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

Project Leader: Astrid Volder, Bruce Lampinen
Department of Plant Sciences, University of California, Davis, One Shields Ave., Davis, CA 95616
(530) 752.8527; avolder@ucdavis.edu

PROJECT SUMMARY

Objectives:

For the current year and ongoing:

- Determine the impact of ongoing drought experiments on seasonal standing root length density and root traits (e.g., tissue density)
- Installation of a dedicated field trial at UC Davis to measure impact of irrigation strategies on root production, root traits & physiology
- 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. In general, there exists a tradeoff between the 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 show 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. There were no consistent differences in root surface area per unit root mass. 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 on Krymsk, 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.

Total water used for establishment until 10/19/15 was 2.2 acre foot. Only one tree out of 360 was lost (99.7 % survival rate). Differential irrigation treatments will be implemented in 2016.
Guard rows were used to test the impact of heading and pruning at planting on stem water potential, growth and root production. Newly planted trees overall 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. 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. However, after switching to microsprinkler irrigation in June treatment differences were strongly reduced.

The overall goal is to combine information derived from this project (root phenology, root morphology and root water and nutrient uptake), 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, Patrick Brown, UC Davis; David Doll, UCCE - Merced County; Allan Fulton, UCCE-Tehama County; Blake Sanden, UCCE-Kern County

For More Details, Visit

- Poster location 68 Exhibit Hall A + B during the Almond Conference; or on the web (after January 2016) at Almonds.com/ResearchDatabase
- 2014 - 2015 Annual Reports CD (14-PREC5-Volder); or on the web (after January 2016) at Almonds.com/ResearchDatabase
- Related projects: 15.STEWCROP-Gaudin; 15-HORT22-Shackel; 15-HORT13-Lampinen; 4-PREC1-DeJong