Manipulating Irrigation Patterns to Evaluate Fine Root Traits, Root Production Rates, and Fine Root Physiology in Almond Trees

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PROJECT SUMMARY

Objectives:

- Measure impact of irrigation strategies, transplant source (pot vs bare root) and pruning on root production, root traits & physiology on newly installed trees (2nd leaf) at UC Davis
- Assess the impact of heading & pruning at planting on root production and rooting depth

Background and Discussion:

Root, shoot, and vascular traits are tightly linked to expected survival and growth rate under drought conditions. The supply of water to and within plants is determined by soil water availability (water content and soil type), plant architectural traits (e.g., root:shoot ratio, root depth, root surface area, leaf area, tissue density), as well as axial and radial hydraulic conductance of the root system. Generally, there are tradeoffs between characteristics that confer stress resistance and those that allow a high physiological activity. We aim to study variation in root morphological, anatomical and physiological traits in response to multiple irrigation scenarios.

Results from samples collected in July and November 2014, and March and November 2015 showed that standing root length density in a field trial with 5 levels of irrigation (70, 80, 90, 100, 110 % ETc) led to decreased standing root length in the lowest and two highest irrigation treatments in July, but not in November when overall standing root length was decreased. In addition, root length density decreased strongly with each 10 cm step down to a sampling depth of 60 cm. These data suggest that both under- and over-application of water can cause reductions in standing root length density in almonds, although it is unknown whether this is due to decreased production rates, increased root mortality, or a combination of both.

In 2015 a dedicated field trial (1.1 acre) was installed at UC Davis to study both temporal and spatial patterns of root production, morphology, and physiology in response to short- and long term drought. Both bare-root and pot grown trees (Nonpareil, Wood Colony and Monterey on Krymsk) were planted in February 2015 with a 15 ft (between row) x 9 ft (within row) spacing. At planting, bare-root trees and potted trees had similar total root length, but potted trees had a much greater proportion of length in the fine root fraction. All trees were pruned, but not headed or staked.

Newly planted trees exhibited a very even root production rate to 1 m depth, however, trees that were headed and pruned had strongly reduced initial root production below 1 m depth compared to unheaded and unpruned trees, 5 months after planting. Headed and pruned trees as well as pot grown versus bare-root trees had significantly less negative stem water potential early in the season, when trees were drip irrigated. Although bare root trees were significantly larger at planting, pot grown trees exhibited greater relative growth rates and initial size differences between trees were greatly reduced by March 2016. Reduced irrigation treatments were implemented in June 2016, and trees receiving 70% irrigation had lower water potentials. Pruned trees exhibited less negative water potential early in the season, but more negative water potential later in the season, for bare root trees only. Root data for 2016 are being processed.

The overall goal is to combine information derived from this project with information from associated projects (N uptake rates and N movement in soils) to improve the design of irrigation and fertigation systems as well as recommend optimal irrigation strategies.

Project Cooperators and Personnel: Ken Shackel, UC Davis; David Doll, UCCE - Merced County; Allan Fulton, UCCE-Tehama County; Blake Sanden, UCCE-Kern County

For More Details, Visit

- Poster location 78, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2017) at Almonds.com/ResearchDatabase
- 2015 - 2016 Annual Reports CD (15-PREC5-Volder); or on the web (after January 2017) at Almonds.com/ResearchDatabase
- Related projects: 16-STEWCROP5-Gaudin; 16-HORT22-Shackel (COC); 16-HORT13-Lampinen; 14-PREC1-DeJong