Growing Tropical Fruit & Nut Trees
For The Homeowner
October 15, 2010
UH CTAHR Master Gardening Conference
Tropical Fruits and Nuts

- Successful cultivation is strongly influenced by:
  Variety (cultivar)
  - Most trees are propagated vegetatively:
    - grafting, budding, airlayering, cuttings
  - Some trees propagated from seed:
    - papaya, coffee, mangosteen

Growing environment is important.
Cultural practices can be important.
Propagation Methods

- Rambutan bud grafting
- Lychee airlayering
- Macadamia grafting
- Papaya seed germination
Importance of Pruning and Training Tropical Fruit Trees

- Manage tree size*
- Manage flowering and fruiting
- Facilitate Harvesting
- Manage disease and pests
Lychee: Australia
Macadamia

(Macadamia integrifolia = smooth shell macadamia)

- All orchards consist of grafted trees on seedling rootstocks
- All cultivars (varieties) developed in Hawaii
- Trees begin bearing 4 years after planting
- Nuts drop to the ground when mature and are harvested by hand or mechanically
- Nuts are husked, dried and roasted for consumption & sale

Farm and Forestry Production and Marketing Profile for Macadamia Nuts (Nagao, 2010)

http://www.agroforestry.net/scps/Macadamia_specialty_crop.pdf
Optimum Macadamia Growing Conditions in Hawaii

• Deep, well-drained soil is best but orchards also found on rocky soil

• Rainfall: 60 inches (1524 mm)  
  drier in spring during flowering

• Temperature: Average annual 69 F (20.6)  
  Average maximum    78 F (25.6 C)  
  Vegetative flushing range 68-86 F (20-30 C)  
  Average minimum    60 F (15.6C)  
  Flowering range    59-64 F (15-18 C)
Propagation

- Grafting onto seedling rootstocks
Trees planted into field 8-12 months after grafting. (Varieties: 344, 508, 660, 294, 800, 741, 246)

Trees are pruned during first 3 years to produce a well-structured tree with good branching.
Relatively free of insect & disease problems. Insect pests managed through biological control and frequent harvesting.
Harvested from the ground (4-5 week harvest intervals and husked within 24 hrs).
Home Processing of Macadamia Nuts

Husk and dry in-shell nuts on wire racks for 3-4 weeks.
Crack when kernels rattle in the shell.
Separate shells and dry kernels in food dehydrator.
  2-3 days @100 F
  4-5 days @ 125 F
  2 days @ 140 F
*Roast @ 275 F for 20-30 min.

Best Cultivar for Hi: Kaimana

- Seedling of Hak Ip (1965)
- Matures June to July
- Spreading growth habit
- Flowers in about 4 years after planting
- High number of male flowers produced early in the season with higher proportion of female flowers later in the season

<table>
<thead>
<tr>
<th>Fruit Wt. (grams)</th>
<th>Fruit Diam. (mm)</th>
<th>Edible Pulp (%)</th>
<th>Abortive Seeds (%)</th>
<th>Soluble Solids (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 26</td>
<td>30 - 40</td>
<td>71 - 75</td>
<td>40</td>
<td>20 - 24</td>
</tr>
</tbody>
</table>
Additional Lychee Varieties for HI

Bosworth

Groff
Natural flowering of lychee, longan and rambutan in Hawaii can be inconsistent.

- Environmental signals for induction of flowering are not consistent from one year to the next (growing environment is important for consistent production).

- Excessive vegetative growth restricts flowering and are affected by:
  - Growing location (soil, rainfall)
  - Fertilizer applications
  - Pruning
<table>
<thead>
<tr>
<th>Location</th>
<th>Tree Age</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panaewa 1</td>
<td>7</td>
<td>40</td>
<td>13 - 125</td>
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<tr>
<td>Panaewa 2</td>
<td>10</td>
<td>49</td>
<td>10 - 111</td>
</tr>
<tr>
<td>Kurtistown</td>
<td>5</td>
<td>33</td>
<td>6 - 73</td>
</tr>
</tbody>
</table>
Crop Cycle
Kaimana Lychee in Hawaii

Vegetative Growth
- Temp 25-29°C
- High water
- Prune, old Panicle removal, irrigate, fertilize

Floral Induction and Development
- Temp <15°C
- Low water
- Low N
- ? Weeks (4-8)
- Low Rainfall

Flowering

Harvest

Girdle

Rest
- Temp >15°C
- High Rainfall
- Weak Flowering or Vegetative growth

25°C = 77°F

15°C = 59°F

Temp <25°C
Low water
Low N

Temp >15°C
High Rainfall

25°C = 77°F

15°C = 59°F

Temp <15°C
? Weeks (4-8)
Low Rainfall
Pruning and *(fertilization)* after harvest are employed to stimulate uniform vegetative flushing.

Do not over-fertilize at this time.

*(application of foliar fertilizer may be an option)*
Girdling (cincturing) of branches
Effect of Winter Tip Pruning on Flowering of Kaimana Lychee
Panicles emerge from pruned shoot.
Problems Encountered

Erinose mites

Fruit fly

Birds
Lychee Growing Tips

‘Kaimana’ is the desired variety due to its consistent flowering under Hawaii growing conditions.

Concentrate fertilizer application during fruit development eg. 14-7-28+, 8-6-32+.

Prune soon after harvest.

Flowering occurs in response to low temperatures that coincide with maturation and regrowth of terminal shoots.

Dry weather enhances flowering but does not substitute for low temperatures.

Autumn girdling can enhance flowering.

Avoid applying high amount of nitrogen.

Avoid fertilizer application after September.

Keep historical information on yield (flowering) and fertilizer applications to estimate future fertilizer applications.
Longan Production in Hawaii

Cultivars Grown: Biew Kiew (commercial)
Chompoo, Egami (home garden)
Longan Flowering

- Factors involved in natural flowering similar to lychee, therefore, trees should be managed similarly.
- Egami tends to flower and produce more consistently for the homeowner.
- Flowering induced with soil application of potassium chlorate.
  - Rates: 250 to 500 g/tree.
- Fruit thinning maybe necessary particularly with some varieties.
- Trees tend to be less responsive to subsequent applications.
- Sodium hypochlorite and calcium hypochlorite can induce some flowering.
‘Egami’, a New Longan Cultivar from Hawaii

Philip J. Ito¹, Francis Zee², and Mike Nagao³

¹Emeritus Horticulturist, CTAHR; ²USDA-ARS Pacific Basin Agricultural Research Center; ³CTAHR Dept. of Tropical Plant and Soil Sciences

Egami’ is a very productive cultivar of longan (Dimocarpus longan (Lour.) Steud.). It was selected at and can be pruned to maintain a low stature. Initially during flowering more male flowers are produced on the

Figure 1. The original ‘Egami’ longan tree at the Kona Research Station.

Figure 2. Fruits of ‘Egami’ longan.
Flowering Biew Kiew Trees
Sodium Hypochlorite

Egami  Treated:  1/28/03

Control

Egami
Rambutan Production in Hawaii

Cultivars Grown: Jitlee, Binjai, R9, R167, Silengkeng, R156, R134, R162
Rambutan Flowering in Hawai‘i

- Occurs in response to water stress
- Symptom = Leaf curling
- Main season (July to August)
- Minor season (April to May)
Flowering and Fruit Set of Rambutan In Hawaii

• Lack of pollination results in development of deformed fruits.
• Cultivars planted in HI produce few male flowers for pollination.
• Strategies to enhance development of male flowers important for production.
Male (male tree)

Flowering rambutan tree

Hermaphroditic female (majority of flowers)

Hermaphroditic male (very few present < 0.1%)
Silengkeng cultivar
(pollinator)
(Produces male & female flowers)
Citrus

- How can I make my citrus fruits sweeter?  
  Fertilizer???
- Variety
- Cultural practices
- Environment
## Combined Effects of Ecological Factors on Citrus Fruit Qualities

<table>
<thead>
<tr>
<th>HUMID TROPICS</th>
<th>ARID DESERT</th>
</tr>
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<tbody>
<tr>
<td>Warm Nights, High Rainfall</td>
<td>Cool Nights, Low Rainfall</td>
</tr>
<tr>
<td>High Sugar, High Juice</td>
<td>Brilliant Color, Minimal Surface Blemishes, Low Sugar, High acid, Thick Peel</td>
</tr>
<tr>
<td>Thin Peel, Poor Color, Fungal Blemishes</td>
<td></td>
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## Propagation: Bud Grafting

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Variety</th>
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<tbody>
<tr>
<td>Tangerine</td>
<td>Cleopatra mandarin, Heen Naran, Rangpur lime, Citrus sunki</td>
</tr>
<tr>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td>Grapefruit</td>
<td>Cleopatra mandarin, Heen Naran, Rangpur lime</td>
</tr>
<tr>
<td>Lime</td>
<td>Heen Naran</td>
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<tr>
<td>Pummelo</td>
<td>Heen Naran, airlayers</td>
</tr>
</tbody>
</table>
Additional Fruit Crops of Interest
Avocado

Propagation: Grafting; Plant grafted trees!

- Sharwil (B): winter – spring (green), 8-20 oz
- Greengold (A): winter – spring (green), 8-20 oz
- Kahaluu (B): fall – winter (green) 12-20 oz
- Malama (B): fall-winter (purple), 14-24 oz

(A) Day 1 am female, Day 2 pm male
(B) Day 1 pm female, Day 2 am male
Grafted avocado: multiple cultivars to extend harvesting season.
Canopy Management

Develop strong framework
Manage tree size to facilitate easy harvesting
### Pitaya (Pitahaya, Dragon Fruit) Crop Cycle in Hawaii

<table>
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<tr>
<th>Jan</th>
<th>Feb</th>
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<th>Apr</th>
<th>May</th>
<th>Jun</th>
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**Flowering** (Jul → mid Aug)

**Fruit Development** (end July → mid Oct)

**Harvest** (end Aug → end Oct)

Pitaya: long-day-plant

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Pitaya Fruit Growth

16-30 fruits/tree
Avg. wt.  550 g
Production Constraints

Disease

Strong Seasonality

Information on the performance of various clones under HI growing conditions.

Plant self-fertile clones.
<table>
<thead>
<tr>
<th>Name</th>
<th>Varieties</th>
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<tbody>
<tr>
<td>CEBRA</td>
<td>Nic FL Mex</td>
</tr>
<tr>
<td>SEOUL KITCHEN</td>
<td>FL</td>
</tr>
<tr>
<td>VALDIVIA ROJA</td>
<td>Mex</td>
</tr>
<tr>
<td>SIN ESPINAS</td>
<td>Nic FL</td>
</tr>
<tr>
<td>PHYSICAL GRAFFITY</td>
<td>FL</td>
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</tbody>
</table>
Mango in Hawaii
Constraints to Mango Production

Insect and Disease Management

Consistent Flowering

Canopy Management
Mango anthracnose
(*Colletotrichum gloeosporioides*)

Publications and Photos by
Scot C. Nelson, CTAHR Plant Pathologist


Mango Powdery Mildew


Insect & Disease Management

http://www.extento.hawaii.edu/fruitfly
Flowering

1. Shoot Initiation
   - pruning, nitrate sprays, cool temp

2. Induction
   - Cool temp (<59 F)
     (florigenic promoter)
   - Warm temp
     (vegetative promoter)

Vegetative Flushing

Branch Age

<59 F

(florigenic promoter)
Mango Cultivars Responding to Potassium Nitrate (4%)

• Haden
• Momi K
• Ruby
• Joe Welch

• Keitt
• Excel
• Pope
• Manzanillo
Canopy Management

Rockhampton, Australia  South Florida  Taiwan
“Condo” Mangos

Cogshall
Fairchild
Neelum
Lancetilla
Mallika
Rosigold
Angie

Neelum
Fairchild
Cogshall
Angie
Mallika
Rosigold

‘Lancetilla’ mango
Mangosteen In Hawaii

“Queen of Fruits”
### Mangosteen Crop cycle
**East Hawaii (2008-2010)**

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
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<td><strong>Flowering period #1</strong></td>
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<td><strong>Harvest period #1</strong></td>
<td><img src="image37" alt="Harvest period #1" /></td>
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</tbody>
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**Flowering period #1**: (mid June → mid Aug)

**Flushing period #1**: (mid June → mid Aug)

**Flushing period #2**: (mid Nov → late Dec)

**Harvest period #1**: (early Aug → early Sep)

**Harvest period #2**: (early Jan → mid Mar)

**Flushing period #2**: (mid Nov → late Dec)
Production Constraints

Long juvenile period

Inconsistent flowering

Insect pest damage (mangosteen caterpillar)

Canopy area has a greater contribution to first flowering (precocity) than age.

First bearing = 50.3 m² (541.4 ft² ) canopy surface area

**Canopy**
- Height = 14.5 – 15 ft
- Diameter = 8.5 – 9 ft
Durian Crop Cycle in Hawaii

“King of Fruits”

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
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</tr>
</thead>
</table>

- **Flushing (Jan)**
- **Flushing (Mar → May)**
- **Flushing (Aug → Sep)**
- **Bud development (beg Feb → April)**
- **Bud Development #2 (June → Aug)**
- **Flowering (end Mar → April)**
- **Flowering #2 (June → Sep)**
Fruit Maturation

D 24: ~ 20 weeks
Ave. wt.: 4.9 lbs

Mon Thong: ~ 26 weeks
Ave. wt.: 14.7 lbs.
Production Constraints

- Inconsistent flowering
- Inconsistent fruit set; pollination problems.
- Varieties best for HI
Hermaphroditic flowers

Female flowers

Propagation from Seeds
Fruits from female flowers

Male tree
Papaya ringspot virus disease
Other Tropical Fruits

• Coffee
• Annonas
• Banana
• Spice Crops
• Cacao
End