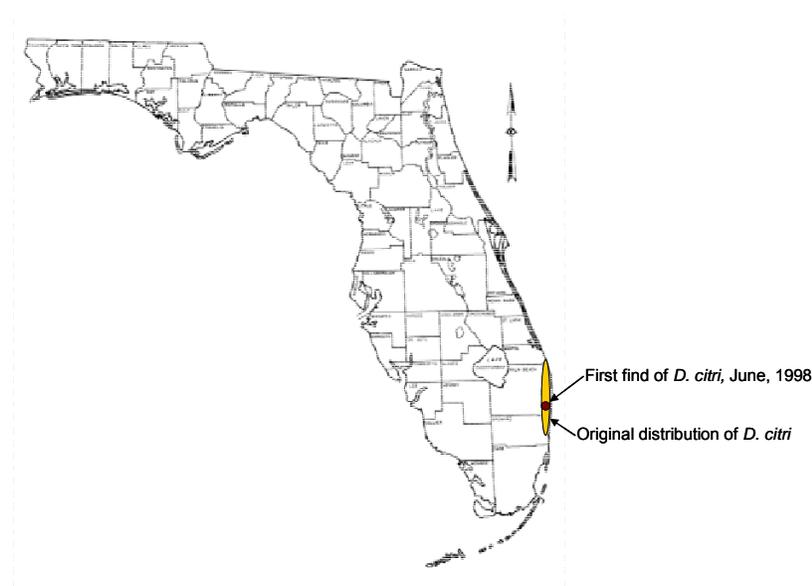


## 2.6 Large-scale distribution of *Diaphorina citri* Kuwayama and citrus Huanglongbing in Florida

Halbert S.E.<sup>1</sup>, Manjunath K.L.<sup>2</sup>, and Brodie M.W.<sup>3</sup>

<sup>1</sup>Florida Department of Agriculture and Consumer Services, Division of Plant Industry, P.O. Box 147100, Gainesville, FL 32614-7100, USA, <sup>2</sup> USDA/ARS, National Clonal Germplasm Repository for Citrus and Dates, 1060 Martin Luther King Blvd., Riverside CA 92508, USA, <sup>3</sup> Florida Department of Agriculture and Consumer Services, Division of Plant Industry, 6706 Lone Oak Blvd., Naples, FL 34109-6834.

*Diaphorina citri* Kuwayama was detected in 1998. We suspect that the insect was discovered within 6 months to one year of its establishment in Florida (Halbert et al. 2003). The original distribution was coastal, spanning three counties (Fig 1). It was distributed throughout the state primarily through migration, hitchhiking on its host plants, and retail trade in *Murraya paniculata* sold as ornamental plants (Halbert et al. 2003; Halbert 2008). Early surveys indicated that the initial psyllid population was free of huanglongbing associated bacteria.

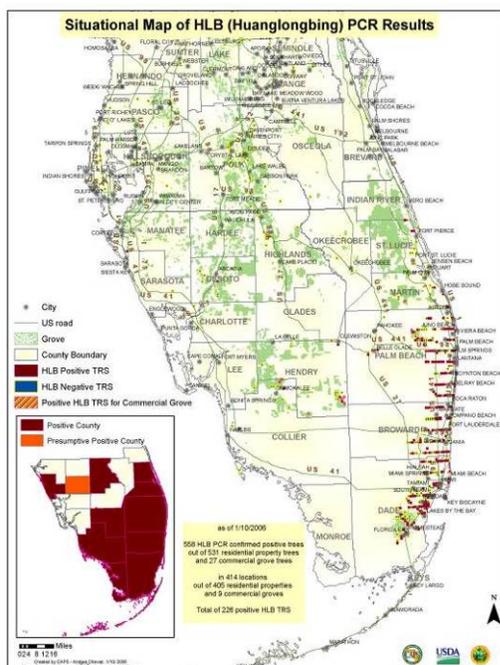


**Figure 1. Distribution of *Diaphorina citri* in Florida at the time of discovery in June 1998.**

Huanglongbing (HLB) was discovered in 2005. The initial delimiting survey found that the highest incidence of infection was in the SE urban areas of the state, suggesting that the disease spread began in South Miami-Dade County (Halbert 2008) (Fig 2.).

It took several months after the initial discovery of *D. citri* in Palm Beach County for the psyllids to be detected in Miami, and even longer for the insects to become abundant. Given our relatively firm date for the initial establishment of *D. citri*, we estimate that our HLB epidemic was at most six years old. It is possible that diseased plants already existed in Florida before the vector arrived, but the disease would be self-limiting without the vector.

Classic epidemiological data indicate that most psyllid vectors do not fly far (Gottwald et al. 1991a, b). Similarly, flight distances of approximately 1.5 km have been documented for *Trioza erytreae* (del Guercio) (van den Berg and Deacon 1998). However, we could not account for the extent of the observed distribution of HLB in Florida by short distance flights, as reported in the literature, combined with known movement of potted plants by residents.

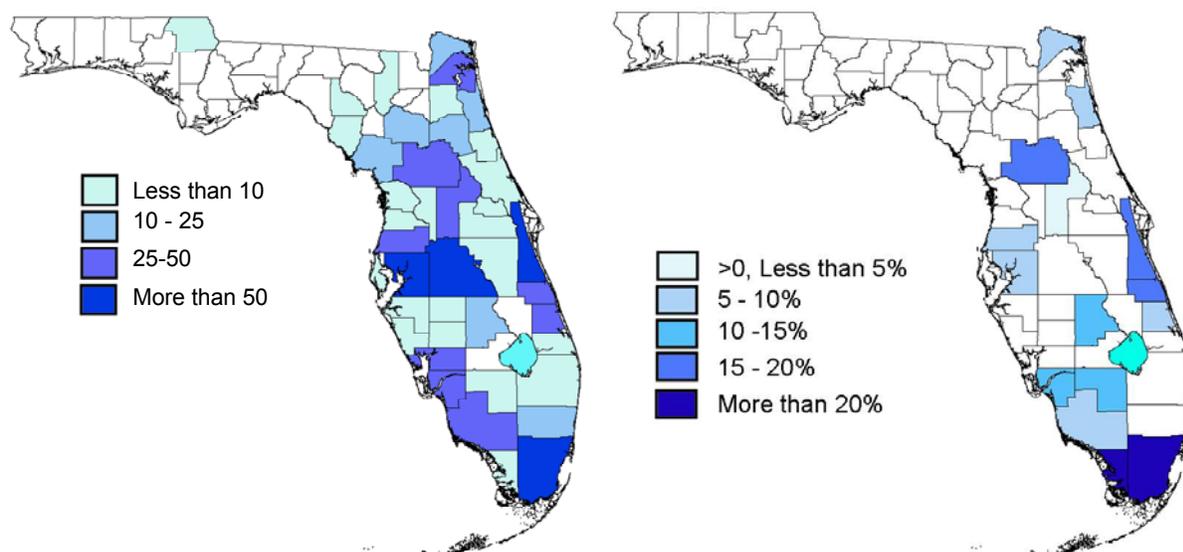


**Figure 2. HLB distribution at the time of the second (SW Florida) delimiting survey, January 2006. (Map: Andrea Chavez)**

Several other means of long distance distribution were postulated to explain the rapid range expansion of HLB in Florida. First, there is strong circumstantial evidence that *D. citri* sometimes can fly much farther than the literature would suggest. Eastern borders of large groves on the west side of the Florida Everglades had high incidence of HLB. The most likely source of inoculum is heavily infected urban areas on the east coast of Florida, approximately 70 km away, on the far side of the Everglades swamp.

At the time that HLB was becoming established, *Murraya paniculata* was one of the more popular landscape plants produced in Florida. Most of the production occurred in south Miami-Dade County, where the HLB epidemic was most intense. Unfortunately, there was no way to find out how many pots of *M. paniculata* traveled north, because they are counted together with other tropical foliage; however, it is safe to say that thousands of pots were sold. *Murraya paniculata* was found to be a host of Florida HLB bacteria (Zhou et al. 2007). We have found HLB-infected psyllid vectors, including nymphs, on *M. paniculata*. We also found infected psyllid vectors at a discount store near Florida's north-eastern border on *M. paniculata* plants that were traced to a Miami-Dade County nursery (Manjunath et al. 2008). Thus, it seems clear that HLB moved around Florida via trade in *M. paniculata* plants produced in Miami-Dade County.

HLB also moved by means of trade in retail citrus plants. We have tested nearly 800 psyllid samples from plants for sale for the presence of HLB by real time PCR (Manjunath et al. 2008). We use cycle threshold (Ct) of 30 as our cut-off point for a positive reading. Of the 782 psyllid samples tested so far, 8.6% were positive for HLB (Fig 3).



**Figure 3.** First map (left) shows numbers of *Diaphorina citri* samples collected on plants for sale by county. Second map (right) shows percent HLB-positive samples of *D. citri* collected on plants for sale by county.

By September 2008, confirmed infected plants had been found in 32 counties, and infected *D. citri* had been found in two more counties. Thus, huanglongbing spread approximately 540 km (320 mi) in 10 years after the initial discovery of psyllids in the state.

An incursion rate of 20 km (12 miles) per year is proposed in the literature for Brazil (Gottwald et al. 2007). We postulate that longer psyllid flights in the absence of host material and distribution of infected plants and infected insect vectors in retail trade may account for the rapid spread in Florida.

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