Identification of almond rootstocks with resistance to Armillaria root disease

Kendra Baumgartner*[1], Phillip Fujiyoshi[1], Daniel Kluepfel[1], Craig Ledbetter[2], Javier Castillon[3]

[1]USDA-ARS, Davis, CA; [2]USDA-ARS, Parlier, CA; [3]Duarte Nursery/Dry Creek Laboratories, Hughson, CA, *kbaumgartner@ucdavis.edu

What is Armillaria root disease?

Armillaria root disease is caused by the fungus *Armillaria mellea*, which decomposes the woody roots of the tree.

Such destruction to the root system inhibits water and nutrient uptake from the soil, significantly reduces crop growth and yield, and eventually kills infected trees. Peach and almond are among the most *Armillaria*-susceptible crops.

Disease diagnosis

Disease centers (below) are localized areas of dead and dying trees.

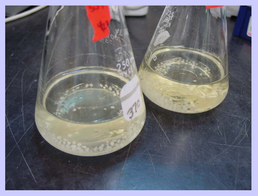
Leaf symptoms:
- stunted shoots with dwarfed leaves
- premature defoliation

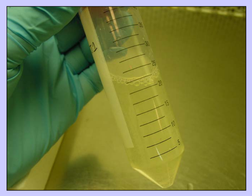
Signs of the fungus:
- white mats of fungus (mycelial fans) beneath the bark at the base of the trunk and on infected roots

Screening rootstocks for resistance

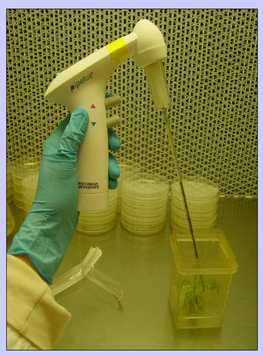
We developed a rapid rootstock screening procedure for use in the lab.
Our procedure relies on rooting cuttings in tissue culture.

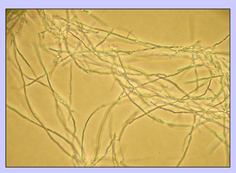
The vegetative stage of the fungus (mycelium), which infects plants, is grown in liquid culture for 7 days.





Then the culture is homogenized with a hand-held blender into many small fragments, which are quantified and adjusted to the same concentration across all strains used in the experiment.

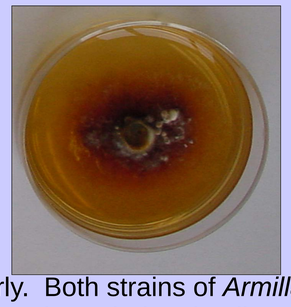




The pathogen is inoculated to the surface of the tissue culture medium, and grows to colonize the entire medium in two weeks.

Plants are incubated for two months, during which time dead plants are tallied. Mortality is our measure of resistance; rootstocks with the highest % mortality are the most susceptible.

Three strains of the pathogen were tested, including two *Armillaria mellea* from *Prunus* in Sacramento & Solano Counties and one *Armillaria tabescens* from peach in South Carolina.



Across all rootstocks, the strains of the pathogen behaved similarly. Both strains of *Armillaria mellea* were equally virulent. The strain of *Armillaria tabescens* was less virulent in all rootstocks.

Rootstock	% Mortality at 2 MPI	Notes
Krymsk 86	33.44a	More resistant than Marianna 2624
Krymsk 1	41.11ab	As resistant as Marianna 2624
Marianna 2624	**46.11ab**	**Resistant control**
Lovell	71.79c	As susceptible as Nemaguard
Nemaguard	**76.44c**	**Susceptible control**
Hansen536	89.12d	More susceptible than Nemaguard

We canvased almond farm advisors and researchers, and compiled an initial set of rootstocks for examination (see table above). These were selected based on the following criteria:

-widespread use in almond orchards
-building interest among almond growers
-graft-compatibility with almond
-used as a resistant or susceptible control in our infection assay
-likely to be *Armillaria*-resistant (i.e., plum parentage)

Resistant and susceptible controls were Marianna 2624 and Nemaguard, respectively. Their relative resistance was based on field observations, and so we were not sure how they would perform in our screening procedure. Fortunately, the results were as expected. Mortality at 2 months post-inoculation was 46% for Marianna 2624, compared to 76% for Nemaguard.

Krymsk 86 (Kuban 86) was the most resistant of the six rootstock, more so than Marianna 2624, albeit not at statistically significant levels. Similarly susceptible were Nemaguard and Lovell. Hansen 536 was the most susceptible rootstock. Therefore, in future screening experiments, we will use Krymsk 86 and Hansen 536 as resistant and susceptible controls.

Empyrean 1 (Barrier 1) and Bright 5 are currently being tested. Additional rootstocks we plan to test include Cadaman and Viking

Acknowledgements

We gratefully acknowledge the valuable support of the Almond Board of California. Duarte Nursery provided stock tissue cultures of all rootstocks, which were propagated by the Ledbetter lab. Phillip Fujiyoshi gathered the strains of the pathogen from diseased orchards, prepared inoculum, and tested each and every dead plant for the presence of the pathogen.