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

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PROJECT SUMMARY

Objectives for Current Year:

- Development of confocal based assays for sodium, chloride and potassium ion detection in almond cells and structural characterization of root cell morphology under salinity stress.
- Conduct pilot screen of selected rootstocks.

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. However, currently there exist no robust screening tools for the large scale evaluation of salinity tolerance for rootstocks at the seedling level. Our work is aiming developing and applying these, driven by the hypothesis that sodium sequestration and compartmentalization in almond tree cells is a quantitative predictor for salinity tolerance.

The foundation for 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.

Life cell fluorescent microscopy affords localizing and evaluating saline induced structural and morphological changes in the cell and cell wall as a robust criterion for halotolerance across various rootstocks. Towards the selection of elite material, we develop confocal based assays for sodium detection. We established a methodology and protocols to specifically image sodium in the context of referential cellular markers, such as vacuoles, in woody plant cells. This allows us to quantitate sodium transport in roots, stems and leaves toward assessing the subcellular sodium sequestration. We will extend the fluorescence ion screening toward potassium and d chloride in almond cells. 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. 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 advanced microscopy tools.

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

For More Details, Visit

- Poster location 46, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2016) at Almonds.com/ResearchDatabase
- Related projects: 15-HORT16-Aradhya/Ledbetter/Kluepfel; 15-HORT20-Brown/Grattan; 15-HORT25-Brar (2014-15 Annual Report CD)