

H-6 - Huanglongbing Epidemiology: Tracking the Dragon Through Time and Space

Tim R. Gottwald, USDA, ARS, USHRL, Fort Pierce, FL 34935

The epidemiology of Huanglongbing (HLB) caused by *Candidatus Liberibacter asiaticus* (CLa) has been observed and written about, but few quantitative epidemiological studies have been conducted. This is due to the perennial nature of the disease requiring a dedication to data collection over multiple years and the inability, until recently, of detection by PCR, requiring a reliance for disease monitoring on visual assessment. Monitoring the occurrence of symptoms, can be problematic. The lag in time between transmission by psyllid vectors or propagation and the onset of symptoms can be quite variable and quantifying the severity of disease symptoms in individual trees may not be a true indication of pathogen concentration. Additionally, due to the temporal variation in symptom expression, trees infected at the same time may express symptoms over one or more years. This variable lag period, compromises the accuracy of spatial and temporal studies. Symptoms observed are the expression of infections that have occurred over multiple years in the past. Thus we are visually assessing a ‘fuzzy history’ of infection that has occurred over a prior time period equivalent to the lag period. Nevertheless, epidemiological information can be used to predict the economic and physical life of a given planting and provide a means to investigate the efficacy of potential control interventions.

The spatial and temporal dynamics of HLB were investigated in plots in Reunion Island (RI) and southern China (LCF, LARI) to estimate the rates of disease increase and expected longevity of infected sweet orange and mandarin groves infected with CLa.

Analysis of disease progression. HLB epidemics are multiyear in duration and rarely progress to an asymptote before removal of the planting occurs. Therefore both the exponential and the logistic models adequately described disease progress over time. In the LCF plot an asymptote was reached after 13 yrs. But for groves that became unproductive and were removed, disease incidence only reached 0.76 after 6 yr (LARI) and 0.84 after 9 yr (RI), but the logistic model predicted asymptotic disease levels (0.99) after 7 and 13 years for these plots respectively.

Spatial analysis of HLB data. Spatial pattern analysis was undertaken to better understand the relationships among infected trees near to and at distance from each other and thereby gain some understanding of vector spread of HLB, and was accomplished by examining the HLB data at various spatial levels (hierarchies). Combined interpretations of spatial analyses indicate two mechanisms of vector spread of HLB, within local areas and over longer distances. Within local areas, aggregations of infected trees occur that at times can be quite large (up to 1672 trees). In this case vectors apparently spread the disease to either adjacent or nearby trees. Spatial autocorrelation also identifies a prevalence of reflected clusters or areas of aggregation that are discontinuous with the main cluster. These are interpreted as indicative of the presence of secondary foci that are quite prevalent and are at a distance of about 25-50 m from the main cluster of disease and each other. Such a pattern of widely spaced foci perhaps indicates a spatial

mechanism associated with longer distance vector movement. Longer regional scale vector transmission has not been investigated.

Citations:

1. Gottwald, T. R., Aubert, B., and Huang, K. L. Spatial pattern analysis of citrus greening in Shantou, China. Proc. 11th Conf. Internat. Org. Citrus Virol. 11:421-427. 1991.
2. Gottwald, T. R., Aubert, B. and Xue-Yaun, Z. Preliminary analysis of citrus greening (Huanglungbin) epidemics in the People's Republic of China and French Reunion Island. Phytopathology 79:687-693. 1989.
3. Gottwald, T. R., Gonzales, C. I., and Mercado, B. G. Analysis of the distribution of citrus greening in groves in the Philippines. Proc. 11th Conf. Internat. Org. Citrus Virol. 11:414-420. 1991.
4. Zhao, Xue Yuan. Citrus yellow shoot (Huanglungbin) in China: a review. Proc. Int. Soc. Citriculture 466-469. 1981.