Diagnostics and Non-Fumigant Management Approaches for Prunus Replant Disease

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PROJECT SUMMARY

Objectives:

- Develop molecular diagnostics for prediction and characterization of RD.
- Optimize anaerobic soil disinfestation (ASD) for affordability and ease of commercial implementation.

Background and Discussion:

This project focuses on the biology and management of almond replant disease (RD), which is caused by a soilborne complex of microorganisms found after successive plantings of *Prunus* species. RD can occur in the absence of plant pathogenic nematodes, and it suppresses root development, tree growth, and early and cumulative nut yields.

Progress in objective 1, to "*Develop molecular diagnostics for prediction and characterization of RD*". This year we gained several new leads on microbial community members that may contribute to induction of RD. We used PCR and high-throughput sequencing (HTS) of rDNA to assess the relative abundance of thousands of bacteria, fungi, and oomycetes that populate the roots and rhizosphere on Nemaguard peach rootstock plants in: (i) RD-inducing soils (i.e., soils used for stone fruit and nut production, without fumigation or heat treatment) and (ii) non-RD-inducing soils (fumigated or heat-treated almond replant soils, vineyard soils, Arbuckle-area almond replant soils). RD induction was assessed with a greenhouse bioassay, followed by the HTS, with 10 diverse soils. We used a similar approach with orchard-based ASD trials at Kearney (KARE), in which we compared the relative abundance of the microorganisms arising from RD-inducing soil treatments (non-treated controls) to the abundances resulting from RD-preventing treatments (soil fumigation, ASD). Among bacterial community members highest in relative abundance and most strongly associated with RD induction in the greenhouse and orchard trials were operational taxonomic units (OTUs) of an unknown member of the Streptomycetaceae family and members of the *Steroidobacter* genus. In the orchard trial samples, fungi and oomycetes most strongly associated with RD induction included *Pythium ultimum*, *Phytopythium vexans*, and *Ceratobasidum* sp. In the greenhouse trial, relative abundances of fungi and oomycetes were less correlated with RD induction, compared to the orchard trial.

Progress in objective 2, to "*Optimize anaerobic soil disinfestation (ASD)*". Under this objective we collected nut yields and growth data from our four ASD trials established in 2013-14 (rice-bran-based ASD) and tree growth and microbial samples from our "second generation" ASD × WOR (whole orchard recycling) trials that were established in Kern County (two locations) and at KARE in 2016. We completed preplant treatments for a new ASD × WOR trial at CSU Fresno; to be planted in winter 2018.

In our oldest ASD trials, conducted where there was RD but not significant nematode pressure, stand-alone rice bran ASD and preplant fumigation treatments both increased yields strongly and equivalently (4th-leaf cumulative kernal yields were 3651, 3709, and 1877 lb/ac in ASD, fumigated, and control treatments, respectively).

In our "second-generation" ASD trials at KARE, which are testing economical carbon sources (almond hull, almond hull and shell, and 6 additional sources) and ASD application methods (conventional drip, with and without tarp), preliminary tree growth responses indicate that we can effectively manage RD with reduced-cost ASD methods. Leaf nutrient analyses will be completed for selected ASD and WOR treatments.

For More Details, Visit
- Poster location 70, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2018) at Almonds.com/Research Database
- 2016 - 2017 Annual Reports (16-PATH1-Browne) on the web at Almonds.com/Research Database
- Related Projects: 17-AIR10-Simmons; 17-HORT3-Yaghmour (Duncan)