

Variable Rate Irrigation Practices on Almond

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Introduction

Almond growers in California are under continuous pressure to grow orchards with limited water supplies. In recent decades, pressurized micro-irrigation systems have greatly improved distribution uniformity and water use efficiency of applied water. However, different portions of a field may have varying water and fertilizer requirements due to soil spatial variability, water quality, climate and other factors influencing tree growth across the block. Most irrigation systems have little capacity to differentially irrigate. Applications to the entire field are based on the needs of the 'weakest' areas, which may lead to over applications and reduced system efficiency and yield potential. Variable rate irrigation (VRI) systems may improve water use efficiency by tailoring irrigation zones and sets to meet changing tree water requirements.

Objectives

- Demonstrate variable rate irrigation capacity to improve water and nutrient use efficiency, tree growth, and yield in commercial almond orchards
- Determine variable irrigation requirements based on site climatic conditions, soil texture and salinity, and tree growth stage among other site specific factors to improve water use efficiency.
- Develop a system to assist growers in defining "zones" of similar characteristics, then develop variable irrigation scheduling programs for each zone to meet crop needs.
- Retrofit existing irrigation systems to control water applications in small zones (1 acre)
- Develop irrigation schedules that meet an orchard's crop water requirements, decrease water and nitrogen losses and reduce energy use.

Methods

Site selection

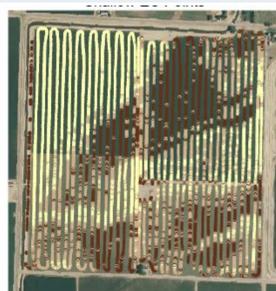
A 70 acre, 4-year old commercial almond orchard has been selected in Tulare County, CA to establish the trial in 2018 (Fig. 1).

- 1-acre variable irrigation zones on 50% of the field and irrigation scheduling using VRI technology will be compared to the grower standard irrigation practices on the other 50%

Methods

Zone delineation

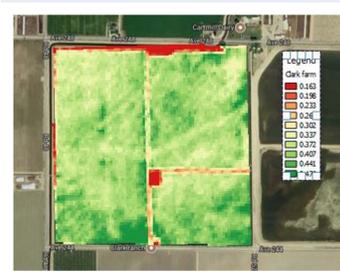
Irrigation zone boundaries will be determined based on a soil spatial and canopy variability using electromagnetic conduction (EM38) surveys or measures of soil resistance with the VERIS system, tree canopy photosynthetically active radiation (%PAR), and normalized vegetation index (NDVI) imagery. New methods of canopy cover and volume index based on drone NDVI imagery will be evaluated.



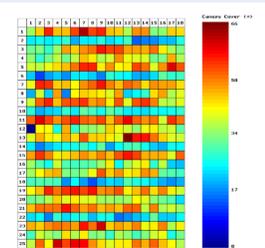
VERIS



% PAR



NDVI



Canopy Volume Index

Irrigation scheduling

Irrigation scheduling for the different zones and the conventional control will be determined using a combination of evapotranspiration measurements from an on-site weather station, soil moisture monitoring and tree water status measurements. Soil moisture capacitance probes will be distributed across different soil zones of both the VRI and conventional irrigation system to guide irrigation decisions related to frequency and duration. Physiological measurements of tree water status will be collected in a subset of trees, to determine how consistently the different zones relieve water stress across the block. A pressure chamber will be used to determine midday stem water potential (SWP) before and after irrigation. Dendrometers will be installed in a subset of zones to compare continuous plant water status measurements with SWP. Flow meters will be installed in each zone to compare water use efficiency between VRI and conventional irrigation zones



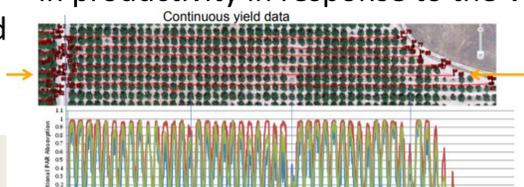
dendrometer

Yield

A weigh cart with load cells, GPS, and auto-sub sampler will be used to measure continuous almond yields within each irrigation zone in both the VRI and conventional systems. The almond sub-samples will be evaluated for kernel weight and quality. Canopy light bar measurements at harvest and almond yield will be correlated to records of total water, to identify changes in productivity in response to the VRI system.



Pressure Chamber



Harvest cart with load cells and GPS