Phytophthora: An old problem with new challenges

By Evan Johnson

Diseases caused by phytophthora continually threaten Florida citrus production. Brown rot can directly reduce yields of early maturing varieties including Hamlin and grapefruit, can delay harvest of fresh market fruit until infected fruit have dropped, or risk packinghouse rejection of the load because it can spread post-harvest. Foot and crown rot can kill trees but are uncommon when the correct rootstock is chosen. Root rot, a perennial problem that can silently reduce tree vigor and fruit production, is well known and should be frequently monitored for damaging populations in commercial groves.

All three of these diseases have been manageable in the past; however, dynamics of phytophthora inoculum and management of phytophthora root rot have changed with endemic huanglongbing (HLB).

Figure 1. Phytophthora brown rot (upper left), crown/foot rot (upper middle), root rot (upper right) and Diaprepes weevil feeding on structural roots (bottom).

BROWN ROT

Brown rot occurs when phytophthora spores directly infect fruit. This causes leathery brown lesions on the fruit that can form a fuzzy white mycelium under humid conditions (Figure 1). Besides the immediate loss of fruit, brown rot can also spread from fruit to fruit after harvest when fruit are in proximity. Brown rot can either be an inconvenience on unskirted trees or a major problem, depending on the species of phytophthora in a grove.

Two species of phytophthora commonly affect Florida citrus. Both are primarily soilborne but differ in how they spread as brown rot.

The most widespread is *Phytophthora nicotianae* (also known as *Phytophthora parasitica*), which can cause severe root rot in many soils, but only infects fruit when inoculum is splashed from the soil. Generally, *Phytophthora nicotianae* only causes brown rot on fruit within 3 feet of the ground.

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Phytophthora palmivora prefers moist dense soils and can cause severe brown rot infections because the inoculum can climb the tree from fruit to fruit. This can lead to severe yield losses as all the fruit on the tree are at risk.

In general, brown rot can be controlled with fosetyl-Al or other phosphites before the main brown rot infection period around July. Treatment

is effective for up to 12 weeks. Copper sprays can provide a protective barrier against infection if fall rains are expected. While copper can limit spread of brown rot caused by *Phytophthora palmivora* as soon as it is noticed, it cannot cure existing infections. It is therefore recommended to treat for brown rot before infection occurs.

FOOT AND CROWN ROT

Foot and crown rot occur when phytophthora infects the bark of the trunk or structural roots. Lesions develop on the bark and can spread to girdle the tree, leading to rapid decline and death (Figure 1, page 18). In most cases, foot and crown rot can be prevented using rootstocks that are resistant to bark infection. Susceptible varieties such as Cleopatra mandarin and Pineapple sweet orange should not be planted in locations with a history of phytophthora, since they are most susceptible to foot rot at a young age.

This can be complicated by the Diaprepes root weevil as foot rot-tolerant rootstocks can become susceptible due to feeding damage from weevil larvae (Figure 1, page 18) in fine soils with high bicarbonate and/or pH, especially when *Phytophthora palmivora* is present. *Phytophthora palmivora* is highly aggressive in combination with weevil root damage on varieties that are generally considered phytophthora-tolerant, like Swingle and some other trifoliates and hybrids. Minimizing and managing root rot reduces the inoculum potential of phytophthora in the soil, which also reduces the risk of foot rot. If necessary, fungicides such as mefanoxam can be used according to labeled rates on trunk lesions.

The simplest management of phytophthora root rot is to plant clean nursery stock in well-drained soil (beds in the flatwoods) and to avoid excessive irrigation beyond the plant's needs.

ROOT ROT

Phytophthora root rot is the most common phytophthora disease in Florida and is generally the source of inoculum for foot rot and brown rot. It occurs when phytophthora spores infect fibrous roots of citrus, eventually leading to root death and sloughing (Figure 1, page 18). The simplest management of phytophthora root rot is to plant clean nursery stock in well-drained soil (beds in the flatwoods) and to avoid excessive irrigation beyond the plant's needs.

It is also important to use tolerant rootstocks, like most trifoliate hybrids, that are adapted to the local soil conditions. These rootstocks are not completely resistant but reduce pathogen invasion of tissues and are able to regenerate roots faster. Under the right conditions, the number of resting spores in the soil can reach damaging populations (more than 20 propagules/cm^3 of soil). Traditionally, at these damaging populations chemical management with phosphites, fosetyl-Al and oomyceticides such as

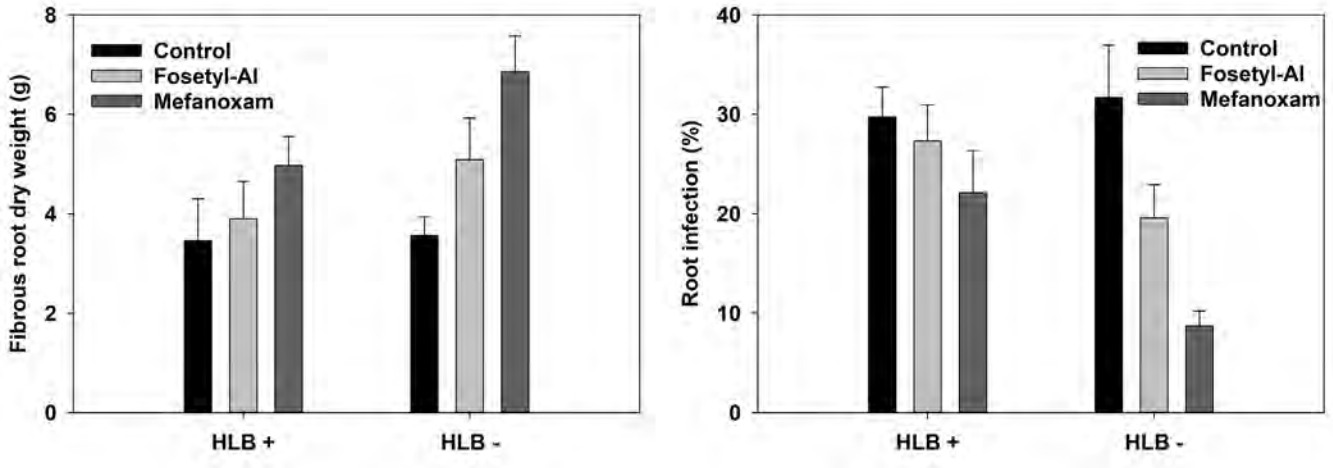

Figure 2. Reduced efficacy of fosetyl-Al and mefanoxam against fibrous root damage and phytophthora infection of HLB-affected greenhouse trees compared to trees without HLB

mefanoxam is needed to protect tree vigor and fruit production. Rotation of chemistries is essential to avoid resistance development.

Unfortunately, another aspect of phytophthora root rot is that HLB predisposes roots to infection. This can overcome the tolerance of many trifoliate rootstocks and lead to the rapid development of damaging populations, further exacerbating the root loss effects of HLB or phytophthora alone. Because these trees have few fibrous roots, these increases in phytophthora populations are generally cyclical and coincide with major root flush events.

Chemical management of phytophthora should therefore be conducted during periods of major root flushes. Although roots are not easy to monitor directly, root flushes normally follow leaf flushes with the largest root flush occurring during the fall. The value of chemical management of phytophthora in groves with high HLB incidence to improve fruit yields is not currently known. Another side effect of the phytophthora/HLB interaction is the reduced efficacy of chemical management of phytophthora (Figure 2). The reason for the reduced efficacy remains unknown. These two aspects of the interaction

make it difficult to recommend the best approach to managing existing phytophthora root rot problems.

In new plantings, prevention remains the best management option. Properly preparing the land can greatly reduce existing phytophthora populations as the number of resting spores will decline without available host roots. In fine textured soils or soils with a high water table, setting up proper bedding and drainage will also help.

However, no amount of land preparation will help if the trees are infected with phytophthora from the onset. Potting media is a perfect environment for phytophthora, and the propagule counts can reach much higher levels than are normally seen in the field. This will hinder establishment of the tree and stunt growth, which will only be compounded if the tree develops HLB within the first few years.

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Replants pose a problem as the roots of neighboring mature trees may harbor a damaging population of phytophthora that can quickly spread to new plants through the swimming zoospores that are highly attracted to the sugary exudates from new root growth. Trees in new plantings will have considerable root growth right after planting as the tree establishes itself in the new soil. Therefore, chemical management of phytophthora on replant trees in older groves will help the root systems establish without damage from phytophthora before they become affected by HLB.

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