

## Current Research Objectives

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**Research topic:** Developing defined media for *Liberibacter crescens* has suggested a simple, inexpensive, and unregulated approach for HLB control.

**Primary Research Objective(s):** Develop defined media for *L. crescens* (the closest cultured relative of the HLB pathogen) and use the media to test ways to culture the pathogen. To our surprise, this work led to a proposal for a simple means to control HLB.

**Research Goal:** By understanding the physiology of the HLB pathogen and its relatives, we can learn new ways to control the disease.

**Outcomes to date:** We have just published (<https://www.frontiersin.org/articles/10.3389/fmicb.2018.00668/full>) that citrate is the preferred carbon source for *Liberibacter*. We have also learned that the optimal citrate level for *Liberibacter* growth is very similar to that found in citrus phloem, and the haemolymph of the Asian citrus psyllid, the two habitats of the HLB pathogen, *Ca. Liberibacter asiaticus*. Plants load citrate into phloem in response to phosphorous (P) deficiency. Citrus growers in both Florida and California have been advised not to apply very much P to citrus groves because of the high P levels already present in soils. However, soil P is insoluble and the plant has to work very hard to solubilize it and does so by citrate excretion from roots. Hence, the manner in which citrus is fertilized has resulted in high citrate levels in phloem, making citrus phloem the ideal habitat for the HLB pathogen. Our proposed solution to HLB is to simply foliar fertilize with P, thereby lowering citrate levels in phloem and starve the pathogen. Growers have led the way in nutritional approaches for the control of HLB. These approaches work in some cases but not all. Here we provide a mechanism and a clear path whereby by a simple fertilization approach should reduce the level of the pathogen in the plant and reduce symptoms.

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