Using SWP to Delay the Start of Irrigation in the Spring

Project No.: **HORT43.Shackel**

Project Leader: Ken Shackel, Department of Plant Sciences, University of California, Davis, One Shields Ave., Davis, CA 95616-8683, (530) 752-0928
kashackel@ucdavis.edu

Project Cooperators and Personnel:
Bruce Lampinen, UC Davis; Roger Duncan, UCCE, Allan Fulton (/Luke Milliron), UCCE.

A. Summary It is widely believed that irrigation should be sufficient to match orchard evapotranspiration (ET) demand throughout the season, and further, that early season irrigation (i.e., starting soon after leaf out) will maintain a 'bank account' of deep soil water to insure against excessive water stress at harvest. A growing body of evidence in walnuts however, indicates that a substantial delay in the start of irrigation (i.e., 1-2 months after leaf out), even though it is associated with an increased depletion of soil water, actually results in less water stress, as well as a noticeable improvement in tree appearance, at harvest. The basis for this effect is not clear, but our working hypothesis is that early season irrigation may be detrimental to root development and health, particularly for the deep roots that are important during harvest. Three almond orchards (two in Tehama and one in Modesto) were identified and monitored in 2019, prior to imposing any delayed irrigation treatments. All orchards showed near baseline (fully irrigated) SWP levels through April, indicating a good possibility that the start of irrigation could be delayed compared to current grower practice at all sites. In both Tehama and Modesto, there was also a trend for higher yields to be associated with somewhat higher levels of water stress. In Modesto, the replicate with the highest yield (2950 kernel pounds/acre) had the driest average SWP (-13.1 bars) compared to the other replicates (e.g., yield of 1820 kernel pounds/acre and SWP of -11.7 bars), and in Tehama, the more vigorous orchard (on a deep class 1 soil) had substantially lower yield (1760 kernel pounds/acre) and exhibited generally less water stress than the yield (2840 kernel pounds/acre) from a less vigorous and more water stressed orchard. These are preliminary background monitoring results, with irrigation delay treatments to be applied in 2020.

B. Objectives

The objective for 2019 was to collect data on grower irrigation management, SWP, PAR, and yield at north (Tehama) and mid-south (Modesto) commercial almond sites. These values will be used as pre-treatment reference values for the irrigation delay treatments to be applied in 2020.

C. Annual Results and Discussion

Initial measurements indicate that each site is relatively uniform in terms of tree water status (SWP), but there are clear SWP differences between sites as a result of soil types and irrigation practices. The contrasting sites in Tehama Co. (Figure 1) are of particular interest as they are on contrasting soils, both are 50% Nonpareil, but one site

(field #28) is on a class 1 Columbia silt-loam soil, and the other (field #11) is on a class 2/3 loam/gravely loam soil. The grower closely matched ET with irrigation over the season in the shallow soil (field 11), whereas ET was not matched in the deep soil at any time (Field 28). Field 11 trees experienced substantial stress (-20 bars) when applied irrigation did not match the calculated ET, but Field 28 trees were able to tolerate a substantial period of no irrigation without reaching this level. Field #28 trees are high vigor and it is clear that soil water is readily available because the trees show minimal water stress (SWP), despite being irrigated at about 50% ET. On the other hand, field #11 trees are less vigorous and show mild to moderate water stress, even though they are irrigated at 100% ET. Interestingly, 2019 yields were lower in field #28 (1760 lbs/ac) than field #11 (2840 lbs/ac), possibly suggesting that the vigor in field #28 may be 'excessive.' These are initial results, prior to the application of any irrigation differential, but it may be possible to reduce irrigation in field #28 in order to control vigor and improve cropping.

Trees at the Modesto Co. site were substantially above baseline SWP in April, but fell to relatively severe levels by mid-July (Figure 2, irrigation data not yet available). At this site we did find significant within-orchard (i.e., rep-to-rep) differences in yield due to field position, with rep 1 having the highest and rep 2 the lowest yields (right hand table, Figure 2, lines indicate statistically significant differences). Interestingly, we also found significant within-orchard SWP differences, but in this case the largest difference were between reps 1 and 3. Interestingly, rep 1 had the highest yield and the lowest SWP, which is the same trend we saw in Tehama.

D. Outreach Activities

Other than routine interaction with the cooperating farm advisors and growers, no outreach activities specific to this project have been performed at this early background information gathering stage.

E. Materials and Methods

Experimental plots were established in commercial almond orchards in Tehama Co. (2 sites), and in Stanislaus Co. (1 site). Applied water (Tehama), SWP and yield (Tehama and Stanislaus) data were collected to serve as a baseline condition for evaluating field uniformity and designing treatments for 2020.

F. Publications that emerged from this work

None to report.

Figures:

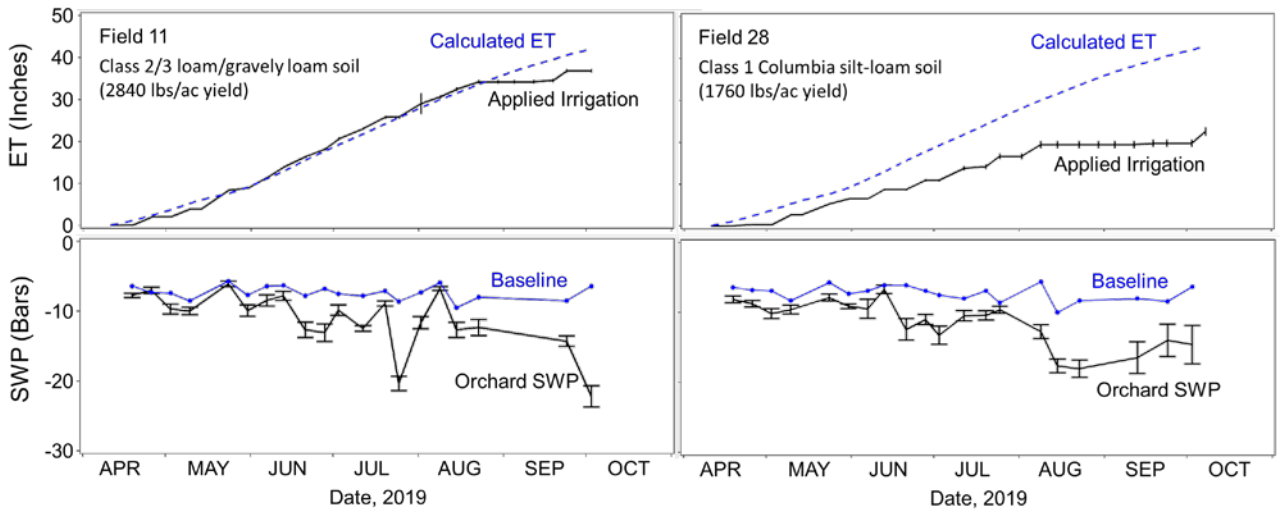
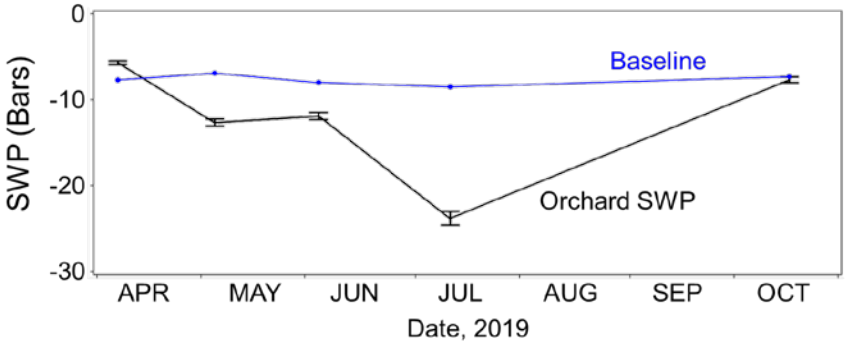


Figure 1. Cumulative applied irrigation and calculated ET (top panels) and periodic orchard and baseline SWP measurements (bottom panels) over the 2019 season at the two Tehama county sites. Also shown are the soil types and grower reported yields for each site. Error bars for irrigation and SWP are ±2SE (approximate 95% confidence range).



Yield (kernel lbs/ac)		SWP (bar)	
Rep	Mean	Rep	Mean
1	2950	3	-11.7
4	2450	4	-12.2
3	1820	2	-12.5
2	1800	1	-13.1

Figure 2. Periodic orchard and baseline SWP measurements over the 2019 season (left), and table (right) summarizing the mean yields and SWP values for each block, for the Modesto orchard. Error bars for SWP are ±2SE, which represent about the 95% confidence level for each value. Vertical lines for SWP are as in figure 1, and vertical lines in the table indicate which means are significantly different (means covered by the same line are not statistically different).