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—Scientific Note—

Efficacy and Effects of Trunk Injection for Delivering Imidacloprid and Oxytetracycline to HLB-affected Sweet Orange Trees

Leigh Archer, Jawwad Qureshi, and Ute Albrecht*

University of Florida, IFAS Southwest Florida Research and Education Center, Immokalee, FL

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Huanglongbing (HLB), associated with the phloem-limited bacterial pathogen, *Candidatus* Liberibacter asiaticus (*C*Las), is vectored by the Asian citrus psyllid, *Diaphorina citri*. The location of the pathogen in the tree vascular tissue limits the effectiveness of foliar-applied therapeutic compounds. Because of the abundance of the psyllid vector throughout Florida, management is challenging and typically relies on insecticides applied as a foliar spray or by soil drenching. Trunk injection is an alternative delivery method which supplies crop protection materials directly into the xylem of a woody species. This technique can optimize the availability of the compound while minimizing drift, runoff, or damage to non-target organisms.

Five-year-old HLB-affected 'Valencia' sweet orange (*Citrus sinensis*) trees were injected with therapeutic compounds in Oct. 2020 and Apr. 2021 using two ChemJet tree injectors on opposite sides of the trunk. Trees received injections of either 2 g of ArborOTC (37% oxytetracycline) dissolved in 40 mL water, 4 mL of Xytect (10% imidacloprid), or 40 mL of water as a control. Trees were monitored for differences in: i) canopy health measured using visual ratings; ii) psyllid mortality by caging laboratory reared adults on individual shoots; iii), bacterial titer in roots, bark, and leaves using RT-qPCR; and iv) fruit quality, fruit drop, and yield at harvest.

Four months after the first injection, trees injected with oxytetracycline had a significantly higher mean Ct-value in both root ($P < 0.0001$) and leaf tissue ($P = 0.006$) compared to the mean Ct-values of trees injected with the water control. From December until February, fruit drop averaged 20% in oxytetracycline treated trees, compared to 82% in control trees ($P < 0.0001$). This corresponded to an average yield at harvest of 9.4 kg after oxytetracycline injection and 2.5 kg in the water control ($P = 0.0012$). Fruit quality ($P = 0.003$) and peel color ($P < 0.0001$) at harvest were significantly improved for oxytetracycline-injected trees compared to the water control. Tree health was significantly ($P < 0.0001$) improved in oxytetracycline injected trees compared to the controls six months after injection.

Leaf concentrations of imidacloprid two weeks after injection were 271 ppb, which caused a 63% mortality of reared adult psyllids and reduced progeny survival by 80% ($P = 0.0038$) compared with the control. Two months after injection, leaf concentrations of imidacloprid were below 35 ppb, corresponding to 18% psyllid mortality. No significant difference in psyllid mortality was evident five months after injection, when leaf imidacloprid concentrations were below 10 ppb. *C*Las titers were not affected by imidacloprid injections.

Neither the oxytetracycline nor the imidacloprid formulation used in this study are currently labeled for injection in bearing citrus trees. Although we detected no oxytetracycline residues in harvestable fruits five months after injection, this will need to be confirmed in additional studies. Moreover, the long-term effects of trunk injection on citrus tree health will need to be determined specifically regarding effects of wounding and of phytotoxicity of the applied compounds. These results suggest trunk injection could be an effective delivery method for existing or novel therapeutics to manage HLB by targeting the insect vector or the pathogen causing the disease.

Corresponding author. Email: ualbrecht@ufl.edu