Welcome to our 53rd Annual Program for the Citrus and Beverage Industry!

This year’s conference will again focus on key issues facing our industry, and will span the topics of global beverage processing to the marketing of new and innovative products. Please join us for discussions on the worldwide nature of our business, insights into consumer and media perceptions, and interesting new research and technical briefs for the citrus and juice processing industry. The Friday morning session will include a look at the economics of the citrus and will feature a panel discussion and summary of promising scientific HLB research to help sustain our industry.

Appreciation goes to everyone who contributed to this year’s event. We would like to recognize our committee members, who facilitated the selection and invitation of our knowledgeable speakers, all of whom are active in academia, industry and government. We would also like to give a special thank you to our invited speakers, who enthusiastically agreed to share their insights and expertise. And last, a very heartfelt thank you to our sponsors, whose generosity enhances the value, affordability and uniqueness of this event each year.

We look forward to the next few days of talks and interaction, with opportunities to meet old friends and business contacts, and the chance to make new ones. Once again, we hope you will find this conference a rewarding and beneficial experience. Especially in this 53rd year, we look forward to your participation!

Renée Goodrich Schneider
Program Organizer
University of Florida, IFAS, FSHN
Gainesville, FL
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Conference Committee

Liz Baldwin  
USDA-ARS  
Winter Haven, FL

Richard Bogey  
Florida’s Natural Growers  
Lake Wales, FL

Jessica Brower  
USDA, AMS  
Winter Haven, FL

Michelle Danyluk  
University of Florida, IFAS, CREC  
Lake Alfred, FL

Jennifer Davis  
Firmenich Inc.  
Lakeland, FL

Savy DiBenedetto  
Program Chair  
The Coca-Cola Company  
Apopka, FL

Renée Goodrich Schneider  
Program Organizer  
University of Florida, IFAS, FSHN Dept.  
Gainesville, FL

Joe Gruber  
Jedson Engineering Inc.  
Jacksonville, FL

Donald L. Hendrix  
Firmenich Inc.  
Safety Harbor, FL

David Johnson  
Peace River Citrus  
Arcadia, FL

Weston Johnson  
The Coca-Cola Company  
Apopka, FL

Jon Leonard  
Florida Chemical Company, Inc.  
Winter Haven, FL

Keith Schneider  
University of Florida, IFAS, FSHN Dept.  
Gainesville, FL

Greg Schrader  
JBT FoodTech  
Lakeland, FL

Linda Staten  
USDA-AMS  
Winter Haven, FL

Douglas P. Van Strijp  
Southern Gardens  
Clewiston, FL

Roger D. Waters  
Brown Citrus Systems  
Winter Haven, FL

Elizabeth Webb  
Brown International  
Winter Haven, FL

Barry Wilson  
Safe Chem Inc.  
Zellwood, FL

Alan Wyland  
The Coca-Cola Company  
Apopka, FL
The International Citrus & Beverage Conference
Agenda

Tuesday, September 17, 2013
4:00PM  Registration (until 7:00PM)

Wednesday, September 18, 2013
7:30AM  Registration (until 5:00PM)
7:30AM  Morning Refreshments  
Sponsored by: Vincent Corporation
8:30AM  Welcome and Introductory Remarks  
- Renée Goodrich Schneider, Program Coordinator, FSHN, IFAS, UF  
- Susan Percival, Chair, FSHN, IFAS, UF  
- Douglas Archer, Associate Dean for Research, Director of Florida Agricultural Experiment Station, IFAS, UF  
- Savy DiBenedetto, Program Chair, The Coca-Cola Company

SESSION 1 – The Global Juice and Beverage Industry

Moderator: Keith Schneider, UF, IFAS, FSHN
9:00AM  World Lemon Outlook, Pablo Britti, S.A. San Miguel ................................................. (p. 3)
9:40AM  The Citrus Industry in Mexico, Alberto de la Fuente, Citrofrut ........................................ (p. 4)
10:20AM  Break
10:40AM  South African Citrus and Fruit Industry, Kobi du Plessis, Granor Passi
11:20AM  China Citrus Industry: Current Status and Future Growth, Yi Shen, Firmenich Aromatic China

SESSION 2 – Marketing and Consumer Trends – US and Beyond

Moderator: Jon Leonard, Florida Chemical Company
1:30PM  The Importance of Grapefruit and Other Unique Citrus Species to Modern Japanese Culture, Makiko Sekiguchi, Takasago ......................................................... (p. 5)
2:05PM  Flavor Trends in Alcohol Beverages, Jeannie Christodoulou, Firmenich............................... (p. 6)
2:40PM  Break
3:00PM  Citrus Flavor Barometer: A Look at the Iconic World of Citrus Flavors and Emerging Trends, Jay Klosterman, Givaudan Flavors Corp. ......................................................... (p. 7)
3:35PM  Communicating with Consumers on Today’s Hot Topics, David Schmidt, IFIC.. (p. 8)
4:10PM  New Trends in Processed Fruit and Vegetable Products, Don Giampetro, ITI Tropicals
6:00PM  Networking Reception (until 7:00PM)  
Sponsored by:  
- Brown International Corporation, LLC.  
- Chemical Systems  
- DoehlerGroup  
- Firmenich  
- Florida Chemical Company, Inc  
- Givaudan Flavors Corp  
- International Flavors & Fragrances Inc  
- Symrise Inc  
- Treatt
### Thursday, September 19, 2013

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<td>7:30AM</td>
<td>Registration <em>(until 5:00PM)</em></td>
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<tr>
<td>7:30AM</td>
<td>Morning Refreshments</td>
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<td>Sponsored by: <strong>Givaudan Flavors Corp</strong></td>
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#### SESSION 3 – Juice and Beverages: Nutrition, Regulations, QA and Biotechnology

**Moderator:** Barry Wilson, Safe Chem, Inc.

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<th>Time</th>
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<tr>
<td>8:30AM</td>
<td>The USDA National Organic Program - Information Session</td>
<td>Marty Mesh</td>
<td>Florida Organic Growers/Quality Certification Services</td>
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<tr>
<td>9:05AM</td>
<td>Conventional vs Organic – A Market Research and Sensory Case Study</td>
<td>Lisa House</td>
<td>FRE, IFAS, UF</td>
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<tr>
<td>9:40AM</td>
<td>Functional Properties and Health Benefits of Orange Juice</td>
<td>Thais Cesar</td>
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<td>10:15AM</td>
<td>Break</td>
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<td>10:35AM</td>
<td>Citrus Fiber as a Food Product Ingredient – Technology and Benefits</td>
<td>Tris Chapman, Brock Lundberg</td>
<td>Tristan Chapman Consulting and Fiberstar</td>
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<tr>
<td>11:10AM</td>
<td>Food Science, Technology and Safety Communication with the Media</td>
<td>Ben Chapman</td>
<td>North Carolina State University</td>
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#### SESSION 4 – Horticultural and Flavor Aspects of Citrus Greening – A Primer for Processors

**Moderator:** Dave Johnson, Peace River Citrus Products

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<th>Time</th>
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<tr>
<td>1:30PM</td>
<td>Breeding Citrus Cultivars for a Changing Citrus Industry</td>
<td>Ed Stover, USDA, ARS, Horticultural Research Laboratory</td>
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<td>2:05PM</td>
<td>Genetically Enhanced Trees and the Nursery System</td>
<td>Mike Irey, United States Sugar Corporation</td>
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<td>2:40PM</td>
<td>Break</td>
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<tr>
<td>3:00PM</td>
<td>Greening and Horticultural Practices</td>
<td>Steve Futch, UF/IFAS Extension</td>
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<tr>
<td>3:35PM</td>
<td>Flavor Characterization of Greening-affected Orange Juice</td>
<td>Elizabeth Baldwin, USDA, ARS, Horticultural Research Laboratory</td>
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<tr>
<td>4:10PM</td>
<td>Florida Section IFT, 2013-2014 Meetings and Events</td>
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<tr>
<td>5:30PM</td>
<td>Poolside Reception <em>(until 7:00PM)</em></td>
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Sponsored by: **Enerfab, Inc**  
**JBT FoodTech**
Friday, September 20, 2013

7:30 AM  Registration (until 10:00 AM)

7:45 AM  Breakfast
Sponsored by:
- Bell Chem Corp.
- BioSun Flavors & Food Ingredients
- D L Newslow & Associates, Inc.
- DCR Engineering Services, Inc.
- Safe Chem Inc

SESSION 5 – Citrus Research: Where We Are with a View Towards the Future

Moderator: Richard Bogey, Florida’s Natural Growers

8:30 AM  The Economics of Citrus Greening, Matthew Salois, Florida Department of Citrus (p. 16)

9:15 AM  Panel Presentations from Citrus Research Leaders, Summarizing and Highlighting the Most Promising HLB Research Being Conducted by the Scientific Community Within and Beyond Florida (p. 17)
- Michael Sparks, Florida Citrus Mutual
- Jacqueline Burns, Center Director, CREC & SWFREC, IFAS, UF
- Calvin Arnold, USDA, ARS Horticultural Research Laboratory
- Tom Turpen, Citrus Research and Development Foundation

10:45 AM  Panel Summary and Questions

11:30 AM  Adjourn
We sincerely thank all speakers for agreeing to share their expertise and work. Many of our speakers have graciously prepared abstracts and we hope these will be useful to you as a possible source of industry practices. While informative, opinions and recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the Institute of Food and Agricultural Sciences, University of Florida.
World Lemon Outlook

Pablo Britti
San Miguel, Tucuman, Argentina

History can help us to understand the present and why something is likely to happen again based on examples from the past. Today, in the Communications Age, it is pretty easy to find information from past events. But, do we take the time to look for and analyze it?

Since history has the potential to be forgotten, efforts must be put towards preserving the important information so that it is accessible anytime.

The same thing happens in business. It is important to know the history of a business or industry, when is it a profitable time to invest and when it is not. Knowing the business records, managers can be prepared for times when the business doesn’t make much money and, on the other hand, get ready to maximize revenues when winds are blowing in the correct direction.

During the last decade, the lemon industry has shown fluctuations year after year. In order to understand the present and prepare ourselves for the future, we’ll be reviewing what happened in the main lemon countries such as Italy, US, Turkey, Spain and Argentina. This speech will be covering processing evolution, corresponding offer, demand situation, stocks and weather conditions. This last topic is focused on Argentinean frost faced in August 2013.

Throughout the presentation we will be looking at the central lemon situation in context of the main by-products juice, oil and peel.

Contact Information
Pablo Britti, Business Manager, San Miguel, Cazadores de Coquimbo 2860 - Edif 2 | Vte Lopez, Bs As (1605) Argentina |Mob: +54 911 3407 3095 | e-mail: pbritti@sa-sanmiguel.com
China Citrus Industry: Current Status and Future Growth

*Yi Shen*
Firmenich, Shanghai, China

During the past 30 years, the citrus industry in China has developed rapidly in both acreage and yield. In 1990, citrus acreage in China reached 1.14 million hectares, ranking first in the world. In 2008, China, for the first time, surpassed Brazil to become the world’s largest citrus producer. Nowadays Chinese citrus are mainly for fresh market, with only 5% for processing.

China has a large area suited for citrus cultivation, mainly the tropical and subtropical regions between 20°N to 33°N and 95°E to 122°E. Nine provinces, including Hunan, Fujian, Guangdong, Sichuan, Guangxi, Huibei, Zhejiang, Jiangxi and Chongqing, contribute 95% to the national total production of citrus.

This report introduces the current status of citrus industry including the status of citrus production, the citrus growing area and the structural changes of citrus varieties in China. The report also introduced a summary of “The layout of the citrus advantage regions in China” for the period of 2008 to 2015 which have been compiled by the Ministry of Agriculture of China.

We will discuss private industry which is mainly involved in the following 3 parts: fresh fruit, canned citrus and orange juice processing. Although China orange juice processing capacity and yield increased greatly in recent years, the orange juice industry is facing nowadays several challenges. The challenges are discussed and the solutions are explained in details.

The report introduced the general overview of China beverage market, especially China juice market and summarized the key trends toward citrus juice drink. In addition to the current status of China citrus industry, the report provided the prospects of citrus industry in China.

Contact Information
Yi Shen, Firmenich, No.3901 Jindu Rd., Xinzhuang Industry Park, Shanghai. 201108. China,
Tel: +86 21 33237298, Email: YISHEN@firmenich.com
The Importance of Grapefruit and Other Unique Species to Modern Japanese Culture

Makiko Sekiguchi
Takasago, Tokyo, Japan

Fresh grapefruit has become one of the most popular fruits for Japanese consumers. Without local cultivation, Japan must rely solely on importation. Despite this, and since Japan has various domestic citrus fruits available, it is the most commonly-consumed and familiar citrus following the locally-produced mikan. Hence, we seek to understand grapefruit’s appeal in Japan.

In addition to numerous health benefits recognized with fresh fruit consumption, the flavor of grapefruit is also firmly embedded within modern Japanese food culture. Grapefruit flavor can be seen not only in beverage products but also in confectionery, dairy, and even throughout culinary segments. Whether utilized in LTOs (limited time only) or well-established brands, grapefruit-flavored products occupy significant market shelf space. Why does this foreign citrus flavor attract us so much? The key to our understanding may exist among the organic compounds that impart the unique flavor of grapefruit which appeals to the Japanese.

Among non-Japanese markets, overall consumer preference towards grapefruit (fruit, juice, and flavor) is low when compared with other citrus offerings such as orange and lemon. However, interest continues to grow for two common Japanese citrus fruits, mikan and yuzu. Both are said to originate from China several centuries ago, but each has been cultivated in Japan since then, and thus we refer to them as Japanese citrus. Having completely different characteristics (mikan being the most popular citrus fruit with its sweet-sour flavor while lacking aroma; and yuzu, a citrus too sour to be eaten fresh, but possessing a wonderfully unique aroma), these two citrus fruits are relatively known outside Japan. Used (similar to lemon) to flavor various food dishes, beverages, or even confectioneries, yuzu especially has the potential of greater acceptance by consumers outside East Asia. Furthermore, these two fruits may lead to the introduction of other unique Japanese citrus fruits (and flavor offerings) that remain unknown outside Japan.

Contact Information
Makiko Sekiguchi, Takasago International Corp., Flavor Marketing Department, Nissay Aroma Square 17F, 5-37-1, Kamata, Ota-ku, Tokyo 144-8721, Japan, Tel: 81357440579, Email: makiko_sekiguchi@takasago.com
Bacon! It’s what’s for breakfast, right? Well, not so much just for breakfast anymore. Find out how bacon and a multitude of flavors from savory to sweet are finding their home in alcohol. Today’s consumers enjoy the novelty of new flavors to the comfort of classic ones. Most importantly they gravitate to ones that evoke happiness and feeling good. Linking the consumer emotionally with the right profiles can ensure repeat purchases. In an increasingly socially connected world, people also want something they can talk, tweet and share with their friends and family. There are a number of trends influencing flavor direction in the world of alcohol. For one, we see culinary cocktails opening up a wide range of directions – try a red velvet cupcake flavor or a hot habanero black cherry flavor. Furthermore, there is a huge surge of alcohol products being targeted to women, both “sinful” to “skinny” reduced-calorie drinks. Consumers today have many options, from hot and cold fountain drinks to seasonal flavors increasingly being launched. Typically, seasonal flavors are traditional flavors that appear during specific times of the year. These associated flavors have been passed down through generations and remind consumers of times past. While historically associated with fall and winter, there is an increase with “limited time offers” for spring and summer. In this talk, Firmenich is predicting what will be next – let’s leverage the learning’s of what is happening in alcohol to be prepared for other food and beverage categories. With demands to bring new products to market quickly, we will show you how these flavor trends can relate to your citrus world.

Contact Information
Jeannie Christodoulou, Marketing Manager, Firmenich, Inc., 3919 Kidron Rd, Lakeland, FL 33811, USA, Tel: 863-292-7258, Email: jchr@firmenich.com
Citrus Flavor Barometer: A Look at the Iconic World of Citrus Flavors and Emerging Trends

Jay Klosterman
Givaudan Flavors Corp., Cincinnati, OH

For decades, citrus has been the preferred flavor family in beverages. Refreshing and flavorful, citrus has an incredibly broad appeal and can be applied in everything from sports drinks to flavored alcoholic beverages. Historically, marketers and developers have maintained a basic and broad approach to citrus flavors: orange was “orange,” lemon was paired with lime, and grapefruit was limited to 100% juice applications.

Today, innovation within the citrus flavor families is alive. Driven by changing demographics and a progressive beverage market landscape, each flavor family – orange, lemon, lime, grapefruit, and “citrus” – has certainly evolved. Join us as we take a deep dive look into each flavor individually, exploring the current market trends and exposing the mechanisms driving the changes. We will also connect these market dynamics with Givaudan’s industry leading Consumer Insight data to highlight new opportunities going forward.

Contact Information
Jay Klosterman, Product Manager, Marketing, Givaudan Flavors Corp., 1199 Edison Dr., Cincinnati, OH 45216, USA, Tel: 513-948-5449, Email: jay.klosterman@givaudan.com
Communicating with Consumers on Today’s Hot Topics

David B. Schmidt
President & CEO, International Food Information Council (IFIC) & IFIC Foundation, Washington DC, www.foodinsight.org

Schmidt will provide an overview of today’s food and health issues impacting the citrus and beverage industry and offer communication tips and resources to address related consumer questions. Insights on consumer attitudes on food, including citrus, and health will be gleaned from recent national consumer surveys: the April 2013 IFIC Foundation Food & Health Survey and the July 2013 IFIC Functional Foods Survey. Highlights will include nutrition and safety concerns of consumers; their perception of adequate nutrient intake from citrus vs. actual intake; their perception of various food processing methods; and how oranges and orange juice stack up against other food choices with a similar “health halo”. Survey findings will be brought to life with video clips of consumers on the street as well.

Schmidt will also summarize the recently released 3rd edition of the IFIC Foundation’s “Food Biotechnology: A Communicator’s Guide to Improving Understanding” which was produced under a partnering agreement with USDA’s Foreign Agricultural Service. The guide is being translated in seven languages beyond English and is being used around the world by individuals and organizations to balance the dialogue on this controversial, yet important, food production technology.

Contact Information
David Schmidt, President & CEO, International Food Information Council, 1100 Connecticut Avenue, NW #430, Washington, DC 20036, USA, Tel: 202-296-6540, Email: schmidt@ific.org
The USDA National Organic Program - Information Session

Marty Mesh
Florida Organic Growers/Quality Certification Services, Gainesville, FL

Quality Certification Services/Florida Organic Growers Executive Director, Marty Mesh, will begin this session with a description of the impressive growth of the organic market and the opportunities this represents for the citrus industry. Following, Mesh will focus on helping participants to understand what they need to know to successfully comply with the organic regulations and obtain organic certification. Additionally, Mesh will touch on important questions related to pesticide residue testing and biotechnology.

Contact Information
Marty Mesh, Executive Director, Florida Organic Growers/Quality Certification Services, PO Box 1231, Gainesville, FL 32604, United States, Tel: 352-377-0133, Email: qcs@qcsinfo.org
Fiberstar, Inc. manufactures, distributes and sells two branded, globally distributed, all natural, patented functional ingredients derived from citrus fiber sources: Citri-Fi®, a food ingredient, and Imulsi-Fi™, a cosmetic ingredient. The technology used to make these products expands the surface area and increases its functional properties, which increases water holding capacity and can be used to improve texture of many different products. Customers are interested in these products because of the binding properties and clean label declarations. Due to the sales growth (including sales in over 60 countries), the company is currently undergoing an expansion project at its production facility located adjacent to Southern Gardens Citrus.

Applications for citrus fiber products are broad and vary from bakery and meat to dairy and beverages. In beverage products, Citri-Fi’s function is to improve stability and/or texture. In meats, Citri-Fi binds both water and oil to increase yields and can replace synthetic salts and stabilizers. Other applications include partially replacing oil, fat, and eggs to reduce costs in bakery, meat, and dairy products. The typical usage rate is less than 1% but Citri-Fi can bind ten times its weight which frequently equates to both a cost savings and texture benefit.

To help provide focus and funding for new product development efforts, Fiberstar spun off its research division in 2010 to form a new company, Fiberstar Bio-Ingredient Technologies, Inc., which has received both Phase I and Phase II SBIR grant funding from USDA to develop new fiber based ingredients that improve the health and nutrition of foods. In addition to supporting the growth of current Citri-Fi products, Fiberstar Bio’s focus is on utilizing more citrus fiber byproduct streams as well as developing new products.

Contact Information
Tristan Chapman, Principal, Tristan Chapman Consulting, 3340 Brantley Oaks Dr., Ft. Myers, FL 33905 USA, Tel: 863-673-0521, Email: tristanchapman@me.com

Brock Lundberg, Vice President of Technology, Fiberstar, Inc., 713 Saint Croix Street, River Falls, WI 54022, USA, Tel: 715-874-4656, Email: b.lundberg@fiberstar.net
Food Science, Technology and Safety Communication with the Media

Benjamin Chapman  
North Carolina State University, Raleigh, NC

Many see a widening disconnect between food production/processing and the meals that normal folks consume in their homes or restaurants. This gap, coupled with an increasing interest of certain online populations seeking to influence micro and macro food-related decision making, has placed the food industry at a crossroads. Less is publicly known about the complexities of the food system yet anything sort of full transparency leads to distrust. Drawing from data derived from case studies of recent events, participants will be provided with a framework of when-to and how-to proactively and reactively engage the public around food safety and technology. Case studies include pathogens in fresh cantaloupe; a hepatitis A outbreak linked to pomegranate seeds; online communities used to source illegal foods including raw milk for human consumption, trust in the beef industry during the 2012 LFTB/Pink Slime events; and, the online discussion of food safety events. Built on evidence from the field of risk communication attendees of this session will be exposed to successful engagement strategies as well as the missteps important for lessons learned.

Contact Information  
Benjamin Chapman, Ph.D., Assistant Professor, Food Safety Specialist Department of 4-H Youth Development and Family & Consumer Sciences North Carolina State University, NC Cooperative Extension, Raleigh, NC, USA, Tel: 919.515.8099 (office), Email: benjamin_chapman@ncsu.edu
Breeding New Citrus Cultivars for a Changing Citrus Industry

Ed Stover, Greg McCollum, Randall Driggers, Jinhe Bai, and David Hall
USDA/ARS, Ft. Pierce, FL

Huanglongbing (HLB) is widespread and severely impacting Florida citrus, and a few diseased trees have been verified in CA and TX. Citrus researchers are immersed in extensive and broad-ranging efforts to identify solutions to HLB, while Florida growers adopt practices to sustain production and quality in HLB-infected groves. Previous research indicates susceptibility to HLB throughout cultivated citrus scion types: in FL none are immune and many are extremely adversely affected. However, with HLB widespread in FL, it is clear that not all cultivars are affected equally, and mainstays of the Florida citrus industry are among the most HLB-compromised. HLB was assessed in commercial groves with high HLB-incidence: ‘Temple’ had the lowest HLB symptoms and Liberibacter (Las) titer, while ‘Murcott’ and ‘Minneola’ had the highest and sweet orange only slightly less. The USDA Ft. Pierce farm is managed to evaluate HLB responses in diverse genotypes. Some current cultivars and conventional hybrid seedlings demonstrate resistance/tolerance, at least to strain(s) of Las present. Some have abundant foliage symptoms, but full canopies and seemingly normal fruit set and size. In a 3-year replicated trial of ‘Triumph’ (T), ‘Jackson’ (J), ‘Flame’ (F), and ‘Marsh’ (M), all trees had HLB symptoms and similar Liberibacter titers. However T&J maintained full canopies and had fruit with normal size, yield and quality while F&M fruit were fewer and unacceptable. Interestingly T and J appear to be hybrids of the highly HLB-susceptible sweet orange and grapefruit. Several Clementine x Orlando hybrids, including some commercial cultivars, show remarkable tolerance to HLB. Poncirus trifoliata is the best documented citrus resistance source, and is cross-compatible with citrus, but its fruits are essentially inedible. It has been used in the USDA citrus breeding program for over a hundred years, primarily to confer greater cold-hardiness, and several advanced hybrids show considerable HLB resistance and near-commercial fruit quality. Useful resistance/tolerance to HLB is clearly present in cultivated citrus and more distant relatives, and efforts are underway to combine sources of resistance in cultivars with accepted market phenotypes. Unfortunately cultivars within sweet orange are almost genetically identical and offer little chance of identifying resistant types, and the same is true for standard grapefruit. The USDA has recently developed some hybrids which closely resemble sweet oranges, but have different genetics, and are being tested in the hope that they have reduced susceptibility to HLB. Testing production and quality in the presence of HLB will be necessary for any proposed solutions. For the processing industry, transitioning to reliance on new citrus cultivars, that are not sweet oranges and grapefruit, will involve considerable expense and uncertainty. The industry has learned to deliver consistent juice quality through hard-won experience with standard cultivars to create products with high consumer demand. Transgenic methods of achieving HLB-resistance offer tremendous potential for greater resistance, while retaining familiar cultivars. Numerous transgenic strategies are underway to develop HLB/psyllid resistance in established cultivars, some show promise, and new ideas are added regularly. All the approaches described are being investigated by the USDA citrus breeding program and collaborators, as well as other researchers.

Contact Information
Ed Stover, Research Horticulturist, USDA - Agricultural Research Service, US Horticultural Research Lab, 2001 S Rock Rd, Fort Pierce, FL 34945, USA, Tel: 772-462-5951, Email: ed.stover@ars.usda.gov
Genetically Enhanced Trees and the Nursery System

Mike Irey and Ricke Kress
United States Sugar Corporation, Clewiston, FL

Citrus huanglongbing (synonym=citrus greening, HLB), a bacterial disease caused by Candidatus Liberibacter asiaticus, is widely regarded as one of the most serious diseases of citrus. First found in Florida in 2005, HLB is now widely distributed in across the Florida industry with incidences of up to 100% of the trees infected in some areas of the state. The majority of the current management programs involve the use of “enhanced nutritional programs” and aggressive control of the Asian Citrus Psyllid that vectors the disease. Due to the additional costs associated with both management strategies, the current management practices are generally considered as being not sustainable in the long term and are, at best, short term strategies to sustain tree health until a long term solution can be found. Most HLB researchers and producers agree that the only long term viable solution is host plant resistance. However adequate resistance/tolerance has not been found in the current scion varieties used in commercial production. Thus, durable resistance through conventional breeding approaches is many years away. In the near to medium term, many researchers feel that resistance obtained through biotechnology will be the best chance of producing resistant scion varieties for the industry. However, even if we had the resistant tree in hand today, there are some logistical and nursery capacity issues that must be overcome in order to deploy these trees in a timely manner. The issues that make the deployment of this technology difficult span across several areas including regulatory issues, lack of nursery capacity across the industry, economic issues associated with access to the technology, and the pure logistics associated with rotation of the current inventory of trees. This presentation will detail some of the challenges and present some possible solutions for deployment of genetically enhanced trees.

Contact Information
Mike Irey, Director of Research, United States Sugar Corporation, 111 Ponce de Leon Ave, Clewiston, FL 33440, USA, Tel: 863-902-2249, Email: msirey@ussugar.com
Greening and Horticultural Practices

Stephen Futch  
University of Florida – CREC, Lake Alfred, FL

Florida citrus growers are producing citrus in a rapidly changing environment. Over the past 30 years, freezes (1983, 1985, and 1989), hurricanes (2004), citrus canker (1984-2006), the real estate bubble and most recently citrus greening (2005) and citrus black spot (2010) have all impacted the ability to produce citrus and achieve satisfactory economic return from this agricultural operation. Citrus greening is also referred to as Huanglongbing (HLB). Since 1998, total citrus acreage in Florida has decreased by 37% from 845,260 to 531,493 acres with a likewise decrease in total yield in 1997-98 to 2012-13 crop year of 49% from 304.4 million to 155.1 million boxes of all citrus varieties. In 2011, abandoned citrus acreage now totals 136,534 acres. Total production costs have more than doubled since 1998 to more than $1,817 per acre which does not include harvesting and delivery costs, taxes or debt service. Some growers are suggesting that their cost easily exceeds $2,000 per acre when you aggressively manage psyllids and apply additional nutrients to the foliage of the tree. To remain in the citrus business, growers must effectively control the Asian citrus psyllid which is the vector of HLB. Production programs to slow the spread of greening include management of psyllid and enhanced foliar nutrient programs (EFNP). These programs consist of up to 12 sprays per year that strive to keep psyllid to very low levels as determined by scouting and the application of nutrients being applied to the foliage of the tree in an attempt to maintain tree health after trees become infected with greening. While citrus black spot is primarily limited to south Florida, it is expected to spread throughout the citrus industry adding additional production programs to minimize fruit drop.

Contact Information
Stephen Futch, Extension Agent, University of Florida – CREC, 700 Experiment Station Road, Lake Alfred, FL 33850, USA, Tel: 863-956-8644, Email: shf@ufl.edu
Flavor Characterization of Greening-affected Orange Juice

Elizabeth Baldwin, Anne Plotto, Jinhe Bai, John Manthey, Sharon Dea, Randy Cameron, Gary Luzio, Jan Narciso, Bill Widmer, Smita Raithore, Sophie Deterre and Mike Irey

The citrus disease, Huanglongbing (HLB) has been demonstrated to impart off-flavor to orange fruit and juice, this being more prevalent in fruit that are symptomatic for the disease (small, green and lopsided). Differences are greater for Hamlin than for Valencia fruit and greater earlier in the season. We tested orange juice for both taste and smell, and while there were differences for both between healthy and symptomatic HLB juice, differences were more significant for taste. Chemically, HLB symptomatic fruit juice has generally lower sugars, sometimes higher acids and higher levels of bitter limonoids (limonin and nomilin) as well as various flavonoids and alkaloids, that are probably due to plant defense response or retarded fruit maturation. The most obvious off-flavor culprits are the bitter limonoids, however, they rarely reach reported thresholds in juice, even in symptomatic HLB fruit juice. We determined that thresholds of these compounds were lower when in combination, meaning that they acted synergistically in orange juice, reaching a combined threshold level at which they could be perceived as bitter. In addition, nomilin exhibited a tingly and metallic taste that match descriptors for HLB juice from earlier trained descriptive panel work. We also blended symptomatic HLB juice with healthy juice and panelists could detect a difference at 25-50% HLB juice. Meanwhile, Florida growers are resorting to foliar nutritional spray programs for management of HLB disease, in lieu of removing symptomatic trees, to maintain tree health and yield. As the impact of these programs on HLB-infected fruit flavor and aroma is unknown, we looked at the effects of 3 different foliar nutritional spray treatments applied to healthy and HLB-infected trees for effects on flavor chemical composition and sensory quality of the fruit, and compared them with juice from fruit treated with a conventional spray program: healthy fruit from non-infected trees (healthy), asymptomatic fruit from HLB-infected trees (HLBa), and symptomatic fruit from HLB infected trees (HLBs). Both Hamlin and Valencia varieties were investigated over multiple harvest dates and several seasons. Differences in general between healthy and HLB fruit juice were greater for HLBs fruit, for ‘Hamlin’ variety, and earlier in the season. Sensory differences in taste and sometimes smell between nutritionally-treated HLB fruit and healthy controls were greater in the first few years than in later years, with descriptors including more bitter, grapefruit like, sour, astringent, and metallic. The sugar/acid ratio was generally lower in HLB fruit and content of bitter limonoids higher, regardless of the nutritional treatment. However, differences were minimal or not significant for ‘Hamlin’ in 2012 January, Valencia in 2011 April, and Valencia in 2012 April, with descriptors sometimes including more sweet and more flavorful for nutritionally-treated HLB fruit juice. More seasons of study are warranted, to determine if nutritional treatments have any effect on flavor, but finding healthy trees for comparison is becoming more difficult.

Contact Information
Elizabeth Baldwin, Research Leader, USDA-Agricultural Research Service, Horticultural Research Laboratory, 2001 South Rock Road, Fort Pierce, FL 34945, USA, Tel: 772-462-5979, Email: Liz.Baldwin@ars.usda.gov
The Florida citrus industry today faces an unprecedented challenge with control of invasive pests and diseases. Of these pest and disease challenges, the greatest is citrus greening disease (also known as Huanglongbing disease or “HLB”). The economic viability of the citrus industry starts with planting trees. Today, growers are reluctant to plant trees due to lack of confidence in the ability of new trees to survive HLB. Moreover, management strategies implemented to cope with HLB have led to soaring costs of production. As a result, tree mortality rates today exceed tree replanting rates resulting in an industry that is shrinking in both size and relevance. A recent calculation estimates that between 2006 and 2010, over 8,000 jobs and $4.5 billion in economic output was lost due to HLB in the orange growing and juice processing sector alone.

In spite of the dismal appearance of the status quo, however, there is reason to suspect that HLB does not spell the “end of orange juice”. The Florida industry has organized an aggressive response recognizing that the only pathway to solutions for HLB is through research. Drawing on expertise worldwide, the citrus industry has focused research on short-range solutions to slow spread of the disease, mid-range research to counteract the disease in affected trees, and long-range research to develop durable solutions through development of resistant trees. A robust portfolio of projects has been established, but additional effort is necessary to address the short-term challenges of slowing spread and creating an environment in which new plantings can be expected to survive to productive age.

The purpose of this presentation is threefold: 1) to provide an overview of the economic impact of greening on the Florida citrus industry, with particular attention to changes in orange production and cost trends, 2) to provide projections on long-run orange production under alternative loss and planting scenarios and to show how investments in research can affect those trends, and 3) to provide an economic framework for optimal decision-making on disease management and research strategies.

Contact Information
Matthew Salois, Director of Economic and Market Research, Florida Department of Citrus, Economic and Market Research Department, P.O. Box 110249, Gainesville, FL 32611, USA, Tel: 352-392-1874, Email: msalois@ufl.edu
Panel Presentations and Discussion: Citrus Greening Research – Outlook and Highlights

Jacqueline Burns, Calvin Arnold, Michael Sparks and Tom Turpen

Huanglongbing (HLB), also known as citrus greening disease, undoubtedly poses a very serious threat to the Florida and global citrus industry. First detected in Florida in 2005; by 2008, it had been identified in most of the citrus growing counties in the state. Today, active research programs to combat HLB encompass every aspect of the disease: the psyllid vector, horticultural practices designed to mitigate effects of the disease, resistant rootstocks and, eventually, trees, and many, many others. These panel presentations, by citrus industry and research leaders, will provide an overview of the most promising research avenues and results that will guide the short- and long-term strategies to manage HLB and maintain a robust citrus industry.

Contact Information:
Jacqueline Burns, Center Director, CREC & SWFREC, IFAS, UF, 700 Experiment Station Rd, Lake Alfred, FL 33850, Tel: 863-956-5897, Email: jkbu@ufl.edu
Calvin Arnold, Lab Director, USDA – ARS, U.S. Horticultural Research Lab, 2001 South Rock Road, Fort Pierce, FL 32945, Tel: 772-462-5810, Email: calvin.arnold@ars.usda.gov
Michael Sparks, Florida Citrus Mutual, 302 S. Massachusetts Avenue, Lakeland, FL 33801, Tel: 863-682-1111, Email: mikes@flcitrusmutual.com
Tom Turpen, Program Manager, Citrus Research and Development Foundation, Tel: 469.371.2608, Email: tom.turpen@innovationmatters.com
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