Evaluation of Orchard Irrigation Scheudling Using Trunk diameter Fluctuations and Shaded Leaf Water Potential

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Executive Summary

It has long been recognized that the plant is the best indicator of its water status but until recently, plant-based monitoring involved discrete measurements in both space and time. Our recent work indicates that changes in trunk diameter correlate with tree water status. The linear variable displacement transducer (LVDT) can continuously and accurately record trunk diameter to the micron level. We have found that maximum daily trunk shrinkage (MDS), defined as the difference between daily maximum and minimum trunk diameter values, is related to plant water status in mature trees. Last seasons, we found that MDS in a commercial orchard was a much more sensitive indicator of tree water stress than stem water potential (SWP) in terms of signal strength) actual/baseline measurements) as shown in Fig. 1 (not included here).

While SWP is currently the state-of-the-art in plant-based irrigation scheduling, the technique requires that interior leaves be covered with a small bag 2 hours prior to the measurement. Thus, two trips to the field by the technician are required. Last season, we found that interior, shaded leaf water potential (LWP) was highly related to SWP in full irrigated trees. Measuring interior, shaded leaves requires only trip to the field, making this approach much more likely to be adopted by growers. Moreover, LWP measurements on interior, shaded leaves correlated well with air temperature at the 2:00 pm time of the measurement. When expressed in English units (those familiar to most growers and their workers), baseline pressure bomb readings for interior, shaded leaves can easily be determined by simply taking 10% of the 2:00pm air temperature value. For example, if the air temperature is 90 F, the baseline (threshold) pressure bomb reading is about 9.0 bars. Thus, if the actual interior, shaded leaf measurement is 9-10 bars, the trees are not under water stress while higher pressure bomb values suggest that increased irrigation is required.

The next step in the use of trunk diameter measurements in irrigation management is developing and testing MDS-based scheduling protocols. This is required before MDS can be used to automate irrigation scheduling. Additionally, the “10% rule of thumb” for determining shaded LWP baselines must be verified in the field before this approach can be considered an alternative to the existing SWP approach to guiding irrigation management. Developing a simple rule of thumb for interpreting readings from the new “pump-up”, hand-held pressure chamber invented by Ken Shackel and now being marketed commercially should encourage adoption of this advanced monitoring technique.

Objectives

1) To evaluate an MDS-based irrigation scheduling protocol versus a commercial almond grower’s current soil/atmospheric-based approach, and 2) to test the utility of

using pressure chamber measurements of interior, shaded leaves as indicators for irrigation management.