Orange Juice – Will it be Available to Drink in the Future? (Agriculturally or Commercially)
Southern Gardens Citrus

• Who is Southern Gardens Citrus?
• What do we do?
• Diseases and Citrus
  – What are they?
  – What are we doing?
  – Prognosis
• 187,858 total acres
  – 151,000 acres sugar
  – 30,000 acres citrus
  – 6,858 acres other
• 1 sugar mill: 42,000 tons per day*
• 1 integrated refinery with packaging: 15 million cwt capacity – 10% of U.S. production
• Railroad – longest short track railroad in Florida
  – 278 miles track
  – 28 locomotives
  – 1,138 railcars
• 1 citrus processing plant: 20 million box capacity (newest facility in the industry)
• Total 1,700 employees
LAND HOLDINGS
187,858 acres

U.S. SUGAR CORPORATION
GENERAL VICINITY MAP

LEGEND
- SUGAR MILL
- CITRUS PLANT
- TOWN
- CANE LAND OWNED BY U.S.S.C.
- CITRUS OWNED BY SOUTHERN GARDENS
Citrus Greening – AKA Huanglongbing

- Considered to be the most serious disease of citrus (NAS 2009)
  - Bacterial disease
  - Insect vectored
  - First found in FL in 2005

- Coming on the heels of the citrus canker eradication project
  - Grower aversion to removing trees
HLB Initial Symptoms
Southern Gardens Won the Lottery

- First found at Southern Division Grove in Oct 2005
- Decisions on how to proceed would have to be made with very little knowledge
- Once aware of the disease, the decision was made to be as proactive as possible and learn about the disease at the same time
HLB Increasing Throughout the State
October, 2005

2 counties
HLB Increasing Throughout the State April, 2006

12 counties
HLB Increasing Throughout the State
June, 2007

24 counties
HLB Increasing Throughout the State
February, 2008

30 counties
HLB Increasing Throughout the State
August, 2008

32 counties
How Fast Does it Spread? Oct05-Mar06
How Fast Does it Spread? Apr06-Sep06
How Fast Does it Spread? Oct06-Mar07
How Fast Does it Spread? Apr07-Jul07
How Fast Does it Spread? Aug07-Oct07
Best guess through 2010 and extrapolating through 2011

- 2013 – Nobody knows, groves range from low levels to 100% (more towards the 100%)
World-Wide Best Practice

- Grove inspection program – 4X per year
- Aggressive roguing of infected trees
- Full-time scouting for the ACP
- Aggressive ACP control program
- Growing costs have increased by over 40%
Challenges

• What should the control strategy be in a high inoculum load area?
  – Is there a difference between strategies if you want to let a grove play out or if you are in it for the long haul?

• What should the control strategy be in a low inoculum density area?

• Since you have to make the decisions on the fly and on a large scale, do you try the alternative strategies?
  – What if you are wrong?
Nutritional Approaches

• Many different “programs”, many share some common components
• Most are a combination of foliar nutritional applications, phosphorous acids, and products said to be elicitors of SAR responses
• The nutritional approaches cost more than pre-HLB growing costs but less than the traditional approach (psyllid control and roguing)
  – Increased fertilizer costs offset by no scouting or tree roguing
• Most growers are still controlling psyllids
Nutritional Approaches

• Being adopted even though there is essentially no hard data……
  – Mostly anecdotal data from block-scale grower demos
  – Many are fairly recent
  – Few replicated trials – Virtually NO quantitative data!

• The basic goal is stretch the life of the existing trees – in many cases the trees do look better
Nutritional program - What do we know and what don't we know?

• What we know:
  – The trees on a nutritional program recover to some degree (more foliage, less dieback, less symptoms?)
  – Where it has been tried in the past, it has not worked long term (China, South Africa)

• What we don't know:
  – What are the active ingredients?
  – How long will the trees remain productive?
  – Is it economically sustainable?
  – Will we be able to replant resets and young groves?
Concerns with Alternate Approaches

• There are “forever” decisions
  – Can’t go back
• Accepting 100% infection
  – Will we be able to grow off young trees under high inoculum load?
• How long is your time horizon?
• If you stick with the “best practices” program, you can always change your mind, but not the other way around....
So where are we?

- Virtually everybody agrees that the losses are HLB associated (along with stress) [Infected Healthy]
- It is likely that losses will continue to increase as Valencia season progresses
- Initial replanting efforts have resulted in high levels of infection in less than 5 years
  - Nutritional programs do not seem work on young trees
- Groves (even those on nutritional programs) are beginning to decline
Disease Research & Development

• Finding a solution to the HLB Greening disease requires multiple steps to putting the answer “behind the tractor”.

• 4 steps –
  – Research
  – Regulatory Approval
  – Horticultural/Agricultural Production
  – Consumer Approval
Southern Gardens Research

- Texas A & M University
  - Disease resistant plants
- Integrated Plant Genetics
  - Disease resistant plants
- Cornell University
  - Insect resistant plants
- AgroMed LLC
  - Identification of synthetic resistance genes
- University of Florida
  - Gene delivery system
- USDA
  - Screening of potential genes
Southern Gardens Projects

• Working with multiple partners
  – Federal
  – State
  – University
  – Private

• Different stages of research
  – From just starting to possibly close to the identification of the commercial product

• When successful, the outcome will be for the good of the Florida (and overall citrus) industry
Progress on regulatory approval

• We have had multiple consultations over the last 7 years with:
  – USDA-APHIS
  – EPA
  – FDA
  – Since it is a PIP (plant incorporated protectant) will require approval by all 3.

• Starting the process for an EUP (experimental use permit) with the EPA
  – Establishes a temporary tolerance
  – Allows larger scale testing
Challenging the Solution

• Psyllid house
  – Screening for resistance is time consuming if done in the field
  – Must have a way to screen large numbers of citrus varieties and transgenics
  – SGC has developed a greenhouse facility dedicated to screening for HLB using natural spread by psyllids
    • Our own internal projects
    • Industry research projects
Additional Research

Screening completed in 6-8 months

Results faster than field trials
• Regulatory Approval/Commercialization Plan
  – Confirmation of resistance from developed technology is first step towards commercialization.
  – Regulatory approval of technology will be based on generation of data and details to satisfy all Federal requirements of USDA, EPA and FDA.
Regulatory

• PIP – Plant incorporated protectant
  “Plant-incorporated protectants are pesticidal substances produced by plants and the genetic material necessary for the plant to produce the substance”

• Will be regulated by:
  – EPA (PIPS)
  – USDA (Plant Pests)
  – FDA (Bioengineered Foods)
<table>
<thead>
<tr>
<th>Study</th>
<th>Cost (1000’s)</th>
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<tbody>
<tr>
<td>Recombinant protein production</td>
<td>300</td>
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<tr>
<td>Antibody production</td>
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<td>ELISA method development</td>
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<td>ELISA Validation</td>
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<tr>
<td>Western method development</td>
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<tr>
<td>Composition/Expression/Agronomics</td>
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<td>Southern blot</td>
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<td>Sequencing</td>
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<td>Within generation analysis</td>
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<td>Efficacy</td>
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<td>Inheritance</td>
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<td>Acute oral mouse</td>
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<td>Aa homology search</td>
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<tr>
<td>Toxin homology search</td>
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<td>Thermolability + in-vitro digestibility</td>
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<td>42-day broiler</td>
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<tr>
<td>90-day rat feeding (full tox profile)</td>
<td>275</td>
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<tr>
<td>90-day rat feeding - China (full tox profile)</td>
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<tr>
<td>Human health risk assessment</td>
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<tr>
<td>Protein equivalency – recombinant v. plant-made</td>
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<tr>
<td>Non-target organisms and ecotoxicology</td>
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<td>Honeybee toxicity</td>
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<td>Non-target risk assessment</td>
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<tr>
<td>Product characterization (gene description, transformation, etc.)</td>
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<td>Event PCR method</td>
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<td>Certified ref. materials (EU)</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>3295</strong></td>
</tr>
</tbody>
</table>
Consumer Acceptance

• After the EPA, FDA and USDA, we now know it is safe for the environment, people, and animals, but…..
  – We have additional items to address:

• Source of the gene is important:
  – Crab
  – Human
  – Pig

• How it is presented is important
  – Nice to have vs. necessary
  – Other benefits
Consumer Acceptance

• It has to be done right......
Labeling and Genetically Modified

California voters in control of GMO labeling initiative

A proposed law could impose extreme labeling requirements on foods and beverages sold in California.

VIEWPOINTS

Retailers Race to Keep Pace With Consumers

Retailers and suppliers like to say that everything they do is built around the needs of consumers. But that’s impossible to accomplish 24/7. The best you can do is integrate this goal into daily strategies and processes, and hope that it pays off most of the time.

Some companies are doing very good jobs with this. Two such cases were highlighted at the recent OMA Executive Conference and are worth pointing out here.

In fact, suppliers involved in joint business planning with Sam’s often bring insights based on considerable research into Sam’s member needs. General Mills, for example, conducted research with Sam’s members that led to important product packaging changes for the emphasis on how it connects with consumers, from the role of baristas in one-on-one communications, to interactions over social media such as Facebook and Twitter. The company gains consumer insights in its retail outlets that can be translated into CPG.

Sam’s Club and Starbucks are among companies doing a good job, but big challenges loom for all retailers.

Unfortunately, yes, and one likely case is mobile.

It’s true that retailers are stepping up to the plate with new and updated initiatives around mobile, including a string of new apps, but that may not be enough.

Consider that a little over two years ago Allrecipes.com, a recipe website for consumers, had less than 1% of traffic from mobile devices. That has grown to 35% today, and the company is predicting it will reach 45% to 50% by December, said Lisa Sharples, president and chief revenue officer.

By DAVID ORGEL
Editor-in-Chief
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Consumer Education

• Expectations of Today’s Agricultural Operation:
  – Provide a food supply sufficient to feed the world
  – Use less water
  – Use less chemicals
  – Use less land and conserve the land that is used
  – Protect wildlife
  – Satisfy all State and Federal regulations
  – Improve product quality and
  – Oh by the way, grow at a lower cost
So with all of this being said….

- As of today, there are no research results or indications that the HLB greening disease can be solved without genetically Improved citrus trees.
- Expected benefits for the future:
  - Assurance that the US citrus industry will survive and grow and not be replaced by foreign imports.
  - Elimination of all chemicals now being used to control the insect that vectors the disease from infected trees to healthy trees.
So with all of this being said….

- We are moving forward……
  - Feel we have an acceptable approach for all entities: agriculture, regulatory and consumer.
  - Initial data shows that we have resistance.
2013 International HLB Conference

• Plenty of promising technologies but no game changers
• General consensus was that multiple technologies would be needed to control HLB
• Plant resistance would more than likely be the mainstay of any program
  – Transgenics will probably be the source of resistance
### Commercialization Time Line

<table>
<thead>
<tr>
<th>Bus Unit</th>
<th>Project</th>
<th>Successor</th>
<th>Start</th>
<th>Finish</th>
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<tbody>
<tr>
<td>SGC</td>
<td>Greenhouse testing of advanced lines</td>
<td>5</td>
<td>01-Jun-2012</td>
<td>01-Jun-2013</td>
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<td>SGC</td>
<td>Propagation of plants for second round of greenhouse testing</td>
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<td>SGC</td>
<td>Second round of greenhouse testing of advanced lines</td>
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<td>SGC</td>
<td>Field testing of advanced lines -disease resistance</td>
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<td>SGC</td>
<td>Agronomic testing of advanced lines</td>
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<td>SGC</td>
<td>Selection of possible lines to advance</td>
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<td>SGC Nursery</td>
<td>Propagation of Commercial Budwood Source</td>
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<td>01-Jan-2016</td>
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<td>SGC</td>
<td>Subselection of lines to further expand</td>
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<td>SGC Nursery</td>
<td>Transplanting and growing off of Commercial Budwood Sources</td>
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<td>Subselection of lines to propagate for Commercial sale</td>
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<td>SGC Nursery</td>
<td>Production of Commercial Trees for sale</td>
<td>15,16</td>
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<td>SGC</td>
<td>Collection of agronomic and safety data for Regulatory Package</td>
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<td>SGC</td>
<td>Submission of Regulatory Package</td>
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<td>SGC Nursery</td>
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<td>SGC Nursery</td>
<td>First Sale of Commercial trees</td>
<td>20</td>
<td>01-Jan-2019</td>
<td>31-Dec-2019</td>
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</tbody>
</table>
Effect of Greening Over Time

April 19, 2007

December 16, 2008

April 23, 2009

September 23, 2010
It is a daunting task, but the end goal is in sight....