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

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PROJECT SUMMARY

Objectives:

1. Using a *citizen research approach* determine potential of linking yield to carbohydrate content in trees
2. Determine the pattern of carbohydrate content during dormancy and bud break.
3. 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.

Background and Discussion:

California's Central Valley is affected 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 that can affect tree phenology.

These factors combined with the increasing use of saline ground water supplies have produced an unprecedented set of new abiotic stresses that affect horticultural production. Vegetative life of any perennial 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 stresses and allow survival of dormancy.

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 uses to interact with the environment. The understanding of carbohydrate physiology as plants respond to environmental stress while accomplishing their reproductive functions is of key importance for predicting yields, analysis of stress, 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 started and successfully developed a *citizen research* project that allows for analysis of carbohydrates in almond orchards across California (Objective 1). Initial results suggest that there is a strong correlation between winter content of sugars in twigs and yield (for Jan-Feb R^2=0.96). As accumulation of sugars in wood occurs from mid-summer until fall, it is important to look at the post-harvest management from the perspective of carbohydrate content. 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 seasonal patterns of carbohydrate reserves, we observed almost complete depletion of starch content by mid-summer that correlates with nuts maturation. Wood carbohydrate accumulation occurs from mid-August and accelerates after wood growth ceases. Results of field trial on changing thermal pattern affecting buds and branches of trees during dormancy suggest that reduced chilling leads to asynchronous flowering pattern (Objective 3).

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

For More Details, Visit

- Poster location 46, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2018) at Almonds.com/ResearchDatabase
- 2016 - 2017 Annual Reports (16-PREC8-Zwieniecki-DeJong) on the web at Almonds.com/ResearchDatabase
- Related Projects: 17-PREC1-Bailey