Root data summary and publication

Project No.:   **PREC10.Volder**

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Project Cooperators and Personnel:
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A. Summary
A post-doctoral scholar started in January 2020 to write up root data from recent projects, addressing the following questions:
- Summary of root responses to groundwater recharge projects across the Valley
- When is the greatest almond fine root production (and at what depth) and how does this relate to observed aboveground growth and phenology
- How do irrigation and soil texture affect fine root production and survival patterns through time
- How does N fertilization amount and timing affect the timing of root production (and death)

B. Objectives *(300 words max.)*

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C. Annual Results 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 and fertilization scenarios. Processing, analyzing and summarizing root data to publication is a time consuming process as we now have tracking information for thousands of roots in our database. The ABC and specialty crops funded project "Development of leaf sampling and interpretation methods for Almond And Development of a nutrient budget

approach to fertilizer management in Almond" finished 5 years ago, but final publication of the root data associated with this project has stalled with the return of the graduate student assigned to this project, to his home country 4 years ago. In addition, we have considerable information about root growth patterns in response to winter recharge practices, as well as root responses to irrigation and aboveground management (PREC5).

D. Outreach Activities
1. Preliminary data has been presented at the the Almond Production short course (2016, 2019), Principles of Fruit and Nut production short course (2016 – 2019), various field days etc. to both growers, PCA's and farm advisors
2. Addition of data to the root chapter in the new almond manual

E. Materials and Methods *(500 word max.)***:**
Due to the large amount of interest in the topic, we started with writing up the data from the winter recharge project. The image collection for this project was finished and the manual tracing of roots in most of the images was already completed. As the root images were analyzed by multiple lab assistants, Xiaochi worked hard to ensure the data was checked for errors and consistency. In addition, we found an unexpected data processing error in the software program itself that led to regularly reported erroneous values. The first 6 months were spent organzing and double checking the data quality. As a result images from the Orland site, where we had less than 12 months of data, were not included in further data analysis.

As the sites have a replication problem (each treatment was only replicated once at each site) statistical data analysis was more complicated and direct comparison of recharge treatment impact was not possible. However, by presenting patterns through time we were still able to draw conclusions and present meaningful data from each site and the manuscript was accepted at California Agriculture. Further detailed analysis of root survival patterns using a proportional hazards analysis is of a wider scientific interest and a draft manuscript is ready to be submitted to Tree Physiology.

F. Publications that emerged from this work
1. Xiaochi has checked and organized all the root and environmental data from the recharge projects in Modesto and Delhi. Data were analyzed using JMP statistical software and figures were drafted using Sigmaplot
2. One manuscript was submitted to California Agriculture, accepted pending revisions, and a revised version was send back to California Agriculture in January 2021
3. An advanced draft manuscript on the controls (soil type, soil depth, temperature, water availability, phenology) of almond root production in Delhi and Modesto is ready for submission to Tree Physiology in March 2021
4. These reorganized data will be the basis for the new root chapter in the almond production manual, of which an advanced draft is available (Volder and Doll)
5. Xiaochi has started working on outlining new manuscripts about the root responses in the SCRI project, but has been experiencing difficulty in getting access to the underlying data