Plant-Based Measures of Water Stress for Irrigation Management in Multiple Almond Varieties

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PROJECT SUMMARY

Objectives:

- Determine whether different almond varieties exhibit differences in stem water potential (SWP) across a range of soil and orchard conditions.
- Determine whether there are differences in response to water stress among selected almond varieties, and whether any observed differences are related to inherent physiological differences among the varieties.
- Determine whether there is a reliable and consistent relationship between SWP and other candidate plant-based and soil-based measures of water stress, particularly those that can be automated.

Background and Discussion:

Accurate and timely irrigation management is a key to both successful almond production and appropriate environmental stewardship, especially in times of protracted water shortages.

In recent years, in deciding when and how best to irrigate, growers have relied increasingly on gauging the trees' level of water stress by using a pressure chamber—"the Bomb"—to measure midday stem water potential (SWP). Although this method is reliable, one drawback is that it requires time and labor and is not amenable to automation.

One important goal of this project is to find an automated method that will substitute for manual measurement of SWP. Most of the methods tried to date have not proven to be reliable, but one based on a very sensitive temperature measurement principle (in-situ psychrometry) has shown promise. This method is only applicable to a single tree, but for that tree it is capable of measuring SWP frequently (every 30 minutes) and hence may give growers information both regarding the level of tree stress (daytime SWP values) as well as soil moisture conditions (nighttime SWP values). To date, this method has shown mixed results, but since it uses an entirely different principle to measure SWP compared to the pressure chamber, the close agreement found on some occasions indicates that it can be made reliable once standard protocols are developed. Given the technical problems that we have observed, this method is not yet ready for grower use.

Reference SWP values for different temperature and relative humidity conditions have been developed for fully irrigated (non-stressed) Nonpareil almonds, but have not been extensively tested in other almond varieties. In addition, the responses to deficit levels of SWP have been described in Nonpareil but not in other varieties. An important goal of this project is to determine whether the same reference and deficit SWP values apply equally across almond varieties. Results to date indicate that under the same orchard conditions, the SWP of many varieties are similar to that of Nonpareil, but that some varieties may be more sensitive to deficit levels of SWP than others. For Nonpareil, there is a very clear relation between SWP, stomatal conductance, and photosynthesis that applies across multiple years and locations. This will serve as an important benchmark for other varieties.

The eventual outcome of this project is likely to be useful for making normal-year irrigation decisions for varieties other than Nonpareil, as well as irrigation decisions in times of water shortages for these varieties.

For More Details, Visit

- 2012.2013 Annual Report CD (11-HORT9-Shackel); or on the web (after January 2014) at www.almondboard.com/researchreports
- Related Project: 13-HORT13-Lampinen