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 (potted vs bare root), and pruning on root production, root traits & physiology on 2nd leaf almond trees at UC Davis

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.

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 86 rootstock) 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 surface area, but potted trees had a much greater proportion of surface area in the fine root fraction. The trees were not staked or fertilized, and were initially pruned, but not headed in the main experiment. The main experiment tested the impact of pruning, irrigation, and nursery treatment, while the edge trees were used to separately test the impact of heading and pruning at planting.

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. In the first season after planting, new root growth primarily occurred in the 0-80 cm deep soil layer during the summer, while root growth production shifted to deeper soil layers (80-130 cm) in the Fall (Sep – Nov).

Headed and pruned trees as well as pot grown versus bare-root trees had significantly less negative midday stem water potential early in the season, when trees were drip irrigated. 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. 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 2017. There was no difference in growth rates between trees planted from root pruning pots versus Ellepots.

Trees that were exposed to 70% irrigation had a 10% reduction in stem area growth over the 2016/2017 season, while trees that were pruned back in both 2015 and 2016 had a 28% reduction in stem area growth rate. There was no interaction between irrigation and pruning treatment.

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

Project Cooperators and Personnel: Paul Martinez, Xinyu Yao, Courtney Nichols, Brian Bailey and Maciej Zwieniecki, UC Davis.

For More Details, Visit

- Poster location 33, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2018) at Almonds.com/ResearchDatabase
- 2016 - 2017 Annual Reports (16-PREC5-Volder) on the web at Almonds.com/ResearchDatabase
- Related Projects: Poster 34 --Edwards/Zhou; 17-PREC9-Volder/Shackel