CITRUS ADVANCED TECHNOLOGY PROGRAM

QUARTERLY & FINAL REPORTS: Control of Citrus Greening, Canker & Emerging Diseases of Citrus

SELECT PERIOD September 2015

○ *Quarterly Report* ● *Final*

Proposal Title

Phytophthora damage to roots: a potential contributor to reduced nutrient uptake and decline of HLB-affected citrus trees

Today's Date	Sponsoring Organization (drop-down)	Category (drop down)
10/21/15	Citrus Research and Development Foundation	Infection Consequences

REPORT UPDATE (500 words-It is not necessary in this public report to disclose your institution's proprietary information or intellectual property.)

Evaluation of root production on HLB-affected trees compared to presumed healthy trees confirmed that root loss is due to reduced root longevity. This root loss is exacerbated by biotic and abiotic stresses in the rhizosphere. Phytophthora propagules per soil volume and per root fluctuate in response to fibrous root density based on intensive rhizosphere soil sampling (i.e., local repeated measures) and extensive sampling (i.e., Syngenta statewide Phytophthora propapgule survey) . Increased susceptibility of Las–infected roots to Phytophthora spp. was evidenced by statewide populations that fluctuated from unprecedented highs in the 2011 season to an unprecedented low in 2013 compared to 25 years of pre-HLB soil populations.

A series of greenhouse studies with potted seedlings investigated the interaction between Las and P. nicotianae (P.n.) The results demonstrated that 1) Las infection of citrus rootstocks predisposes fibrous roots to P.n. infection by increasing root leakage of exudates that attract zoospores and by disrupting host resistance (i.e. carbohydrate-mediated defense); 2) the combination of Las and P.n. causes greater damage than each pathogen alone; 3) the interaction between P.n. and Las on fibrous root damage is mediated by available young fibrous root biomass. More in-depth examination of the interaction between Las and P.n., revealed different disease causation mechanisms for each root pathogen. Las damages fibrous roots by inducing faster growth of replacement roots and root turnover; P.n. damages fibrous roots by causing rapid root collapse immediately after infection, especially new growth; canopy development is reduced after root damage by both pathogens. To explore disease development from the perspective of root carbohydrate metabolism responses to Las and P.n. infection, sucrose metabolism related gene expression was investigated in two rootstocks (Cleopatra mandarin, susceptible to P.n.; Swingle citrumelo tolerant to P.n.). The results showed that sucrose metabolism is more disrupted by Las and P.n. in Phytophthora susceptible Cleopatra mandarin than Swingle citrumelo.

Chemical control of P.n. slows infection of the root system and may slow decline in HLB-affected trees in Phytophthora-infested groves. However, greenhouse and fungicide trials indicate that HLB reduces the effectiveness of fungicides for control of Phytophthora root rot as a consequence of increased root susceptibility to P.n. Based on these results, grove managers should consider practices that: 1) minimize root damage caused by the combination of Las and P.n. (e.g. use of soil fungicides if damaging populations of Phytophthora occur); 2) reduce disruption of sucrose metabolism in rootstocks and scions through balanced use of water and fertilizers to promote regular cycles of root and shoot flushes and sustain fruit growth and maturation; 3) provide optimal growing conditions to maintain tree growth by minimizing the effects of abiotic (e.g., drought, freezes) and biotic stress (root pests and pathogens).

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