Quarantine treatments – tolerance of tropical crops to postharvest stress such as low dose irradiation treatments (banana, dragon fruit, papaya, sweet potato, mixed fruit)

Phytochemistry and nutritional analyses – macadamia nuts, medicinal plants, tropical fruit

Postharvest physiology, storage and handling – longan, rambutan, papaya, avocado
Seasonal differences observed in quality, disease incidence, and shelf-life for 7 harvests over 3 years.

Best packages for longans stored at ideal temperature (10°C) were clamshells, microperforated bags, and Peakfresh film.

<table>
<thead>
<tr>
<th>Package</th>
<th>Disease Incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clam</td>
<td>0</td>
</tr>
<tr>
<td>MP</td>
<td>10</td>
</tr>
<tr>
<td>PF</td>
<td>20</td>
</tr>
</tbody>
</table>

Longan Postharvest Research

2009

2010
Longan visual and sensory quality decreased, and diseases increased for fruit in all package types when stored under fluctuating temperatures typical during shipping.
Sensory quality after 14 days:
1) constant 10°C
2) fluctuating temperatures
   2 days at 10°C
   10 days at 22°C
   2 days at 10°C

Fruit stored in clamshells had higher texture and flavor scores than MP or PF packages when stored under fluctuating temperatures.
• Considering results over multiple seasons and two temperature regimes, longan shelf life and quality was maintained when stored in *clamshell packages*.

**Control:**
14 days at 10°C

**Simulated shipping:**
2 d @ 22°C/10 d @ 10°C/ 2 d @ 22°C
Postharvest and Quarantine Entomology (Peter Follett)

- **Irradiation** – treatments for light brown apple moth, little fire ant, papaya mealybug
- **Novel treatments** –
  * cold + irradiation
  * modified atmosphere packaging (MAP)
  * MAP + essential oils
- **High pressure processing** for coffee berry borer control
- **Biological control** of white peach scale – have permits to release a parasitic wasp
Progress in collaborative research efforts in papaya

1) Improvement in the virus-resistant SunUp papaya whole genome DNA sequence:
   for gene discovery and transgene technology improvement

2) Acceptance “deregulation” of Rainbow papaya in Japan lead by Dr. Dennis Gonsalves, Director, USDA ARS PBARC:
   to maintain, regain, advance market share of US papaya in Japan
The draft genome of the transgenic tropical fruit tree papaya (Carica papaya Linnaeus)

Ray Ming1,2,3*, Shaobin Hou1, Yun Feng1,2,3*, Qingyi Yu1, Alexandre Dionne-Laporte1, Jimmy H. Saw1,2, Pavel Senin1, Wei Wang1,2, Benjamion V. Ly1, Kanako L. T. Lewis1, Steven L. Salzberg1,2, Lu Feng1,2,3*, Meghan R. Jones1, Rachael L. Skelton1, Jan E. Murray1, Cilia A. Chen1,2, Wencheng Shen1,2, Jun Xiao1,2, Moriah Eustice1,2, Eric Tong1, Haibao Tang1, Eric Lyons1,2, Robert E. Pau11, Todd P. Michael1,3, Kerr Wall1,3, Danny W. Rice1,4, Henrik Albert1,5, Ming-Li Wang1, Yun J. Zhu1, Michael Schatz1, Nirajan Nagarajan1, Ricelle A. Acib1,6, Peizhu Guan1,2, Andrea Blas1,7, Ching Man Wai1,2, Christine M. Ackerman1, Yan Ren1, Chao Liu1, Jianmei Wang1, Jianping Wang1, Jong-Kuk Na1, Eugene V. Shakhov1, Brian H. Ha1,7, Jyothi Thimmapuram1,2, David Nelson1,2, Xinjiang Wang1, John E. Bowers1, Andrea R. Gschwend1, Arthur L. Delcher1, Ratnasri Singh1,2, Jun Y. Suzuki1,2, Savarni Tripathi1,2, Kabi Neupane1, Hairong Wei1,7, Beth Irikura1, Maya Pali1,2, Ning Jiang1,2, Wenli Zhang1,2, Gernot Presting1,2,3, Aaron Windsor1,2, Rafael Navajas-Perez1,2, Manuel J. Torres1,2, F. Alex Feltus1,2, Brad Porter1, Yingjun Li1,2, Max Burroughs1,2, Ming-Cheng Luo1,2, Lei Liu1,2, David A. Christopher1,2, Stephen M. Mount1,2, Rakesh H. Meore1,2, Tak Sugimura1,2, Himing Jiang1,2, Mary A. Schuler1,2, Vikki Friedman1,2, Thomas Mitchell-Olufs1,2, Dorothy E. Shippen1,2, Claude W. dePamphilis1,2, Jeffrey D. Palmer1,2,4, Michael Freeling1,2, Andrew H. Paterson1,2, Dennis Gonsalves1,2, Lei Wang1,2,5,6 & Mausudul Alam1,2,3

Papaya, a fruit crop cultivated in tropical and subtropical regions, is known for its nutritional benefits and medicinal applications. Here we report a 3x draft genome sequence of ‘SunUp’ papaya, the first commercial virus-resistant transgenic fruit tree to be sequenced. The papaya genome is three times the size of the Arabidopsis genome, but contains fewer genes, including significantly fewer disease-resistant genes. Comparison of the five sequenced genomes suggests a minimal angiosperm gene set of 13,311. A lack of recent genome duplication, atypical of other angiosperm genomes sequenced so far, may account for the smaller papaya gene number in most functional groups. Nonetheless, striking amplifications in gene number within particular functional groups suggest roles in the evolution of tree-like habit, deposition and remobilization of starch reserves, attraction of seed dispersal agents, and adaptation to tropical elevations. Transgenesis at three locations is closely associated with chloroplast insertions into the nuclear genome, and with topoisomerase I recognition sites. Papaya offers numerous advantages as a system for fruit-tree functional genomics, and this draft genome sequence provides the foundation for revealing the basis of Carica’s distinguishing morpho-physiological, medicinal and nutritional properties.

Papaya is an exceptionally promising system for the exploration of tropical-fruit genomes and fruit-tree genomics. It has a relatively small genome of 372 megabases (Mb), diploid inheritance with nine pairs of chromosomes, a well-established transformation system, a short generation time (9–15 months), continuous flowering throughout the year and a primitive sex-chromosome system. It is a member of the Brassicaceae, sharing a common ancestor with Arabidopsis about 72 million years ago. Papaya is ranked first on the nutritional scores among 53 common fruits, based on the percentage of the United States Recommended Daily Allowance for vitamin A, vitamin C, potassium, folate, niacin, thiamine, riboflavin, iron and calcium, plus fibre. Consumption of it is recommended for preventing vitamin A deficiency, a cause of childhood blindness in tropical and subtropical developing countries. The fruit, stems, leaves and roots of papaya are used in a wide range of medical applications, including production of papain, a valuable proteolytic enzyme.
The whole genome sequence analysis of SunUp papaya is the first for a transgenic organism and a fruit tree.

The sequencing gives you access to the catalog of genes in that organism that will help you understand (among other things) its genetic makeup, to aid in breeding or improvement for pest or disease resistance, horticultural and fruit production or characteristics (like an owner’s handbook).
Laurel wilt

• R. lauricola:
• Symptomology is usually the giveaway that the disease is present
• Leaf and young stem wilting, leaf color change, stem and limb dieback, dark streaks in the sapwood

• Scion wood grafted onto rootstock at Fort Detrick and kept in quarantine for at least 6 month.

• Plate sample on CSMA media to culture the fungus. If the fungus is present, PCR is performed with specific primers to confirm the fungus ID. Research in Florida has shown that larger avocado trees are more affected by laurel wilt than smaller trees
Avocado germplasm backup

- Avocado Sunblotch (AVSBVd)
- Add testing detection kit.
Demonstrated success in Hawaii 2006 - 2011

Sustainable berry production

Potted Ornamental
Specialty Crop Research Initiative (SCRI) ‘Ōhelo (USDA, CSREES) 2008 - 2011
‘Ōhelo cultivar ‘Kīlauea’ from tissue culture plugs (NAP. Oregon)

50 lbs in 3 months
Summary

- ‘Ōhelo - for potted ornamental and berry production.
- **Elevation** 2,500 feet (762 m) to 4,500 feet (1371 meter), **Temperature**: 50 -70F (10 -21 C). Lower temperature encourage bright red color development in young growth and reduce powdery mildew incident.
- **Plants should be kept in direct sun light** with irrigation (0.3 gal. per plant per day).
- Slow release (14-14-14 Type 180); foliar (21-7-7 & 4-41-27) frequency: 1 tsp per gallon, 2 times a month.
- Frequent trimming is beneficial for shaping and plant health. From trimming to expanded new leaf takes 21 d, trimming to flowering 35 days, and trimming to fruit harvest approx. 63 days.
- **Yield approx. 26g to 50.3 per pot during May to July 2010.**
- Ohelo berry is a marginal host for Oriental fruit fly and nonhost for Med, Melon and latifrons
Demonstrated economic values of potted ‘ōhelo as an ornamental at BIAN Charity Plant sale (July 2010)

USDA/ARS display