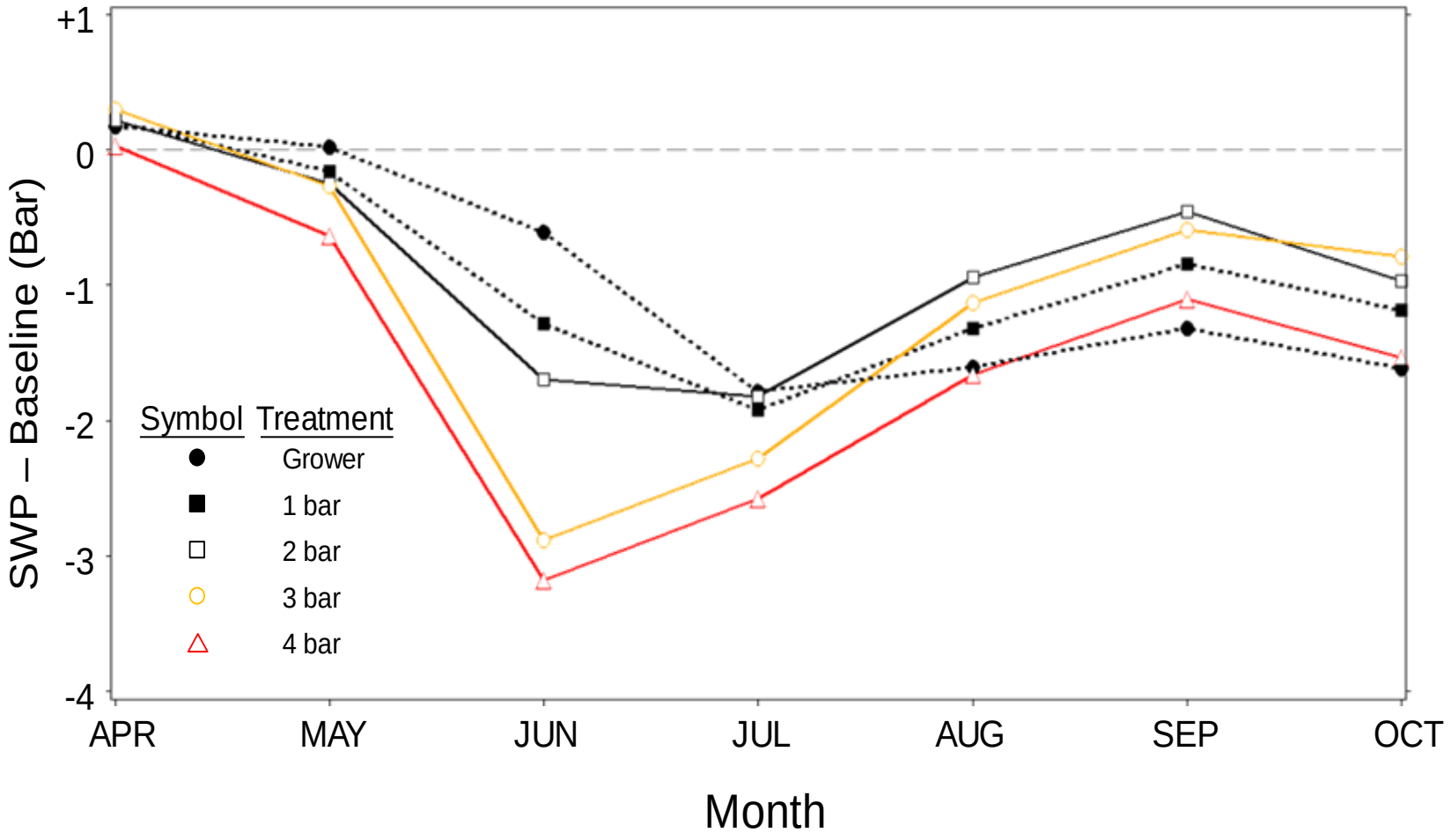




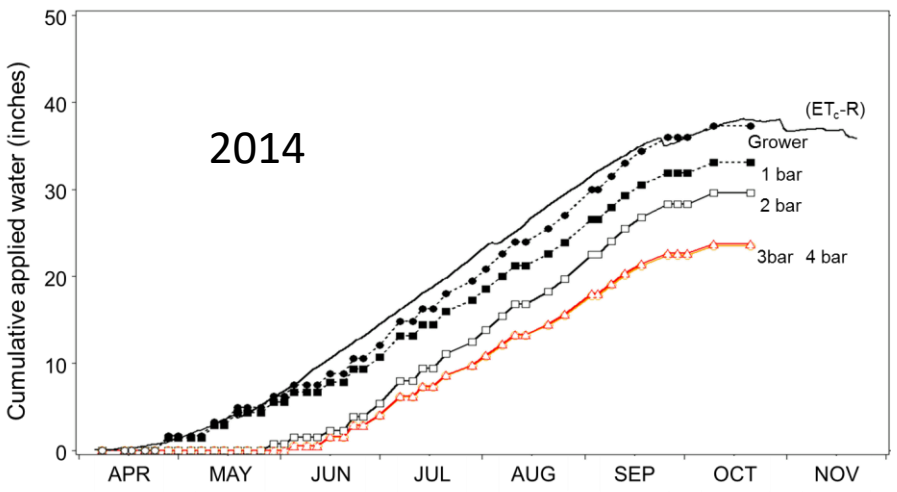
General relationship between early season SWP irrigation thresholds and irrigation start date.

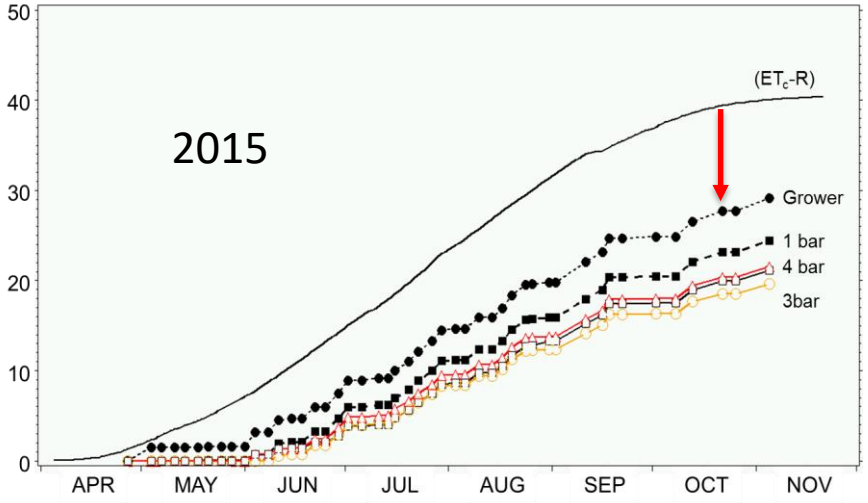
SWP just before the first irrigation (bars below baseline)	Approximate Irrigation Start Date
Grower Practice At or near Baseline (0)	Late April to mid May
1	Mid to Late May
2	Early to Mid June
3	Mid to Late June
4	Late June to Early July

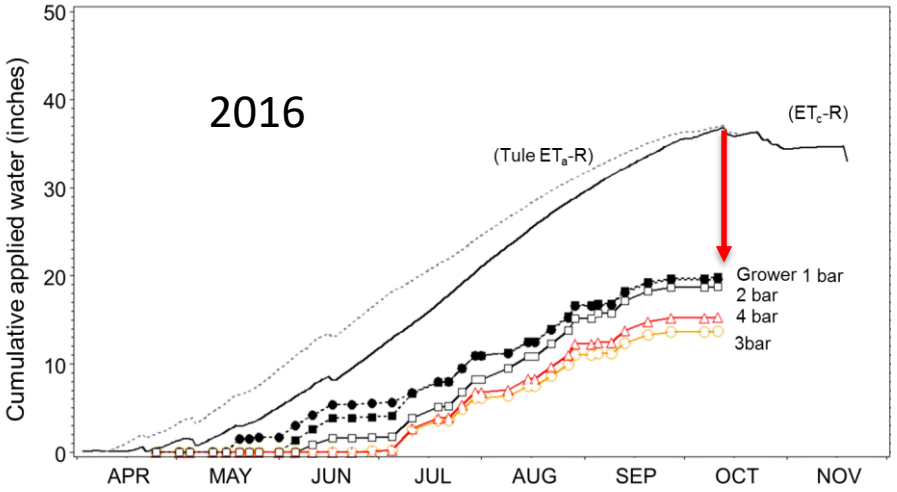
Monthly treatment average SWP values across all 5 years (2014-2018)

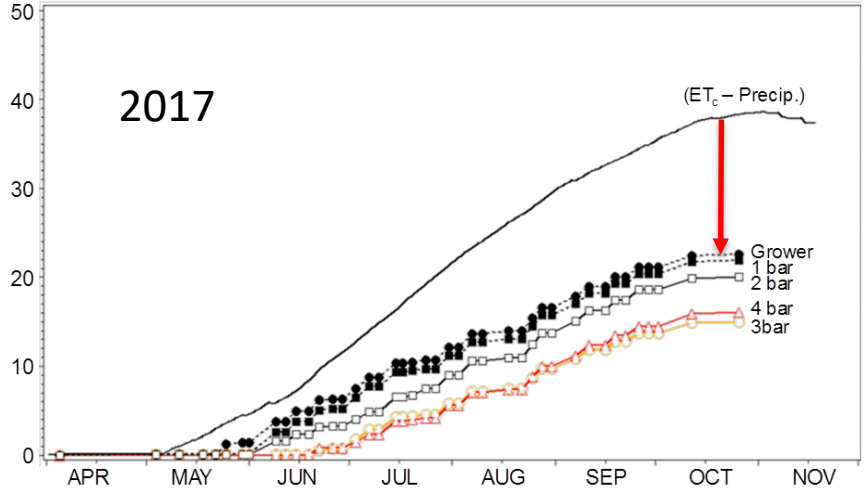


Effect of early season water stress on applied water needed to supply irrigation demand (ET_c minus in-season rainfall)









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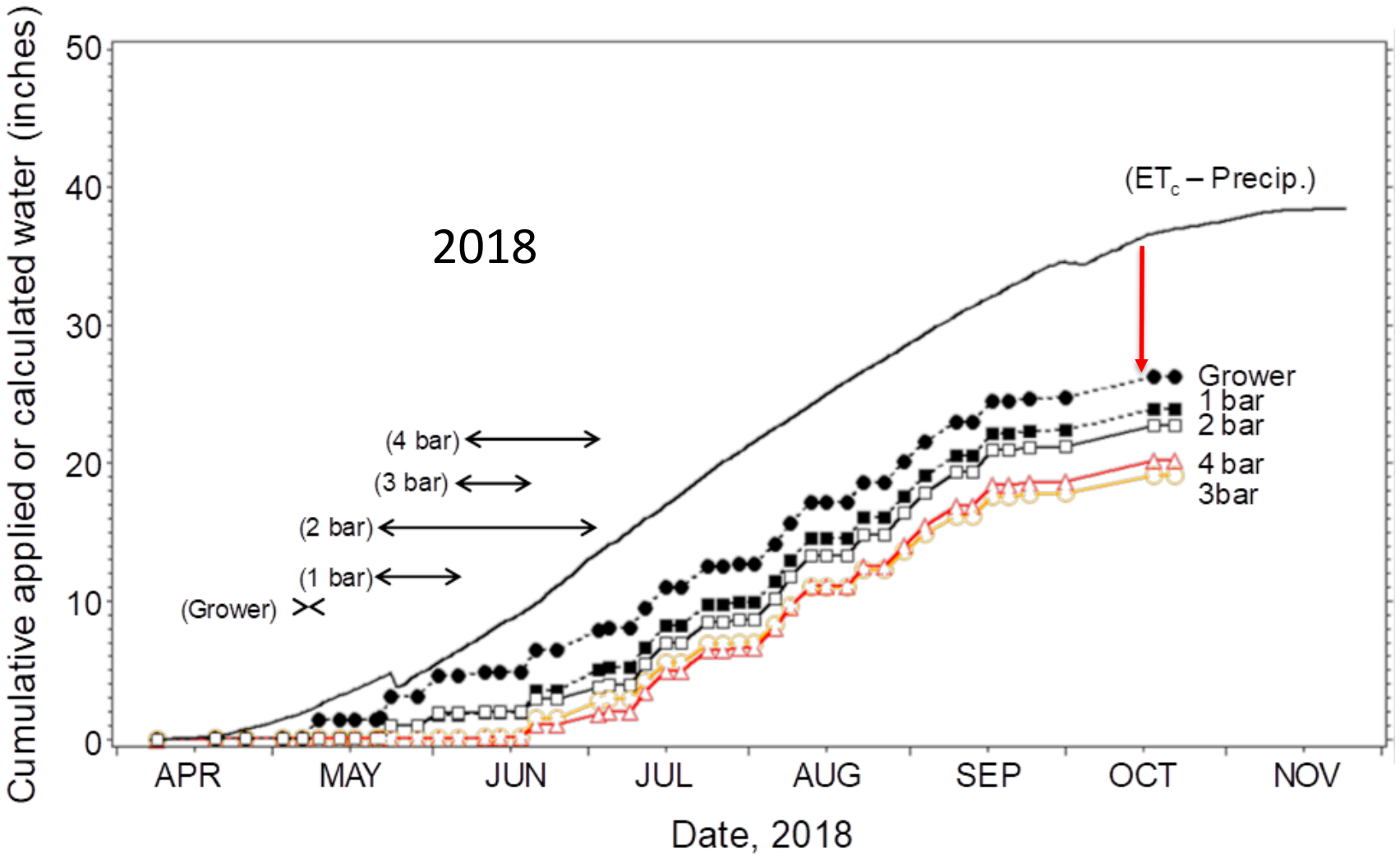
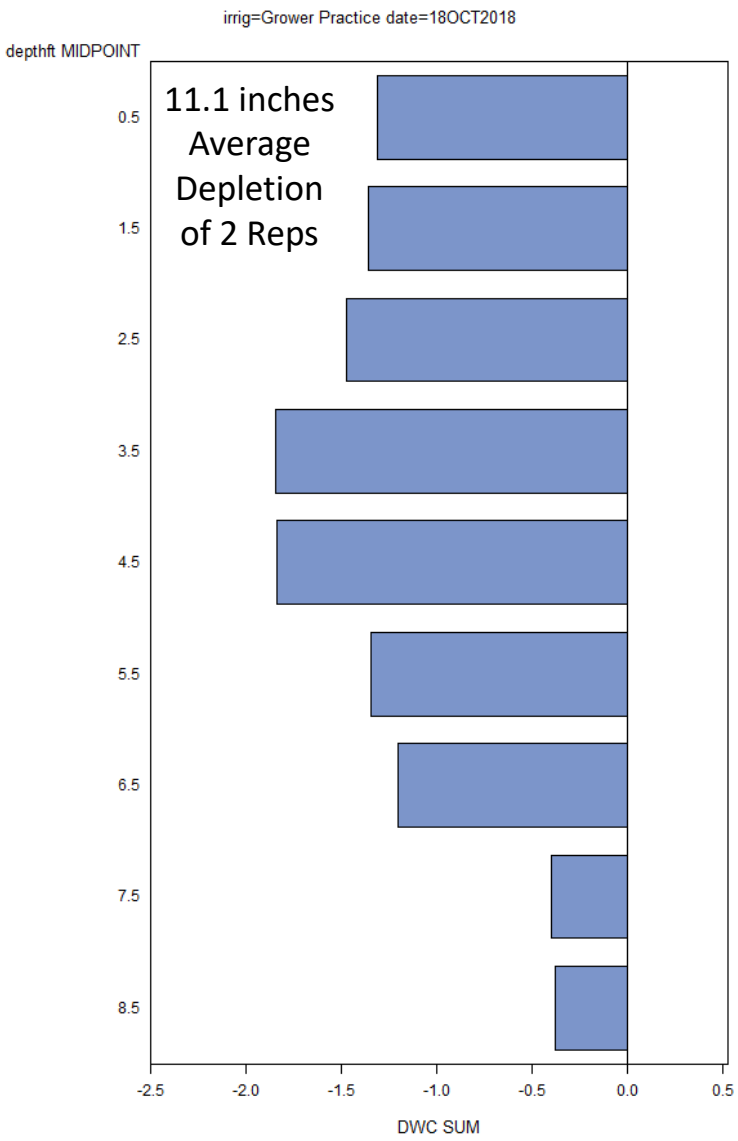
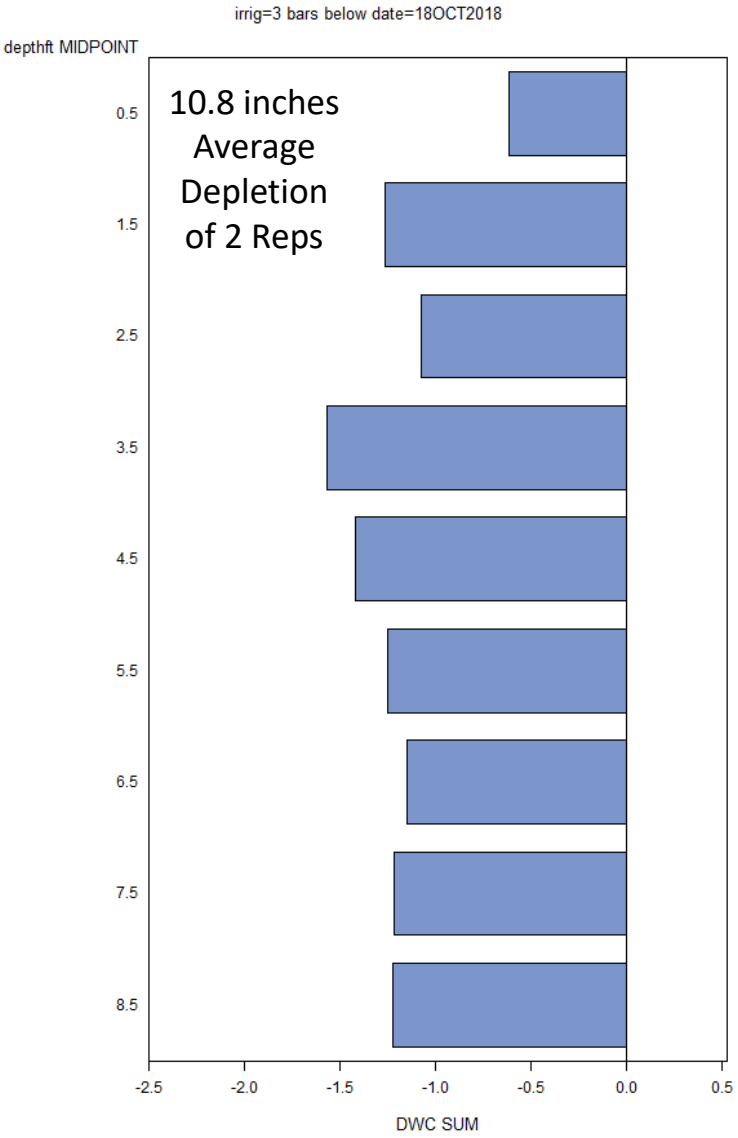


Depletion of Nine-Foot Soil Profile from Apr. 9 to Oct. 18, 2018



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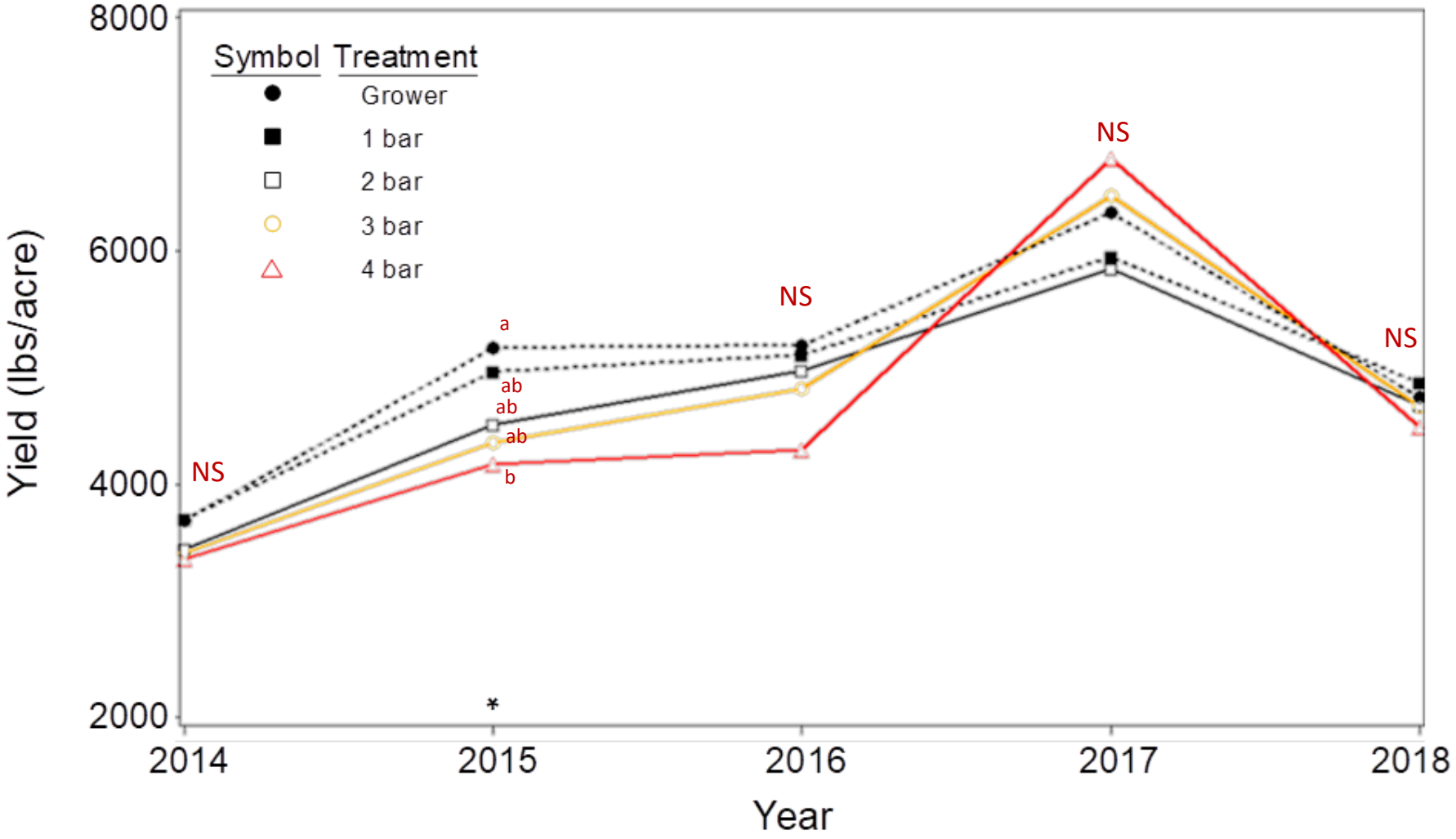
Five-year yield trends



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Effect of early season water stress on Chandler walnut quality. Values are averages over five years (2014-18).

SWP just before the first irrigation (bars below baseline)	Approximate Irrigation Start Date	Nut Weight (grams)	Percent Jumbo & Large Sound	RLI	Percent Mold	Percent Shrivel	Percent Edible Kernel	Relative Value
At or near Baseline (0)	Late April to mid May	10.3 a[1]	77.8 a	54.7	1.1	2.6	45.3	0.892
1	Mid to Late May	10.1 ab	74.4 ab	55.2	1.2	2.8	45.6	0.902
2	Early to Mid June	9.9 ab	72.6 ab	55.2	1.4	2.3	45.3	0.902
3	Mid to Late June	9.5 bc	66.7 bc	54.8	1.7	2.7	45.9	0.906
4	Late June to Early July	9.3 c	57.7 c	54.9	1.5	3.3	46.0	0.908

[1] Different red letter designations behind values indicate statistically different quality responses to irrigation start date and early season crop water stress.

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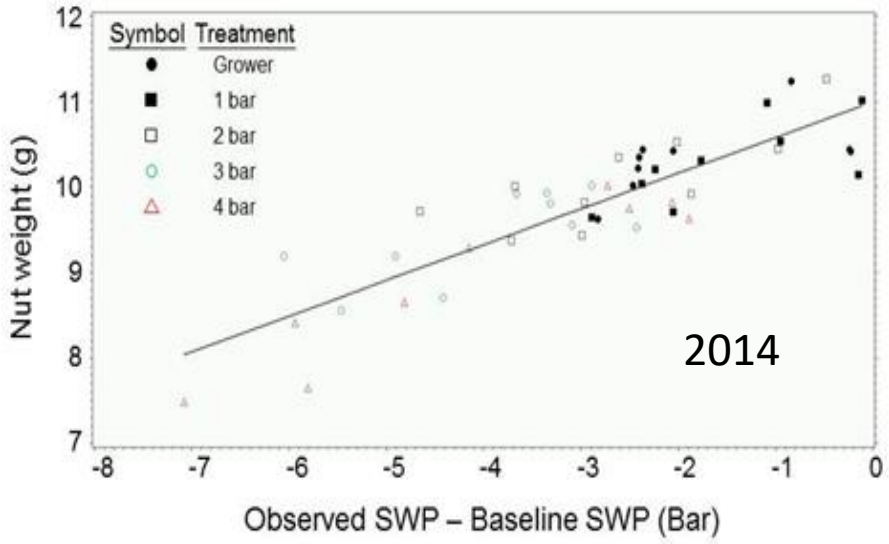
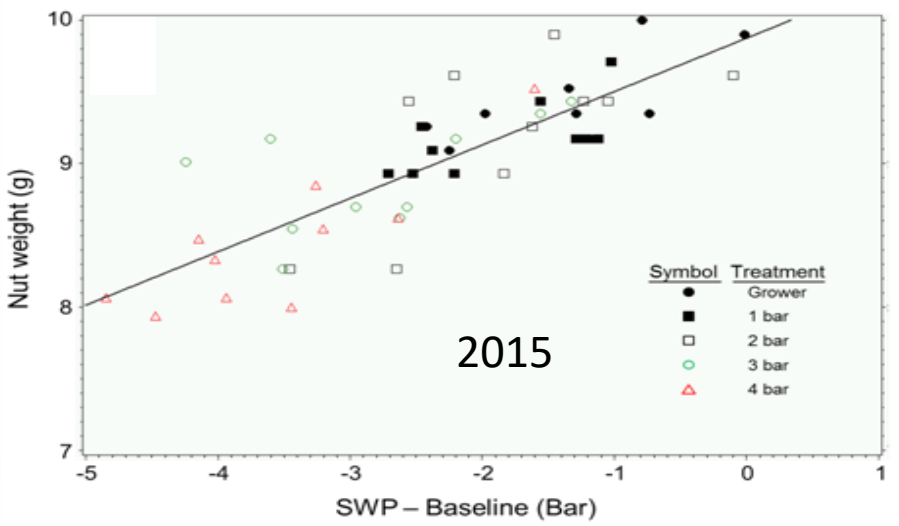
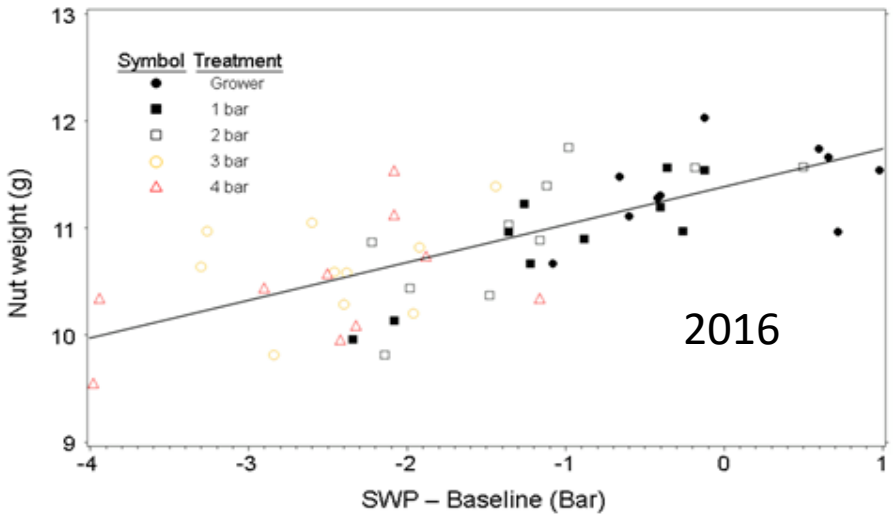
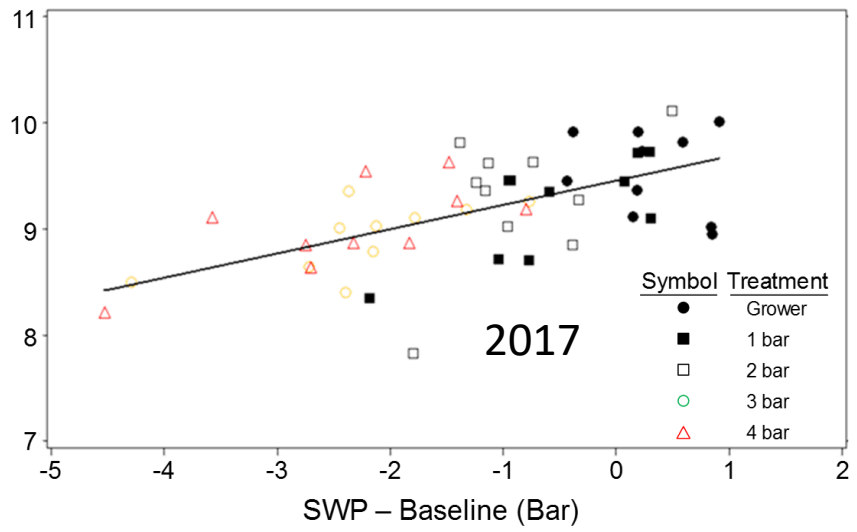
Relationship of nut weight to average observed midday stem water potential in the month of June









Effect of spring water stress on Chandler walnut yield (2014-18 five year cumulative affects)

Tree Stress Just Before First Irrigation (bars below baseline)	Approximate Irrigation Start Date	Approximate Days After Leafout	Five-year Average Dry In-shell Yield (lbs/ac)	Yield Loss % of Highest Yield	Edible Kernel Yield (%)	Reflected Light Index (RLI) (%)	Relative Water Savings (%)
At or near fully irrigated baseline	Late April to Early May	25 to 35	5025	---	45.3	54.7	---
1.0	Mid to late May	45 to 60	4921	2.0	45.6	55.2	8.7
2.0	Early to mid June	60 to 75	4689	6.7	45.3	55.2	16.8
3.0	Mid to late June	75 to 85	4747	5.5	45.9	54.8	32.6
4.0	Late June to early July	85 to 95	4622	8.0	46.0	54.9	28.3

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Summary Points

- When balancing production potential with orchard health, **managed** delays in early season irrigation have merit.
- Delaying early season irrigation does not necessarily mean the orchard will experience more stress in the summer and fall.
- Only one of five years (2015) showed a statistically significant difference in walnut yield and only one delayed treatment (4 bar) was lower.
- Nut weight and size declines the longer the start of irrigation is delayed. It is a consideration when deciding to begin irrigating.
- Edible yield and kernel color, which crop payment is associated with tended to improve with reasonable delays in irrigation start date.
- Reasonable delays in early season irrigation also offers a way to save on energy and water costs.
- More benefit and less risk from managed delays in early season irrigation than under irrigating in mid summer and fall.

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Thank you! Questions?