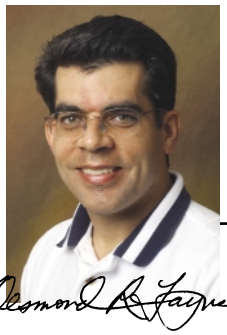

Stone Fruit

Avoiding Armillaria Root Rot

Photos courtesy of Desmond Layne

From the time of initial armillaria root rot infection, the fungus grows as a white mat under the bark of roots (top photo). Honey-colored mushrooms may appear at the base of the tree in the late summer as the fungus tries to complete its life cycle (bottom photo).

HAVE you observed any unthrifty or dying peach trees on your farm this season? Peach trees are not native to the U.S. and are subject to many native pests and diseases as well as adverse environmental factors. In sites where the soil is heavy and poorly drained, if excess moisture results, trees may die from flooding (anoxia) and / or infection with the soilborne fungus, *Phytophthora*. Another cause of premature death is mechanical injury to the tree trunk (tractor blight) that can lead to infestation by peach tree borers.

On sandy sites with high ring nematode populations, peach trees may die from the combined effects of nematode feeding on roots, winter injury, and bacterial canker infection resulting in the phenomenon referred to as peach tree short life (PTSL). The commercial rootstock Guardian may afford advantage to trees on PTSL sites but under other circumstances as noted below, trees may still die prematurely.

Armillaria root rot (ARR), also commonly known as oak root rot, is becoming one of the most serious soilborne fungal diseases of peach in the U.S. In the southeastern U.S. alone, thousands of trees die to this disease every year. Currently, there is no commercial rootstock available that is resistant / tolerant to ARR. Preplant soil fumigation with methyl bromide, Telone II, or Enzone appear to offer only minimal benefit.

Growers are often faced with the dilemma of leaving valuable peach ground fallow or replanting on infested sites. Further, in many areas where peaches can be grown, urban encroachment has supplanted peach orchards with houses or driven land prices beyond what growers can afford to buy or lease. This is not a sustainable situation.

Many growers have a false sense of security when planting peach trees on "virgin" peach ground (sites where peaches have never been grown before). I have personally observed peach trees on "virgin" ground as young as two years old dying of ARR in South Carolina. How is this possible?

Spotting Symptoms

Armillaria is a disease that affects several woody plant species, including oak, many *Prunus* species, and valuable ornamental plants. It survives for up to a century in the soil and is well-protected under the woody bark of infected root pieces. Whether the site was a mixed hardwood forest that was cleared recently, a former peach site, or even a site that had been in row crops for decades, ARR can still be present in the soil. Often, its presence is unknown until a susceptible plant (i.e., peach tree) is grown there and its roots come in contact with the inoculum buried deep in the soil profile. Deep raking of soil to remove infect-

ed root pieces prior to planting can remove much of the inoculum but there are mechanical and practical limits preventing complete inoculum eradication from an infected site.

Once a tree has become infected with ARR, symptom expression above ground may take one to two years to be visible. Infected trees will first appear to be drought stressed and will have leaf cupping, reduced shoot extension, and fruits may be small and turn red prematurely. By the following year, trees are typically dead.

From the time of initial infection, the fungus grows as a white mycelial mat under the bark of roots (see top photo). It works its way from the periphery of the tree (or wherever the infected root was) up toward the crown of the tree. Ultimately, the crown will be entirely girdled and water/nutrient transport will be blocked.

Honey-colored mushrooms may appear at the base of the tree in the late summer as ARR tries to complete its life-cycle (see bottom photo). Unfortunately, ARR can move across root grafts from one tree to the next in the tree row. This can result in a particularly devastating effect when trees are closely spaced as in the high density perpendicular (Kearney) V system.

Symptoms for PTSL and ARR are noticeably different. For one, trees dying from PTSL will usually have a living root system that produces many suckers at the base of the tree. ARR trees, on the other hand, do not sucker because the root system is dead. Cutting back the bark from the crown of an ARR tree will probably reveal the white mycelial mat that smells like a mushroom.

Finding A Cure

Several scientists in the U.S. are working to address the growing ARR crisis. Projects include rootstock breeding and screening, preplant soil fumigant testing, the use of preplant mycorrhizal fungi root dips, passive injection of systemic fungicides into infected trees, and the use of raised beds followed by root-collar excavation. Many of these experiments are in the preliminary stages.

One particularly exciting project that our research group at Clemson is involved in is a long-term project to genetically engineer an ARR resistant rootstock. It just so happens that there is a Chinese orchid that in order to flower requires infection by Armillaria. The orchid has a gene that makes a particular protein (gastrodianin) that digests the infecting Armillaria fungus and it uses the energy for flowering.

By genetic engineering we have been able to introduce this gene into a tobacco "model plant system" which provides quick experimental results and which provides a model system for stone fruits, to test for its efficacy against several soilborne pathogens. Although we are a long way from an ARR-resistant peach rootstock, our preliminary results indicate that this inserted gene confers enhanced tolerance to several important soilborne fungi and nematodes. Disease screening tests of our transgenic plum seedlings to ARR will proceed in the near future.

I thank Drs. Kerik Cox and Guido Schnabel (Clemson University) and Dr. Ralph Scorza (USDA-ARS, Kearneysville, WV), collaborators on these projects. ●

Desmond R. Layne, Ph.D. is an Associate Professor of Pomology and Tree Fruit Specialist in the Department of Horticulture at Clemson University in South Carolina. E-mail questions or comments about this article to dlayne@clemson.edu, or go to *www.clemson.edu/hort/Peach/index.php*.