

# South China HLB Tour and the International Citrus Congress 2008

By Timothy M. Spann, L. Gene Albrigo, James H. Graham,  
Megan M. Dewdney, Mark Ritenour and James P. Syvertsen

The 11th Congress of the International Society of Citri-culture (ISC) took place Oct. 26-31 in Wuhan, China. Wuhan is about 500 miles upstream from Shanghai along the Yangtze River. Florida was well represented at the meetings with UF/IFAS researchers from Lake Alfred, Immokalee and Fort Pierce attending, along with Florida Department of Citrus and USDA researchers and a few Florida growers. The authors participated in various tours and chaired a number of the program sessions during the congress. This article is a very brief synopsis of their trip.

## PRE-CONFERENCESOUTH CHINA HUANGLONGBING (HLB) TOUR

Prior to the congress, from Oct. 22-25, a group of 16 growers, researchers and extension agents from Florida, California and Brazil toured some of the citrus production areas of Guangdong and Jiangxi Provinces in south China. Much of this area was highlighted in the "Incidence and management of HLB in Southern China" article in the December *Citrus Industry*.

Our tour began in Guangzhou (formerly Canton) in the Guangdong Province, a city of 11 million situated on the Pearl River delta and very near Hong Kong; Guangzhou is known as the gateway to south China. Guangzhou has a tropical climate, being warm and humid year-round. In Guangzhou we visited the South China Agricultural University's HLB Institute and met with its faculty. Their research program is well developed with a long history which we heard about from Professor Kung Hsun Lin. Professor Lin is the brother of the late Professor Kung Hsiang Lin who, after completing his doctorate in plant pathology at Cornell, returned to China and made some of the earliest scientific observations on HLB in China. One of his greatest contributions to HLB research was demonstrating that HLB could be eliminated from budwood by thermo-therapy, which led to the development of HLB-free budwood programs.

Our first grove visits were in Qingyuan, a small city about 75 miles north of Guangzhou along the Pearl River. Qingyuan is the start of the more mountainous parts of Guangdong Province with plains and mountains rising to 500 m (1,600 feet). The plains are mostly reserved for growing rice, bananas and row crops. Citrus is grown on terraced hillsides. The citrus in this area is heavily infected with HLB as well as the recently discovered phytoplasma, and psyllids are abundant. One grove we visited was 3 years old and virtually every tree was declining; the previous grove at the same location survived for eight years. Girdling was being used to induce early fruit production so that some crop could be harvested before the grove succumbed completely.

We then drove northeast for a couple hundred miles over some substantial mountains to Heyuan and Xingfeng. This part of Guangdong is very mountainous, and the climate is considerably cooler than in Guangzhou and Qingyuan. Similar to Qingyuan, the flat land areas are reserved for growing rice and row crops with citrus terraced into the hillsides. In

the two groves we visited in this area, we did not see any HLB symptoms or psyllids, but we were told the disease is present at very low levels. The low level of the disease in this region is likely due to its geographical isolation, the cooler climate and aggressive psyllid control. We saw both Satsuma type mandarins and navels being grown in this area and the production was outstanding.

## THE CONGRESS

Oral and poster presentations were made over three days on a wide variety of subjects, including citrus biotechnology, economics, postharvest pathology and quality, HLB research, citrus genomics, climate and environment, new scion and rootstock varieties, fruit quality physiology, citrus biochemistry, regulation of citrus growth by hormones, citrus virus diseases, citrus canker, nutrition physiology, stress physiology, fungal diseases and pest control. The following is a brief summary of the information presented in a few of these sessions with which the authors were involved.

## HUANGLONGBING (HLB)/GREENING

The HLB session was co-chaired by Tim Spann, Yongping Duan (USDA, Fort Pierce) and Georgios Vidalakis (UC Riverside). Talks in this session covered aspects of psyllid and bacteria biology, various aspects of HLB management, genetic diversity and molecular biology of *Ca. Liberibacter* spp., and distribution of HLB around the world.

The opening talk of the session presented data on the role of psyllid control in the management of HLB. This talk presented data about the long incubation period of HLB in some trees, and indicated that psyllids may be able to transmit the disease from infected but non-symptomatic trees.

Authors of the next set of talks presented data and discussion options for chemical and biological control of psyllids. On this same theme, California presented its action plan for HLB and psyllid control. The plan is currently focused on early detection, quarantine regulations and eradication of the psyllid which has now been found in several locations in southern California near the Mexican border. Apparently lacking from the California plan is nursery regulations similar to those implemented in Florida. An overview of ongoing research and disease spread in Brazil was also presented.

Perhaps one of the most interesting talks for many of us from Florida was the presentation about the positive identification of HLB in 2007 and the disease's spread in Cuba. HLB is established in all of the citrus producing areas of Cuba and they have implemented survey and tree removal programs along with biological and insecticide-based psyllid control programs.

Additional talks covered plant-based changes induced by HLB, including nutrient, carbohydrate and transcriptional changes. A number of talks in the afternoon were focused on progress being made in sequencing the HLB bacterial genome and discovery of molecular differences in HLB bacterial isolates from different geographic locations.

## CLIMATE AND ENVIRONMENT

The climate and environment session was co-chaired by Gene Albrigo, Eduardo Carlos (Brazil) and Zhonghai Sun (China). Albrigo led off this session with a presentation on climate change — both natural cycles and industrial global warming — and what effect both these climate events may have on citrus. A warmer climate in Florida will yield citrus production more like that in tropical countries with shorter maturation periods resulting in poorer fruit quality and more difficulty in getting adequate flower induction.

Australian researchers discussed how areas in southern Australia (currently too cool for citrus production) could be used for citrus production if changes in climate occur. Detailed effects on fruit production are being developed as part of their work.

Chinese researchers reported how freeze years have occurred at regular intervals which may be related to short-term climate cycles, perhaps related to sun spot activity. Work related to the search for freeze tolerance genes and the physiological and chemical changes associated with freeze tolerance was also presented.

California researchers presented data on drought-stimulated gene expression which may be involved in drought-induced flowering of citrus. The flowering development process after drought induction can be triggered in most winters in Brazil by starting irrigation.

Colored shade cloths were compared for citrus production in Israel. The cloths reduced high temperatures and raised humidity, which reduced water use. Net photosynthesis appeared to increase in response to these favorable conditions. White and transparent shade cloths resulted in increased yield under their conditions and were superior to black and red colors.

A report from Texas claims that citrus trees can be in heavy production in two to three years if they are produced by micro-budding in “cone-tainers” and planted in high densities when six to nine months of age. Costs for nursery trees are reportedly less because of rapid production and the small greenhouse space required per plant.

In another session, Texas A&M researchers reported on work that suggests citrus products reduce colon cancer because of fiber content and specific anti-cancer chemicals. Japie Kruger reported that his ‘open hydroponics system’ using carbon-based liquid fertilizers was cheaper and more effective than conventional fertilizer and irrigation systems. He suggested that the system was not a ‘one kind fits all,’ but had to be tailored to the specific soil in the orchard.

## CITRUS CANKER

Research on citrus canker was presented in contributed paper and poster sessions and a workshop. Jim Graham from CREC was a co-organizer and moderator for the oral sessions. The topics covered included exclusion, quarantine or eradication programs in countries free of canker (Spain), eradicating canker (Sao Paulo, Brazil and Queensland, Australia), and countries with existing epidemics (Southern China). Subject matter of the presentations covered molecular detection of the bacterium, strain identification and population biology of strains in citrus groves.

From the disease management standpoint, presentations were made on the timing, frequency and formulations of copper sprays for control of the disease on highly susceptible cultivars in Uruguay (sweet orange), Argentina (lemon) and Florida (grapefruit). Strategies for development of transgenic resistance to canker in the host were discussed by colleagues

in labs from China and Florida, and the genetic basis for disease causation in the bacterium by colleagues in Brazil.

The objective of the workshop was to familiarize citrus researchers with the current situation for management of canker in world citrus industries including China, Brazil, Argentina and Florida. Canker is causing serious new epidemics and challenges for fresh fruit production and shipping to markets in these industries due to the emergence of epidemics on susceptible cultivars and/or in the aftermath of suspension of eradication. Issues relating to the stringent regulations for shipping canker-exposed, asymptomatic fruit to canker-free markets in the United States and European Union were discussed. Hence, exclusion, eradication and very active suppression (removal of infected trees) are being actively pursued as alternatives to “living with canker.”

## POSTHARVEST PATHOLOGY AND QUALITY

The Postharvest Pathology session was chaired by Samir Droby (Israel) and Antonio Ippolito (Italy) and included 11 presentations. Most presentations in this session focused on fruit disease caused by green mold (*Penicillium digitatum*). *Penicillium* diseases, primarily green and blue mold, are the primary disease organisms on fruit grown in Mediterranean climates that have dry summers. While stem-end rots, such as *Lasiodiplodia theobromae*, are the principal postharvest diseases of fresh citrus in places like Florida that have abundant summer rains, *Penicillium* molds are also important in these areas. Because of the significant losses due to *Penicillium* diseases each year and the fact that only certain species of *Penicillium* can invade citrus fruit, work was presented on how these organisms bypass the fruit’s natural defense systems. In addition, the effectiveness of pre- and/or postharvest Na- or K carbonate treatments, postharvest biofungicides, and postharvest use of new “reduced risk” fungicides (i.e., fludioxonil and pyrimethanil) on green mold were reported. The new fungicides may be of particular interest if resistance develops to thiabendazole or Imazalil, which are now commonly used.

The Postharvest Quality session was co-chaired by Mark Ritenour, John Bower (South Africa), and Zhengguo Li (China) and included 13 presentations addressing a broad range of topics, many with potential application to Florida. For example, one report suggested that foliar-applied magnesium (Mg) could reduce peel breakdown of mandarin. With work during the past two seasons in Florida suggesting that application of foliar potassium may reduce peel breakdown, additional testing of foliar-applied Mg under Florida conditions also appears warranted. While dips in hot water or molybdenum (Mo) were previously shown to reduce chilling injury (CI) of lemons, two reports evaluated potential mechanisms for this resistance. Other research with lemons showed that treatments with salicylic acid or polyamines (naturally occurring growth factors) maintained fruit quality during storage as effectively as GA3 + 2,4-D.

Research into degreening practices mostly focused on the effects of ethylene gas or ethephon on carotenoid development in mandarins (Ponkan and satsuma). If considering washing grapefruit, oranges, or tangelos before degreening (i.e., on a pre-grade line), 15 seconds of commercial high-pressure washing was found to inhibit color development. Mandarins were also evaluated for their propensity to develop off-flavors. At least in part, researchers showed that the peel of ‘Murcott’ mandarin was less permeable to gas diffusion and had higher rates of respiration than ‘Star Ruby’ grapefruit resulting in a greater accumulation of ethanol and acetaldehyde.

## CITRUS FUNGAL PATHOGENS

The Citrus Fungal Pathogens session was co-chaired by Megan Dewdney, Antonio Vincent (Spain) and Hongye Li (China). There were several presentations about detection and control of Phytophthora diseases of citrus, which indicates the continued importance of these diseases around the world. It was learned that in Syria, as suspected but never confirmed, Phytophthora was a problem in groves and is a contributor to production decline. The same researchers presented data on fungal and bacterial biocontrol agents and their ability to mitigate the effects of *P. nicotianae* on three rootstocks. They found that disease incidence decreased and plant growth was enhanced with the fungal mix, but the bacterial mix only enhanced growth of Volkameriana lemon.

Brazilian research was presented about the detection of *P. nicotianae* by a PCR diagnostic system to screen nursery material quickly, reliably and relatively inexpensively. One of the benefits of the PCR system is that staff does not need training to identify Phytophthora species under a microscope. Phytophthora branch canker, caused by *P. citrophthora*, is an emerging problem in Spain on Clementines and was found to be closely associated with soils with an impervious clay layer and the practice of girdling branches to improve fruit set.

Research from Italy was presented on the detection and quantification of a fungal citrus disease found in parts of the Mediterranean called mal secco. The goal of the research was to develop a technique that would allow the scientists to better quantify the fungus (*Phoma tracheiphila*) in plant tissue for rapid diagnosis and use in breeding programs. A disease-like syndrome with vein yellowing, defoliation, die-back and wilting under stressful environmental conditions, called dry root rot, is emerging in Italian groves. The syndrome is associated with poor soil permeability and a fungus, *Fusarium solani*, although this fungus has not been proven as the causal agent.

In Queensland Australia, the registration of benomyl, a key component of the fungicide program against black spot, was lost. To adjust for the loss of benomyl, work is ongoing

with organic mulch and optimized fungicide timing, which show some promise. Work from South Africa with fluorescent dyes and *Alternaria alternata*, the causal agent of Alternaria brown spot, has shown that smaller spray volumes (400-530 gal/acre) are more effective at distributing fungicides uniformly across a leaf surface and result in better disease control than high spray volumes (>1,000 gal/acre).

The final presentation of the session was about the relationship of leaf wetness, temperature and cultivar to the severity of Alternaria brown spot on tangerine and tangerine hybrids. The work is aimed at improving the forecast accuracy of the Alter-Rater model.

## ABIOTIC STRESS PHYSIOLOGY

The session on abiotic stress physiology was co-chaired by Jim Syvertsen and Shengxi Xie (China). This was a relatively "light" session on the final afternoon with only seven talks. This was a well attended session however, as there were novel presentations on salinity problems in Israel and mechanisms of salt tolerance in citrus rootstocks in Spain and Florida. Progress on improving our fundamental understanding of salinity tolerance in citrus appears to be centered in Australia, Spain, Israel and Florida. Other presentations summarized rootstock tolerance to salinity in Egypt and effects of drought stress on nitrogen metabolism in citrus rootstocks in China. A program to promote water conserving irrigation methods for south Texas was also presented.

Overall, the ISC Congress was a huge success with nearly 1,000 participants from virtually every citrus growing country in the world in attendance. The 12th ISC Congress will take place in Valencia, Spain in 2012, and talks with our Spanish hosts have already been initiated to try to increase presentations in weak areas (e.g. citrus stress physiology and entomology) by using symposia and invited speakers, as well as to increase the appeal of the meetings to growers.

*The authors are University of Florida-IFAS citrus researchers*