A Leaf Monitoring System for Continuous Measurement of Plant Water Status to Assist with Irrigation Management of Specialty Crops

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PROJECT SUMMARY

Objectives:

Our goal for the 2017 growing season was to implement plant water stress based precision irrigation from the beginning of the season until harvest to further validate the benefits of utilizing a continuous leaf monitoring system to sense plant water status. The specific objectives were:

- Quantify the benefits of a plant water stress based site-specific irrigation management scheme, that employs a wireless mesh network for almond crop in comparison to grower irrigation management schemes.
- Demonstrate the technology to growers.

Background and Discussion:

Over the last six years, we have setup a wireless mesh network consisting of sensors capable of monitoring soil and plant water status, and controllers capable of actuating latching solenoid valves to implement precision irrigation in an almond orchard in Nickels Soil Laboratory, Arbuckle, CA. During the 2015, 2016, and 2017 growing seasons we expanded the scope of this project to a 5-acre plot. This plot was divided into two management zones based on soil and plant characteristics. Specially developed continuous leaf monitors that estimate plant water status by measuring leaf and air temperatures, ambient relative humidity, wind speed and incident light on the leaf were deployed in each management zone to implement site-specific irrigation management.

During the 2016 growing season, grower based as well as stress based irrigation management was implemented throughout the whole growing season. The grower based irrigation utilized a set of three soil moisture sensors located at different depths in a specific location in the orchard to make irrigation decisions. The stress based precision irrigation management utilized stress indices derived from leaf monitor data to make irrigation decision on a daily basis. While plant water stress was monitored using leaf monitor data, midday stem water potential was also obtained using a pressure chamber to verify the methodology. Attempts were made to maintain plant water stress (SWP) between -12 to -14 bars prior to and post hull split periods. During hull split, attempts were made to maintain plant water stress around -16 bar. The results indicated that stress based irrigation required about 75 and 86% of grower water application amounts in zones 1 and 2, respectively with no significant effect on yield or quality. The 2017 experiments were conducted to verify the results of the previous year. Yield, amount of water applied, and quality data have been obtained and are currently being analyzed. This management zone based precision irrigation system that uses a wireless network and leaf monitors was demonstrated to growers, farm advisors, extension specialists, and others during the 2017 Nickels Field day on May 10, 2017. An article which presents this research was published in the May/June issue of Progressive Crop Consultant (p 24-29) as well as in the Resource magazine published by the American Society of Agricultural and Biological Engineers (p 6-7, July/August 2017).

Project Cooperators and Personnel: Dr. Bruce Lampinen, UC Davis; Dr. Franz Niederholzer – UCCE Farm Advisor (Colusa, Sutter, Yuba counties), Erin Kizer, Channing Ko-Madden, Kelley Drechsler, and Julie Meyers, Graduate Student Researchers, Chunxia Jiang, Ronilson De Souza Santos, and Gabriela Michelon, Visiting Graduate Students, Biological and Agricultural Engineering Department, UC Davis.

For More Details, Visit

- Poster location 42 Exhibit Hall A + B during the Almond Conference; or on the web (after January 2018) at Almonds.com/Research Database
- 2016 - 2017 Annual Reports (16-HORT24-Upadhya) on the web at Almonds.com/ResearchDatabase
- Related Projects: 17-HORT31-Bailey; 17-HORT28-McElrone; 17-HORT21-Gilbert; 17-HORT22-Shackel; 17-HORT32-Bali/Culumber