Effect of Lemon Variety and Rootstock on Development of Lemon Tree Wood Rot

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In 1992, a species of wood-decaying fungus, *Coniophora eremophila,* was first reported to be associated with a brown heartwood rot occurring on lemon trees in Yuma (Matheron, Gilbertson & Matejka, 1992), although wood decay had been documented in lemon trees for at least 30 years earlier. In 1997 a second fungus was isolated from decayed heartwood of younger lemon trees and was identified as *Antrodia sinuosa***.** Finally, in 1999 a third fungus (*Nodulisporium* sp.) associated with gumming and a white wood rot at pruning wounds was shown to be yet another pathogen of lemon tree branches.

Research supported in the past by the Arizona Citrus Research Council, USDA and other entities has revealed important information pertaining to the biology of the brown heartwood rot fungi *Antrodia* and *Coniophora*, the susceptibility of different types of citrus to brown heartwood rot, and potential disease management strategies (Bigelow, Matheron & Gilbertson, 1996; Bigelow, Gilbertson & Matheron, 1998)**.** A summary of this information is listed below.

1. *Coniophora* has been found growing and sporulating on fallen dead wood of a number of desert plants, shrubs and cacti in Arizona; however, to date the fungus has not been observed sporulating on infected lemon wood. *Antrodia* has not been observed on desert plants; however, this fungus has been found sporulating on fallen dead lemon wood within infected lemon orchards and on infected branches of living lemon trees.
2. The optimum temperature range for growth of *Antrodia* and *Coniophora* is 30-35EC (86-95EF).
3. For *Coniophora,* the rate of decay in Lisbon lemon was three times that observed in Valencia orange, Orlando tangelo and Marsh grapefruit. The rate of wood decay caused by *Antrodia* also is higher in lemon than in orange, tangelo and grapefruit trees.
4. The degree of wood decay caused by *Antrodia* and *Coniophora* is related to temperature, with the highest rate of decay observed during hot summer months, and lowest rate of decay recorded in the winter.
5. Initial wood decay rate experiments in mature lemon trees suggested that *Antrodia* rather than *Coniophora* is a greater threat to lemon trees. Furthermore, in recent years, new brown heartwood rot infections of citrus trees in Yuma have been virtually all caused by *Antrodia sinuosa*.

What is not known about brown heartwood rot is the possible effect of rootstock, lemon variety or tree age on disease development. To answer these questions, a lemon tree planting was established in 2003 at the University of Arizona Yuma Mesa Agricultural Center. This experimental planting contains Allen Eureka, Frost Nucellar, Limoneira 8A, Corona Foothills, and Prior trees on rough lemon, *C. macrophylla* and *C. volkameriana* rootstocks. Trees are arranged in a randomized complete block design with 15 replicate trees of each type for a total of 225 trees. In July 2006, August 2007, and August 2008, 10 different branches on trees of each

lemon variety/rootstock combination were inoculated with *Antrodia sinuosa* by inserting a small wooden dowel colonized with the pathogen into a hole drilled into each test branch, using procedures described earlier (Bigelow, Matheron & Gilbertson, 1996). In March 2007, April 2008 and May 2009, inoculated branches were removed from trees, split open, and the length of the wood decay column in each branch was measured.

Effect of rootstock. In all three trials, lemon trees on *C. macrophylla* rootstock and inoculated with *Antrodia* had significantly larger wood decay columns compared to those on *C. volkameriana* and rough lemon rootstock. Considering all tested lemon varieties in all three trials, those on *C. volkameriana* and rough lemon rootstocks had wood decay columns 32 and 38% shorter, respectively, than the same lemon varieties on *C. macrophylla*, which averaged 4.4 inches in length.

Effect of lemon variety. The rate of wood decay development was a function of lemon tree variety and rootstock. For trees on *C. macrophylla* rootstock, the highest length of wood decay columns for the three individual trials averaged 5.6 inches on branches of Frost Nucellar, whereas the smallest wood decay columns, averaging 3.0 inches in length, were recorded on Corona Foothills established on the same rootstock. For trees established on *Citrus volkameriana* rootstock, the largest and smallest wood decay columns on average were 3.4 and 2.3 inches in length, respectively, on Frost Nucellar and Eureka. Finally, for trees on rough lemon rootstock, the biggest and smallest wood decay columns were 3.6 and 2.0 inches, respectively, on Prior and Frost Nucellar. For these lemon varieties on their respective rootstocks, the differences in length of wood decay columns were statistically significant in each of the three separate trials conducted.

Effect of tree age. During the 3-year period of this study, no significant changes in the degree of wood decay related to tree age was apparent. The average length of wood decay cankers for all trees inoculated in 2006, 2007, and 2008 was 3.6, 2.9, and 3.7 inches, respectively.

The rate of brown heartwood rot development caused by *Antrodia sinuosa* on lemon scion varieties is affected by the rootstock on which these trees are developed. In general, disease progression was more rapid on trees with *C. macrophylla* rootstock; however, the lemon scion on which the largest or smallest amount of wood decay was observed was usually different among the three rootstocks evaluated. Although rootstock and lemon scion affect the rate of brown heartwood development caused by *Antrodia sinuosa*; even a reduced rate of disease development is a serious threat to trees with a life span exceeding 30 years. Disease management practices (Matheron, Porchas & Bigelow, 2006.) should also include minimizing branch fractures and other nonpruning wounds as well as early detection and removal of infected branches before the onset of the increased wood decay development period that normally extends from May to October.

References

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