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Proceedings Editor: Mike A. Nagao
University of Hawaii
College of Tropical Agriculture & Human Resources
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Conference Agenda

17th Annual International Tropical Fruit Conference

Conference Hotel Information
The Hilo Hawaiian Hotel is offering conference participants a discounted rate of $85/night for standard rooms and $99/night for deluxe ocean view rooms. The number of rooms is limited and arrangements must be made directly with the hotel by August 28, 2007. Please use the enclosed hotel request form and send it to the Hilo Hawaiian Hotel at 71 Banyan Drive, Hilo, Hawaii 96720. The Hilo Hawaiian's telephone number is 808-935-9361 and the fax number is 808-969-6472.

The 17th Annual International Tropical Fruit Conference is dedicated to the memory of William Whitman, long-time HTFG supporter, and Richard Hamilton whose research and development greatly contributed to the tropical fruit industry in Hawaii.

Directions to 'Imiloa Astronomy Center:
From Banyan Drive and the Hilo Airport, take Kanoelehua Ave. southbound toward Volcano, go past the Prince Kuhio Plaza on your left. Make a right onto Puainako St. and proceed for one and a half miles. Turn right onto Komohana St. Proceed about ¼ of a mile on Komohana and turn right onto Nowelo St. Take the second left onto 'Imiloa Pl.

This conference is presented by Hawaii Tropical Fruit Growers and made possible by a grant from the Hawaii County Department of Research and Development. HTFG thanks the county for its continued support of this organization and of agriculture in the State of Hawaii.

"The Times They Are A-Changing"
September 28 - 30, 2007

'Imiloa Astronomy Center
600 'Imiloa Place
Hilo, Hawaii
Conference Agenda

Friday Night Program
September 28, 2007

5:00 p.m. REGISTRATION OPENS

5:30 p.m. RECEPTION
Heavy pupus & no host bar

6:30 p.m. Welcome & HTFG Update
Richard Johnson, HTFG President

7:00 p.m. An Overview of Tropical Fruit Production in Australia
Yan Diczbalis, Keynote Speaker

Saturday Conference Program
September 29, 2007

7:30 a.m. REGISTRATION OPENS

8:00 a.m. Welcome
The Honorable Harry Kim
Mayor, County of Hawaii

8:15 a.m. Membership Meeting
Richard Johnson, HTFG President

8:30 a.m. Post-Harvest Technologies for Lychee, Rambutan, and Longan
Yan Diczbalis, Keynote Speaker

9:30 a.m. UH & USDA Research Updates:
Mixed Fruit Boxes for Export and Little Fire Ant Control
Peter Follett, Ph.D. Research Entomologist
USDA-ARS PBARC

Rambutan Disease Update
Lisa Keith, Ph.D.
Research Plant Pathologist
USDA-ARS PBARC

10:15 a.m. UH & USDA Research Updates:
Management of Flowering and Fruiting of Kaimana Lychee in Hawaii
Tracie Matsumoto, Ph.D.
Research Horticulturist
USDA-ARS PBARC

Pattern of Nutrient Levels in Kaimana Lychee Leaves and Fruits
Mike Nagao, Ph.D.
Horticulturist
UH CTAHR

Post Harvest Practices for Longan and Rambutan
Marisa Wall, Ph.D.
Research Food Technologist
USDA-ARS PBARC

11:00 a.m. Virtues of Foliar Application of Nutrients to Tropical Fruits
Kenneth Gemmill
Nutrient Technologies

11:30 a.m. It Was Nice While It Lasted: Strategies for Finding Funding to Support Tropical Fruit Growers
Douglas L. Vincent
Special Director for Grants & Contracts
UH Manoa CTAHR

12:00 n. LUNCH
Conference Agenda

1:00 p.m. Facilitating the Interstate Movement of Hawaiian Tropical Fruits
          David B. Lamb
          Import Specialist, Mexico, Canada, Hawaii. & US Territories
          USDA,APHIS,PPQ Permits & Imports
          Commodity Import Analysis and Operations (CIAO)

1:30 p.m. Field Production Research and Technologies for Lychee, Rambutan, and Longan
          Yen Diczballis, Keynote Speaker

2:30 p.m. Marketing Tropical Fruits
          Tom Tjendarlsen,
          Managing Director
          Chilean Fresh Fruit Association

3:15 p.m. Fruit Tasting & Wrap Up

Dinner & Auction

6:00 p.m. No Host Bar

7:00 p.m. Dinner and Live Auction

Sunday Conference Program
September 30, 2007

Join HTFG on a field trip to Peter Kincaid’s Anuenue Farms in Kurtistown, a tour of Eric Weinert’s Hawaii Pride irradiation facility, and Bob and Susi Hamilton’s Plant It Hawaii/Hula Brothers packing facility in Keau. Workshops will be presented RAIN or SHINE, so be prepared!

8:30 a.m. Vans leave the Hilo Hawaiian Hotel

9:00 a.m. Work Smarter, Not Harder: Mechanizing Your Orchard for Greater Productivity
          Anuenue Farms (producers of longan, lychee, & rambutan)

10:30 a.m. Tour of Irradiation Facility
          Hawaii Pride

12 noon LUNCH
          Plant It Hawaii/Hula Brothers

1:00 p.m. Work Smarter, Not Harder (continued)
          Tour of packing facility and demonstrations - sprayers, mowers, automated irrigation, and more
          Plant It Hawaii/Hula Brothers

2:00 p.m. Return to Hotel

Hawaii Tropical Fruit Growers
P.O. Box 1582
Hilo, HI 96721-1582
Phone: 808-969-7926
Email: admin@hawaiitropicalfruitgrowers.org
www.hawaiitropicalfruitgrowers.org

Information on the conference, including registration, hotel reservation, and membership forms will also be available on the HTFG website. If you are not a HTFG member and would like to qualify for “member prices,” please send your membership form and payment with your conference registration. Registration receipt deadline is Sept. 20.
President’s Address
HTFG President’s Address
17th Annual HTFG International Tropical Fruit Conference

I’m Richard Johnson, the President of Hawaii Tropical Fruit Growers. Welcome to Hawaii Tropical Fruit Growers’ 17th Annual International Tropical Fruit Conference. Thank you to the County of Hawaii for their continuing support of our organization and this conference though their generous grant. I’d like to introduce our new Executive Director, Amy Brown.

In the last year we lost two great contributors to our industry and we are dedicating this 17th Conference to their memory. Dr. Mike Nagao will give a short presentation on Richard Hamilton and Bill Whitman and how they have had a significant impact on our industry.

Now, in accordance with the by-laws of HTFG I call to order the annual General Membership Meeting of HTFG.

Last year I told our members that 2006 was a turning point for our industry. Thanks to the efforts of Senator Inouye, we had received a $200,000 grant earmarked for Hawaii Tropical Fruit. In partnership with the University of Hawaii, we were able to direct these funds into 8 major research, marketing and product development projects and that money is working for us today. Unfortunately, Congress severely limited earmarked funds for 2007 but we are working to restore this funding in 2008. One of the threats we talked about last year was the emergence of foreign competition in our major market segments. The threat has become a reality. Despite our best efforts in opposition to allowing Thailand irradiated fruits into the U.S., the Proposed Rule was approved by USDA and we expect to see Thai fruit entering the U.S. later this fall. In the meantime, we are going head-to-head with rambutans imported to the mainland from Mexico, Guatemala and other locations in Central America. Prices are down dramatically. Hawaii’s rambutans are of excellent quality and that it giving us some advantage in the mainland marketplace. However, the reality is that foreign competition has arrived and we must proceed deliberately and intelligently to remain competitive. HTFG is dedicated to that goal. We will continue to focus available resources on critical research, marketing and product development to make sure that our industry grows and prospers.

HTFG as an organization continues to grow and prosper. Membership has grown from 112 in 2004 to 150 in 2005. In 2006 we had 158 members including 29 commercial growers and today we are at 171 members, including 36 commercial growers. Our treasury is healthy and our Board is managing the organization well.

In accordance with the HTFG by-laws, it is my responsibility to nominate a slate the 2008 HTFG Board of Directors. I hereby nominate the following individuals to the Board:
Gini Choobua – 2007 Treasurer and Cacao Chapter President
Bob Hamilton – 2007 Vice President
Leslie Hill – 2007 Board Member
Jenny Johnson – 2007 Secretary and Research Committee Chairperson
Richard Johnson – 2007 President
The Board, after being elected by the membership will select the HTFG officers for 2008. Are there any nominations from the floor? (There were none).

(A motion to approve the slate as presented was moved and seconded and the motion was approved by a voice vote.)

Thank the East Hawaii Chapter for all of their hard work in planning this conference and thank you all for attending. We hope that it is a productive conference for you.
Yan Diczbalis, B. Agr. Sc., M. Agr. Sc., Regional Industries Development Officer for the Centre for Wet Tropics Agriculture, South Johnstone, Queensland, Australia, will be the keynote speaker for the Hawaii Tropical Fruit Growers’ 17th Annual International Tropical Fruit Conference.

Yan started his career as a grain crops agronomist. In 1990, he eagerly accepted an offer to join the Horticulture Group in Darwin in the Northern Territory to work on water requirements and irrigation management. During his 13 years with the NT DPIF, eight of which he was Senior Horticulturist, Irrigation Research and Management, he gained considerable experience on water requirements and irrigation management of a number of tropical crops including rock melons, mango, rambutan, mangosteen, and durian.

Yan joined the Queensland Department of Primary Industry in early 1999 as Senior Research Scientist, Tropical Exotic Fruits, based at South Johnstone, a small village approximately 60 miles south of Cairns. During this time, his research and industry development programs included: Unlocking Lychee Research; floral manipulation and canopy management in rambutan and longan; nutrition and phenology survey of durian and mangosteen orchards in North Queensland; and enhancing fruit yield and quality of rambutan and longan by optimizing irrigation and nutrition systems.

Recently, Yan took on the challenge of Regional Industry Development Officer, a position which involves close interaction with horticulture and agriculture industry leaders in the development of existing and new industries. A major part of his role is assisting in the commercialization of an emerging N. Queensland cocoa industry.

Yan noted that none of the above activities and achievements would have been possible or enjoyable without the support of his family.
DEDICATION

The 17th Annual International Tropical Fruit Conference is dedicated to

the memory of

William F. Whitman, long-time HTFG supporter,

and

Richard A. Hamilton, Horticulturist and Professor, whose research at the University of Hawaii greatly contributed to the development of Hawaii’s tropical fruit and nut industries.

William (Bill) Francis Whitman
1914-2007 Horticulturist

Bill’s Vision
To grow successfully tropical fruit trees that are intolerant to cold & have not previously been brought to the fruiting stage in Dade County.
To introduce new species of tropical and subtropical fruits.
*To discover, introduce and propagate improved varieties & clones of tropical & subtropical fruits.
To experiment with rootstocks and grafts & to make observations on cold damage & tolerance.
To distribute information & plant material.

Angela and Bill
Miami-Dade County Recognizes Bill Whitman’s Contributions
Richard (Dick) A. Hamilton
1915-2006

Horticulturist and Professor of Horticulture
Ph.D. Horticulture University of Minnesota
University of Hawaii-Manoa
College of Tropical Agriculture & Human Resources 1947 -1981
Emeritus Professor 1982-2006

Tropical Fruits and Nut Crops in Hawaii
What do all of these fruits and nut varieties have in common?

Lychee: Kaimana, Groff  Papaya: Sunrise, Sunset
Mango: Excel, Rapoza, Momi K, Pope, Gouveia
Avocado: Greengold, Malama
Grapefruit: Puma
Carambola: Kary, Kyra
Macadamia: Keau (660), Kau (344), Mauka (741)
           Makai (800), Pahala (788),
           Purvis (294), Dennison (790)
Banana: Santa Catarina Prata* (Dwarf Brazilian, Dwarf apple)
        Fruit and Nut Varieties Developed in Hawaii or Introduced* into Hawaii by Richard Hamilton
Some tropical fruit and nut varieties developed by Richard Hamilton while at the College of Tropical Agriculture & Human Resources at the University of Hawaii at Manoa.
GOUVEIA
An Attractive New Mango
R. A. Hanchin and Wayne Yee

Figure 1. Mugnol fruit.

Description
Kigna' is from the genus mango, which includes the genera Mangifera indica and Mangifera glomata. The fruit is oval to oblong and is typically green to yellow in color. The skin is smooth and shiny, and the flesh is succulent and sweet. It is a popular fruit in Asia and is commonly eaten fresh or used in desserts.

Origin
Kigna' was developed from a wild mango found in Hawaii. It has been cultivated and propagated by the Hawaii Agriculture and Natural Resources Cooperative Extension Service.

Availability
Kigna' is available at farmers' markets and some specialty food stores.

Figure 2. 'Kau' variety.

A promising new macadamia variety has been named 'Kau' and released for commercial trial. This variety, formerly known as HAE-84, has been named 'Kau' in honor of the Kau Branch Station in Hawaii. It has been selected not only for its excellent taste but also for its hardiness and adaptability to a variety of growing conditions.

The original 'Kau' seedling was discovered in 1966 at the Kau Branch Station in Hawaii. Since then, the variety has been extensively tested and has shown excellent performance in a variety of environments.

Availability
The 'Kau' variety is available to interested growers through the Hawaii Agricultural Extension Service.
Overview of tropical fruit production in Australia

Yan Diczbalis
Queensland Department of Primary Industries and Fisheries
Mean Monthly Rainfall

<table>
<thead>
<tr>
<th>Rainfall (inches)</th>
<th>Rainfall (mm)</th>
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<tr>
<td>0.00</td>
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<td>20.00</td>
<td>400</td>
</tr>
<tr>
<td>25.00</td>
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Regions:

**Fruits from SE Asia**
- Carambola
- Citrus
- Durian
- Jakfruit
- Langsat (Duku)
- Longan
- Lychee
- Mango
- Mangosteen
- Marang (Tarap)
- Persimmon
- Pulasan
- Rambutan
- Salak
- Tarap
- Water Apple

**Fruits from South America**
- Abiu
- Black Sapote
- Custard Apple
- Guava
- Jaboticaba
- Mamey Sapote
- Monstera
- Papaya (Papaw)
- Passionfruit
- Pinaya
- Pineapple
- Rollinia
- Sapodilla
- Star Apple (Cainito)
- Soursop

**Major Fruits**
- Banana
- Mango
- Pineapple
- Lychee
- Papaya (Papaw)

*Banana*
- 24,700 acres (260 growers)
- Valued at US$224 Million per annum
Banana Research

- Nutrition and irrigation management
- Pest and disease management
  - Yellow Sigatoka
  - Nematodes
  - Bunch pests
- Soil Health
- Crop forecasting
- Varieties

Banana production and varieties

- 20M - 28lb cartons
- Cavendish represents 95% of production
- Other commercial varieties
  - Lady Finger
  - Ducasse
  - Red Dacca
  - Sucrerie
  - Plantains
- Interest in promoting use of high Vitamin A varieties (Red Dacca or Sucrerie)

Mango

Industry based on Australian seedling selection;
- Kensington Pride (Bowen) 80% of trees and 90% of production.
Other cultivars include;
- R2E2, Honey Gold, B74
- Keitt, Palmer
- Nam Doc Mai, Khiew Sawoey, Chok Anan

Mango Production (tonnes)

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<thead>
<tr>
<th>Region</th>
<th>2002/2003</th>
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<tr>
<td>Queensland</td>
<td>32937</td>
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<tr>
<td>Northern Territory</td>
<td>12000</td>
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<tr>
<td>Western Australia</td>
<td>3094</td>
</tr>
<tr>
<td>Total Fresh</td>
<td>48631</td>
</tr>
<tr>
<td>Processing</td>
<td>13644</td>
</tr>
<tr>
<td>TOTAL</td>
<td>62175</td>
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</table>

Value: US$96M

DPI’s Prime Research Activity - Breeding
Pineapple

- QLD
  - 5,000 ha
  - 130,000 tonnes
  - US$38M

Lychee

- Industry spread from north Queensland to northern NSW (~1,600 miles)
- 3,000 to 3,500 tonnes
- Production: November-March
- Values at US$14-16M

Papaya (Papaw)

- 980 acres
- valued at US$14.5M

Papaya Research

- Nutrition and irrigation management
- Papaya breeding
- Pest and disease management
- Propagation
Minor Tropical Fruits

• Commercial
  – Rambutan - *Nephelium lappaceum*
  – Longan - *Dimocarpus longan*
  – Mangosteen - *Garcinia mangostana*
  – Durian - *Durio zibethinus*

Longan industry profile

• 75,000 trees; US$8M
  Industry spread along the east coast of Australia
  – Major production area on the Tablelands
  – 1000 – 2000 tonnes/annum
  – Domestic market supply
  – Cultivars; Kohala, Biew Kew, Chompoo, Homestead

Rambutan industry profile

• 30,000 trees US$3.4M. Main industry located in far north Queensland (300-600 tonnes/annum)
  – Smaller (50-100 tonnes/annum) but lucrative industry based in Darwin (Northern Territory)
  – Primarily domestic market supply
  – Active efforts to develop export markets
  – Main cultivars; R9, R134, R156-red, R162, R167, Binjai, Jitlee, Rongrien

Issues - rambutan and longan

• bird and bat problems
• canopy management
• IPM of pests and diseases
• Marketing
  – domestic market profile
  – fruit quality standards
  – new market opportunities
  – packaging
**Durian industry profile**

- 13,000 trees, from Cooktown to Tully (~35 t/annum).
  - Smaller industry in NT
  - Domestic market
  - Cultivars; Monthong, Kan Yao, Luang, Hepe, D. macrantha, D175 (red prawn)
- Major issues
  - Tree die back
  - Fruit quality
  - Imports

**P. palmivora diseases of durian**

- Fruit rot
- Patch canker
- Dieback
- Leaf blight
- Canker

**Mangosteen**

- 14,000 trees, Cooktown to Tully valued at $0.75M
- Smaller industry in NT
- Issues
  - Long juvenile period
  - Crop management
  - Detecting internal disorders
  - Thai imports recently approved by BioSecurity Australia

**Tropical Citrus**

- Various types of citrus fruits displayed
Minor Tropical Fruits

- With excellent tourist market potential

**Abiu – Pouteria caimito**

**Carambola – Averrhoa carambola**

**Guava – Psidium guajava**

**Jackfruit – Artocarpus heterophyllus**

**Pitaya – Hylocereus spp.**

**Star Apple – Chrysophyllum caimito**
Soursop (Guanabana) - *Annona muricata*

Rusties Market - Cairns

**Cocoa Project Background**

- Research project started in 1998 (plantings 2000)
- “Investigate the feasibility and economics of cocoa production in northern Australia”
- How well will it grow & what are the likely costs?

**R&D Program**

- **Hybrid Yield Evaluation**
  - Darwin (Coastal Plains)
  - Mossman (Port Douglas)
  - Broome
  - South Johnstone, Kununurra

- **Farming Systems**
  - South Johnstone (layout and density)

- **Mechanization**
  - Pod splitting

- **Clonal Introduction**
  - Darwin PEQ / South Johnstone
Participants
Currently
• Cadbury Schweppes Australia
• Rural Industries Research & Development Corporation
• Department of Primary Industries & Fisheries, Queensland
Formerly the project also included
• Department of Primary Industries, Fisheries and Mines, Northern Territory
• Department of Agriculture & Food, Western Australia

Reasons for project
• Potential new industry in northern Australia
• Supply & quality concerns
• Increasing demand & falling stock levels
• Cocoa growing - little changed in 50 years
• Science input in a developed economy
• Medium scale production

Project Timeline

Hybrid Yield Trial – Results

Site and layout

Shade
• Temporary shade
  – Gliricidia sepium removed 18 months after planting
• Permanent shade
  – Elaeocarpus grandis silver quandong
- Hybrid material
  - source: CCI Papua New Guinea
  - 5 hybrids

- Irrigation
  - Under tree sprinklers

- Nutrition
  - Irrigation

Primary Processing
- Pod splitting
- Bean extraction
- Fermentation
- Drying
- Grading

Pod Splitting
DPI&F designed equipment for mechanical pod splitting and bean removal.

Wet Bean Extraction
Recent commercial planting

Two groups
• Cocoa Australia
• Cadbury sponsored

Processing

Queensland Fruit Industry Strategies
• Aim to increase domestic consumption.
  – Tropical category
• Strategies
  – Individual business – branding, recipe cards, samples how to eat, processing
  – Industry – advertise
    • Print and TV, paid by industry levies
  – Government - Go for 2&5 campaign, breeding programs in an attempt to extend season via release of early / late varieties

Acknowledgements
• Queensland DPI&F
• Funding organizations
  – RIRDC and HAL
Field production research technology for lychee, rambutan and longan

Yan Diczbalis
Queensland Department of Primary Industries and Fisheries

Lychee production areas

- 280 growers
- 2,000 ha
- Annual Production: 3,000 - 3,500 T

Climatic Zones

Koeppen Climate Classification
- Aw Tropical Wet-Dry
- Am Tropical Wet
- Cw Sub-tropical
- Cf Warm/moist-temperate

Fruit Production Months

<table>
<thead>
<tr>
<th>Country</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
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Location by temperature

- Port Douglas (16.48S)
- Rockhampton (23.40S)
- Nambour (26.65S)

Potentially suitable regions for lychee production in Queensland, Australia.
Unlocking Lychee Research
The Australian Experience

Y. Diczbalis,
T. Campbell,
A. Blair,
P. Chay.

Canopy Management and Flowering

Issues:
- Timing?
- How much wood to remove?
- Variety response?
- Alternatives?

Project Aims
• Evaluate the practical application of research/technology and improve uptake in five key areas.
  – Canopy management and flower induction
  – Nutrition management
  – Irrigation management
  – Pest and Disease management
  – Postharvest

Flowering

Pruning
Pruning model developed for different latitudes so that hardened flushes are ready to move again in winter.

Menzel et al., (2000)

Grower evaluation of canopy management research

- Report mixed results
- Generally correct for cv. Bosworth 3
  - Confidence increased with latitude
- Concerns about its applications to other cultivars
- At higher latitudes fruit often still maturing at the ideal pruning time.

Development of different pruning styles; depending on variety and location
Managing pre-flowering flush

Examine the effect of root pruning

Effect of pre panicle emergence treatments on average block yield of cv. FZS

Irrigation and nutrition management

- Lychee is not overly responsive to nutrition management
  - There are debates about nitrogen management
  - Most fertiliser is applied from flowering to harvest
- Irrigation management most important in the northern growing areas where water requirements in a mature orchard can approach 7.0 ML/ha/annum (709,000 gal/ac)
Leaf Nitrogen % by District 2003

Pest and Disease Management

Pest and Disease Extension

• Classification of pests and disease
• Insect and mite pests
  – Identification of mouth parts and how it relates to control measures
  – Pest ID and registered chemical control
• Diseases
  – Disease ID and control

Spray application workshops
Disease

- Pepper Spot (*Colletotrichum gloeosporioides*)

Trial control measures based on pre flowering/post flowering spray program.

### Effect of fungicide treatments on Pepperspot disease rating on leaf and fruit at harvest

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Leaf Disease Rating</th>
<th>Fruit Disease Rating</th>
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<tr>
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<td>Amistar (40 g/100 L)</td>
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<td>Bion (5 g/100 L)</td>
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<td>Control</td>
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*Leaf and fruit ratings: 1 = nil, 2 = slight, 3 = medium, 4 = severe.

### Markets

- 80 - 90% of lychee are sold on the domestic markets
  - Brisbane, Sydney and Melbourne

- Minor Exports
  - Hong Kong, Singapore, Canada, Tahiti

- Industry lobbying for access to
  - New Zealand and USA (Irradiated fruit)
  - Mainland China (treatment TBA)
Cultivars & Marketing

• Classic Red
  – R134
  – R162
  – R167
  – R156(red)
  – Binjai
  – Jitlee
• Rongrien
• R9

Phenology – NQ Wet Tropics

Fruit Development

Production issues

• Panicle emergence/flowering
• Fruit set
• Managing canopy height
• Winged vertebrate pests

Research and development activities

• Canopy management
  – When to prune
  – Chemical vegetative growth control
• Root Pruning
• Fruit set (NAA and 3,5,6-TPA)
• Final Report (DAQ-289A)
  – Floral manipulation and canopy management in Longan and Rambutan

High Density Orchards Rambutan

Ken Lake
Lakey’s Tropical Fruits

www.rirdc.gov.au
Why High Density?

- Original plantings (10-12 years)
  - Difficult to
    - harvest
    - pest control
    - netting
    - with pruning yield dropped dramatically!

Spacing 12 x 12 m
44 trees/ha

Why High Density?

- Discussions (growers and researchers)
- Success rate of marcotts made it financially possible
- Had a go because someone needed to do it!

Basic Requirements

- Wind breaks
- Level or contoured paddock
- Soil requirements flexible avoid poor drainage areas
- Access to reasonable priced planting material
- Adequate water supply

Orchard setup

- Original planting 6 x 3 m (556 trees/ha)
- Moved to 6 x 4 m (417 trees/ha) in 2000
- Ex papaya paddocks
  - Liming not necessary
- Paddock marginally hilled
- Row centres rotary hoed and ripped
- Each planting hole fertilised with "organic life" at planting

Orchard setup continued

- Marcotts potted for 5-6 weeks
  - Or until roots started to show
- Trees planted
  - covered with Banana bag
Set up continued

- Tree planting
  - Avoid hot months
  - Plant in May – establish in cooler months
- Irrigation
  - Drip (in line) – DRIPIN 750 mm spacing (heavier soil)
  - Sprinklers Waterbird (47L/hr) radius restricted 1.0m, at each tree

Irrigation

- Watermark
  - 45 L/hr
  - Radius restricted
  - 1 sprinkler per tree

Fertiliser Management

- Granular “organic life” for first 12 months
  - Couple of handfuls every six weeks
- Nitrophoska Blue (handful every 3-4 months)
  - 2 handfuls @ 2.5 years

Pruning Management

- Frequent light prunes using the Ledgard Pruner

Growth Regulator Work

- Supported DPI&F work on growth regulator options to help keep top growth under control
  - Root Pruning
  - Chemical growth regulators
    - Like what I see with Cultar® and I believe if the industry can get it registered for foliar application it may be useful as a post-pruning flush size management tool.

Root Pruning

I don’t have to wait for root pruning to be registered!!
Yield
- 20-30 kg/tree
- 7428-11142 lbs/ac

Conclusions
• Final economics of production - unknown
• High Density is the way of the future
  – Higher returns earlier
  – Cheaper to net per unit area
  – Lower picking costs
  – Easier to maintain quality
• Success will depend on
  – ability to keep trees small
  – the long term survival of marcots
  – ability to have trees cropping every year or a big
crop every second year

Longan industry profile
Introduction
• Longan’s introduced in the mid 1800’s by Chinese
  immigrants during the Gold Rush
• Remnant seedling trees still exist along the east
  coast of Queensland

Longan industry profile
Growing Regions
• Approximately 70,000 trees
  – Industry spread along the east coast of Australia
  – Major production areas and estimated tree numbers
    - Atherton Tablelands (Mareeba to Dimbulah) – 40,000 trees
    - Ingham – 4,000
    - Mackay/Sarina – 10,000
    - Rockhampton/Yeppoon/Byfield – 5,000
    - Bundaberg/Childers – 4,000
    - Nambour – 2000
    - Brisbane/Northern NSW - 2000
Longan industry profile
Production and Value

- 700 – 1500 tonnes/annum
- Average Sydney wholesale market prices ($/kg)

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Imported Fruit

Longan industry profile – Domestic Markets

- Domestic market centres
  - Sydney
  - Brisbane
  - Melbourne

Project Work Areas

- Manipulation of flowering using Potassium Chlorate (KClO₃)
  - Method of application
  - Rate of application
  - Timing of application
    - time of application and harvest date
  - Effect of leaf nitrogen
- Bearing capacity
- Heat Sum
- Growth control
- Final Report (DAQ-289A)
  - Floral manipulation and canopy management in Longan and Rambutan

Longan - High Density Orchards
John Magro

- Why High Density
  - South African visitors to John’s Brooks Road orchard claimed he was “ranching”. That got him thinking!
  - Spacing 10 x 8 m
  - 125 trees/ha

Overseas experience

- After visiting orchards in Israel and Thailand John was convinced that high density orchards were worth a go.
- Using cherry pickers is too expensive!
- Its all about increasing productivity and lowering the cost per kg

Basic Requirements

- A clear paddock
- Soil type that doesn’t encourage excess growth.
- Environment where water inputs can be controlled
- Purchased a property at Dimbulah (Western Tablelands) and commenced planting in 1997
  - Longans; 4,500 Kohala, 4,500 Biew Kew
  - Lychee; 1,600 Fay Zee Siu
  - Mango; 6,000 Chock-Anan, 600 Keow Savoe, 600 Kensington Pride Red
Commenced netting in 2002; now have 50 ha under net

Longans - Kohala
- Tried two spacings
  - 8 x 3 m (417 trees/ha)
    - Yield in year 6 (2003) was 30 kg/tree or 12,500 kg/ha
    - Picking cost = 5c/kg compared to 50c/kg at the Brooks road orchard
  - Spacing could be closer
  - 4 x 1.5 m (1,666 trees/ha)
    - Yield in year 6 (2003) was 20 kg/tree or 33,320 kg/ha
    - Good yield, but the spacing is too close and its difficult to spray and maintain quality

Spacing of either
- 7m x 3m (14,200 kg/ha) or
- 6m x 3m (16,600 kg/ha)
- Would still give the same yield per tree and allow fruit quality to be maintained.

Irrigation
- 1 sprinkler per two trees
- Water Marks (60L/hr)
- Consider using drip however need to ensure soil allows sufficient spread of water

Pruning Management
- Net height is 5.0 m
- Trees are allowed to grow to a height of 3.5 to 4.0 m
- Following harvest, trees are cut back to 1.5 m height (chin height)
- Potassium chlorate is used to guarantee flowering during the normal time.

Longan HD - Conclusions
- All the crops John grow’s can be grown under high density
- An environment and soil that does not promote growth is important
- Main benefits are
  - Higher yields in the early life of the orchard
  - Reduced picking costs
  - Cheaper to net
  - Lower production costs per tonne
- No hand pruning
- More efficient use of machinery
Acknowledgements

• Lychee, rambutan and longan growers
• Queensland DPI&F
• Rural Industries Research and Development Corporation (RIRDC)
Post-harvest Technologies for Lychee, Rambutan and Longan

Yan Diczbalis
Queensland Department of Primary Industries and Fisheries
AUSTRALIA
Post harvest project work

- Evaluate the effects of pre harvest fungicide sprays on post harvest keeping quality.
- Preliminary investigations into fruit coatings
- Benchmark Tableland shed harvest and post harvest practices
- Evaluation of storage bags

Effect of pre-harvest Fungicides on post harvest rots.

Coating trials

Initial coatings trial (2002/2003)


Bag type and temperature had the biggest effect (6°C + poly bag)
Lychee Red Life

- Time in hours for 50% of fruit to show 50% or more of browning under standard retail storage conditions – 22-24°C and 50% RH

Benchmarking Shed post harvest performance

Red Life Summary

- Few consignments have a reasonable Red Life
- The best consignment had close attention paid to handling and cooling
- Red Life measurement is a practical way to compare shipments/post harvest techniques
- Need to consider retail ready packaging

Retail Ready Packaging

- Some evidence that poly bags help reduce browning at the wholesale end. Note: browning where bag torn for inspection

Wholesale market

- A lot of cartons of B3 showing browning on the market floor
Problems can occur with the use of poly bags. Suspect poor pre-packing moisture and temperature control has lead to build up of condensation.

Post harvest “bag” trials - Evaluation of improved packaging technologies to improve lychee red life.

- Background
  - Red life of lychee at the retail end of the supply chain continues to be an issue
  - Previous work as part of ULR suggested the red life was generally 4 hours
  - Storage and transport temperatures are important
  - Bag type (poly vs crispy) has been shown to have an effect
    - Use of Polybags can result in condensation issues
    - Use of crispy bags can lead to dry fruit on the verge of browning by the time it gets to the retail store

- Treatments
  - Bag type
    - Crispy bag (PY7), polyethylene (30µm), and a modified atmosphere bag (Breatheway®)
  - Storage temperatures
    - 2°C (36°F), 9°C (48°F) and 14°C (57°F)
  - Lychee cultivars (Fay See Siu and B3)
  - Growers (two/cultivar)

- Measurements
  - Weight loss and browning score at 3 and 7 days after storage

Post harvest “bag” trials - FZS browning score
Post harvest “bag” trials – FZS weight loss

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<th>Grower</th>
<th>Storage Temp (°C)</th>
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Post harvest “bag” trials – B3 weight loss

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Post harvest “bag” trials – B3 browning score

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</tbody>
</table>

Post harvest “bag” trials – bag type and condensation

<table>
<thead>
<tr>
<th>Bag Type</th>
<th>PY7 – crispy bag</th>
<th>MA bag</th>
<th>Poly bag</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Post harvest “bag” trials - Summary

- Fruit browning affected by:
  - Grower
  - Storage temperature
  - Bag type
- In a short supply line (2-3 days) at 14°C (57°F) the PY7 bag is OK but fruit will brown faster when on retail display.
- The poly or MA bags are better suited to longer supply lines with good temperature (5-10 °C) control.
- At 9 and 14°C off flavours developed in MA bags
- No apparent chill damage at 2°C which means there is an opportunity for dis-infestation treatments.
Delivery

Rambutan - Post harvest practices

Harvest
In the cool of morning

Keep fruit cool and moist.

Transfer rapidly to shed. WET FRUIT

Destalk ensuring a stub of stem remains on the fruit.

Fruit packaging options (domestic or export)
- Single layer tray (2.5 kg)
- 6 x 800 g punnets (5.0 kg)
- 10 x 200-250 g punnets (2.0-2.5 kg)
- Fruit on panicle with leaf (1.0 kg) - Chinese New Year

Packaging designed to minimise moisture loss.

Quality and size grade fruit.

Store and transport at 10-12°C

Delivery
External Pests

Evaluation of Petroleum Oils as a Postharvest Treatment for Rambutans

HAL project: MG05014
Project leader: Peter Leach
Project dates: Dec 2005 – March 2006
Aim: Remove the need for methyl bromide fumigation for rambutans to Japan.
Funding: Voluntary contribution from Rambutan and Tropical Exotic Growers Association and Northern Territory Horticulture Association

Rambutans for Japan

- No fruit fly restrictions
- Phytosanitary Inspections conducted by AQIS and Japanese MAFF
- Failed inspection
  - fumigation, additional inspection costs and reduced shelf life
- Major pests of concern
  Citrus mealybug, Green coffee scale, ants
Petroleum oils

- Caltex Post Harvest Dip (CPHD)
- Food grade
- C15 Alkane (very light)
- Currently registered for use on Citrus
  - 3% for 30sec. Dip or Spray
- Not organically produced but can be used without affecting certification

Conclusion

- 3% solution for 30 seconds controls adult and juvenile mealybug
- 20% CPHD failed to control eggs
- Control over other insects needs further investigation.
  - Initial results very positive for scale ants and thrips
- No phytotoxicity problems with rambutan, lychee, longan and mangosteens.

Longan

Delivery

Harvest
In the cool of morning

Keep fruit out of sun.

Transfer rapidly to shed.

Trim stalk leaving fruit on the panicle.

First grade fruit ≥ 30 mm (1.2") diameter
Or
Final quality grading of fruit as per marketing group specifications.

Quality and Size grade fruit

Untreated fruit
Pack ≤ 5.0 kg carton
Store and transport at 8 - 10°C

So2 treated fruit
Pack ≥ 5.0 kg banded plastic tray
Store and transport at 4 - 5°C

Longan postharvest

- Longans are packed untreated or treated with Sulphur Dioxide (SO2)
- Pack size is 5.0 to 8.0 kg
- Untreated fruit
  - Short shelf life due to skin discolouration
- Alternatives to SO2 have been investigated

So2 treatment

- Application 540 mg/kg of fruit for 20min
- Air fruit 2-3 hrs after treatment
- Ratio 5:1 (free space (L): fruit weight (kg))
- WHP = 2 days
Packaging options - untreated

Untreated
5.0 kg (11 lbs)

Packaging options - treated

SO₂ treated
8.0 kg (17.6 lbs)

Post harvest handling and storage

• Dr. James Drinnan (2004)
  – RIRDC Project No DAQ-249A
• Objectives
  – Determine optimal storage temperatures and packaging requirements for longan.
  – Develop alternative post harvest strategies to sulphur dioxide fumigation.

Methodology

• Longan cultivars
  – Kohala and Biew Kiew

• Treatments
  – Storage temperature (5-25°C)
    • 5, 7½, 10, 12½, 15 & 25°C

Packaging assessed during the project included

• Open netting (onion bag)
• Oven bag (cellophane)
• Plastic poly bag
• Lychee bag (light plastic with holes in)
• Paper bag
• Glad wrap
• Vitalfilm
• Crispy bag (used in lychee industry)
• Plastic container (takeaway food) with and without paper
• MIP bag (modified interactive packaging - Bantec® International)
• MIP container (modified interactive packaging - Bantec® International)
• Veggie bag

Packaging characteristics
Alternatives to SO₂ gassing

- pre harvest sprays with wettable sulphur
- increasing the nutrient status of the tree prior to harvest
- coating the fruit with light oils
- dipping fruit in various disinfectants, sanitizers, bleach or hot water
- pre-conditioning fruit in progressively lower temperatures

Fruit dips

- Trial disinfectant/sanitizers/bleach
  - Hot water (45-90°C), Chlorine Dioxide (Castle Wash), Sani Chlor, Soda Ash, Mango Wash, Semperfresh, polyshine, NaOH and various acids (Hydrochloric, Acetic & phosphoric).
- HCL dip
  - (0.5 - 4.5%) and pH (0-1); time (3-60 min)
  - stored at different temperatures (5, 10, 15°C)
  - packaging types (open nets, MIP bags, plastic poly bags).

A rating scale from 1 – 10 was developed to describe the level of skin browning.

Chilling damage on Kohala fruit. Damage penetrates through the skin to the flesh.

A range of packaging types trialled.

The effect of increasing time and concentration of an HCl dip on skin colour.
Skin colour of control and acid treated fruit following dehydration.

Skin colour of control fruit, HCl acid treated fruit, and SO₂ treated fruit.

Recommendations

- Few days - protect fruit from dehydration (poly bag, vita film) and store 15-20°C
- A week - protect fruit from dehydration (poly bag, vita film) and store 10-15°C
- 2-4 weeks - protect fruit from dehydration (poly bag, vita film, MIP packaging) and store just above the critical temperature for chilling injury 10°C for Biew Kiew, 7.5°C for Kohala.
- Over 4 weeks -
  - Treat fruit with SO₂ or dipped in HCl. Store fruit at low temperatures 4-5°C and keep reasonably dry in order to prevent disease developing.
  - Packaging (crispy bag or MIP packaging)
  - Ideal conditions will allow storage up to 60 days.
  - SO₂ treated fruit - preferred method
  - HCl would provide a slightly inferior alternative.

Summary

- Current industry practices generally result in high quality fruit arriving at the market
- Retail display and storage is often limiting, particularly for lychee and rambutan
- Continued attempts to seek solutions to skin browning, however as suppliers of fruit we need to remember “fresh is best”

Acknowledgements

- Lychee, rambutan and longan growers of Australia
- DPI&F colleagues
It was nice while it lasted: Strategies for Finding Funding to Support Tropical Fruit Growers

Douglas L. Vincent, Ph.D., P.A.S.
Special Program Director for Contracts and Grants
College of Tropical Agriculture and Human Resources
University of Hawaii at Manoa

Agricultural Diversification: Hawaii Tropical Specialty Fruit Research and Development – FY2006

- CTAHR was awarded $204,252 from a USDA CSREES Special Research Grant.
- Working closely with HTFG, we funded 8 projects, ranging from $5,500 to $56,363.
- Crops included Longan, Lychee, Rambutan, Cacao, Surinam Cherry, Avocado.
- Projects varied from pest control, pre-harvest and postharvest practices, new crop development, marketing and market development.

How it happened...

- This funding has come to CTAHR and Hawaii growers through the efforts of Senator Daniel K. Inouye.
- HTFG developed a compelling case for new funding for research and development for tropical specialty fruits.
- The grant came to CTAHR and using the same model as the USDA Federal Floriculture Grant, we developed a process for evaluating research proposals.
- Funding was put into the USDA budget by Senator Inouye, through Congressional Earmarks.
- Funding was received Fall, 2006 with anticipated annual funding thereafter.

So what happened...

- After several years of control of the Congress, the Republicans couldn’t seem to finish the budgets on time.
- After the November 2006 election, the Democrats took over control of the Congress.
- Blaming the Republicans, Senator Byrd and Rep. Obey announced in December 2006, that there would be NO earmarks put into the FY 2007 budget.
- Byrd and Obey announced new rules for submission of earmarks for the FY 2008 budget.
- Still no budget for FY 2008.

Current Status of the Funding

- None of the FY 2008 budgets have been sent to the President. The House has passed all 12 of the budgets; the Senate 4/12. No conference committees have been convened.
- On September 26, 2007, the House passed a Continuing Resolution to fund the country at FY 2007 levels through 11/18/07. The Senate needs to pass it and the President must sign the bill into law.
- Funding for the Agricultural Diversification is included in the House version of the USDA budget at $218K. It is not in the Senate version.

If the funding comes back...

- CTAHR’s commitment is to continue supporting the existing projects and to restore funding depending on the amount received.
- We will work closely with the HTFG and others that served on the advisory committee to ensure fairness.
- BUT we don’t know when, or even if, funding will be restored. We won’t know until a new budget is passed. Likely in December 2007 or January 2008.
Other places to “go fish”

- Federal Grants:
  - USDA National Research Initiative Competitive Grants Programs (various programs with different deadlines).
  - USDA CSREES Small Business Innovation Research - currently closed.
  - Check with USDA Rural Development or Natural Resources Conservation Service Offices for other potential opportunities.

- USDA ARS PBARC - not a funding agency but support is there.

Other places to “go fish”

- Hawaii Department of Agriculture:
  - HDOA Pesticide Branch Revolving Fund.

- Hawaii Farm Bureau Federation:
  - Research Grants - currently closed but expect RFP in near the end of the year with a deadline early in the new year.

- County Governments:
  - Hawaii County has been very generous in its funding for research projects to support Hawaii County farmers.
  - Other counties may likewise support projects.

Bottom-line...

- There are other opportunities to find funding for research to support tropical specialty fruit research.
- Strong stakeholder group support is necessary.
- Partnering and leveraging funding helps.

Thank you for your attention. I’ll try to answer your questions or we can have lunch.
Mixed Fruit Boxes for Export and Little Fire Ant Control

Overview

- Quarantine treatments
- Mixed fruit gift boxes
- Little fire ant field study

Hawaii
Exports approved for 11 fruits

- Papaya*
- Rambutan
- Longan*
- Banana*
- Lychee
- Star fruit
- Mango
- Abiu
- Atemoya
- Sapodilla
- Pineapple*

Hawaii: Proposed rule in October will add 7 fruits

- Mangosteen
- Dragon fruit
- Cherimoya
- Atemoya
- Breadfruit
- Jackfruit
- Melon

Next: guava, passion fruit, others?

New products
Mixed fruit box

- Present guidelines permit quarantine treatment of only 1 fruit type
- Generic irradiation doses: 150 and 400 Gy
- Objective: Develop a mixed-fruit gift box
- Regulatory possibilities:
  1. Re-pack in a insect-proof room
  2. Treat fruit mixed in the final box

Dose mapping study
Single vs. mixed fruit boxes

- Mango, papaya, banana, longan
- Calculated fruit density and bulk density
- 27 dosimeters/box
- Irradiated at 400 Gy

\[ y = -279.68x + 526.39 \]

\[ R^2 = 0.4406 \]
Single vs. mixed fruit
Dosimeter placement

Mixed fruit box
Results
- Mixed fruit in final box should be acceptable for irradiation treatment
- APHIS accepts concept
- Next: More tests with different fruits and using full carriers
- Collaboration with interested exporters

Harry & David
Luxury fruit baskets

Little fire ant
Wasmannia auropunctata
- Native to Central and South America
- 1999 - Puna, 3 pops, 30 acres
- 2005 - 37 pops, 250 acres
- Small, light colored, slow moving
- Painful stings
- Tends scales and mealybugs
- Supercolonies
- Difficult to eradicate
- Field test to evaluate controls

Hawaii Distribution
- Courtesy: Pat Conant HDOA
Field control study
Honualani orchard

- Treatments
  - Amdro (toxic bait)
  - Esteem (IGR bait)
  - Conserve (spray)
  - Control
- ¼ acre plots, 16 trees, 4 replicates, rambutan/mangosteens orchard
- Treated at 2 week intervals
- Sampled on trunks using sticky tape
- Sampled across rows using peanut butter on sticks
Sampling Methods

Field Control of LFA

Population Density
Methods
- Sampled 3 habitat types
  - Orchard
  - Windbreak
  - Pasture
- Sampled area randomly selected (N = 25)

Population Density - ground only

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Mean # Ants</th>
<th>Extremes</th>
<th>% Samples with Reproducitives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orchard</td>
<td>491.1</td>
<td>11-4794</td>
<td>32</td>
</tr>
<tr>
<td>Windbreak</td>
<td>474.0</td>
<td>22-1821</td>
<td>48</td>
</tr>
<tr>
<td>Pasture</td>
<td>186.6</td>
<td>12-564</td>
<td>24</td>
</tr>
</tbody>
</table>

- Estimated >95 million LFA/acre !!

Field control study
Results
- Enormous little fire ant densities
- Amdro and Esteem reduced but did not eliminate ants
- Baits applied to the ground did not control ants nesting in trees
- Ants numbers recovered quickly
- Little fire ant displaced other ants
Little fire ant control

Registered For Tropical Fruits
- Amdro
- Esteem
- Entrust

Other Products
- Abamectin
- Methoprene
- Fipronil
- Caltex Citrus Post-harvest Dip

More research needed!

Mahalo!

Questions?
Postharvest Practices for Longan and Rambutan

Marisa Wall
Research Food Technologist
Postharvest Tropical Commodities Research Unit
U.S. Pacific Basin Agricultural Research Center, Hilo, HI

Causes of Marketing Losses

- Over-ripeness
- Mechanical damage
- Water loss
- Decay
- Improper temperature
- Wrong atmosphere
- Lack of sanitation
- Excessive delays

Keys to Success

- Initial quality
- Maturity at harvest
- Careful handling
- Proper environmental conditions
- Good sanitation practices

GOAL: Production and delivery of premium fruit that consistently delights consumers.

Temperature Management

Proper postharvest temperature
- slows metabolic changes
- reduces respiration, transpiration, and ethylene rates
- minimizes pathogen growth

The perishability of a commodity is generally related to its respiration rate.
Integrating Preharvest and Postharvest Practices to Improve Fruit Quality of Rambutan and Longan
M. Nagao, M. Wall, L. Keith, K. Nishijima, M. Nishina

- Determine the effectiveness of preharvest fungicide applications on postharvest disease development and fruit quality
- Determine optimum storage conditions and develop packaging strategies to extend shelf-life

Rambutan Cold Storage, 14 days – Expt #1

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Binjai</th>
<th>Jitlee</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 °C</td>
<td>![Binjai 10°C]</td>
<td>![Jitlee 10°C]</td>
</tr>
<tr>
<td>15 °C</td>
<td>![Binjai 15°C]</td>
<td>![Jitlee 15°C]</td>
</tr>
<tr>
<td>20 °C</td>
<td>![Binjai 20°C]</td>
<td>![Jitlee 20°C]</td>
</tr>
</tbody>
</table>

Postharvest pathogens - rambutans
Lasmenia sp. Pilidium acerinum

Preharvest fungicides
Seranade® (Bacillus subtilis) on rambutans

Rambutan Research
Combine preharvest treatments (+/- fungicides) with postharvest practices (temp. + packaging)
Test under simulated shipping conditions
Maximize fruit quality

Longan Postharvest Research
Longan respiration rates at 4 temperatures

![Graph showing CO2 production over days after harvest at 4 temperatures (5°C, 10°C, 15°C, 20°C).]

Longan Weight Loss during Storage

![Bar chart showing percent weight loss over days after storage at 4 temperatures (5°C, 10°C, 15°C, 20°C).]

Longan quality after 14 days at different storage temperatures

- 20 °C – fruit unmarketable
- 10 °C or 15 °C – fruit in good condition
- 5 °C - fruit had chilling injury.

MAP – Modified atmosphere packaging

- Fruit respiration and transpiration passively modify the atmosphere (CO₂,O₂,RH) inside semi-permeable bags.

Packaging - MAP

**Advantages**
- Reduce water loss
- Slow respiration and ethylene rates
- Reduce fruit abrasions
- Prevent disease spread among units
- Brand identification

**Disadvantages**
- Possibility of condensation
- Pathogen growth
- Potential for anaerobic conditions

What’s next?

- Steady state gas concentrations inside various packages at different temperatures
- Optimize package for maximum quality and shelf-life
- Test under simulated shipping conditions
MAHALO

Darsen Aoki
Kate Nishijima
Suzy Sanxter
Sandra Silva
Lionel Sugiyama

Tropical Fruit Growers!
Rambutan Disease Update

Dr. Lisa Keith
Research Plant Pathologist
Tropical Plant Genetic Resource Management Unit
USDA-ARS, PBARC

Topics
- Disease surveys
- Leaf bioassay
- In vitro fungicide assays
- Fungicide field trial
- Canker disease

Disease survey (% incidence)

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Sileng Keng</th>
<th>R167</th>
<th>Binjai</th>
<th>Jitlee</th>
<th>R134</th>
<th>Daun Hijau</th>
<th>Gula Batu</th>
<th>Chompoon</th>
<th>Sitang Ku</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lasmenia</td>
<td>88.9</td>
<td>57.5</td>
<td>54.4</td>
<td>52.8</td>
<td>66.7</td>
<td>80.0</td>
<td>71.4</td>
<td>53.3</td>
<td>73.3</td>
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<tr>
<td>Pestalot.</td>
<td>0</td>
<td>41.4</td>
<td>10.3</td>
<td>8.3</td>
<td>0</td>
<td>6.7</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Phomops.</td>
<td>0</td>
<td>6.9</td>
<td>4.4</td>
<td>5.6</td>
<td>6.7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Lasiodip.</td>
<td>0</td>
<td>1.5</td>
<td>5.9</td>
<td>1.4</td>
<td>0</td>
<td>13.3</td>
<td>0</td>
<td>20.0</td>
<td>0</td>
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<tr>
<td>Collotot.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7.1</td>
<td>0</td>
<td>20.0</td>
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<tr>
<td>Mucor</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>Guignard.</td>
<td>0</td>
<td>2.9</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>Glioceph.</td>
<td>0</td>
<td>7.3</td>
<td>5.9</td>
<td>6.9</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fusarium</td>
<td>0</td>
<td>2.9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
</tbody>
</table>

Disease Survey Summary

- Lasmenia (% incidence, 52.8% on Jitlee to 88.9% on Sileng Keng)
- Pestalot (6.7% on Daun Hijau to 41.4% on R167)
- Colletotrichum (% incidence, 7.1% on Gula Batu to 20% on Sitang Ku)
- Phomopsis, Gliocephalotrichum, Lasiodiplodia (<7%)

Leaf as a Source of Inoculum

Typical Lasmenia symptoms
Leaf Bioassay

- Complete Koch's postulates
- Test for pathogen virulence
- Test for host resistance

Rambutan Pathogens

Lasmenia sp. Fusarium sp. Colletotrichum sp.

4 days post inoculation

Leaf Bioassay Conclusions

- Koch's postulates: multiple fungi cause leaf spots; can serve as a source of inoculum
- Wounding was necessary for symptom development
- Fungi vary in virulence
- Host resistance varies
**Control - Fungicides**

- Trilogy® (Certis) is an extract from neem oil
- Abound® (Syngenta) is a broad spectrum, systemic azoxystrobin fungicide
- Serenade® (AgraQuest) is a patented strain of *Bacillus subtilis*

**In Vitro Fungicide Assays**

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Concentration (x = 1%)</th>
<th>Concentration (x = 1%)</th>
<th>Concentration (x = 1%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/3x</td>
<td>1x</td>
<td>3x</td>
</tr>
<tr>
<td>Lasmenia 10-5</td>
<td>37</td>
<td>55</td>
<td>71</td>
</tr>
<tr>
<td>Lasmenia 20-3B</td>
<td>63 (C)</td>
<td>60 (C)</td>
<td>70 (C)</td>
</tr>
<tr>
<td>Lasmenia 9-5A</td>
<td>18 (A)</td>
<td>59 (B)</td>
<td>74 (C)</td>
</tr>
<tr>
<td>Lasmenia 9-2</td>
<td>22 (A)</td>
<td>52 (B)</td>
<td>68 (C)</td>
</tr>
<tr>
<td>Lasmenia 25-2</td>
<td>26 (A)</td>
<td>62 (B)</td>
<td>74 (C)</td>
</tr>
<tr>
<td>Lasmenia 9-5B</td>
<td>100 (C)</td>
<td>78 (C)</td>
<td>74 (C)</td>
</tr>
</tbody>
</table>

**Trilogy® - % Inhibition**

<table>
<thead>
<tr>
<th>Concentration (oz/gal)</th>
<th>Concentration (oz/gal)</th>
<th>Concentration (oz/gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>6.2</td>
<td>15.4</td>
</tr>
<tr>
<td>Lasmenia 10-5</td>
<td>66 (B)</td>
<td>65 (B)</td>
</tr>
<tr>
<td>Lasmenia 20-3B</td>
<td>67 (C)</td>
<td>92 (C)</td>
</tr>
<tr>
<td>Lasmenia 9-5A</td>
<td>77 (C)</td>
<td>78 (C)</td>
</tr>
<tr>
<td>Lasmenia 9-2</td>
<td>86 (C)</td>
<td>68 (C)</td>
</tr>
<tr>
<td>Lasmenia 25-2</td>
<td>74 (C)</td>
<td>73 (C)</td>
</tr>
<tr>
<td>Lasmenia 9-5B</td>
<td>34 (B)</td>
<td>56 (B)</td>
</tr>
</tbody>
</table>

**Abound® - % Inhibition**

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Concentration (x = 1%)</th>
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<th>Concentration (x = 1%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/3x</td>
<td>1x</td>
<td>3x</td>
</tr>
<tr>
<td>Lasmenia 10-5</td>
<td>2</td>
<td>24</td>
<td>46</td>
</tr>
<tr>
<td>Lasmenia 15-2</td>
<td>3 (A)</td>
<td>23 (A)</td>
<td>41 (B)</td>
</tr>
<tr>
<td>Colletotrichum 21-4B</td>
<td>7 (A)</td>
<td>7 (A)</td>
<td>21 (A)</td>
</tr>
<tr>
<td>Colletotrichum 25-4</td>
<td>7 (A)</td>
<td>23 (A)</td>
<td>38 (B)</td>
</tr>
<tr>
<td>Phomopsis 7-2B</td>
<td>0 (A)</td>
<td>16 (A)</td>
<td>39 (B)</td>
</tr>
<tr>
<td>Phomopsis 15-4</td>
<td>0 (A)</td>
<td>11 (A)</td>
<td>38 (B)</td>
</tr>
</tbody>
</table>

**Abound® - % Inhibition**

<table>
<thead>
<tr>
<th>Isolate</th>
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<tbody>
<tr>
<td></td>
<td>4</td>
<td>6.2</td>
<td>15.4</td>
</tr>
<tr>
<td>Lasmenia 10-5</td>
<td>3</td>
<td>23</td>
<td>41</td>
</tr>
<tr>
<td>Lasmenia 15-2</td>
<td>2 (A)</td>
<td>24 (A)</td>
<td>46 (B)</td>
</tr>
<tr>
<td>Colletotrichum 21-4B</td>
<td>67 (C)</td>
<td>68 (C)</td>
<td>68 (C)</td>
</tr>
<tr>
<td>Colletotrichum 25-4</td>
<td>45 (B)</td>
<td>37 (B)</td>
<td>36 (B)</td>
</tr>
<tr>
<td>Phomopsis 7-2B</td>
<td>20 (A)</td>
<td>16 (A)</td>
<td>27 (A)</td>
</tr>
<tr>
<td>Phomopsis 15-4</td>
<td>22 (A)</td>
<td>21 (A)</td>
<td>32 (A)</td>
</tr>
</tbody>
</table>
**Serenade® - % Inhibition**

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Concentration (oz/100 gal)</th>
<th>A = highly resistant; B = moderately resistant; C = sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lasmenia 10-5</td>
<td>100 (C)</td>
<td>100 (C)</td>
</tr>
<tr>
<td>Lasmenia 20-3B</td>
<td>100 (C)</td>
<td>100 (C)</td>
</tr>
<tr>
<td>Lasmenia 9-5A</td>
<td>100 (C)</td>
<td>100 (C)</td>
</tr>
<tr>
<td>Lasmenia 9-2</td>
<td>100 (C)</td>
<td>100 (C)</td>
</tr>
<tr>
<td>Lasmenia 25-2</td>
<td>100 (C)</td>
<td>100 (C)</td>
</tr>
<tr>
<td>Lasmenia 9-5B</td>
<td>100 (C)</td>
<td>100 (C)</td>
</tr>
</tbody>
</table>

**Conclusions – In Vitro Fungicide Assays, % Inhibition**

- **Trilogy®**
  - Lasmenia, 61%
  - Pestalotiopsis, 26%
  - Colletotrichum, 15%
  - Phomopsis, 14%

- **Abound®**
  - Lasmenia, 78%
  - Pestalotiopsis, 44%
  - Colletotrichum, 52%
  - Phomopsis, 30%

- **Serenade®**
  - 100% effective at all concentrations tested

**Field Fungicide Application**

- **Binjai & Jitlee**
- Control: no spray
- Rate: Low end of the recommended rate (2 qt/ac)
- 21 day cycle
- Looking at effect on immature fruit drop
Stem Canker Disease

- *Dolabra nepheliae*
- Originally described from Malaysia
- Also known on pulasan in Australia
- Classified by FAO as a ‘minor disease’
- Potential damage of this disease
- Mechanisms of control

Future Goals

- Screening germplasm for sources of resistance
- Stem canker: etiology; mechanisms of control
- Fungicide efficacy trials

Mahalos

- Lionel Sugiyama
- Francis Zee
- Tracie Matsumoto
- Russell Kai
- Carol Riley
- Tsuyoshi Tsumura
- Claire Arakawa
- Jason Okamoto
- Amy Strauss

- Marisa Wall
- Kate Nishijima
- Darsen Aoki
- Mike Nagao
- Joel LaPinta
- Amy Rossman
- Ricardo Goenaga
Management of Flowering and Fruiting of ‘Kaimana’ Lychee in Hawaii

Tracie Matsumoto, Francis Zee, Mike Nagao, Malvin Nishina and Virginia Easton Smith

Background

- Pruning and foliar fertilizer resulted in an average lychee harvest >100 lb per tree per year in 2005 and 2006.

Last year we reported on a prune and foliar fertilizer procedure that resulted in greater than 100 lbs of ‘Kaimana’ lychee harvested per tree at the USDA, ARS, Tropical Genetic Resource Management Unit field at the Waiakea research station.

Overview

I. Test pruning and foliar fertilizer technique on ‘Kaimana’ lychee grown at different areas on the Big Island

II. Determine effect of degree of pruning and timing of foliar fertilization on lychee production.

Here we will summarize the data we obtained using this pruning and foliar technique at commercial lychee orchards in Kona and Hamakua. We will also report on the effect of the degree of pruning and timing of foliar fertilizer application on lychee fruit production.
The Big Island is a wonderful natural laboratory with different climatic regions located within relatively close proximity to each other. The locations where the field trials are located are in Waiakea at ~500 ft elevation, Wailea at ~380 ft and Captain Cook at 1250 ft elevation.

**General Procedure**

- Tree pruned – remove old, dead or crossing branches, tree height reduced, tips pruned back ~12 inches to remove "dragon-head"
- Foliar Fertilizer application one week after pruning (3 gal/tree)
- For 100 gal of nutrient spray
  - 3 lb of 19-19-19 plus micro (0.5% Ammoniacal, 6.6% Nitrate, B 0.02%, Cu 0.05%, Fe 0.1%, Mn 0.05%, Mo 0.001%, Zn 0.05%)
  - 1 quart of “Pack Hard” (Ca 8%, Boron 0.5%)
  - ½ quart of “Clean Crop” liquid iron (chelated Fe 4.5%)

The general procedure is outlined here.

**Data Collection**

- Temperature and rainfall data collected for each location
- Vegetative flushes recorded every 1-2 weeks (photograph).
- New flushes tagged and observed every 2 weeks.
- Leaf tissue collected monthly.
- Harvest weights - marketable vs unmarketable fruits measured.
- Fruit color, weight, width, total soluble sugars and internal quality measured.

Summary of data collected.
Here is the standard development of the pruned trees. The trees are pruned, new shoots are evident from week 2 to 4, the flushes mature and by week 8, the tree is fully matured.
This graph shows the average temperature and rainfall located at the Hamakua orchard. The daily maximum temperature is in red, the daily average is in black and the daily minimum temperature is in light blue. Rainfall is in dark blue. The coldest temperatures of 59.4°F to 58.7°F was observed between January 27th to February 15th. Total rainfall from September to August was 88.9 inches.
Here are the trees pruned and fertilized. Little fruit to no fruit production was observed.

Pruned trees NOT fertilized also had very little to no fruit.

Foliar fertilized trees had moderate fruit production.
Control trees also had moderate fruit production.

This graph shows the average temperature and rainfall located at the Kona orchards. The daily maximum temperature is in red, the daily average is in black and the daily minimum temperature is in light blue. Rainfall is in dark blue. The coldest temperatures of 60°F to 59.4°F was observed between January 19th to February 15th. Total rainfall from September to August was 27 inches.
Control trees that were not pruned or fertilized showed moderate to no fruit production.

Pruned and foliar fertilized trees had good fruit production.

Similar to Kona location 1, control trees not pruned or fertilized had little to moderate fruit production.
Pruned trees had good fruit production.

Overview

I. Test pruning and foliar fertilizer technique on 'Kaimanā' lychee grown at different areas on the Big Island.

II. Determine effect of degree of pruning and timing of foliar fertilization on lychee production.

At the USDA, ARS, Tropical Genetic Resource Management Field at the Waiakea Station, we started preliminary experiments on determining the effect of the degree of pruning and timing of foliar fertilization on lychee production.

Conditional vs Harvest Prune

Here are examples of trees conditional vs harvest pruned. Conditional prunes are more severe and are used to shape the tree canopy while harvest prune is a less severe prune used to remove the terminal branches.
Here is a map summarizing the treatments used in the experiment. The top block of trees were conditionally pruned and trees on the bottom block were harvest pruned. The colors represent the foliar application which was 1 week (red), 1 week and 4 weeks (purple) or 4 weeks (blue) after pruning. Pruned but not fertilized trees are indicated in white. Circles in yellow represent trees that were only harvested and not pruned or fertilized.

This graph shows the average temperature and rainfall located at the Waiakea orchard. The daily maximum temperature is in red, the daily average is in black and the daily minimum temperature is in light blue. Rainfall is in dark blue. The cold temperatures of 60°F or below were observed as early as November 23 and as late as June 8th. Total rainfall from September to August was 154 inches.

This graph represents the average pounds of harvestable fruits taken from three trees per treatment. The standard protocol of harvest pruned trees foliar fertilized one week after treatment yielded the highest amount of fruit. The general trend is conditionally harvested fruit yield less than harvest pruned trees. More or later fertilizer application also tend to reduce yield.
No Treatment – Fruit Harvest Only

Here is an example of the tree that was harvested and not pruned or fertilized. Notice the fruit development on the tree is not uniform.

Harvest Prune and Foliar Spray Aug (1 week)

This is the recommended protocol of harvest pruning and foliar application 1 week later. Notice the good yield and uniform fruit development.

Conditional Prune and Foliar Spray Aug (1 week)

Here is an example of the tree conditionally pruned with foliar fertilization 1 week after pruning. The total yield is less but fruit development is still uniform.
This graph shows the harvest dates for each of the trees in the experiment. The recommended harvest prune and foliar spray application 1 week after prune has a narrow harvest dates. Harvest pruned trees yield mature fruit earlier in the season and this harvest period can be extended by later (4 week) foliar fertilizer application.

With the extended fruiting season, pests and diseases can also become more prevalent as evident by the increasing percentage of unmarketable fruits during the later harvest dates.

Summary

- Prune and Foliar Technique have potential to improve lychee production in Kona
- Best treatments for Hamakua are to do nothing or apply foliar fertilizer without pruning. More research is needed to optimize production.
- Experiments are being repeated for the upcoming lychee season
- Combination of pruning and foliar fertilizer application may lengthen lychee harvest season
Thank you to the Hawaii Tropical Fruit Growers, Cooperators, Collaborators and Staff for making this research possible!
Pattern of Nutrient Levels in Kaimana Lychee Leaves and Fruits
Mike A. Nagao, Laura K. Awong, Andrea M. Kawabata and Susan K. Cabral
University of Hawaii, CTAHR
Beaumont Research Center
875 Komohana St.
Hilo, HI 96720

ABSTRACT
‘Kaimana’, a selection of the ‘Haak Ip’, is the most important lychee cultivar grown in Hawaii due to its ability to flower consistently in environments found in most growing locations. It has a low-chilling requirement for flower induction and produces large, heart-shaped fruits with about 40% abortive (“chicken-tongue”) seeds. In this study, ‘Kaimana’ fruit growth, patterns of moisture and nutrient accumulation during fruit development, and the nutrient composition of leaves were monitored to develop nutrient management information and guidelines suited for this cultivar. Fruits exhibited a sigmoid growth pattern, with rapid increases in fruit weight occurring between 6 and 12 weeks after anthesis; maximum fruit weight was attained at 12 to 15 weeks. Moisture accumulation was also greatest during the 6th to 12th week and accounted for 78% of the final weight of mature fruits. Accumulation of N, P, K, Ca, and Mg in fruits also followed a sigmoid pattern, paralleled fruit growth and reached maximum concentrations at 12 weeks after anthesis. The rapid increases in nutrient uptake between week 6 and 12 were most evident with N and K. Changes in foliar concentrations for N, P and K followed similar patterns. Leaf concentrations were highest at panicle emergence and decreased during fruit development, with the steepest decline coinciding with the period when fruits exhibited their most rapid increase in growth. A gradual increase in leaf Ca and Mg occurred during fruit development and appeared to be related to leaf age. The data illustrate the importance of adequate nutrition for optimum fruit growth and for maintaining the vegetative health of producing trees.
Pattern of Nutrient Levels in Kaimana Lychee Leaves and Fruits

Mike A. Nage, Laura K. Aung, Andrea M. Kavalske and Susan K. Cebal

University of Hawaii, CT AHR
Beamanon Research Center
875 Kamehamea St.
Hilo, HI 96720

Objective
Study Kaimana fruit growth, patterns of moisture and nutrient accumulation during fruit development, and the nutrient composition of leaves.

Overall Goal
Develop nutrient management information and guidelines suited for this cultivar.

Kaimana Leaf Analysis at Onset of Panicle Emergence

<table>
<thead>
<tr>
<th>% of Dry Matter</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVE</td>
<td>1.72</td>
<td>0.25</td>
<td>0.87</td>
<td>0.58</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Emerging panicle

(Nikolat et al., 2008)

Nutrient Accumulation in Mature Kaimana Lychee Fruits

<table>
<thead>
<tr>
<th>Lbs Per 100 Lbs Fresh Fruit</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>*grams</td>
<td>0.17</td>
<td>0.03</td>
<td>0.22</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>(77.1%)</td>
<td>(13.6%)</td>
<td>(98.8%)</td>
<td>(13.6%)</td>
<td>(16.7%)</td>
<td></td>
</tr>
</tbody>
</table>

(A. Nikolat et al., 2008)

Nutrient Accumulation in Kaimana Terminals & Panicles

<table>
<thead>
<tr>
<th>Grams nutrients accumulated per 20 terminals (0.96 lbs.)</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parawax 1</td>
<td>1.74</td>
<td>0.22</td>
<td>1.45</td>
<td>1.40</td>
<td>0.54</td>
</tr>
<tr>
<td>Parawax 2</td>
<td>2.23</td>
<td>0.64</td>
<td>1.76</td>
<td>1.78</td>
<td>0.68</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1.99</td>
<td>0.33</td>
<td>1.67</td>
<td>1.92</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Terminals consisted of all leaves, branch, and panicle materials above the fourth leaf.

Kaimana Fruit Growth

<table>
<thead>
<tr>
<th>Weeks after Anthesis</th>
<th>Dry wt.</th>
<th>Fresh wt.</th>
<th>Moisture content</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>3</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>4</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>0.00</td>
<td>0.00</td>
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</tr>
<tr>
<td>6</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>7</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>8</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>9</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>10</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>11</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>12</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>13</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>14</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>15</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

80
Summary

- Moisture during 6th to 12th week after flowering critical for good fruit development.
- Total soluble solids are high before fruits attain full maturity.
- Rapid accumulations of N & K occur in fruits during the 6th to 12th week of development and are associated with decreases in leaf N & K.
- Gradual increases in Ca & Mg concentrations in leaves parallel their accumulation in fruits during development.

Acknowledgments

- This research was supported through grants funded by the Hawaii Department of Agriculture (HDOA) and the Hawaii Farm Bureau Federation, and the USDA CSREES Special Research Grant: Agricultural Diversification: Tropical Specialty Fruit Research and Development.
- We gratefully acknowledge the support of the Hawaii Tropical Fruit Growers and farmers, P. Ito, J. Higaki and R. Hamilton.
Facilitating The Interstate Movement Of Hawaiian Tropical Fruits

United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine

Proposed Interstate Movement of the Following Fruits:

• Mangosteen *Garcinia mangostana*
• Dragon Fruit *Hylocereus and Selenicereus*
• Melon *Cucumis melo*
• Cowpea pods and its relatives *Vigna unguiculata*
• Breadfruit *Artocarpus altilis*
• Jackfruit *Artocarpus heterophyllus*
• Fresh Pods of *Moringa oleifera*

Proposed Treatment Measures

• Irradiate in an APHIS approved facility
  – Hawaii or mainland
  – monitored by an APHIS inspector
  – Certificate of Irradiation Certificate

• Irradiation at 400 minimum gray dose
  – OR
• Irradiation at 150 minimum gray dose subject to:
  – Treatment with broad spectrum insecticide, OR
  – Post harvest dip of warm soapy water and brushing, AND,
  – Pre harvest inspection of orchard for surface pests
  – Pre-departure inspection for external pests if fruit is to be treated on mainland at 150 gray

Proposed General Measures

• Commercial Shipments
• Packaged, labeled and safeguarded from re-infestation

Proposed Commodity Specific Mitigation Highlights:

• Cowpea- Cowpea must be treated at 400 Gray and inspected for the cassava red mite, *Oligonychus biharensis* and Lepidopteran adults/pupae
• Breadfruit and Jackfruit - must receive a post harvest fungicidal dip appropriate to *Phytophthora tropicalis*
• Melon - must be washed to remove soil.
Traditional Rulemaking In APHIS

- Many steps

Need Identified
Risk, environmental, and other analyses prepared as necessary
Work plan prepared, reviewed, and designated “not significant,” “significant,” or “economically significant” by the Office of Management and Budget (OMB)
Proposed rule drafted; all required analyses completed
Proposed rule reviewed by USDA attorneys and policy officials, plus OMB if “significant” or “economically significant”
Proposed rule published in the Federal Register with 60-day comment period
If an interim rule, effective prior to start of comment period
Comments arrive; Public hearings may be held

Issues raised by commenters are considered; decisions made about how to proceed
New work plan for final rule prepared, reviewed, and designated
Final rule published in the Federal Register
Final rule reviewed by USDA attorneys and policy officials, plus OMB if “significant” or “economically significant”
Final rule effective, usually 30 days after publication

Introducing The Proposed Notice Based Streamlined Process

Any one or combination of the following Designated Phytosanitary Measures:
- Approved existing post harvest treatment
- Pre-departure inspection
- Port of entry inspection
- Commercial Shipments
- Recognition of pest free areas based on ISPM Standard #4
Steps To The Notice Based Streamlined Process

- Interstate movement request submitted to CIAO
- Pest Risk Assessment (PRA) prepared
- Risk management measures identified in analysis
- One or more of the five designated phytosanitary measures identified?

Additional Steps In The Notice Based Streamlined Process

- PRA published and made available for 60 day comment
- Analysis of comments results in designated measures adequate to mitigate risks
  - No revisions required
  - Non substantive revisions
  - Substantive revisions required with designated measures adequate to mitigate risk

Additional Steps In The Notice Based Streamlined Process

- Federal Register notice published
- Commodities posted to searchable database
- Timeline? - Several months less than traditional rulemaking process

Comments Reveal Risk Analysis Problems?

- Substantive problems revealed
- Measures not appropriate to mitigate the risk
- Then - Rulemaking based process must begin.
- Typical timeline of traditional rulemaking process is 12 to 36 months

THANK YOU!
THE GROWING GAME

THE GOAL:
produce a crop that will give a good financial return

THE PLAYING FIELD is your orchard.

• The 'Virtues' of Foliar Feeding
My expertise in foliar nutrition began in the Early '70s while a Pest Control Advisor in the Imperial Valley of California working with crops such as Cotton, Lettuce, Melons and Citrus to mention only a few.
Tell the Shank Ranch story of increased cotton with foliar applications, increase of 1/3 bale of cotton which is 165 pound of cotton lint which at that time equaled an increase of approximately $60 per acre over the non treated 35 acre section.
I began working foliar nutrition on the Hawaiian Islands in 1999. I worked on Golf Turf, Guava Production, Vegetable Crops to mention a few. This trip is my 47th trip to Hawaii. Only two trips were for pleasure, the other 45 strictly nutritional work.

• Longan Fruit Production in Hilo, Hawaii
My experience with Longan Fruit began in 2005 with recommendations on Kauai. Longan fruit production using basic agronomic practices which I have used on the majority of crops which I advised on the Mainland. These recommendations follow basic usage of Major and Minor Elements applied in Southern California Avocado, Grape and Citrus Production. The success of the Longan applications in Kauai became apparent and word spread to the Big Island.

"Coco Nut connection."
I visited with Pete Kincaid and gave the longest sales call of my life. For 3 and 1/2 hours Pete and I visited on how to increase size and production of the Longan. I didn't even know how to spell L O N G A N, but similar to any fruiting tree crop, it requires basic agronomic skills.
Applications of Calcium and Boron during the fruiting cycle enhanced fruit set and adherence. Boron elongates the pollination tube and also stimulates the flower ovary to set more fruit and while Calcium strengthens the abscission layer to prevent pre mature fruit drop. Pete and I discussed his natural pruning practices, my suggestion was to foliar feed the crop to adhere more set fruit.

ASK YOURSELF, WHY PRUNE YOUR PROFITS IF BY PROPER NUTRITION THE CROP MAY BE INCREASED BY QUANTITY AND QUALITY?

SLIDE #1: NITROGEN
Nitrogen will make a pretty vegetative tree by stimulating growth. Excessive nitrogen applications during the flowering stage will tend to abort flowers and prevent fruit set.
Deficiency Symptoms of Nitrogen:
1. Plants are very slow growing, weak and stunted
2. Plants generally are light green to yellow in foliage color
3. Nitrogen deficient plants will mature earlier, yield and quality will be reduced

SLIDE #2: PHOSPHOROUS
Deficiency Symptoms
1. Slow growing, weak and stunted plants having a dark green color
2. Older leaves show purple pigmentation

SLIDE #3: POTASSIUM
The combination of Potassium and Copper will increase "color and sugar content" N, P AND K THE MAJOR ELEMENTS!
Deficiency Symptoms
1. Plants lodge easily and are sensitive to disease infestation
2. Fruit yield and quality will be reduced
3. Older leaves show marginal burn, known as scorch

Calcium Slide
Magnesium slide: late application for sugar development
1. Growing root tips and leaves turn brown and die
2. Leaves curl and leaf margins turn brown with newly emerging leaves sticking together at their margins, leaving expanded leaves shredded on their edges
3. Fruit quality is reduced: a) Blossom end rot, be) Internal decay, c) reproduction may be delayed or terminated, e) conductive tissue at the base of the plant will decay, resulting in reduction of water uptake and wilting.
Sulfur Slide

**Deficiency Symptoms**
1. Light yellow green coloration on younger leaves
2. Fruits are light green and lack succulence
3. Roots are longer than normal with stems becoming woody

Zinc Slide:
* Mention to make Zinc applications early in the season; heavy late season applications of zinc will delay sugar development

**Deficiency Symptoms**
1. Interverinal chlorosis of new leaves, producing a banded appearance
2. Increasing severity of deficiency, leaf and plant growth become stunted
3. Fruit and Nut trees, rosetting occurs with branch die back
4. Zinc deficiency symptoms cause 'little leaf' and shortened internodes area
5. in Grapes, zinc deficiency is contributed to 'shot berry'

Manganese Slide

**Deficiency Symptoms**
1. Reduced or stunted growth with divots with interveinal chlorosis on younger leaves
2. Cereals develop gray spots on their lower leaves (gray speck)
3. Legumes develop necrotic areas on their cotyledons (marsh spots)

Iron Slide

**Deficiency Symptoms**
1. Interverinal chlorosis on younger leaves
2. with severe deficiencies, chlorosis of older leaves occur

Copper Slide,
* Reintegrates combination with Potassium

**Deficiency Symptoms**
1. Reduced or stunted growth with distortion and necrosis of the apical meristem
2. May cause which tip or bleaching of younger leaves and summer die-back
3. Gumming of trunks on citrus trees

Boron:

**Deficiency Symptoms**
1. Abnormal growth of meristematic tissue
2. Apical growing points eventually become stunted and necrotic
3. Leaves and stems become brittle

THE LONGAN TEAM

**HEAD COACH:** Ken Gemmill

**Line Coaches are the Growers**

2007 to 2008 Season

Nitrogen is the Team’s Quarterback

- Promotes Vegetative Growth
- Protein Formation
- Chlorophyll Formation

Phosphorous is the Teams Center

Necessary in Longan Production for:
- Reproductive Growth
- Early Maturity and Fruit Quality
- Transportation of Sugars and Starches
**Potassium: The Team’s Half Back**

- Moisture uptake from soil and translocation in plants
- Starch and Protein synthesis
- Increases quality and shelf life of fruits and vegetables
- Important for cell growth
- Improves resistance to lodging, pest and disease

**Calcium: The Team’s Receiver**

- Calcium is involved in plant vigor & cell division
- Functions with Potassium and Magnesium as team players to benefit plant vigor
- Strengthens cell walls & increases fruit shelf life
- Importance of moisture and nutrient translocation

**Magnesium: The Team’s Full Back**

- Magnesium is essential part of chlorophyll molecule
- Aids in formation of Sugars, Oils and Fats

**Sulfur: The Team’s Lineman**

- Involved in protein synthesis
- Active in the structure and metabolism in plants
- Sulfur reduces the incidence of disease

**Zinc: The Team’s Running Back**

- Zinc is an auxin formulator (P.G.R)
- Necessary for protein synthesis and degradation
- Functions as a growth regulator

**Iron: The Team’s Guard**

- Essential for synthesis of chlorophyll
- Involved in respiratory enzyme system
- Involved in protein synthesis and root-tip meristem growth
- Iron is involved in Nitrogen fixation, photosynthesis and electron reduction reactions
Manganese: The Team’s Lineman

- Involved in oxidation and reduction process in photosynthesis of plants

Copper: The Team’s Guard

- Copper affect the formation and chemical composition of cell walls
- Involved in electron transportation and oxidation reactions
- Copper is part of enzymes that reduce both atoms and molecular O2

Boron: The Team’s Tight End

- Important in cell division, maturation and growth
- Associated with pollen germination and growth
- Improves the stability of pollen tubes

Tools of the Game

- TECH-FLO® products are chemically reacted, neutral, micronized powders formulated as flowable dispersions for use as nutritional sprays

Longon Tissue Analysis
Kurtistown, HI August 2, 2006

<table>
<thead>
<tr>
<th>Element</th>
<th>% Adequate</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>1.35-1.65</td>
<td>1.89</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.15-0.30</td>
<td>0.15</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.75-1.50</td>
<td>0.92</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.55-1.00</td>
<td>0.43</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.25-0.40</td>
<td>0.24</td>
</tr>
<tr>
<td>Sulfur</td>
<td>0.15-0.25</td>
<td>na.</td>
</tr>
<tr>
<td>Minor Elements</td>
<td>P.P.M.</td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>30-75</td>
<td>17</td>
</tr>
<tr>
<td>Manganese</td>
<td>45-100</td>
<td>24</td>
</tr>
<tr>
<td>Iron</td>
<td>60-120</td>
<td>33</td>
</tr>
<tr>
<td>Copper</td>
<td>10-50</td>
<td>14</td>
</tr>
<tr>
<td>Boron</td>
<td>30-80</td>
<td>49</td>
</tr>
</tbody>
</table>

Tools of the Game

- TECH-SPRAY™ products are liquid concentrates supplying plant nutrients in water-soluble form for use as nutritional sprays. They are designed to be used with TECH-FLO® flowable products but may also be used by themselves or in combination with other foliar nutrients
**Tools of the Game**

- Tec Gro products are soluble high analysis powders designed to correct crop nutrient deficiencies
- Tech Gro B-17
- Tech Gro Mira Cal
- Tech Gro Alpha df

**The First Play of the Game**

- First prior to Potassium Chlorate over new flush growth.
- 4 qt. Tech Flo Cal Bor
- 2 qt. Tech Spray Hi-K
- 1 qt. Tech Spray ZnPK (to adjust pH of spray solution to 5.0 to 5.5)
- Per 100 gallons of spray solution
- Repeat application in 3 weeks

**Quarter Back Sneak**

- Sizing applications may be made 3 weeks after treatment #3 on 3 week intervals:
  - 2 qt. Tech Flo Copo Cal
  - 2 qt. Tech Flo Gamma
  - 2 qt. Tech Spray Hi-K
  - 1 pt. Tech Spray ZnPK / 100 gal as buffering agent

**Sizing Stage of Growth**

**Finishing Application Stage**

**The Game Winner is You**
Other Tropical Crops

The End

• SpecialThanks to the Longan Growers of Hawaii
• Special Help from B.E.I. Hawaii
• If you require ANYTHING: Please visit
  Nutrient Technologies Web:
  TECHFLO.COM
• Call Ken Gemmill: Office: 760-741-3797
• Cellular: 760-212-0309
Presentation to
McClure & Tjerandsen
September 29, 2007

Leading Retail Grocery Chains

**Worldwide**
- Wal-Mart - USA
- Carrefour - France
- Metro Group - Germany
- Tesco - UK
- Seven & i - Japan
- Ahold - Netherlands
- Kroger - USA
- Costco - USA

**North America**
- Wal-Mart
- Kroger
- SuperValu
- Safeway
- Ahold
- Publix
- Delhaize
- H.E. Butt
- Winn-Dixie
- Meijer

Market Share Forecast

<table>
<thead>
<tr>
<th>Grocery &amp; Consumables</th>
<th>2007</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dollar Share</td>
<td>Number of Shares</td>
<td>Annual Sales (Dollar)</td>
</tr>
<tr>
<td>Total Traditional Grocery</td>
<td>46.9%</td>
<td>66,000</td>
</tr>
<tr>
<td>Packaged Grocery</td>
<td>44.1%</td>
<td>27,100</td>
</tr>
<tr>
<td>Fresh Fruit &amp; Produce</td>
<td>8.8%</td>
<td>21,000</td>
</tr>
<tr>
<td>Dairy &amp; Frozen</td>
<td>2.3%</td>
<td>5,000</td>
</tr>
<tr>
<td>Super warehouse</td>
<td>1.7%</td>
<td>1,000</td>
</tr>
<tr>
<td>Deli &amp; Small Grocery</td>
<td>1.3%</td>
<td>8,000</td>
</tr>
<tr>
<td>Total C-Sales</td>
<td>15.3%</td>
<td>988,000</td>
</tr>
<tr>
<td>Convenience (on-site)</td>
<td>15.3%</td>
<td>988,000</td>
</tr>
<tr>
<td>Convenience (off-site)</td>
<td>2.4%</td>
<td>25,000</td>
</tr>
<tr>
<td>Total Non-traditional Grocery</td>
<td>20.5%</td>
<td>398,000</td>
</tr>
<tr>
<td>Convenience</td>
<td>14.8%</td>
<td>2,000</td>
</tr>
<tr>
<td>Dairy &amp; Frozen</td>
<td>1.7%</td>
<td>1,000</td>
</tr>
<tr>
<td>犹如</td>
<td>0.02%</td>
<td>50,000</td>
</tr>
<tr>
<td>Total Dollar Share</td>
<td>52.5%</td>
<td>1,000,000</td>
</tr>
</tbody>
</table>

*Does not include grocery sales. Source: Progressive Grocer Magazine

Expected Compound Annual Sales Growth vs. Inflation 2006-2011

How $100 is spent in supermarkets

- Grocery: 39%
- Produce: 10%
- Health & Beauty Aids: 5%
- Pharmacy: 4%
- Dairy: 9%
- Meat: 13%
- General Merchandise: 20%

Source: Progressive Grocer Magazine

Produce accounts for 10% of North American retail store sales

... and 17% of the store's profit.

Source: Progressive Grocer Magazine
Where is that growth coming from?

Consensus suggests much of that growth will come from tropicals.

Where will growth in produce appear?

It’s partially driven by anticipated population shifts.

To continue growing, what do retailers say they need?

• Consistent supply
• Consistent quality
• Competitive pricing

What could we be doing to increase our business?

• Trade Direct Mail
• “Day At The Market” Presentation
• Partial Sponsorship of FPFC Luncheon
• Press Release to Food Editors
• Retail Information Leaflets/Photos for Ads
• Food Editor (s) to Hawaii (e.g. Sunset, Catering)
• PMA Fresh Summit/PMA Foodservice
• Make Web Site User Friendly
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- Make Web Site User Friendly
Recommended Next Steps:

- Assess and confirm areas of marketing opportunity.
- Prepare market development plan.
- Assure funding for plan.
- Field plan and monitor results.

Mahalo!

McClure & Tjerandsen
September 29, 2007