Pitahaya or Dragon Fruit Production in California: A Research Update

2014 Pitahaya Production Seminar & Pitahaya Festival & Research Field Day

Ramiro Lobo & Gary Tanizaki
UC Cooperative Extension, San Diego County

Overview

• Background
• Pitahaya production worldwide
• Why pitahaya research?
• Current research efforts at UC
• Field observations & results to date
• Marketing and Economic Prospects
• What next?
The Pitahaya

- Also known as Strawberry Pear, Dragon Fruit in South East Asia, Pitahaya in Mexico and Pitaya in Central America

- Native to tropical America, range from Southern Mexico to Northern South America

- Taken by the French to South East Asia at the turn of the 19th century

Pitahaya Types

- Several species of Hylocereus identified, but there is uncertainty about proper identification

- Differentiated by stem & fruit characteristics (bracts, shape and fruit color - skin and flesh)

- Two commonly available in CA:
  - Hylocereus undatus (red skin, white flesh)
  - Hylocereus sp. (primarily red skin & red flesh)

- Many Hylocereus hybrids (several skin and flesh colors combinations, from yellow to deep magenta or dark red)

- Selenecereus megalanthus - Yellow or Colombian, yellow, thorny skin and white, translucent flesh
  - Reclassified as Hylocereus megalanthus
Why Pitahayas?

• Great potential as a new, water efficient crop for Southern California
• Increasing demand for new, healthy and exotic fruits
  • Current demand exceeds supply, current prices are high (retail @ $ 3-8/pound)
  • Relatively high antioxidant activity when compared to other subtropical fruits
• Makes great landscape plant - fruiting cactus, water efficient, very adaptable

Fruit Uses

• Used in refreshments in Central America
• Red flesh used as colorant in the processed food industry (Snapples, Sobe, Pitaya+)
• Consumed fresh, as a desert item in the US, Canada, and Europe
  • Sliced in salads or cut in half and served chilled, with flesh eaten with spoon
• Used for decoration – Southeast Asia, US
• Great potential for value added products (ice cream, chips, chewy bars, wine, yarn dye, etc.)
Dragonfruit Production

Pitahayas in California
U.S. Production

- US production is limited, but acreage increasing rapidly (1000-1200 acres)
  - California (400 - 500 acres.)
  - Florida (500 - 600 Acres)
  - Hawaii (100 - 200 Acres)
- Mostly white fleshe varieties used for fresh consumption or for décor/garnish
- Market is turning red...Pink/Red fleshe varieties becoming more popular
- Red fleshe varieties sell at higher price

Central & South America

- Nicaragua is main producer of Hylocereus sp. (red flesh) in Central America
  - 1000-1200 Hectares planted under various
  - Fresh fruit exported to Canada and Europe (APRONOT) & pulp exported to US and Japan
- Colombia top producer of yellow pitahaya (S. megalanthus)
- Ecuador also producing both Hylocereus sp. and S. megalanthus
- Backyard/small scale production in Guatemala, El Salvador, Honduras, Costa Rica
Nicaraguan Production
Asia, Africa, Australia

- Vietnam main producer of Hylocereus undatus in South East Asia (Est. 40,000 Has)
  - Predominantly white flesh fruit, but converting to red flesh
  - Export based industry targeting the US, China & Europe
  - Fruit exported to the US must be irradiated – very costly!
- Thailand (~3000 Has.), Malaysia (~500 Has.), Indonesia, Taiwan and the Philippines also becoming important producers
- Israel (~100-200 Has.) has been significant producer/shipper to the European Union
- South Africa and Australia increasing production

Varieties??

- Several species & up to 70 different clones available in Southern California
- No data or information available on the performance of various clones
- Lack of reliable information about varieties a major challenge to growth of industry
- 19 varieties under experimentation at SCREC, 30+ under observation
Commercial Varieties?

- Five clones grown commercially in Nicaragua
  - Orejona, Rosa, Cebra, Lisa, San Ignacio
  - Many other clones available
  - All produce fruit without hand pollination

- Several clones promoted as “superior” but no replicated research data available

- Improved, proprietary varieties available from Israel, Taiwan and private breeders in US

- Big challenge for commercial production and main reason for our research project

Research Efforts to Date

- Evaluated varieties for commercial production in California (Bender, Tanizaki)

- Develop post harvest management and information and strategies (Cantwell, Tanizaki)

- Genetic characterization of pitahaya accessions using AFLP markers (Douhan, Vidalakis, Pagliacia)

- Confirm presence of Cactus Virus X (CVX) and screen pitahaya accessions for the virus (Mathews, De Soto, Aguiar, Tanizaki)

- Sensory evaluation of selected varieties of Pitahaya (Cantwell, Arpaia, Ovenland)
Ongoing/Future Research

- Evaluation of selected varieties in Ventura and Riverside Counties (De Soto, Aguiar)
- Determine irrigation requirements for Pitahaya cultivars Lisa and Physical Graffiti under two trellis systems (De Soto, Tanizaki)
- Evaluate selected pitahaya varieties under shade (De Soto, Aguiar)
- Monitor and catalogue pests and disease incidence (Wilen, Bethke, Downer)

Varieties Under Study

- Cebra (Nic)
- Rosa (Nic)
- Orejona (Nic)
- Lisa (Nic)
- Sin Espinas (Nic)
- San Ignacio (Nic)
- Mexicana (Mex)\(^1\)
- Colombiana (SD/Col)\(^3\)
- Valdivia Roja (Mex)
- Bien Hoa Red (SD)\(^1\)
- Bien Hoa White (SD)\(^2\)
- Delight (SD)
- American Beauty (FL)\(^1\)
- Haley’s Comet (FL)
- Physical Graffiti (FL)
- Vietnamese Giant (FL)\(^2\)
- Yellow Dragon (FL/Col)\(^3\)
- Seoul Kitchen (FL)
- Armando (Nic)*
- El Grullo (Mex)*
Pitahaya Guide

Ave Wt. (grams): 468  
Brix Score: 15.75  
Mkt. Wt./Plant (grams): 8746  
Days to Harvest: 46  
Origin/Source: Nicaragua

Cebra
Rosa

Ave. Wt. (grams): 384
Brix Score: 16.06
Mkt. Wt./Plant (grams): 7217
Days to Harvest: 45
Origin/Source: Nicaragua

Orejona

Ave. Wt. (grams): 438
Brix Score: 15.78
Mkt. Wt./Plant (grams): 4598
Days to Harvest: 45
Origin/Source: Nicaragua
Lisa

- Average Weight (grams): 465
- Brix Score: 17.02
- Marketable Weight/Plant (grams): 13319
- Days to Harvest: 44
- Origin/Source: Nicaragua

Sin Espinas

- Average Weight (grams): 393
- Brix Score: 16.5
- Marketable Weight/Plant (grams): 3527
- Days to Harvest: 43
- Origin/Source: Nicaragua
San Ignacio

Ave. Wt. (grams): 552
Brix Score: 15.6
Mkt. Wt./Plant (grams): 12712
Days to Harvest: 48
Origin/Source: Nicaragua

Mexicana

Ave. Wt. (grams): 495
Brix Score: 14.04
Mkt. Wt./Plant (grams): 9165
Days to Harvest: 40
Origin/Source: Nicaragua
Colombiana

Ave. Wt. (grams): <200
Brix Score: 20.90
Mkt. Wt./Plant (grams): 0
Days to Harvest: 150-180
Origin/Source: SD/Col.

Valdivia Roja

Ave. Wt. (grams): 250
Brix Score: 17.9
Mkt. Wt./Plant (grams): 8588
Days to Harvest: 40
Origin/Source: Mexico

[Image of Colombian flowers and fruit]

[Image of Valdivia Roja flowers and fruit]
Bien Hoa Red

Ave. Wt. (grams): 360
Brix Score: 18.9
Mkt. Wt./Plant (grams): 1477
Days to Harvest: 41
Origin/Source: San Diego

Bien Hoa White

Ave. Wt. (grams): 388
Brix Score: 11.85
Mkt. Wt./Plant (grams): 7394
Days to Harvest: 37
Origin/Source: San Diego
Delight

Ave. Wt. (grams): 371
Brix Score: 18.08
Mkt. Wt./Plant (grams): 14931
Days to Harvest: 41
Origin/Source: San Diego

American Beauty

Ave. Wt. (grams): 380
Brix Score: 18.51
Mkt. Wt./Plant (grams): 5566
Days to Harvest: 43
Origin/Source: Florida
**Haley’s Comet**

- Ave. Wt. (grams): 482
- Brix Score: 16.7
- Mkt. Wt./Plant (grams): 5979
- Days to Harvest: 38
- Origin/Source: Florida

**Physical Graffiti**

- Ave. Wt. (grams): 374
- Brix Score: 17.93
- Mkt. Wt./Plant (grams): 23429
- Days to Harvest: 40
- Origin: Florida
Vietnamese Giant

- Ave. Wt. (grams): 338
- Brix Score: 15.6
- Mkt. Wt./Plant (grams): 6511
- Days to Harvest: 41
- Origin/Source: Florida

Yellow Dragon

- Ave. Wt. (grams): <200
- Brix Score: 21.15
- Mkt. Wt./Plant (grams): 0
- Days to Harvest: 150-180
- Origin: Florida/Colombia
Seoul Kitchen

Ave. Wt. (grams): 518
Brix Score: 12.18
Mkt. Wt./Plant (grams): 15379
Days to Harvest: 41
Origin/Source: Florida

Armando

Ave. Wt. (grams): 390.5
Brix Score: 16.11
Mkt. Wt./Plant (grams): 4881
Days to Harvest: 41
Origin/Source: Nicaragua
Several Others Cultivars Under Observation
## Several Others Cultivars Under Observation

![Image](image)

## Pitahaya or Dragon Fruit Variety Evaluation Chart

*For Cold Hardiness & Heat Tolerance: 1 = low tolerance & 5 = High Tolerance*

<table>
<thead>
<tr>
<th>Variety/Origin</th>
<th>Color</th>
<th>Skin/Flesh</th>
<th>Cold Hardiness</th>
<th>Heat Tolerance</th>
<th>Avg. Wt. (grams)</th>
<th>Brix Score</th>
<th>Mkt Wt/Plant (grams)</th>
<th>Days to Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cebra (Nic.)</td>
<td>R/R</td>
<td>3.5</td>
<td>3.5</td>
<td>468</td>
<td>15.73</td>
<td>8746</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>2. Rosa (Nic.)</td>
<td>R/R</td>
<td>3.5</td>
<td>3.5</td>
<td>384</td>
<td>16.05</td>
<td>7377</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>3. Orejona (Nic.)</td>
<td>R/R</td>
<td>3.25</td>
<td>3.75</td>
<td>458</td>
<td>15.78</td>
<td>4588</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>4. Uva (Nic.)</td>
<td>R/R</td>
<td>3.75</td>
<td>4</td>
<td>465</td>
<td>17.04</td>
<td>13519</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>5. Sin Espinas (Nic.)</td>
<td>F/R</td>
<td>2.25</td>
<td>2.75</td>
<td>393</td>
<td>16.5</td>
<td>3527</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>6. San Ignacio (Nic.)</td>
<td>R/R</td>
<td>3.75</td>
<td>4</td>
<td>552</td>
<td>15.6</td>
<td>12712</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>7. Mexicana (Mex.)</td>
<td>F/W</td>
<td>3.25</td>
<td>3</td>
<td>495</td>
<td>14.04</td>
<td>9305</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>8. Colombiana (SD-Col.)</td>
<td>Y/W</td>
<td>1</td>
<td>1</td>
<td>&lt; 200</td>
<td>20.90</td>
<td>0</td>
<td>150-180</td>
<td></td>
</tr>
<tr>
<td>9. Valdivia Roja (Mex.)</td>
<td>R/R</td>
<td>5</td>
<td>4.5</td>
<td>250</td>
<td>17.9</td>
<td>8588</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>10. Ben Hua Red (SD)</td>
<td>GR/P</td>
<td>1.75</td>
<td>1.75</td>
<td>350</td>
<td>18.9</td>
<td>1477</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>11. Ben Hua White (SD)</td>
<td>F/W</td>
<td>2.5</td>
<td>2.5</td>
<td>388</td>
<td>11.85</td>
<td>7394</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>12. Delight (SD)</td>
<td>R/PW</td>
<td>3</td>
<td>3.5</td>
<td>371</td>
<td>18.08</td>
<td>14931</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>13. American Beauty (FL)</td>
<td>GR/P</td>
<td>2.75</td>
<td>2.5</td>
<td>380</td>
<td>18.51</td>
<td>5566</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>14. Haley’s Comet (FL)</td>
<td>R/P</td>
<td>4.5</td>
<td>4.25</td>
<td>482</td>
<td>16.7</td>
<td>5979</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>15. Physical Graffiti (FL)</td>
<td>R/P</td>
<td>4.5</td>
<td>4.5</td>
<td>374</td>
<td>17.93</td>
<td>23429</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>16. Vietnamese Giant (FL)</td>
<td>PR/W</td>
<td>3.25</td>
<td>3.25</td>
<td>338</td>
<td>15.6</td>
<td>6511</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>17. Yellow Dragon (FL-Col)</td>
<td>Y/W</td>
<td>1</td>
<td>1</td>
<td>&lt; 200</td>
<td>21.15</td>
<td>0</td>
<td>150-180</td>
<td></td>
</tr>
<tr>
<td>18. Eden Kitchen (FL)</td>
<td>PR/W</td>
<td>4</td>
<td>4</td>
<td>519</td>
<td>17.18</td>
<td>3379</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>19. Armande (Nic.)</td>
<td>R/R</td>
<td>4</td>
<td>4</td>
<td>390.5</td>
<td>16.11</td>
<td>4881</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>20. El Guapo (Mex.)*</td>
<td>R/R</td>
<td>4.5*</td>
<td>4.5*</td>
<td>489*</td>
<td>18.11*</td>
<td>U/K</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>
Results to Date

• Most varieties in trial adapted well to growing conditions at SCREC
  – Valdivia Roja, El Grullo*, Physical Graffiti, Haley’s Comet and Lisa most tolerant to heat and cold

• Most selections set fruit WITHOUT hand pollination
  – Physical Graffiti, Seoul Kitchen, Delight, Lisa and San Ignacio top producing varieties

• Most varieties in trial produce well WITHOUT shade, some would benefit from it.

• Fruit size & quality very good, good marketable yields
  – Except for Colombiana/Yellow Dragon, all varieties produced fruit with good market weight
  – Colombiana/Yellow Dragon, Bien Hoa Red/American Beauty, Delight, Physical Graffiti, Valdivia & El Grullo* had the highest brix scores
Results to Date

• External appearance:
  – Sin Espinas, Lisa, Physical Graffiti, Delight, American Beauty and Bien Hoa Red

• Flavor where flesh color is visible:
  – American Beauty, Bien Hoa Red, Physical Graffiti, Delight, Sin Espinas and Lisa

• Flavor in a blind test, flesh color masked with light:
  – Bien Hoa Red, American Beauty, Physical Graffiti, Sin Espinas and Lisa

• Clear differences among varieties in terms of sugars, acids, and antioxidant content
  – See handout on post-harvest and composition analysis

Results to Date

• Recently completed DNA work confirmed suspicions about various cultivars:
  – Bien Hoa Red and American Beauty considered the same
  – Delight, Haley’s Comet and Physical Graffiti are very closely related
  – Seoul Kitchen, Vietnamese Giant, Bien Hoa White and Mexicana very closely related
  – Yellow Dragon and Colombiana considered the same
  – Lisa, Rosa, Cebra could considered the same
  – Armando and San Ignacio related related but not same as other Nicaraguan varieties
  – Sin Espinas unique & different from other Nicaraguans
  – Valdivia Roja unique, closely related to El Grullo (new entry)

• Variety selection determined by your personal preferences and intended use
PACKING/MARKETING

• Few handlers/packers available in SoCal, may have to pack on your own
• Most buyers want fruit commercially packed in 6, 10, and 20 lb. boxes.
• Market preference for red/colored flesh varieties, over $1.00 more per pound
• Most imports from Vietnam, Nicaragua, Florida and California appear on Reports
• Quality, flavor, local…our selling points!
**Pitahaya Market & Price Info**

- USDA-AMS Market Report calls everything “Red Pitaya” but refers to skin color, no indication about flesh color.

- [www.usda.ams](http://www.usda.ams)
  - Market News
  - Fruit Vegetables and Specialty Crops
  - Market News Portal – Fruits and Vegetables
  - Fruits
  - Dragon Fruit (Red Pitaya)
    - From here you can refine the report by market, date, etc.

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**Packaging and Marketing**

<table>
<thead>
<tr>
<th>Date</th>
<th>Market</th>
<th>Origin</th>
<th>Color</th>
<th>Pack</th>
<th>Type</th>
<th>Price US $</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/18/14</td>
<td>Los Angeles</td>
<td>Nicaragua</td>
<td>Red</td>
<td>10 lbs.</td>
<td>Conventional</td>
<td>32.00 – 33.00</td>
</tr>
<tr>
<td>8/18/14</td>
<td>Los Angeles</td>
<td>Vietnam</td>
<td>Red</td>
<td>10 lbs.</td>
<td>Conventional</td>
<td>23.50 – 29.00</td>
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<tr>
<td>8/18/14</td>
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<td>California</td>
<td>Red</td>
<td>10 lbs.</td>
<td>Organic</td>
<td>57.50 – 57.50</td>
</tr>
<tr>
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<td>California</td>
<td>Red</td>
<td>6 lbs.</td>
<td>Organic</td>
<td>42.85 – 42.85</td>
</tr>
<tr>
<td>8/18/14</td>
<td>Los Angeles</td>
<td>Nicaragua</td>
<td>Red</td>
<td>10 lbs.</td>
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<td>38.00 – 38.00</td>
</tr>
<tr>
<td>8/18/14</td>
<td>San Fran</td>
<td>Nicaragua</td>
<td>Red</td>
<td>10 lbs.</td>
<td>Conventional</td>
<td>50.00 – 50.00</td>
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<tr>
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<td>San Fran</td>
<td>Florida</td>
<td>Red</td>
<td>20 lbs.</td>
<td>Organic</td>
<td>60.00 – 65.00</td>
</tr>
</tbody>
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Source: USDA/AMS Website
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</tr>
<tr>
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<td>Vietnam</td>
<td>Red</td>
<td>10 lbs.</td>
<td>Conventional</td>
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<td>California</td>
<td>Red</td>
<td>10 lbs.</td>
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<td>Los Angeles</td>
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<td>Conventional</td>
<td>56.00 – 60.00</td>
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</tr>
<tr>
<td>8/21/14</td>
<td>San Fran</td>
<td>Florida</td>
<td>Red</td>
<td>½ B.C.</td>
<td>Conventional</td>
<td>60.00 – 60.00</td>
</tr>
</tbody>
</table>

Source: USDA/AMS Website

Marketing Pitahaya or Dragon Fruit:
10 Things a Distributor Wants (Frieda’s Handout)

Understand your customer’s business
- Labeling and Trace Back

Participate in Marketing
- Food Safety and Insurance

Don’t be Greedy
- Quality Control

Target Dates and Yield Estimates
- Pack Size & Pricing

Post-Harvest Control
- Variety & Flavor

Success in agriculture depends on marketing what you grow at a profit. Do your homework, develop a business/marketing/food safety plan and spend time talking to prospective buyers or consumers!!
Economic Prospects

- Great potential as a commercial crop alternative
- Establishment costs are high and can range from $15000-25000/per acre
- Value per acre can be significant if yield and quality are maximized (> 20,000 lbs/acre)
- Downward pressure on price will continue because of increased domestic production and import volume ($1.50 to $3.00/lb. farm gate prices; $6-8 at CFMs)
- Red fleshe'd varieties usually sell at a higher price than white fleshe'd varieties (~ $1.00/lb)
- Risky Business…BE CAUTIOUS!!

Results to Date
Up to us as an industry to prevent this from happening to Pitahayas!!

The End...Questions??

Ramiro E. Lobo  
Small Farms and Agricultural Economics Advisor  
UCCE San Diego County  
9335 Hazard Way, Suite 201

(760)745-4716  
relobo@ucdavis.edu  
http://cesandiego.ucdavis.edu