Subcellular and Molecular Characterization of Salinity Tolerance in Almonds with Novel Tools

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PROJECT SUMMARY

Objectives for Current Year:

- Development/refinement of confocal based assays for the detection of sodium, chloride and potassium in almond cells.
- Conclude ongoing salinity experiments with Hansen and Empyrean-1 and expand to additional genotypes. Correlate ion localization patterns with cell structural modifications.

Background and Discussion:

California is experiencing increasing soil salinization, which is projected to accelerate in the current drought conditions due to the increased use of saline ground water. Almond plants, one of the most economically important crops in California and one with the highest expansion rate, are strongly sensitive to salt stress. Selection of elite rootstocks with improved salinity tolerance affords a way to ensure high yield production in this long term trend. The development of universal cellular and molecular methodologies towards identifying sodium uptake, ion sequestration and its effect on cellular morphology and viability for various rootstocks and rootstock/scion combinations is a hitherto unexplored approach.

Real time *in vivo* fluorescent microscopy affords localizing and evaluating saline induced structural and morphological changes in the cell and cell wall as a robust criterion for determining halotolerance across various rootstocks.

In the first part of our three-year research plan the plant specific methodologies for the detection of the implicated ions in salinity stress, sodium, potassium and chloride have been established. Among our results are the first successful subcellular potassium and chloride imaging experiments in all plants. The latter constituents a major step forward, since no approaches in plants have been reported so far. Structural root cell morphology changes and ion compartmentalization in selected rootstock genotypes will be examined throughout. Cellular morphologies under salinity will be characterized and comprehensively charted. Using specific fluorescent dyes for cell wall, key structural components in the root cell tissue will be analyzed, to provide comprehensive structural visualization. This will enable the correlation of salt tolerance with subcellular ion compartmentalization to efficiently characterize tolerant genotypes.

Distinct, genotype specific, subcellular accumulation patterns of sodium and potassium were observed in almond rootstock root cells. We hypothesize that a combination of ion uptake and redistribution including sodium and potassium, alleviates cytotoxic effects of increased NaCl uptake by a mechanism related to ion balances that are not yet fully explored and understood.

The established methodology will provide the flexibility for future extensions beyond salinity stress to assess cellular structural modifications in response to biotic and abiotic stresses, including that of various pathogens. We expect that dissemination of the developed methodology will spur rapid adaptation and follow up studies, in tandem with a proliferation of the use of advanced microscopy tools in almond research on the cellular level.

Project Cooperators and Personnel: Thomas Wilkop, Yukun Cheng, Angelo Herringer, Bruce Lampinen, Tom Gradziel, Patrick Brown, and John Labavitch, UC Davis; John Preece and Malli Aradhya, USDA National Clonal Germplasm Repository; Roger Duncan, UCCE - Stanislaus County

For More Details, Visit

- Poster location 36, 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-HORT23-Drakakaki); or on the web (after January 2017) at Almonds.com/ResearchDatabase
- Related projects: 16-HORT16-Aradhya/Ledbetter/Kluepfel (COC); 16-HORT20-Brown/Grattan; 16-HORT26-Sandhu