Development of Tree Carbohydrate Budget of Almonds Under Changing Central Valley Climatic Conditions

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PROJECT SUMMARY

General objectives:

- Develop tools for studying tree physiology under variable environmental conditions including detailed analysis of starch and soluble sugar concentration dynamics, enzyme activity, and expression pattern of genes encoding enzymes from carbohydrate metabolism pathways.
- Determine the pattern of carbohydrate content during dormancy and bud break.
- Determine cumulative impact of abiotic stresses on carbohydrate transport and use including the combined effects of thermal and water stress.

Background and Discussion:

California's Central Valley in 2014/2015 experienced the most severe drought in more than 1,200 years. The drought effect is magnified by a slow climatic shift that is reducing the Valley's fog cover. The net result is an increased incidence of variable thermal conditions during winter including: higher average temperatures, more severe frost nights, and hot sunny days.

These factors combined with the increasing use of saline ground water supplies necessitated by decreasing surface water supplies have produced an unprecedented set of new abiotic stresses that affect parts horticultural production. Vegetative life of any plant can be described as a continuous struggle to acquire, transfer, and store energy that is necessary to grow, reproduce, and protect from environmental abiotic and biotic stress.

Carbohydrates (sugars) are responsible for the majority of long distance energy transfers and long term storage of energy in plants. They are the ultimate currency that the plant has to interact with environment. The understanding of carbohydrate physiology as plants respond to environmental stress while accomplishing their reproductive functions (yield) is of key importance for predicting yields, determination of plant stress levels, and a plant's ability to mediate salinity, drought, or winter survival. Understanding of carbohydrate management is especially important in long-lived perennial crops like almond that must balance short-term (seasonal) vs multi-year benefits with effects being carried out over multiple years.

We have completed analysis of yearly carbohydrate (starch, sugars) spatial dynamics in almond trees in relation to tree phenology (Objective 2). Results show that during the bud break period there is a short period of carbohydrate depletion in locations near flowers. Further results suggest large swings in carbohydrate content in bark and wood in a manner that potentially can be used to predict time of blooming and dormancy readiness. In yearly pattern of carbohydrate reserves, we observed almost complete depletion of starch content by mid-summer that correlates with almond maturation. Pre-winter accumulation was slow and not completed in studied trees until end of November – potentially important knowledge for determination of tree management during fall.

Currently we focus our attention on developing field trial to determine impact of chill accumulation and carbohydrate availability on dormancy breaking (Objective 1). We also started large scale program of data collection across Central Valley – Citizen research program allowing for resolving issues related to (Objective 3).

Project Cooperators and Personnel: Aude Tixier – Postdoc, UC Davis

For More Details, Visit

- Poster location 79, 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-PREC8-Zwieniecki-DeJong); or on the web (after January 2017) at Almonds.com/ResearchDatabase
- Related projects: 16-PREC5-Volder; 14-PREC1-DeJong