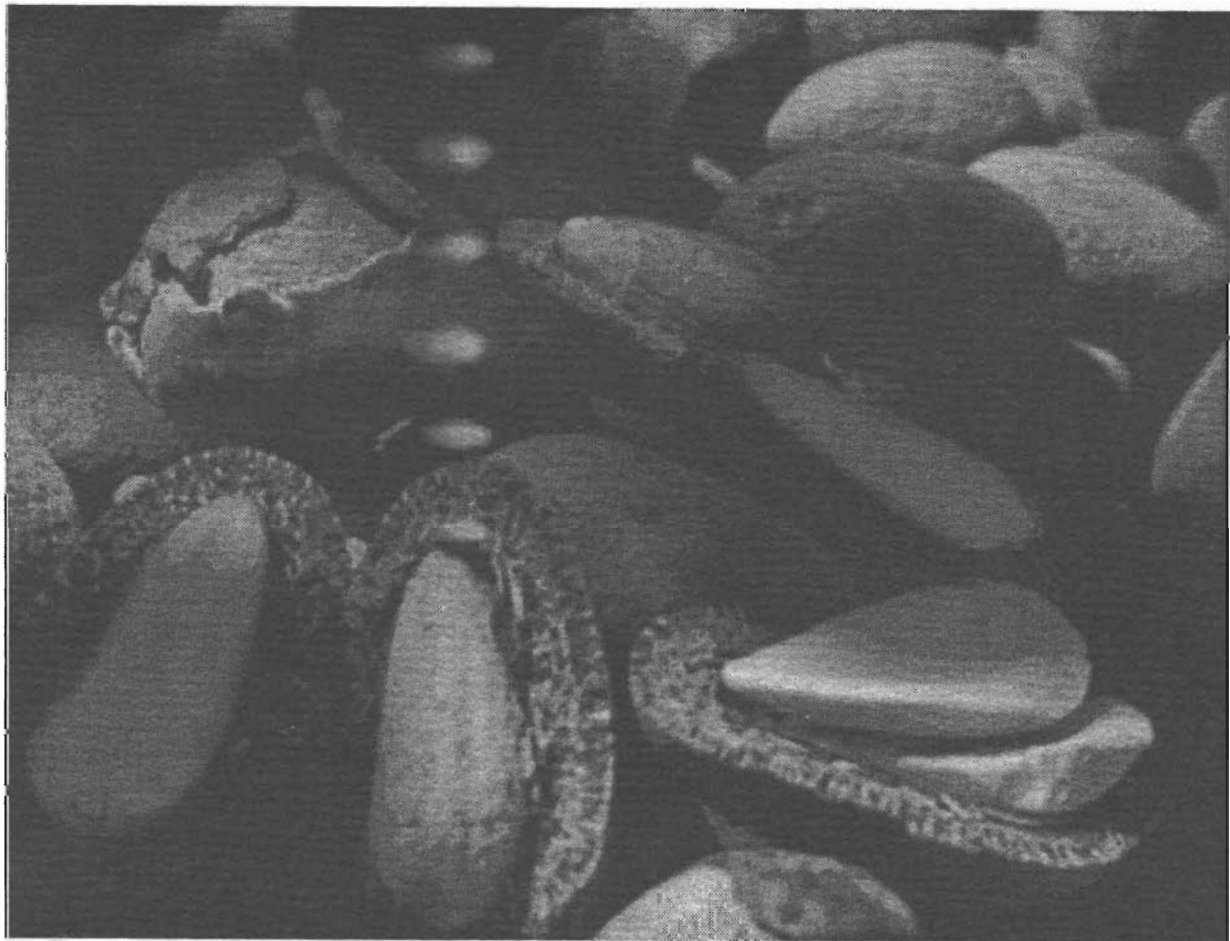


PROCEEDINGS:
3rd ANNUAL
HAWAII TROPICAL FRUIT GROWERS
CONFERENCE

October 22 – 24, 1993
Hawaii Naniloa Hotel
Hilo, Hawaii



Proceedings:
Hawaii Tropical Fruit Growers
Third Annual Conference

October 22–24, 1993
Hawaii Naniloa Hotel, Hilo, Hawaii

PREFACE

Marketing and promotion of tropical speciality fruits was a major focus of the conference. A panel presented perspectives on marketing from a state agency, a grower, and a restaurateur. The presentation on the Australian experiences in marketing tropical fruits was also informative and potentially useful for Hawaii growers, who will be faced with related situations and issues when their orchards come into production.

The hosts at the three field trip orchard sites should be commended for their open and frank comments, as well as for their unselfish sharing of information on cultural practices for tropical fruits.

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Cover: The pendula nut (*Couepia longipendula*) is an undomesticated tree of the Amazon. At present it is harvested as a subsistence food, but it has potential for development into a commercial horticultural crop. Photo courtesy of Charles Clement; see p. 23–28.

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Third Annual International Tropical Fruit Conference

October 22, 23 and 24, 1993
Nanihoa Hotel, Hilo, Hawaii

PROGRAM

*Sponsored by the Hawaii Tropical Fruit Growers and the
University of Hawaii College of Tropical Agriculture and Human Resources*

FRIDAY, OCTOBER 22, 1993

5:00 - 5:30 pm	Registration
5:00 - 6:00	No host cocktails
6:00 - 7:00	Roger Goebel, "Overview of Australia Commercial Fruit Industry"
7:00 - 8:00	Charles Clement, "The Domestication and Commercial Utilization of Tropical Amazonian Fruit"

CONFERENCE AND ANNUAL MEETING

SATURDAY, OCTOBER 23, 1993

7:45 - 8:45 am	Registration
8:45 - 9:00	Opening Remarks, Eric Weinert, HTFG President
9:00 - 9:15	Welcome from Mayor's Office
9:15 - 10:00	Roger Goebel, "Cultural Practices of Rambutan, Durian, Mangosteen"
10:00 - 10:20	BREAK
10:20 - 11:15	Roger Goebel, "Cultural Practices of Longan and Lychee"
11:15 - 12:00	Mike Strong, "Cultural Practices of Atemoya and Its Market Development"
12:00 - 1:00 pm	LUNCH
1:15 - 1:30	Eric Weinert, "Hawaii Agricultural Promotional Association"

Conference and Annual Meeting - cont.

1:30 - 2:15	Roger Goebel, "Marketing Tropical Fruits in Australia"
2:15 - 3:15	Marketing Panel, Masa Hanaoka, DOA Morton Basson, Kau Gold Oranges Sam Hugh, Ham Produce Peter Merriman, Hawaii Regional Cuisine
3:15 - 4:00	BREAK, Fruit Tasting
4:00 - 4:30	Annual Meeting
6:00 - 7:00	No host Cocktails
7:00 -	Banquet and Auction

FIELD TRIP

SUNDAY, OCTOBER 24, 1993

8:00 am	Bus leaves Hawaii Nanihoa Hotel
8:30	Les Barclay, Onomea Mixed Tropical Fruit Orchard featuring rambutan, mangosteen and abiu
10:30	Brian Paxton, Hakalau Tropical Fruit Farm and Nursery
12:30 pm	LUNCH - Kole Kole Park
1:45	Liloa Willard, Papaikou Tropical Fruit Farm
3:15	Bus returns to Hawaii Nanihoa Hotel

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Welcome Addresses

Leslie Hill

President, East Hawaii Chapter, Hawaii Tropical Fruit Growers

Welcome. I would like to acknowledge that the Hawaii Tropical Fruit Growers are presenting this conference in conjunction with the College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa. We have participation from a number of our government's officials today, and I would like to introduce some of them before we begin. Yuki Kitagawa is head of the Hawaii Department of Agriculture; Marshall Ige is chair

of the House agriculture committee; Dennis Shimamoto is newly appointed to the Governor's Agriculture Coordinating Committee; Po-Yung Lai is head of Hawaii Cooperative Extension Service; and Jack Fujii is head of the College of Agriculture, University of Hawaii at Hilo. I would like to thank you all for your support of our industry.

Eric Weinert

President, Hawaii Tropical Fruit Growers

A lot of people think that agriculture is dead. Sugar companies are closing along the Hamakua Coast and on Oahu. Today we have state officials and growers here who are looking at tropical fruits as alternatives in crop diversification. I am very optimistic about the future of agriculture in Hawaii, and especially tropical fruits. In terms of diversity, this fruit group represents over 100 crops that are possible for our islands.

As a nursery person, the question I get asked most is, "What should I grow?" That is up to you, and I am glad that you are at this conference. The more information you have, the better equipped you will be to answer that question. My opinion is that we need to diversify. We need to diversify the state's agricultural industries, and I think you should be diversifying on your own farms, and not "put all your eggs in one basket." There are many opportunities, and some good tasting fruits.

I hope you will join the Hawaii Tropical Fruit Growers. This is our third annual conference, and this series has been possible through good support by the Hilo chapter of HTFG. The Hawaii Agricultural Commodities Service acts as executive director for HTFG and publishes an excellent newsletter that includes coverage of HTFG activities and concerns. We encourage you to support the newsletter with your advertising.

Previous state-funded research done for our industry by the University of Hawaii has been on pesticides for lychee, by Dr. Vince Jones, and postharvest studies on rambutan and carambola, by Dr. Bob Paull. The USDA Agricultural Research Service has announced that pending

publication in the Federal Register, carambola (starfruit) can be exported to the U. S. mainland after a 12-day cold treatment. A similar treatment for lychee is expected soon. These are big breakthroughs to a huge new market. Also with state assistance, HTFG has completed a marketing plan, written by Gloria Wong, and some excellent color brochures to show the seasonality of our fruits.

In the future, I expect we will see less state funding, and we will have to rely more upon ourselves. Following the pattern that has developed in such places as Australia and Florida, future research will be funded or partially funded by our group. We need to band together as growers and carefully select priorities for future research. This is an important reason to join and support your grower groups.

One key thing that HTFG has been pushing for is overflights. These would overfly pest-sensitive areas and allow us to ship into the northern U. S. mainland cities in the winter months. This would allow us to avoid treating the fruits and fly them directly into Chicago and other cities. We need these export markets, even to support local prices.

Unlike those who want to capture a little segment of the market and are reluctant to share information, HTFG is very open to sharing information and is dedicated to making the "pie" bigger. Many fruits have excellent potential. We need to grow quality products and market them cohesively. The consumers will buy, but it is up to us.

Honorable Stephen Yamashiro
Mayor, Hawaii County

If you look around the room and at the people next to you, you will see that agriculture is a very important part of our county's economic future. It will be with us and become more and more important as we progress into the future. This has a caveat: it will not be the large-scale industrial agriculture that we have known in the past. More and more, we will have smaller, more diversified, entrepreneurial farms. We have to consider our strengths and limitations and assess the challenges in developing and marketing agricultural commodities.

Our papaya industry is an example of a commodity that has depended on fresh fruit sales and has not gone into developing byproducts. In the Portland airport I saw dried papaya spears on sale at a good price, but we are not doing that here. I think that in the past we did not have the energy resources; the cost of energy was so high that we could not devote the resources to developing these other types of product, and it was essentially a third-world economy that we were working in. Now that we have the alternatives and possibilities of using solar, geothermal, and other natural energy resources available because of developments and changes in technology that allow these resources to be better utilized, we may have the opportunity to diversify our fruit industry and make these other products.

We have to realize that the success of these other products will depend on the perception of quality of the fresh fruits that are sold out of this community. If we let the names like Puna papaya and Kona coffee, and other products that have been identified with quality, slip, and we don't maintain that quality, we could produce all the other byproducts and they will not be successful. If we maintain the quality of the fresh product, then we will be able to develop other products which I think will eventually be the basis of our industry.

When I travel I like to go through some of the markets. I see tremendous diversification in offerings of fruits and tropical products. Sadly, few of those products are coming from Hawaii. Consider the capabilities we have, especially on this island, for growing these products, the climatic zones, the growing conditions. But the products are not there because we have not been able to

address the pest infestation problems, real or perceived.

Our challenge is to develop these products in a quality manner. Your challenge is not only how to grow them. Our University has done well in developing products that we can grow. A shortcoming is development of the means of marketing products, and of new products that can be marketed. There is no use to be able to grow, even to grow well, if we cannot sell the products, get them to market, get them off the island.

In an agricultural industry which is traditionally very labor-intensive, be it a sugar plantation or a fruit orchard, one big challenge is how to address the need for labor. I don't know if anyone has the answer. We have discussed this, and looking at our community we see a tremendously underutilized labor force that is already being paid by government: our people on public assistance. I wonder if we could discuss whether or not we could have a requirement, such as President Clinton's talk about "workfare" as opposed to "welfare," for allowing our farmers to pay these people at the minimum wage, or lower. When you figure that their medical and other benefits are being picked up by the government already, this would allow this labor force to be put to productive use without saddling the agricultural community with the burden of all the expenses for non-cash labor requirements.

The products that we are going to try to market in competition with nations and states are going to have to be those that we can get to market in an economically reasonable fashion. When we face the fact that a decision on the North American Free Trade Act is coming up, it is likely we will be competing with areas having much lower labor costs than we have. But given the niche markets I think we can carve out, we can all be successful. It is only by sharing information in conferences like this and working together, that we in our pocket market, our pocket production area, are going to be able to be successful over the long term.

I congratulate all of you on being here. I wish you well and hope you have a successful conference.

Overview of Australia's Commercial Fruit Industry

Roger Goebel

District Inspector, Department of Primary Industries, Queensland, Australia

What my wife, Guilia, and I have seen so far here in Hawaii looks somewhat familiar. We come from Innisfail, about an hour south of Cairns in the northern part of Queensland. It's the greenest part of Australia, with the highest annual rainfall, which falls in a four- to six-month period, often in very heavy downpours. This wet season is followed by a couple of months of dry, fine weather, during which the sugarcane growers harvest their crop. We have a 30-acre farm (Etty Bay Exotics) that was part of a sugarcane farm seven years ago. The soil is extremely sandy; in fact, it is beach sand. Our main fruit trees are about 350 rambutan trees ranging from three to six years old. We also have about 200 longan trees and are putting in a few more. There is an acre of papaya consisting mostly of 'Sunrise' solo and 'Exotica', with a few of the common Innisfail yellow as well. We have a range of other fruits, timber trees, and tropical vegetables. The timber trees are quite important in terms of environmental care, to rehabilitate formerly forested areas that were cleared for sugarcane. They reduce wind and soil erosion. Large areas of North Queensland have gone to World Heritage. Much of that area is in timber, and as a result of that timber now being available, the value of timber has doubled and continues to increase, and many people are planting high-quality timber trees.

My employment is with the Department of Primary Industries, a state department that has extension, regulatory, and research operations. Lately we have had a major Black Sigatoka outbreak 300 km north of us, and our staff has been up there counting banana plants and talking to growers. Even though I am a regulatory officer, because of my interest in tropical fruit trees, and staff turnover, I have become the second most experienced horticultural person in our Department for Queensland's wet tropical areas.

My area runs from the Papua New Guinea coastline through the Torres Strait down the never-never of Cape York through the populated area to about Sarina, which is just north of the Tropic of Capricorn. It is about 1000 miles of coastline that I travel quite regularly (Figure 1). We have a massive network of growers; I belong to the Rare Fruit Council, the Rambutan and Other

Tropical Fruits Growers Association, the Innisfail Banana Growers, and the Innisfail Pawpaw Growers. This kind of network is what you need to get information. People are coming across new ideas everywhere, and without a suitable network and newsletters to record the information, and farm visits to actually see it, you are isolated.

There are tropical horticultural crops growing in a number of areas of Australia (Figure 2). Some of these areas are quite isolated from each other.

In Western Australia, Carnarvon is a tropical fruit growing area. The Ord area, also in Western Australia, is a massive potential growing area, but humidity is very low in the dry season. The Darwin and Katherine areas produce a lot of tropical fruits. Their rambutan season is a six-week season in the middle of summer, which comes in just before ours and right when our lychees do.

On the Queensland coast, we can divide our horticulture into three groups: equatorial, which is what I would consider for mangosteen, durian, rambutan; the dry tropics, which is appropriate for mangos and cucurbit crops; and subtropical-to-temperate, such as at Stanthorpe, where we have a major apple industry.

Above the Green Coast we get into the Tablelands, dry tropics ranging into subtropical-temperate, where avocados and low-chill peaches and nectarines are grown. A lot of pineapples are grown around Nambour. Bundaberg is a major tomato and small crops area. Rockhampton is a major pineapple area, but is getting into mangos, lychees, longans, and others. Around Mackay is one of the big sugar belts. The Bowen area is extremely dry; the 'Bowen' mango, commonly called 'Kensington', originated there. The Bowen-Townsville area has extensive mango orchards. Beyond that, we get into a very wet area, from Tully up to Mossman. Two-thirds of the Australian banana industry is concentrated between Tully and Babinda. That's one reason we're terrified of cyclones; if one crosses the coast here, Australia is almost out of bananas. The other major banana growing areas are down around Nambour and northern New South Wales, but they have been stagnant for a long while. In contrast, the North Queensland banana industry has grown at 15 percent per year for the last eight to ten years.

Australia does not export significant amounts of bananas and there's a total quarantine ban on imports.

The bulk of the population of Queensland is concentrated around the cities. Many of the outlying areas are very isolated, with miles and miles with only scattered population. It's said that Australia is a continent of coastal dwellers, and that's not too far wrong. The population of Australia is about 18 million.

Australian agriculture is often based on what is the easiest thing that brings in the most money. In our tropical areas, that has been sugarcane. It is drought- and cyclone-proof. Its management is rapidly changing, as the amount of sugarcane that's being burned now has been reduced to about 20 percent of the total crop.

The Department of Primary Industries has a long and proud history of involvement with Queensland agriculture. Up until the last few years we had the Queensland Agricultural Journal; we had Extension Officers who went around to visit farms. Nowadays we have Extension Officers who will address groups of growers, but unless you have an organization you don't stand much chance of getting information out of the Extension Officers. We had a research station in Cairns called Kamerunga. About a third of our really experienced staff have left during the last few years. The research station itself has been sold, and they are trying to transfer the research projects to another one, called South Johnstone, near our place in Innisfail. In the past, the researchers were all funded by the state government; they worked on whatever crops they thought were going to be interesting. Now you work on the crops that the growers are prepared to fund you to work on. So bananas and other crops with large incomes will get worked on, and a lot of the lesser crops will be put on the shelf.

Banana, tomato, and pineapple are our big three horticultural crops. The North Queensland banana industry produces about 10 million 13-kilo cartons worth about 140 million Australian dollars (\$ M), the whole Queensland banana industry is worth just under \$200M, and the whole Australian banana industry is worth about \$220M. The mango industry is about \$48M and increasing rapidly. Avocado is about \$5M, increasing slowly. The rockmelon industry is about \$30M, with some new varieties coming in for export, which may give it a boost. Papaya is worth around \$7M; most of the papayas grown are large, round, yellow-fleshed fruits weighing up to 2 kilos. Pineapple and tomato

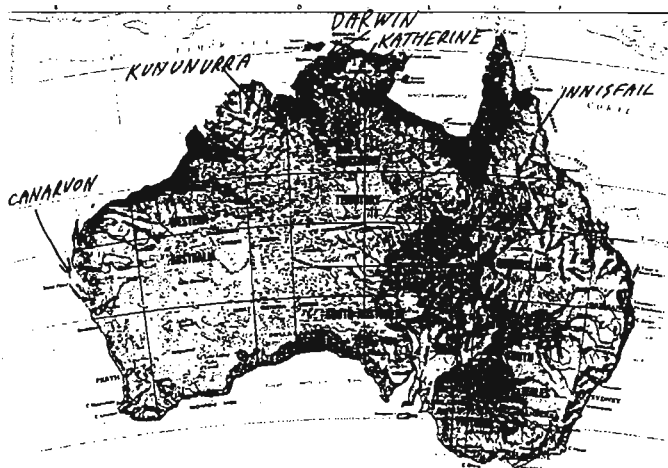


Figure 2. Australia's tropical fruit growing areas.

are each around \$150M. Passion fruit is about \$4.5M.

Banana

Most of the bananas grown are Cavendish type, a selection called 'Williams'. The use of bunch covers, detrashing, and desuckering makes it a labor-intensive industry. Kept in lines, we leave them in for three or four years and then the whole lot is wiped out, fallowed for a couple months to a year, and then replanted. It is a very intensive industry. North Queensland has about 450 banana farms, ranging from a couple acres to 500 acres.

Mango

The main commercial variety of mango is the 'Kensington' (often called 'Bowen' mango). No one really knows where our 'Kensington' mango came from. It's a fairly large mango. The main production time is mid-summer. We have worked on a lot of other mango types, trying to extend the range of mangos. A cross between 'Kent' and 'Kensington' called R2-E2 is a massive, 2-kg fruit. The tree is very vigorous and is good for windbreaks. 'Palmer', 'Keitt', 'Brooks', and 'Kensington' are the four top commercial mangos. If you've eaten those mangos you may have noticed that they're all similar: not highly turpentine flavored, relatively fibreless, and reasonably well colored. 'Keo Savoy' and 'Nam Doc Mai' have been planted in small amounts for green fruit for our Asian market. 'Nam Doc Mai' is my favorite mango; we are told that we have some of the best

selections of it. It doesn't color up very much; it's long and thin, nearly all pulp, almost completely fibreless, with a very thin seed. Unfortunately, in our area it splits a lot if you try to get it to full maturity. If the black beetle or something else comes along to wipe out the flowers, 'Nam Doc Mai' will pick itself up again and reflower. It may be possible to get it to bear most of the year round if we work at it.

Custard Apple

A large custard apple industry is located in Nambour, Rockhampton, Bowen, and Mareeba. Queensland custard apples are allowed into Western Australia, which is our most difficult state to get produce into. They are extremely reluctant to take anything because of fruit fly and other reasons. Our department officers came up with a quality assurance program for custard apples, which has allowed our fruit to go in.

Rollinia

We grow some rollinia, *Rollinia deliciosa* and *R. mucosa*, and it makes an interesting display at fruit stalls, but it is very difficult to packet and market.

Soursop

We grow soursop, which may be of increasing value for fruit drinks for our tourist industry. Soursop fruits inside the canopy, and we use a lot of it in our windbreaks. Our windbreaks are more for environmental maintenance than actual windbreaks. If we get a cyclone, trees are going to go anyway, but if the prevailing 25-knot southeast wind can be slowed down to a 5-knot wind, then the fruit trees get a tremendous advantage. So we use a lot of dual-purpose trees in our windbreaks, such as soursop, jackfruit, and timber trees.

Carambola

One fellow has put a lot of effort into carambola, training them up posts and along wires. He can put mesh on top of these trellises when he is convinced that the crop is going to pay enough. Carambolas have no end of pest problems: fruit fly, black beetle, mites, fruit-sucking moth, and birds. Probably the best way to grow carambolas in Queensland would be to completely enclose them in 15-20 percent shade to keep most of the pests out. 'Fwang Tung' is quite popular, possibly because of its big size, although it is a terrible thing to try to pack. It can be eaten green, like a 'Granny Smith' apple, or ripe. 'Arkin' is probably

becoming the lead variety lately, although some of the Florida types, '11-1' and 'Kembangan', are getting looked at very closely.

Abiu

Abiu has been selected by one of our growers, resulting in two leading cultivars known as the "zed" types, 'Z-3' and 'Z-4'.

Durian

There have been some big mess-ups in durian introductions, and two of our growers have taken it upon themselves to tidy up the situation and turn the durian into an Australian industry.

Salak

Near our farm are orchards producing some salak palm fruit. Anyone who has eaten a good one will say they're fantastic. Sour varieties are used for cooking. The 'Bali' salak is a sweet one.

Mamey Sapote

A lot of Mamey sapote has been planted from seedlings. The future for this fruit may be in the pulp. One fellow has done well selling frozen pulp in punnets to the restaurants.

Jaboticaba

Jaboticaba is a new crop for marketing. It is a lovely fruit picked fresh off the tree, but it loses its unique flavor quite quickly and turns into something like a sweet grape.

Sapodilla

Sapodilla came in very big and went out quickly. People who have held onto them and kept the best varieties and are doing well with them. Our Filipino population values them highly. In Central Queensland the sapodilla trees got big cankers on the trunks and would not grow. Some people didn't manage their orchards and wound up breeding a lot of fruit flies. Those that stuck with sapodillas, put on a good spray program, and learned how to harvest at the right maturity have done well.

Jackfruit

Jackfruits are mostly summer-fruiting. The price in summer drops down to about \$1/kilo, but it goes up to about \$3/kilo for the rest of the year. The majority are marketed half-green for curries to the Indian restaurants in Sydney. Most jackfruit trees were planted in windbreaks, so there are a lot of fruiting trees around.

Inga edulis

Inga edulis, the ice-cream bean, has been planted as a novelty tree. It is interesting from an environmental view, providing shade and a lot of mulch material. The beans sell for about \$1 each in the flea markets, and they can't get enough of them.

Pitaya

Pitayas are sometimes grown on structures built from old railway sleepers, but the wood often has been saturated with herbicide over the years, so that's not such a good idea. The best pitaya plantings I've seen have been growing over large old stumps. Most people try to create a fence-style structure. The pitaya wants to grow everywhere, like an octopus. It has to be trained so you can get in and pick the fruit. They are very shy bearers; they like good soil; they can handle drought but they respond to regular watering; they don't bear well under conditions of neglect; they have a lot of soft-rot problems, possibly due to winds causing the plants to injure themselves. Nobody grows large amounts of pitaya. Earlier this year, Chiquita put out word among growers that they would take as much pitaya as they can get. Someone in the hierarchy tasted it, thought it fantastic, saw it had excellent shelf life, and reckoned it's a real go. So we'll have a big pitaya flood in the next five years. The red pitaya has good flavor, somewhat like a raspberry jam, and it doesn't have any prickles on the fruit at all. The yellow one has large prickles, which drop off very easily, but someone has to rub them off. The red and the yellow are very different fruits, as different as apples and pears.

Cashew

There's a big leaning towards cashews, which have been grown up in the far areas of Weipa and Bamaga for a long time. Some of the big companies are putting in square miles of cashew orchards in Darwin and Mareeba. They're using only the nut, sending them over to India and Brazil for processing and getting them back as processed nuts. The industry is only in its infancy.

Pummelo

Some pummelos we consider "show" pummelos, because they're very large with only a small edible portion. Among the eating pummelos, we have 'K-13', a heavy, sweet, juicy, thin-skinned fruit which was obtained from seedlings from Thailand. 'K-13' lacks the deep red color of some pummelos but has a shelf life of many months.

Casimiroa

Casimiroa was another industry that sort of came and went. There still are some people producing them, and there's a lot of demand, but there are problems with the trees bending and breaking, the fruit getting picked too early, and fruit fly. The first big shipment of casimiroa that went to the markets got sold as 'Granny Smith' cooking apples, and nobody came back and bought them again. The main variety is 'Reinecke Commercial'; others are 'Blumenthal' (which has been called 'Bowen Supreme'), 'Candy', 'Yellow', and 'Vernon'. 'Vernon' is a major pollinator type; anyone who has had anything to do with white sapotes has probably found that you need to plant pollinator trees every six or eight trees, or graft pollinator branches onto the trees.

Star Apple

Star apples appear to be an industry with a future. 'Haitian' is the main cultivar. Fruiting season is mid to late winter, when virtually nothing else is bearing among the tropical tree fruits. It can grow on wetter soils that you might not grow a lot of the other crops on. The trees are very attractive; they come into bearing in about four years if grafted or grown from cuttings, but seedlings can take more than seven years.

Marang

Marangs are popular with our large Filipino community. Those who have succeeded in growing marangs and picking them at the right time get a good price for them.

Champedak

Champedaks are tops in flavor, for those who can handle the smell of them.

Black Sapote

Black sapotes fetched a small fortune this year and last, marketed as "chocolate pudding fruits" or "black persimmons." Often, people who buy them don't know what to do with them, so they need to be sold with promotional leaflets that say, "Wait until they get soft, scoop out all the gooey stuff, put cream on it, lace it with rum, and it's fantastic."

Wax Jambu

Wax jambu is another crop being grown for our restaurants and hotels for displays. Throughout the Torres Straits the kids eat this fruit. As a commercial crop they make a nice

addition to a fruit basket, but they are not much on their own.

Canistel

Canistel is very enjoyable in milk shakes and may have been underrated as a product so far. They have a high nutritional value, which is useful these days when trying to promote a product.

Araca

One of the more unusual fruits is the 'Araca'; it makes a juice that goes well in our tropical climate where we want to drink a lot of liquids. One of these mixed with a couple cups of sugar and a couple gallons of water makes a pleasant tasting chilled drink. It is a good basis for fruit drinks.

Macadamia

What you call the macadamia nut we call the Queensland nut. When I was a kid we used to climb the trees and eat these. We've had to come to Hawaii to get our best varieties, though.

Davidson Plum

One of our jungle plants is the Davidson plum, with a prickly fruit a bit smaller than a tennis ball, which makes an excellent port or red wine. The Native Plants Association serves this regularly at their events, which helps to keep up the members' interest. It isn't grown commercially but is harvested from the wild. This is an example of how we can go all over the world looking for interesting stuff and neglect things in our own back yard.

Herbert River Cherry

The Herbert River cherry grows all through Cape York. It is a lovely ornamental tree with a pleasant tasting fruit. There is probably a lot of scope for selection, but there has been none to date.

Burdekin Plum

The Burdekin plum grows in our arid areas. When left to dry out, the hard seed inside is surrounded by a prune-like flesh. There is a lot of genetic diversity in this plant also.

Candle Nut

Candle nut is one of our tropical nut trees, used by the Aborigines. It is an almond-flavored nut with a fairly high oil content. The shell is very hard, and they can lie on the ground for a long time without anything getting in to eat them.

Native Banana

Our native banana is a seeded type that grows everywhere and looks nice but is too full of seeds to be edible.

I have left out discussion of our major tropical fruit crops, which I will deal with in my other talk.



Q: Regarding mango juices and other value-added mango products, are growers getting a good return for mango products other than fresh fruit?

A: Yes. They get value by getting rid of their fruits that are less than premium grade. However, they are only selling the second grade fruit at about production cost, but they do so eagerly.

Q: Do you export any of these fruits?

A: Yes; it is quite surprising to read the export figures and range of crops exported. Our federal government tells us what a fantastic idea it is to export, and they charge us about \$147 an hour to have an inspector look over our shoulders.

Q: What fruit flies do you have in Australia?

A: The Queensland fruit fly is the eastern seaboard problem. The Mediterranean fruit fly is in Darwin in Western Australia. The oriental fruit fly is confined to a couple of islands around Papua New Guinea and is a recent problem there. Fruit fly is not considered a serious problem in Australia because we have the spraying techniques and management techniques to control it, but it is a serious problem for organic growers. Other fruit flies include the melon and mango fruit flies. A comprehensive book is available from our Department of Primary Industries.

Cultural Practices of Rambutan, Durian, Mangosteen, Lychee, and Longan in Australia

Roger Goebel

District Inspector, Department of Primary Industries, Queensland, Australia

I brought some of our publications over, although some of them are already here. We have a range of publications, such as *Rambutan Culture in North Queensland*, that I will try to get into your library. A lot of people have helped us over in Queensland with publications and exchange of information. I think that is the way to go. We will be continuing to swap publications, but keep in mind that a lot of the practical experience is way ahead of the publications. By the time it is experienced, understood, and published, it has usually changed again, particularly with varieties, so that is a problem we all have to deal with.

Rambutan

Rambutan is my main interest and my main practical-experience crop. It is a very specific crop in Australian climates. It is so specific that Australia was virtually laughed at by people in some Asian countries when we were trying to plant rambutans.

Figure 1 shows the rambutan growing areas of Queensland. This area is the wet tropical coast, above Townsville. Above Mossman, there are extremely difficult transport problems, and although there are some microclimates up there that are really good, what do you do if you grow the thing and you cannot get it off the farm? The main association that represents rambutan growing in Australia works out of Innisfail, so that is the center of rambutan culture for climatic reasons and educational reasons. The natural forest area shown in Figure 1 is natural scrub, it has not been cleared, it's mountainous country. Only certain areas are suitable for crops, and those areas have to be shared with sugar cane and many other crops. The land that is available for rambutans is only a fraction of that area, so we have a lot of constraints on expansion.

Rambutan is not a new crop to Queensland. It has been around for 50 or more years. The earliest introductions that I could trace back were by Ernie Stevens in the early 1930's from Papua New Guinea. The 'Stevens' variety is a very small fruit, relatively sour, with clingstone, and that is why it did not take off as crop but was just a few

backyard trees around the Cairns area. Since then, groups of people including the Scomazzons, Bosworths, Exotic Groves, and DPI went overseas and got collections from everywhere they possibly could, put these collections in selection trials, and up came a group of varieties or selections that we found quite suitable (Table 1). Even within this group, it was found that some do better on some farms than on others. So one thing that I am going to stress is that a lot of these crops are very specific. Because your neighbor is growing it on one side of a fence or one side of a hill or one side of a creek does not mean that you are going to be able to do exactly the same on your block. Lychees have probably shown this the most, but we are starting to see it in the other crops too, particularly in the fruiting behavior of the rambutans.

Some of you talk about being six to seven years behind us, but I think you are on a par with us in a lot of areas. You have the ability to look at people's mistakes and short circuit them, and that means that you have a very short set of steps to climb up to get to the same level as we are, and you are doing it very quickly, so don't put yourselves down. Our sources of plants were Exotic Groves in Innisfail, Limberlost in Cairns, and Rosebud in Cairns. They've nearly all gone out of commercial production for various reasons. Some have closed their nurseries because of ill health, some because they had to open a nursery to get the nursery stock in to allow them to graft up to plant out their own orchards, and now that they've planted their orchards, they're so busy with them that their nurseries have taken a back seat. So, if you wanted to buy a hundred or a thousand rambutans in Australia, you would have to think 6 to 12 months ahead, pay up front, and order it.

There were a lot of seedling rambutans grown in the early stages. From seedling trees, 50 percent are male and 50 percent are female; of the females, out of 100 you may get 1 that's close to a reasonable variety, if the seed was planted out of good stock. A word of warning: unless you need the pollinators for some unusual reason, you are better off to stick with the recommended varieties,

Table 1. Characteristics of rambutan cultivars recommended for North Queensland.

Cultivar ¹	Tree height	Orchard spacing	Fruit size ²	Pericarp color	Spintern color ³	Fruit weight	Percent aril	Brix (mature)	Cling or free-stone	Testa objectionable	Aril crisp or juicy	Skin thickness
		-m-	-mm-			-g-						
Binjai	M-S	10x10	48/40	orange/red	green tips	32-41	41	18-21	cling	not	crisp	thin
Jit Lee (Deli)	M	10x10	60/40	crimson/red	green tips	30-55	35	20-22	free	slight	both	thick
Rongrien	M-L	12x10	53/36	dark red	green tips	32-37	41	19-21	free	mod.	crisp	thin
R9	M-L	12x10	65/40	pink/crimson	red	40-51	36	20-23	free	slight	both	v. thick
R134	M	10x10	56/40	red/orange	red/green	34-46	45	20-22	free	slight	v. juicy	thick
R156 (Red)*	M-L	12x10	48/40	pink/red	green tips	34-43	43	20-22	med.	slight	v. juicy	thin
R156 (Yellow)	M	10x10	50/45	yellow/orange	sl. green tips	38-47	54	19-22	free	mod.	both	thin
R167	M	10x10	58/42	crimson	red/gr. tips	37-46	34	20-23	free	slight	crisp	thick
Silengkeng**	M-L	10x10	65/40	red	green overall	40-48	51	19-21	sl. cling	slight	juicy	thin

1. Other promising cultivars include R37 (yellow, clingstone), Gulah Batu, and R3 (both red, slight clingstone).

2. Length/width excluding spinterns (spines).

3. Except where indicated, color of the base of the spintern is the same as that of the pericarp (skin).

* R 156 (Red) was imported as R 156 but that designation is incorrect; true identity not yet resolved.

** Silengkeng description here does not match the Indonesian description; may be wrongly named. Yield data for this cultivar is not well established.

which are propagated by bud grafts and approach grafts. Marcotts produce a small, bushy tree that lacks vigor. Bud grafts are the best, though approach grafts are reliable. My trials at home have shown that bud grafted trees will overtake approach grafted trees over a five-year period. With many of these tropicals, if you start with a good product and look after it, and it doesn't have any setbacks, you'll be amazed at what it can do. If beetles attack it, or someone hits it with a tractor, or you stress it, it takes a long time to get back to where it was, and it doesn't really catch up.

The nurseries do a good job, but the onus should be on the purchaser to choose good quality product. Look at the age of the timber to be sure it's free of canker (callusing) and mold, pits, and other signs of weak trees that are like bonsai trees. This has been a major problem with grafted longan trees. With rambutan seedlings, most nurseries over here seem to be aware of the incompatibility problems with some types.

We have 32 rambutan varieties on our place. Of that 32, I would say that 'Jitlee', 'R134', what we call 'R156 Red' (no one really knows what it is), 'Rongrien', and 'Binjai' are probably our pick of red varieties. The 'R156 Yellow' is the only yellow that can handle our area; the other yellows loose just about every leaf every year. We have a major mite or thrips problem with the yellows, and we don't have a registered control, so the yellows are on hold because the pests make the fruits look unattractive. Even with that appearance, people who know yellows will pay a good price. They are an excellent fruit, easy to peel, and not so bad as far as the seed coat is concerned.

In selecting an orchard site, if you go for the wrong place you have an uphill battle for the rest of your life. Environment is number one. Temperature of 8°C is the minimum for most rambutan varieties, and a lot of them don't grow even at that temperature. This is an equatorial

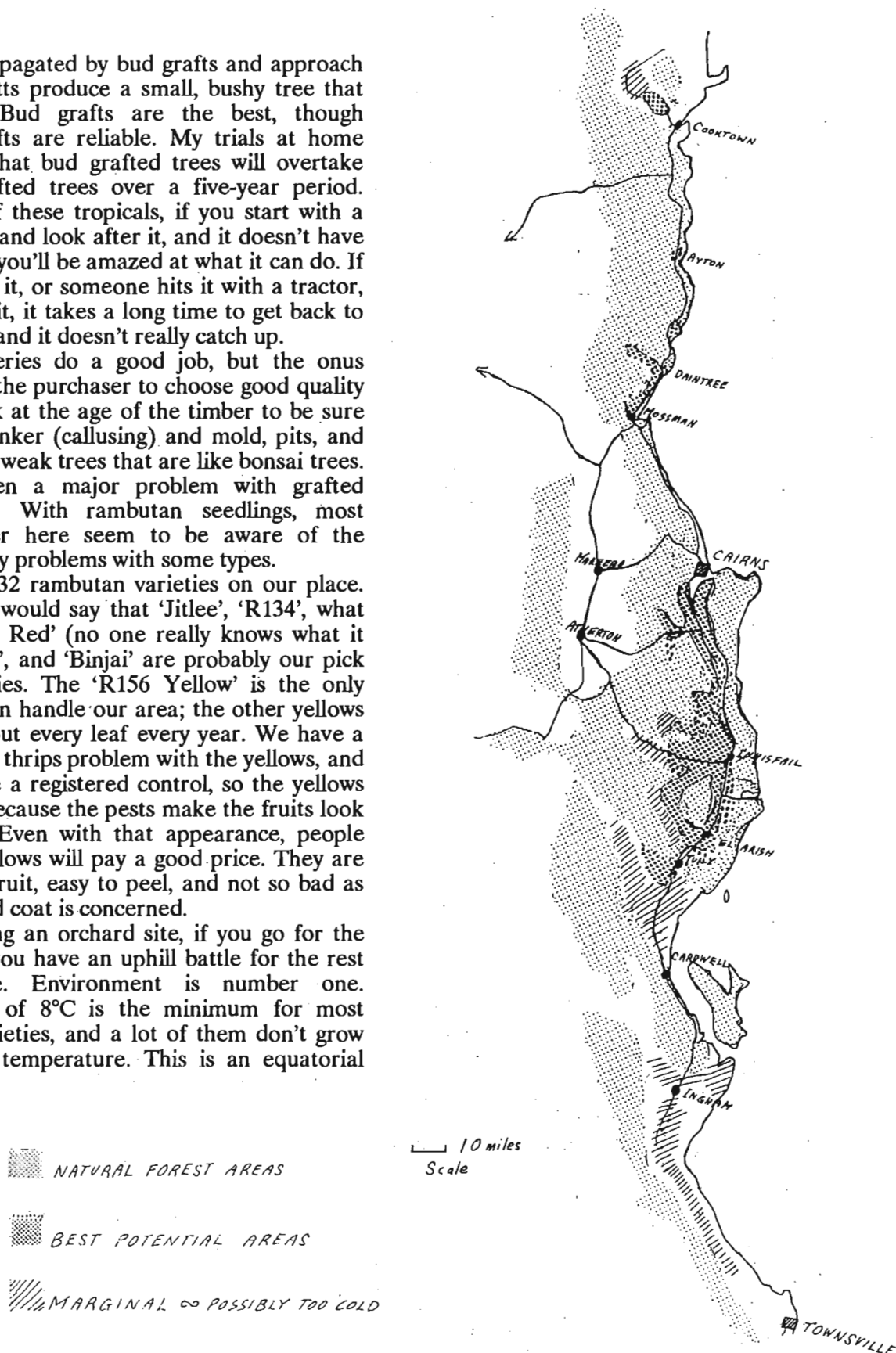


Figure 1. Rambutan growing areas of North Queensland.

tree. Good water is particularly important. A couple of weeks stress and you can say goodbye to the next 12 months' production. They are a surface-rooted tree; they like a lot of mulch and can't handle moisture stress. Water is of two types: irrigation water for the roots, and humidity. I tend to think that high humidity is the key. Good surface and subsoil drainage is very important. Water quality has to be good; if you get leaf burn on avocado, don't try growing rambutan there; they won't handle water with a conductivity reading of above 600 microSeimens/cm.

Wind protection is important. In our orchard we have prevailing winds of about 15 knots. To help establish our trees we had to have banagrass windbreaks. The banagrass is a hybrid between elephant grass and pearl millet. It was developed in South Africa and is supposed to be sterile, but it's not, and it seeds under stress conditions and has become a problem in our area. It is like sugarcane, but it will stand in a single row and stands up to anything less than a cyclone. It has a very aggressive root system, so you need 5-6 m between the young trees and the banagrass, and you have to rip the root system once a year along the edge of the windbreak row. We also put individual windbreaks consisting of three stakes

and 6 ft of 30-percent shade cloth around our transplanted trees to get them established. We have our trees planted at 10-m spacings, and between each two rows of rambutans we have a row of banagrass. Along our boundary line we have planted a lot of timber trees and other fruit trees such as jackfruit, soursop, and rollinia to keep the microclimate.

In Australia, transport to market is important. There are orchards all over the place, and when they come into production, some will have trouble marketing their fruit.

Fertile organic soil and flat land are not quite so important, because you can do something about these. You can build your soil up with regular mulch and fertilizer applications. We've had to do it. We started with beach sand, and after a good wet season a lot of what we've put in is gone, so repeated mulching is necessary.

It is important to deep-rip the soil and get old roots out. To plant the trees we have a device like a posthole digger, but it is sort of like a giant Mixmaster that runs off the back of the tractor (Figure 2). It stirs the soil around but doesn't leave a solid wall as it breaks up the sides of the hole. These planting-site preparers are being used extensively in reafforestation areas. If the area is

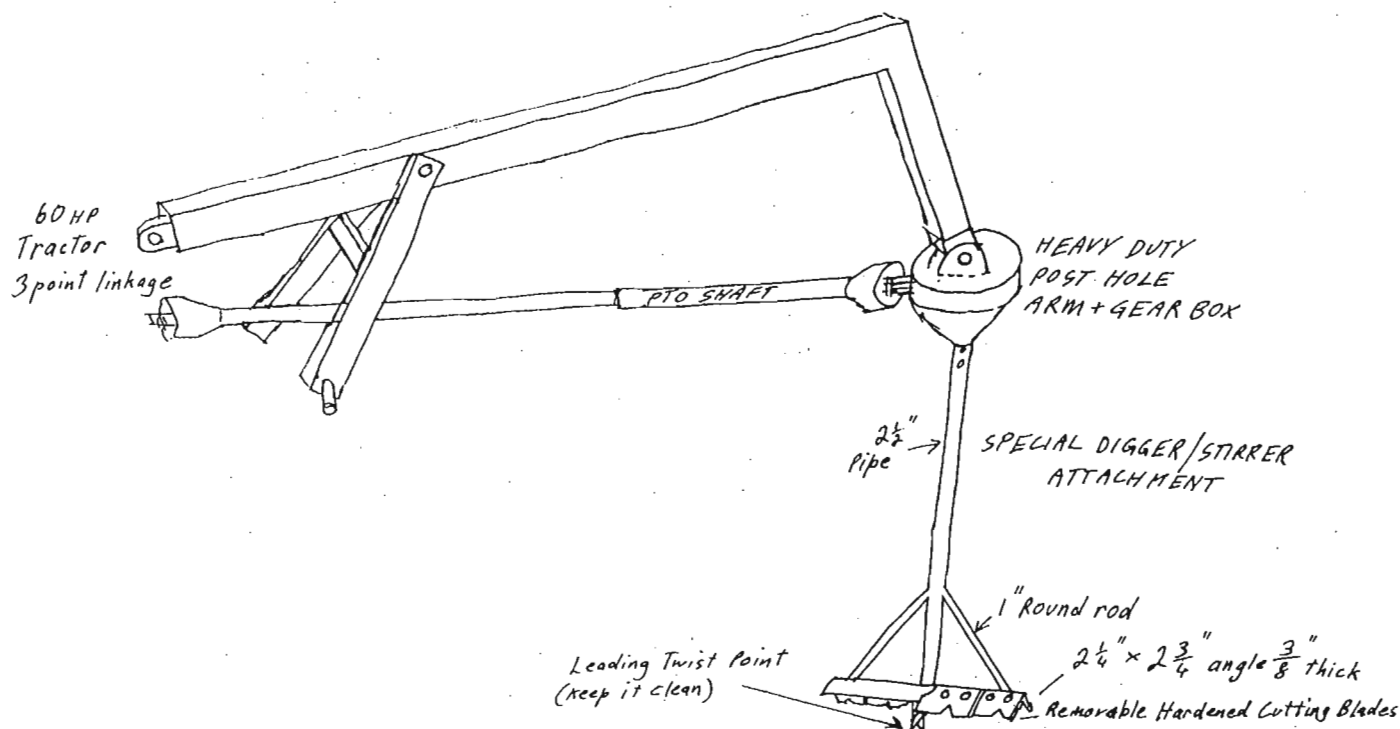


Figure 2. Planting site digging device (clockwise twist).

marked out, we can dig the holes, put the trees in, and connect up the irrigation to about 100 trees in a day. I don't know if that would be possible with your rocky soils.

Even spacing in marking out helps a lot in pruning and picking. We started off with well marked out plantings, but the cyclones blew over some big and medium sized trees. We lifted them up to try to keep the rows even, but they never did well. We found that if they're left down after the cyclone and pruned up as best they can be, they do better. Of course if they're ripped out of the ground, just put a new one in, rather than try to salvage a three-year-old tree that has been severely stressed.

Spacing varies with tree size. With 'Binjai' we can go to 18-24 ft spacing and work it as a hedgerow. None of our hedgerow plantations are in full crop yet, but it is being done and appears to be working well. The work at Kamerunga showed that at 18 x 18 ft, after 10 years you get a ceiling in production. With the larger cultivars we go up to 36 x 36 ft. There is some room for intercropping while these are growing, but if you overcome the temptation to plant closer, and put up with all the mowing, in ten years you'll be glad you used the extra plant spacing.

In Queensland we have a lot of irrigation products available to us. We get 36 inches of rain at our place, which comes in primarily four months of the year, and a couple months of dry. Our irrigation system must completely supply the water needs of the plant during that dry season. Don't put the sprinklers or the main lines right next to the tree; you want the main lines 2-6 ft away, so the rooting system doesn't strangle the spaghetti tubes or your main tree-line tubes. When that happens you have to relay the irrigation in the whole orchard.

Fertilizer schedule is an interesting subject. Everyone will tell you what they're doing, what they did, and what they'd like to do, and none of them will be the same. Basically, first you're trying to grow a tree, then you're trying to grow a crop. Under ideal conditions, we can get 400 kg of marketable rambutan off a ten-year-old tree. The following year the crop from that tree will vary from 90 to 400 kg. The aim in fertilizing is to build the frame of the tree. Start by having a reasonable amount of organic matter available to the plant; this might mean a wheelbarrow full of compost incorporated at each planting site. We put in a bit of dolomite for calcium and magnesium. Incorporation of superphosphate is very important;

young trees need phosphate early, and it is difficult to make up for a lack of it. Get it spread out well so that as the roots grow they are encouraged to move outwards. A few months after planting you can get into higher nitrogen, lower phosphate, and relatively low potassium, depending on what mix you put in at planting. Be gentle with the mix. We mix our complete fertilizers, around 14-6-10, with an equal amount of chicken manure or Dynamic Lifter. Don't let your workers just throw a handful of fertilizer down; it needs to be well spread out. Because we have a lot of irrigation, much of our fertilizer is put out through the irrigation, and that is by far the best way, provided that you have your sprinklers compensated if you're on sloping ground so that they all deliver the same amount of water.

As the trees grow and start to flower, increase the potassium level. It still requires quite a good nitrogen level because it's dropping a lot of leaves and is mulching itself, but it needs that potassium lift. If you don't have the K there you will have trouble with your sugars and filling out your fruit. We're concerned about flat fruit, but we don't have any answers for it yet; we are concerned about low K levels contributing to that. Finally, trace elements are very important. We use a multi-trace element packet at about 1 kg/ha/yr through the irrigation system. Rambutan trees will show iron deficiency (new growth of small yellow leaves) in winter, and this can be helped with iron chelates.

Our cropping cycle is unusual, I think. There are a couple dozen fairly large orchards with a range of varieties, and they rarely come into season at the same time. The bulk of the crop comes in at Easter, but the rest of the crop from different farms is spread out. We are worried about the day when the major producing varieties on each of the farms all come in together. Farms only 10-15 km apart may have a three-week difference in peak crops from different trees. As the trees are young they are erratic; as they grow older they stabilize into a cropping pattern that usually is two harvests from each tree: an early or late summer harvest, and a midwinter harvest. The latter crop is usually about a third of the late summer harvest but has a far greater value, as there is less fruit at that time of the year. Each variety comes in a little differently, and each year they don't behave the same. We'll know a bit more in about 20 years about how our rambutans behave.

We have a lot of problems with our trees. Ants and mealybugs cause downgrading of fruits. Black beetles chew holes in the fruits, which turn black. Sunburn, mites, and flat fruit are other major problems. Loopers and black beetles attack leaves of young trees and set them back. Flat fruits look good but are often low in sugars, with air pockets inside. Flotation is the quickest way to find them.

Leaf burn is a major problem in rambutan. Brian Watson has determined that they can't handle chlorides, so we stay away from muriate of potash, because of the chlorides and also because of the small amount of diesel fuel that is put in to allow it to flow freely. Desiccation stress can also cause leaf burn.

After harvest, we pack the fruit in trays, sometimes as single-layer trays and sometimes as bulk-packed panicles, which doesn't require as much sorting. The industry is moving into punnet packs to take the 5 percent of the best fruit and sell it in the top-dollar market (Figure 3). The bulk of our fruit goes to people who know rambutan, and that's the Asian market down in Sydney and Melbourne.

Under dry conditions we still get fruiting but may get only one or two fruits per panicle; under good conditions 16–18 fruits per panicle is more common. A lot of our varieties were culled because the panicles were too tight. 'Stevens' has a small, sour fruit with clingstone; this cultivar set our rambutan industry back a bit. 'R9' is a late cultivar grown to try to get those late-season profits; its biggest problem is that it produces flat fruit that are difficult to tell from good fruit. 'R134', 'R156 Red', 'Binjai', 'Jitlee', and 'Rongrien' are the favorites on our farm. We get some green fruit drop during the first few years, but this is a natural panicle thinning process, and although the trees can drop a lot of fruit, they seem to balance themselves out and produce a good crop.

Fruits are picked from daybreak to about 10:00 am, before the field heat gets into them. A lot of growers depanicle the fruit into a water bath, removing the floaters, and this keeps the fruit cool and wet. Then they go through a grading machine to a sorting table to a big merry-go-round and into different bins, from which they are packed. The grading machine moves the fruit 6 ft and turns them over twice. With four people standing around it to cull, the result is really good quality control. One rotten rambutan will drop the price of the whole tray. Reject fruits go either to pigs or to street stalls. What sells in the street stalls is still good fruit, but it has excessive marking on it. If a

rambutan drops on the floor, throw it away, because those spinterns (hairs) are going to bend, go black, and look horrible in a day or two. You have to be very gentle all the time. To send rambutans to Western Australia, we are required to dip the fruit in Rogor (dimethoate) at 4 ppm; a lot of growers refuse to do this, and sacrifice that market. Western Australia has the Mediterranean fruit fly but doesn't have the Queensland fruit fly, and they want to keep it out. The dipping must be done under government supervision, and the growers have to pay \$34/hr for me to stand there and watch.

Rambutan is a crop with a good future in North Queensland.



Figure 3. Tray of rambutan punnets (note the inclusion of a promotional brochure).

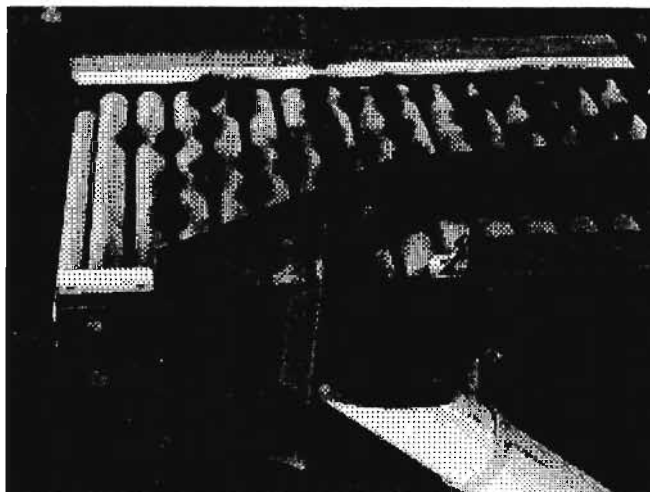


Figure 4. Final quality sorting of rambutans at Exotic Groves Orchard, Innisfail.

Durian

North Queensland has about 15 growers with a total of about 8 hectares. Early planting material came from the South Johnstone Research Station, which was originally material from Kamerunga. Zappalas and Grays have just come back from two years of intensive durian selection overseas, and a lot of their material is still in quarantine. They really have high hopes for the Australian durian industry. Limberlost and Exotic Growers are commercial nurseries that have had durian available but only in small amounts. Most of the durian trees are approach grafted or tip grafted. 'Chanee' and 'D-24' are considered as having the most potential. 'Montong' appears to be a wide group of durian, which is without argument a good tasting durian, but the fruiting of trees so far is less than 10 marketable fruits per tree, and you have to get your \$80 per fruit to make it worthwhile. 'Chanee' and 'D-24' have an appealing flavor, firm flesh, and they produce well. 'Kra Dum Tong' tends to be self-pollinating and is being looked at closely.

Orchard sites should be on well drained soils with low wind, filtered sunlight, and very good water supply. Root rot in durians is a major problem in Australia. Site selection to minimize phytophthora is very important. Soils should be ripped well, with organic matter incorporated not just at planting but 12 or more months before planting. The hole-digger system we use is recommended. Flowers occur in early summer, after about 6-8 years of tree growth. Fruits come in early autumn. It takes 2-8 months for the flower buds to develop, another 2 months for the buds to mature and open, and about 5 months for the fruit to set. Pruning is important, but there is some argument about it. People who see old orchards overseas can see what is needed when the orchard matures, and their advice is to wide-space the trees with the view of interplanting other seedling trees in the middle to give the branches support. Durians are heavy. The tree has a main upright leader with predominantly horizontal branches holding the fruits. These branches need a good, strong crotch angle to keep from breaking. Physical supports are helpful, and sometimes overseas they graft interplanted seedlings later on, so the tree looks like a banyan tree.

Having said this about pruning and training, I should add that our main measure of reducing cyclone damage is the chain saw. Our hardest decision is when to get the chain saw out. You know you have lost 1-2 years production the

minute you bring it out, but if you don't, you can lose your whole orchard. The method is to chop off at least a third of the top of the tree. It's a gamble: if the cyclone crosses the coast, you win, if it goes back out to sea, you cry.

Durians are often approach grafted; it's done in the middle of summer, inside a tent-like structure to keep the humidity up. Do it only when the trees are growing really vigorously. Some growers at field planting don't cut off the regrowth but bend it over to reduce the shock to the tree. Don't be surprised if developing trees race one shoot up, because when it gets to the correct light intensity it will fill out and form a reasonably shaped tree. Don't be tempted to lop the top off, even though the fruits will be borne up high; it's the proportion of the tree that gives it its strength. Multiple rootstocks are a good idea in durian because of the phytophthora disease problem.

Flower buds open around 5:00 pm, get pollinated around 7:00 pm, and are over and done by about 2:00 am. Bats are credited as a major pollinator, but there must be other agents as well.

We use a potassium phosphate system used for avocados to combat phytophthora in durian, and it's working well. We inject with a 60-ml needle with 20 ml of the mix in it. Holes are drilled into the tree, and the needle is put into the hole. It's put under pressure with a little pin, and every day you go around and give it a bit more of a squeeze.

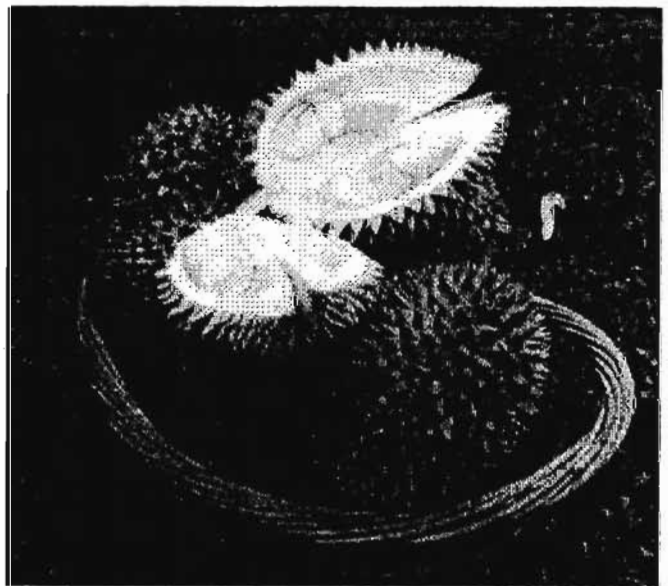


Figure 5. Durians on display.



Figure 6. Plastic baskets help in handling durians.

We do that twice a year. It's a very intensive job, so if you can avoid it by keeping phytophthora out, it's worth it.

We have some problems with the fruit and may have to use some sort of a bag over the fruit. Fruit-spotting bugs allow rots to get in and ruin the locules. Durian has a very limited market in Australia, so the selection of varieties that produce quantities of good flavored fruits is important.

Mangosteen

When planting mangosteens, the size of the seed is important; larger seeds produce larger, quicker growing trees. Mangosteens require careful attention to avoid setback. With trees that are well looked after, we have had fruitings in five years after planting out a one-year-old tree. If it's not well looked after, you may not get fruit for 14 years. Spacings range from 18 to 50 ft. Don't be afraid to space them widely, because they do get to be large trees under good conditions. Wind protection is absolutely critical. They are a good crop for interplanting with timber or other fruit trees. For fertilizer, we apply 15 g of phosphate early, followed with 70 g N, 6 g phosphate, and 50 g K per year, split into six applications two months apart. Gradually increasing the fertilizer and the area it is spread over is important. Fruits are about three to five per pound. It is hard to see the fruits; they are dark in color and inside the canopy where light levels are low. It takes some skill to find and pick them. Don't let them go until they are dark purple, as they lose a lot of flavor when overripe. They can be eaten at the maroon stage,

or when just turning maroon. At the maroon stage there is more sap in it, but it is delightful. For market, pick them at the advanced maroon stage so that they have a couple weeks of shelf life. We blame a bug for sap dribble from the fruits in some areas, but we're still looking at it. We have thrips that scar the skin and turn it brown. There aren't many problems with insect on the leaves. We have seen internal sap bleeding in the fruits in the Cairns area last year, when they had a very dry summer, but we don't see it where the trees are growing well, and I suspect physiological stress due to lack of humidity and water.

Internode length is important; if you are getting short internodes, you have some sort of a problem.

The mangosteen is not as sensitive as rambutan to chlorides in the water. In your nurseries and in the field, sunlight after 3:00 pm has an adverse affect on mangosteens. They can handle some morning sun and a bit of midday sun, but when it gets to be afternoon and the tree and the air is starting to dry, they can be stressed. Maintaining the microclimate is very important.

On the research station at South Johnstone the mangosteens are growing inside shade cloth structures that cost about A\$80 each. As they get to the top, growth is stopped by the winds and sunlight; we hope that the rest of the orchard will develop and provide some protection. I visited an orchard north of Cape Tribulation where they didn't use anything to protect their 2,000 mangosteen trees; they relied on small pockets of the trees grown in the natural jungle, and it seems to be working really well.

We have about three mangosteen growers, with about 2,000 trees each. There is a good future for a limited amount of mangosteen production in Australia. Currently the fruit is returning \$40 to \$80 for a 3-kg tray.

Lychee

When I came to Hawaii I was surprised to see how large the lychee trees were, but after getting to know the climate a little more, I'm not so surprised. This island has so many different microclimates, if you look hard enough you'll find one that will fit with lychee, and you'll find fruits for each of the climates. It just means a lot more work and trial-and-error on your part. I work a lot on Thursday Island in the Torres Strait, and they have some of the most beautiful lychee trees growing there which have never set a fruit!

Lychees grow and fruit from just north of

Cairns to well into northern New South Wales, and there are some inland areas that grow lychee as well. In North Queensland, we recommend well drained soil at least 2 ft deep with very good water having less than 600 microSeimens/cm electrical conductivity. This level will be adequate for most salt-intolerant crops. Wind protection is important. There should be a cool, dry autumn and winter, followed by a wet spring. Light frosts are tolerated but it's better to avoid them. We have a bad erinose mite that requires regular spraying of Rogor, which is sometimes done by air. Therefore, we don't recommend lychee orchards where there are houses nearby.

Cultivars on the coast tend to be 'Tai So' and 'Kwai May Pink', with 'Fay Zee Siu' and 'Kaimana' coming in. 'Fay Zee Siu' appears to be a week or two earlier than 'Tai So', and that can mean three times the price for the fruit.

Inland, these varieties are grown, plus 'Salathial' and 'Wai Chee'. A couple new varieties in quarantine now are 'Way Li' and 'Chin Li', from China. I am told that in China, although they have grown this crop for thousands of years, they are only just starting a serious production industry. By this I mean quite a few orchards, with millions of trees in the three- to seven-year-old age range. It must be spectacular. For us, this won't matter much because we'll be working out of season to them, but it may be a reason for you to watch what China is doing and what markets they aim for.

Before planting, we find that a good safeguard for reducing the erinose mite problem is double-dipping the trees in Rogor using 1 ml/l, immersed for 10 sec and repeated again in 10-14 days.

Because lychees are predominantly marcotted, they should be held firm by a stake. Run the stakes on a steep diagonal, so they are well away from the root system, and tie with a loose binder, like a stocking or a bit of garden hose with a string through it. As the trees get older, prune them heavily and feed them with high potassium levels, to try and get the root system equal to the canopy. The last thing to do with lychee is to leaf-feed them with foliar fertilizer. You really want to build up the strength in the root system, otherwise the first bit of wind that comes along will damage them. Use a reasonable blend of organic and inorganic fertilizer. We use Dynamic Lifter on the ground and urea through the irrigation system or applied to the ground while it's raining. At least an inch, hopefully two, of rain after putting urea out is needed to get it into the ground. If you get 10 inches, you have to turn around and throw some

more out. In the first year we use about 30 g urea; in the second, 40 g; then 60 and 80. The location of the application is important, moving it away from the tree trunk as the tree grows to encourage the root growth outward, supporting the tree. Fertilize during the early summer, so that as the trees come into the stress period, they don't have a lot of fertilizer available. We fertilize after picking and during the following wet season, but as the weather cools down we don't want a lot of fertilizer around, in order to get that period of dormancy and encourage flowering. We apply a soluble trace element fertilizer through the irrigation system at 5 g in 3-5 gallons per year of age per tree for the first couple years.

Irrigation should try to promote growth during the warm season and then close it down during the cool season. North of Cairns, lychee doesn't fruit as well because they don't get that stress period. We've looked at cincturing (girdling) but don't consider it to be viable for commercial production.

There are numerous pests of lychee in Australia. The flower caterpillar comes in and damages the flower. Black beetles eat the panicles and cause fruit drop. When the fruits are up to a reasonable size, the macadamia nut borer comes in, drills into the seed, and causes the fruit to go brown and drop off. If they get to that stage, you may get fruit cracking because of too much irrigation. When they start to color up is when the flying foxes, fruit-sucking moths, parrots, and giant elephant beetles come in from everywhere and finish off the crop.

These problems encourage growers to pick the fruit as early as possible, and with early varieties being quite sour there is a conflict between trying to get some money in and trying to put a decent flavored fruit on the market. Buyers can be put off by the sour fruit and hold off buying again until late in the season, when they can expect sweeter fruit, so the bulk of the season passes before that buyer comes back in. This is a good reason to try to get high quality fruit early in the season.

Our largest lychee grower has about 20,000 trees, the majority being 'B-3', which is 'Kwai May Pink', a very upright, midseason lychee. 'Tai So' is picked at a brownish stage; if picked at the red stage it tastes sour. The amount of chicken-tongue seed (small shrivelled seed) varies from year to year, from 20 to over 60 percent. 'Salathial' is a late lychee, a seedling that grew in Cairns. Although the fruit is small, it is around 90-95 percent chicken-tongue. One thing about later lychees is that even when not fully ripe they are

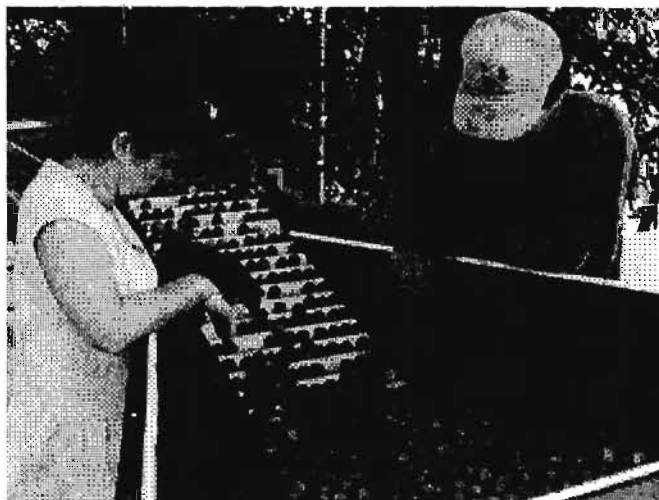


Figure 7. Sorting of lychees before size grading.

still quite sweet.

Most lychees commence flowering with a lot of male flowers, and sometimes we get an all-male flowering; the whole tree flowers and not a fruit sets. We think this is due to insufficient stress. Flowers that set fruit are usually the latter third of the flowering.

Picking is done manually with picking sticks, and ladders are used when the trees get taller. We have some excellent ladders made with structural aluminium that can be picked up with one finger. They have a broad base on the two step legs and a third prop leg; each leg has a plate like a ski pole. You can get on the very top and lean over; they're extremely stable.

In the packing shed, lychees are washed and graded. Often they are depanicked into ice water. The emphasis is on keeping them moist and cool, and they are put into the cold room as soon as they are packed. Lychees are packed into 2½-kg bags, two to a 5-kg box.

Some growers use plastic nets over trees to protect fruits from elephant beetles and fruit-sucking moths, but it is a real problem to get out of the tree and dispose of afterwards. Others go for total-orchard netting, but they can end up with a lot of dead birds in the nets.

At flowering, a spray program which includes Rogor every 10 days may be needed to control erinose mite, which can cause flower drop and damage the developing fruits. If we don't control the mites, we don't get a crop. To avoid using insecticides at this time, because they kill

pollinating insects, it is better to maintain good control over erinose mite throughout the rest of the year.

With new varieties, strict grower-controlled quality guides, and an increasing export market, the lychee has a good future in Queensland.

Longan

When I was growing up, people told me that longan was a Chinese fruit and if I ate them my eyes would go slanty. The whole Australian attitude has changed dramatically away from this sort of ethnic prejudice in the last 15 years or so, and people are really accepting foods that come from overseas. We have had longan around for a long time, but because it wasn't an "English-acceptable" fruit, nobody did much with it except for a few Chinese market gardeners. The old gold rushes brought in the Chinese, and they brought in their longans, and you can find these trees in the arid areas of Queensland in abandoned gold mining areas. Most of those types were very small fruited, with large seed and very little flesh, and this has put a lot of people off longans. Imports of selected varieties over the last 20 years have changed things, and with good crop management, things are going to change again.

Of our main varieties, the earliest one is 'Biew Kiew', then 'Dang'; the middle-season ones are 'Haew', 'Chompoo' and 'Ingham', a seedling from Ingham, which is located between Townsville and Cairns. 'Ingham' seems to fruit out of season to the majority of them, and although its fruit is a little inferior, when there is no fruit on the market and it is Chinese New Year, you can do very well with 'Ingham'. There is room for slightly inferior longans because of the problem of the cropping cycle. Our latest one is 'Kohala'. 'Homestead' rates fairly highly, still, but that is a legacy of grafting problems. When our first longans were made available they were all grafted onto unusual rootstocks and there was tremendous incompatibility resulting in bonsai trees, of which 'Homestead' was the only one that grew and fruited heavily. People were encouraged by that and planted it. Now, we have overcome those early problems, and 'Homestead' is seen as an inferior line.

Longan will handle drier conditions than lychee. There is a tobacco industry on the Tablelands behind Cairns that is reducing, and longans are one of the replacement crops. We don't know what will happen when tobacco farmers plant thousands of longans.

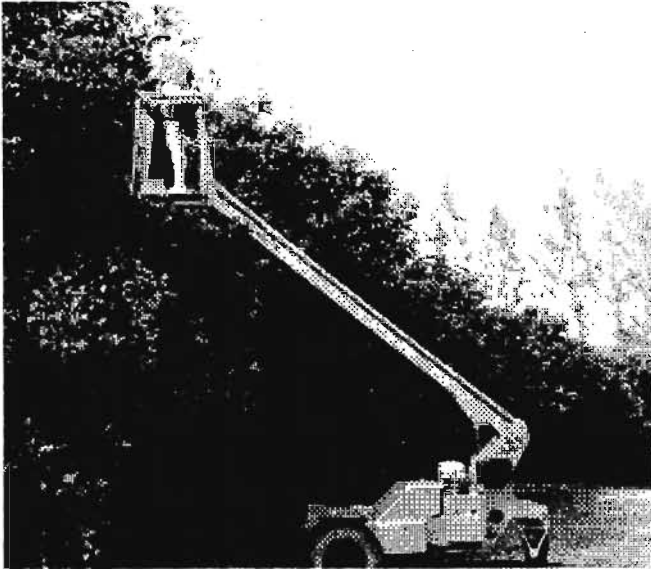


Figure 7. Power ladder aids careful harvesting of rambutan (Tropic Valley Orchard, Innisfail).

Longan tends to have fewer pest problems than lychee. Ants are a problem because they bring in scab and mealybug. The flying foxes come in when the fruit nears ripening.

The key aspect of cropping is to get the size of the fruit up. A small longan is worth little; a medium size one is worth production cost plus a bit; a large longan in excess of an inch is gold in your pocket. Some growers fertilize very heavily during flowering and fruit development, as well as keeping the water up. Other growers go into thinning, in one of three ways. Thin the tree heavily so that it has less branches to produce panicles, or thin panicles by chopping off individual panicles, or thoroughly and selectively thin within the panicles by removing about half the fruit. This latter method is the best for fruit size but is the most time consuming. Some trials done up in the Tablelands showed that thinned trees produced the same weight of fruit as the unthinned trees, but the fruit sold for at least one third more. Managing fruit size in this way means you have to keep the trees pruned to a reasonable level.

I've given up on the Chinese types of longan because they tend to overcrop and don't produce a large enough fruit. We had some problems starting out with rootstock incompatibility in grafted

longan, but they lend themselves well to marcotting. We marcott large branches of 1- to 2-inch diameter, which gives the tree a major pruning when we remove the marcotts. We remove about two-thirds of the leaf area when the marcotts are potted after a good root ball is formed, and we let it go through two flushes before planting out to the field.

If we don't control ants we get scales and mildews that stain the fruit. For ant control we spray carbaryl, Lorsban, or diazinon in a 6-inch ring around the base of the tree. Ants can also be controlled if you keep the ground wet; when the soil dries out we have a lot more ant problems. For "organic" methods, we have looked at the sticky materials. They are adequate just for the fruiting season, lasting only about six weeks before debris gets blown up against them or the ants just walk over themselves. Putting hydrocarbon-based substances like grease round the trunk eventually girdles the tree, so use something like "Tanglefoot" that is not going to hurt the bark.

Longan trees suffer from Pinks disease, a fungal disease that kills large branches. Wind is a problem and so are the large beetles that come in and eat the new leaves. Twig girdlers cause death of individual branches, which is not really a serious problem, but it looks bad. There is a predator against the pink wax scale that seems to be working well. Fruit-sucking moths love longans, as do elephant beetles and, of course, flying foxes and fruit bats. Like most of the other crops, we also get the crop loppers, the people down the street who are too lazy to plant their own tree and come over. Parrots and sunburn are also problems. We have pushed heavily for panicle marketing of longans, because it is so much easier and so much more attractive, and the people who are used to eating longans are used to that style.

With the varieties already in Australia and a bit of careful marketing, the longan has good future. This future will be assisted by any movement toward processing, such as drying or longlife packaging.

[Editors' note: The pesticides uses for Rogor (dimethoate), carbaryl, Lorsban, diazinon, and potassium phosphate described by Mr. Goebel are not currently legal in Hawaii for the crops mentioned.]

Marketing Tropical Fruits in Australia

Roger Goebel

District Inspector, Department of Primary Industries, Queensland, Australia

We live near Cairns, which is a long way from the main markets, the closest being Brisbane, then Sydney, then Melbourne. Our transport is by air for a lot of our tropical fruits such as mangosteen, rambutan, and lychee; even quite a few of the mangos now go down by air. Better road and rail transport is developing. By rail it takes a couple of days to get to Brisbane, an extra day to get to Sydney, and another day to get to Melbourne, so it's four days from putting it on the train to unloading at Melbourne. There are some rail-road combinations; when fruit is sent to Western Australia it is a nightmare, it's nearly a week. Many of our bananas go to Western Australia. We don't have main roads through the middle of Australia; our roads go around the coastline, which really adds time. We had problems with the airlines for quite a long time. We had trouble explaining to them that our fruit was a precious commodity to us, and please don't offload it in Alice Springs for eight hours in the middle of the tarmac without putting an umbrella over it! With the rambutans, the bulk going out of North Queensland are put on the airplanes in our traditional package: a cardboard tray and separate lid. The fruit is packed in rows and covered with a plastic similar to plastic lunch-wrap, and they'll be in the market the next day and sold. Then they go to the fruit shop, where they rip the plastic off. In eight hours they look a bit sick; in two days they look black. So we went to a cluster pack, with a leaflet on the top of the pack to illustrate what a good rambutan can look like. We had been to shops that had signs saying "Rambutans: like lychees; eat when black." We've done our best to get a high quality product to the market, and they seemed to be doing their best to destroy it.

This year we are going to use punnets, which our association has been experimenting with off and on but had balked at the cost. As an individual fruit grower, we can't really fund a whole new packaging system. One of the growers tried using reject strawberry packing and came up with a nice system that has attracted about a A\$10-per-carton premium. Being a kind gentleman, he offered the idea to the rambutan growers' association.

We're following the North Queensland lychee industry example in coming up with a marketing

association that has a level of quality for its product that will be determined by the association. If you don't come up to that level, you'll be helped, and if you refuse to be helped, you'll be expelled from the group. The group has a couple dozen starters. The aim of the marketing system is not really to penalize people but to encourage growers to produce a good product.

The other aim of the marketing association is to try and keep the agents (wholesalers) in line. Traditionally in Australia, the agents dictate quality and price to the fruit shops, and with so many growers producing different crops, they can pick and choose from their growers and give you basically what price they want. They'll tell you that this doesn't happen. They tell you it's the demand, but that is rubbish; they can fluctuate that market within 25 percent at any time, and if you are one of their favorites, they'll look after you. So we do have a biased marketing system. The whole system is in turmoil at the moment, because very large companies like Woolworths are buying direct off-farm. About 20 percent of the fruit crop goes through Woolworths; a lot of it is direct-marketed, bought straight from the growers and bypassing the major market systems. The supermarkets are going to know how much it costs you to grow it, they're going to add a percentage and say "that's your price," and that's it. They will become quite powerful, so to get around that monopoly, associations like FNQ are forming for rambutan, which is a carbon-copy of FNQ-Lychee.

FNQ-Lychee started a few years ago with six growers, who developed a quality control level which has been improved since then. They developed a poster chart that hangs in every FNQ-Lychee supplier's shed. Along with it goes a sizable manual with photographs with the allowable levels of defects for the different grades. The coordinator estimates, roughly, the production a few weeks before harvesting from the majority of the suppliers, and can direct that product to his agents. He charges a small fee, a couple percent of the gross price. The growers that have worked in it for the last three years have all said they're getting A\$3-5/kilo above the standard price by going through that system. So it's working very well. It's based primarily on

description of product.

Australian fruit shops range from very low-income areas that want the cheapest fruit that is still edible right up to the really posh areas. The marketing people go for the middle of the range and upwards and let the lower range sort itself out. If you are getting \$10/carton for your fruit, the carton, transport, and other costs are going to be the same as if you are getting paid \$40. Why go for the low end of the market where you are making no profit or possibly a loss when you can go for the high end? The only way to do that is by establishing yourself in a marketing place, getting a name for your product, and maintaining that quality. It has been done in Australia, and the same system has been done by FNQ-Lychee for export.

This is the first real effort at growers working together, with individual farms, individual packing sheds, but still putting out a product under one label. Each box has the individual grower's name stamped in small letters, for legal reasons, but the box is marked FNQ-Lychee, with a nice map of Australia, and they will sell in that box. FNQ-Lychee has a second box, which is not labelled that way, so they can sell the fruit to the lower-grade fruit shops. The boxes are only available to the members.

Our larger horticultural crops such as avocado, mango, and banana are starting to move that way. They are slow to move that way because, I think, the larger crops have been grown for a while by people who have become a family name in the district. They do what their father or even their grandfather did, and they are very individual and hard to get to work together. It is a real achievement for things like FNQ-Lychee to get off the ground. These fellows are putting out a product such that if you are looking at one farmer's box you can be sure without even having to lift the lid that because it comes from FNQ-Lychee, the next farmer's box is going to be the same quality. If you can get to that level of quality assurance, then you have three-quarters of your battle won.

Rambutans are being packed into punnet trays. The aim with the punnets was to go after the top five percent of the market, which has extraordinarily high return. Trials done last year show that we can do it. The market wants it, and when people get to know what a real, nice, fresh rambutan looks like, then, we hope, the fruit shops will stop selling second-grade fruit as prime quality. It's all a case of market education.

That is all from a grower's point of view. From a political point of view, the Queensland fruit and vegetable growers have a political association, of that name. It used to be COD, the Committee for Direction of fruit and vegetable marketing. They had a very large input to marketing, but now they have been outclassed by individual marketers and are retreating from the marketplace and going more for transport of fruit and vegetables. They can see that the product from North Queensland is better than many others, and all they have to do is get it down south in prime condition.

The political arm of the Queensland Fruit and Vegetable Growers is funded by a levy on just about everything that is sold. There is one levy for the organization's administration, another for promotion of the fruit and vegetables, another for research, and, in the case of the banana industry, a fairly significant levy comes out for the banana industry protection board. Those levys come out before the growers get their check back.

In the case of papayas, which is the highest levied crop, around 38¢/package, the growers are levying themselves very highly so they have the dollars available to do research. When they have a problem, they want to be able to fund it and get someone working on it, rather than have to lobby politicians and wait for four financial years before something happens. They want to get things moving, and they are able to do it. The rambutan growers are taking a leaf out of the papaya growers' book, but because their production is so small, instead of getting \$100,000 they are only getting \$3,000-4,000.

The growers themselves produced a leaflet on rambutan. The rambutan levy doesn't go back into rambutan promotion; it goes into generic promotion. They reckon that in promoting fresh fruit and vegetables generally, every person who grows them gets some benefit. Promoting apples and oranges promotes all fresh fruits and vegetables in competition with take-out foods, popsicles, and other items. The consumer dollar is being fought for by the association. So promotion of rambutan as an individual product has to be done by ourselves.

Some crops have an information booklet on production and handling guidelines. The latest is for papaya. We're trying to help the farmer keep quality product from the minute they choose their variety to when somebody eats it. This is the way to go: guiding people, educating people in the fruit shops, the restaurants, telling them all about the fruit, how to look after it, how to present it and

use it.

The message I have is that you've got to work together. You cannot sit back and let the government or someone else do it for you.

Q: Can farmers set the price of the crop, and how is the price set?

A: Legally, no. But yes, they definitely can. When a fruit is in short supply and good demand, a grower can tell the agent that the price is X and ask if the agent can get it. This is best done by fax. There are some problems because there is so much variation in the products, and people are inclined to brag a bit; it is difficult to find out what they're talking about. If someone says they got \$58/carton for rambutans, you have to ask where it was sold, what kind of fruit were they, when was it sold, was it \$58 for one of 1,000 cartons or just one. When you listen to the daily market report, you have the same problem. They never give the price range, low and high, they just tell you the market average, and you have to be able to see what your quality is in relation to that market average to be able to understand how it relates to you.

Q: What are the prospects for tropical fruit growing?

A: Yes, I am optimistic. But just having a fruit isn't good enough these days; you have to get out there and push it. Australia imports a lot of stuff, but nowhere near what we eat. We have apples, oranges, and bananas as sort of staple, school-lunch type fruits; everything else is seasonal. Rambutan comes out of season to many other fruits. When they are available in mid-winter, as a tropical fruit, they sell really well, and so I'm super-optimistic about rambutans.

We had thought rambutans would come along on the back of lychee. We thought the lychee association would do all the promotion and we could come along and say, "Here's an out-of-

season lychee, with hairs on it." It hasn't been that way. People have said they like the lychees with the hairs better than the other lychees! Longans have come in on the back of rambutans, but they might stand on their own two feet even though they have a narrow production window. Longans are also easy to eat: you peel it, pop the fruit in your mouth, and spit the seed away. Mandarins have replaced oranges to some extent because they are easier to eat. Anything that looks good, is easy to eat, and has either shelf life or ease of storage can be great for the bulk of the market.

If you're talking about salak palm or durian, the big effort there is not to try to sell the fruit but to bring people in to eat it. Next year in North Queensland will be their first major fruit conference, and I hope that will lead into festivals; for example, in February we could have the Tropical Tree Fruits Festival, or the Durian Festival. It would be better to bring the tourists to Queensland rather than worry about how to get a half-ripe durian down to Sydney on a plane or train. Marketing of durian is quite hard. They almost banned it from the Sydney market, it was nearly going to be a forbidden fruit on the market floor because of its strong smell. Now to get them there, they have to be shipped and marketed in sealed styrofoam boxes that cost \$5.00 each.

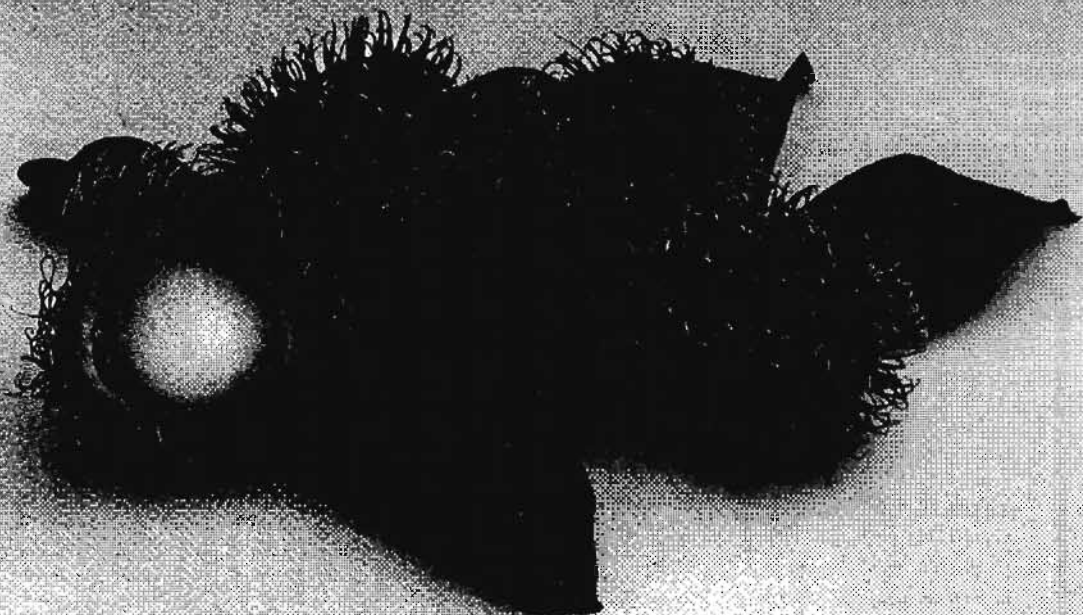
We're hoping that we can attract people to Queensland as an alternative to touring Asia. We have the reefs, the rainforest, and all these tropical fruits. The amount of publicity we can get with our tropical fruits is phenomenal.

Acknowledgement

I would like to thank the HTFG organizing committee for inviting Giulia and me to this conference. The people we met, their enthusiasm, and their well managed orchards made our visit a pleasure and were an inspiration to us.

We look forward to any opportunity we may get to return the warm hospitality and free exchange of information.

RAMBUTAN



Produced by: Rambutan and Other Fruit Growers Assn, P.O. Box 1624 Innisfail 4860
and the Promotions Section Qld Fruit & Veg. Growers

Australian rambutan growers include a color leaflet in their rambutan trays to show what well handled and marketed fruits look like. The reverse of the leaflet contains information on ripeness, storage, nutrition, and uses.

Domestication and Commercial Utilization of Tropical Amazonian Fruits

Charles Clement

Instituto Nacional de Pesquisas da Amazônia, Manaus, AM, Brazil, and
Department of Horticulture, College of Tropical Agriculture and Human Resources,
University of Hawaii at Manoa

The fruits that are most interesting and successful here in Hawaii come from essentially two areas: South and Southeast Asia, and tropical America. This is not an accident. Fruits were probably the first plants that people used as human societies developed, and the domestication of fruit trees probably started earlier than the domestication of any of the other crops that we rely on today.

It is an accident of the world history of the last 500 years that only now are we starting to realize the potential of the tropical fruits. This is because the European colonizers spread their own crops around the world and ignored native crops unless they were immediately acceptable. Fruits like pineapple and papaya attracted European attention immediately and became widespread. Fruits like durian and peach palm didn't and therefore were ignored until recently. But this talk is about domestication, not history.

What is domestication? It is not just fruit tree breeding. In fact, breeders in the last 50 to 100 years, with modern genetics and techniques, have managed to breed and domesticate only one crop (sugar beet). All the other 3,000 domesticates come from thousands of years of selection by indigenous people. It has been a very long, slow process.

Domestication is a process that brings an organism into our household, as it were, and turns it into our servant (Harlan 1992). The genetic makeup of a plant population is changed by conscious human selection during this process. The final result of the domestication process is that a plant loses its ecological adaptation and can no longer survive without humans taking care of it.

An example is the peach palm (*Bactris gasipaes*). When the Indians arrived in Amazonia 10 or 20 thousand years ago, they found a tiny fruit, not much larger than a pea, and from this starting point they developed the larger fruit we now call peach palm, one fruit of which can weigh up to half a pound (Clement 1988).

In the domestication process, there are various kinds of plant populations. There are wild plants, where no selection has been done. There are incipient domesticates, where only a small change has been made in the morphology of the crop. Semidomesticates have larger changes; for example, doubling or tripling of fruit size, and much sweeter flesh. Full domesticates are those that have lost ecological adaptability as well as having modified morphology.

Agriculture in the Amazon developed along with domestication. There are few examples of an advanced degree of human intervention in the landscape without developing an agricultural system or domesticating crops. The case of the Australian Aborigines is an example. But in areas where fruits were important, agriculture became very sophisticated. What may appear to be scrubby woods to the uninitiated may actually be a very productive second-growth forest, producing many kinds of fruits, medicinal plants, construction materials, etc. The agriculture of the Amazon is thus not the kind of agriculture that we are familiar with, but it is nevertheless a very sophisticated system, within which several hundreds of crops have been domesticated.

The reason plants lose their ecological adaptation is that humans substitute human energy for the energy the plants once used to compete in the natural environment (Figure 1). The energy investment for modern monoculture agriculture is very high, and, in an inversely related trend, the diversity in the system decreases. In Amazonian systems, energy investment in terms of labor, petroleum, and chemical energy is not so high, and there is always diversity in the system. While the crops have come to depend on humans for survival, they have retained some of the ability to compete in these complex agroecosystems (Figure 2).

When working with wild species, there is a lot of genetic diversity for every trait that exists in the plant. Humans select out a small part of this

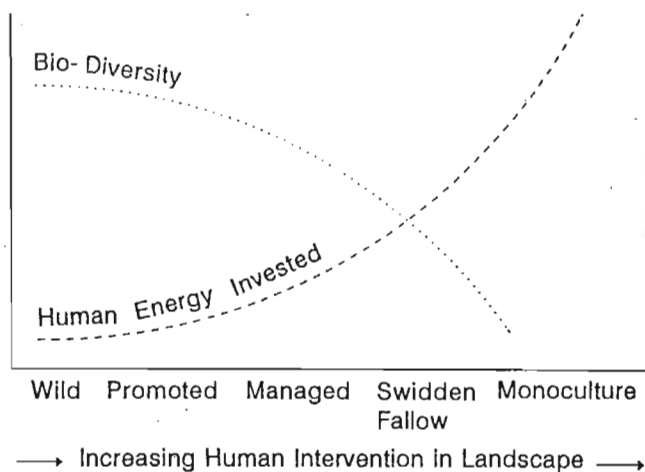


Figure 1. Trends in biodiversity present in various types of human agroecosystems and the energy invested by humans to create these interventions in the landscape.

diversity, so the plant goes through a bottleneck right at the beginning of the domestication process. During the domestication period, genetic diversity increases again. In recent years, both the genetic diversity of the wild species and of our crops is starting to bottleneck again. The reason for the loss of genetic diversity in wild species is because of human occupation of the landscape; it is inevitable. The loss of genetic diversity in the crop populations is a factor that we can and must control, so that in the future the problems of crop diseases can be overcome with genetic resistance, rather than with chemical means, especially as the EPA is now reducing the availability of these chemical means.

In the Amazon, the genetic diversity of crop plants was built up over thousands of years, but it is not uniformly distributed throughout the region. The forest varies, depending on the climate. In the northwest is the area with the highest rainfall and also the greatest biological diversity, and most of the fruit crops were domesticated there. In that region, some fruit crops even became staples. Again, the peach palm is an example, having become a main source of starch in the diet of the American Indians there. I have proposed the northwest Amazon, which has been largely ignored until recently because it does not contain annual crops, as a center of diversity for Amazonian crops (Clement 1989).

There is currently a significant loss of genetic diversity because of habitat loss, but in the Amazon 300 to 500 years ago, during the immediate post-Colombian period, there was also a drastic loss of genetic diversity when European diseases were introduced and the human population of the Amazon and most of the rest of the Americas crashed by 90 to 95 percent. When a domesticated crop is abandoned by its owners, in this case because the owners died, the crop disappears. What remains in the Amazon is just a remnant of what must have been there 500 years ago. Considering the relative richness of the genetic resources in this region today, what a paradise it must have been 500 years ago!

Many of the wild Amazonian fruit and nut trees have been used for the same period that others have been domesticated. Others perhaps are just starting to be used now because we have different interests. In the rest of this presentation a few Amazonian fruits will be introduced and discussed with respect to their degree of domestication and their potential for modern horticulture.

Wild Species

The pendula nut (*Couepia longipendula*, Chrysobalanaceae) received this name because its fruits occur on long, stringy peduncles. The nut is a very nice looking, pale green, pleasant tasting, high oil nut. It has no commercial importance, being used as a subsistence crop, but not available in the markets. The tree is very productive, a marvelous horticultural object. While still a wild species, the pendula nut can surely be transformed into a new crop quickly and easily because of its natural precociousness, high yields, small size and horticultural shape.

The camucamu (*Myrciaria dubia*, Myrtaceae) is a relative of the jaboticaba. It is a shrub that grows wild in very large, nearly monospecific populations in the Amazon river floodplains, with yields estimated at 12 metric tons per hectare per harvest (Peters and Hammond 1990). It has more vitamin C than any other fruit analyzed to date, more than the acerola (*Malpighia puniceifolia*, Malpighiaceae). Thirty years ago, some of this material was exported from Peru to Puerto Rico by a Florida company which attempted to market it in the southeastern U.S.; the marketing effort failed. This crop adapts well to other ecosystems outside the floodplains. Although wild today, this crop has potential to be taken into cultivation because of its naturally high yields.

Incipiently Domesticated Species

Among the incipiently domesticated crops is the cupuassu (*Theobroma grandiflora*, Sterculiaceae). The fruit is a larger version of the cacao, and the pulp is used instead of the seed. It has a very strong, pleasant, sweet-acid flavor that most non-Amazonians prefer to have very diluted. One fruit would be enough to make four or five gallons of juice. This crop is now exploding across the agricultural scene in the Amazon, with several thousand hectares planted already; several hundred hectares are being planted yearly, which for the Amazon, although it is a very large place, is a lot of agriculture. Cupuassu has immense potential (Clement and Venturieri 1990). The Ben & Jerry's ice cream company in the northeast U.S. has been experimenting with it and is expected to start distributing cupuassu ice cream nationwide within the next couple years. Cupuassu has a seedless variant, but it is not good for processing because the seed testa is still present, which detracts from the processed product.

The bacuri (*Platonia insignis*, Guttiferae) is another strong-flavored, sweet-acid fruit, some of the segments of which have no seed. It looks like a giant mangosteen with a yellow rind. The pulp is used as a processed product for ice creams, pastries, and dessert items (Clement and Venturieri 1990). This crop's industry is not booming, but

it is slowly expanding. There is considerable genetic variation within the species.

The Brazil nut (*Bertholletia excelsa*, Lecythidaceae) is borne on a large forest tree in a fruit that looks like a cannon ball, and can have a similar effect if it falls on you. It has been extensively planted by American Indians throughout the Amazon over the last several thousand years. Today, what remains are large populations of high-density stands that look like wild populations but were actually the remains of these plantings (Mori and Prance 1990).

In Brazil, the Brazil nut is now being taken into modern cultivation; there is now a 3,000-hectare plantation in central Amazonia, which is expected to put most of the wild, gathered Brazil nut out of the commercial market. The people who rely upon the wild nut will have to find something else to do; unfortunately, they lack the capital to create large plantations.

The sapucaia, or paradise nut (*Lecythis pisonis*), is in the same family as the Brazil nut. Unlike the Brazil nut which falls from the tree when ripe, the sapucaia opens, and makes a feast for monkeys, macaws, and other animals high in the canopy and therefore only rarely gets to market. This is a fantastic nut, much better than the Brazil nut, on a par perhaps with a very good macadamia.

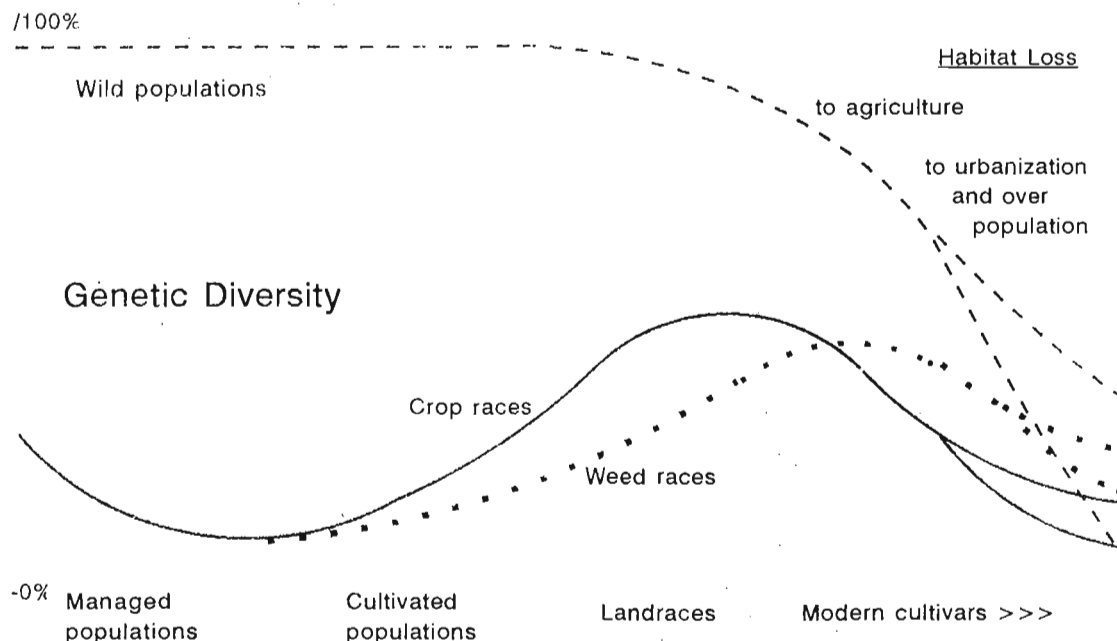


Figure 2. The creation and loss of crop genetic diversity during the domestication process (J. R. Harlan, personal communication). The sum of all wild and cultivated populations contained 100 percent of the species genetic diversity until recently, when habitat loss through human intervention became important.

Semidomesticated Species

The ucuye (*Macoubea witotorum*, Apocynaceae) is a fruit that I came across in the north-western Amazon only two months before coming to Hawaii. We might call this the "honey pot." It is a small, unimposing, brown, bag-like fruit which contains a liquid tasting like a very good honey-water. The pulp of the fruit is actually the liquid, and the seeds float in it. I believe this is a semidomesticated. It probably has little world-market potential, but it is a curiosity that could be very interesting as a back yard tree.

The South American sapota (*Quararibea cordata*, Bombacaceae) is a poorly known but excellent fruit. It has a very sweet, delicious, slightly fibrous, juicy pulp. It was recently introduced into Australia, and we have a couple fruiting trees here in Hawaii at the Malama Ki Research Station. If you have some trees that aren't fruiting, don't lose faith in them; perhaps plant a few more so they can cross-pollinate. This is a semidomesticated, but there is no commercial production. It is a dooryard tree of the western Amazon.

The Amazon tree grape (*Pourouma cecropiifolia*, Moraceae) looks like some of the Cecropias that have gone wild here in Hawaii, except for the fruit, which is very pleasantly flavored, reminiscent of the Concord grape. The pulp and skin mashed together make an excellent base for wine. I doubt this has potential as a monoculture, because it is dioecious and fruiting does not occur until it is around four years old, by which time it is a fairly large tree. It is more of a curiosity than a viable crop at this time.

The araza (*Eugenia stipitata*, Myrtaceae) is a fruit of the Peruvian Amazon, with a canary-yellow flesh that makes an attractive juice that is usually appreciated by those trying it for the first time. It is not well liked in the Amazon because it is very sour, requiring a lot of sugar, and most Amazonians are too poor to sweeten it. For the middle classes who can afford the sugar and perhaps a bit of rum to mix with it, it makes a delightful drink (Clement 1990).

Domesticated Species

The abiu (*Pouteria caimito*, Sapotaceae) is a domesticated of the western Amazon. There are two types. The oblong varieties are the more primitive types and can weigh more than half a kilogram. The spherical varieties have much less latex in the rind, which is very important for those of us with moustaches, and can weigh up to a kilogram.

The biriba (*Rollinia mucosa*, Annonaceae) is another western Amazonian fruit with two types, one with small carpel protuberances and another with large, fleshy ones. These can weigh up to 5 kg. When fully ripe the fruit may be too insipid for most consumers but when just turning from green to yellow, it has a tangy, delicious flavor.

Finally, we have the peach palm (*Bactris gasipaes*), which is one of the major works of the domestication art in the Amazon. The small fruit the American Indians found has been transformed into a variety of types throughout the region, and they are used in different ways by the people. At one time it was a staple (Clement 1988). Now, it is a minor crop, but almost everybody has a few peach palms in their back yards. It was not only a staple starch source, but it was the main source of fermented product to make beers. The beer is delightful, and when the fermentation pot is first opened, there is a noticeable smell of peaches. That is why a palm that doesn't look much like a peach has such a name.

Summary

The story I have tried to present here is the story of where our fruit crops come from. I want to alert you that the Amazon forest is disappearing; the Amazon forest as we know it today will disappear within our lifetimes. Within 50 years, most of it will have been cut down. There is nothing, really, that we can do about that. We can try to slow it down. We can try to help the Third World countries to develop in an ecologically sustainable manner. In a short 50 years we cannot turn around the trends that are causing the devastation of the tropical world today. But we have to move now if we want to save some of this immense crop heritage (Clement 1991). Planting a few of these fruit trees in your backyard helps. Everyone who is a fruit enthusiast is also a crop conservationist.

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Q: You didn't mention the heart of palm product of the peach palm.

A: The Indians only used the heart of palm when they had to cut down the tree for another reason, such as when it got too tall. The heart of palm is actually a product that modern society turned into a crop. Peach palm is being planted at a great rate, possibly 1000–1500 hectares per year, throughout tropical America. The only reason they aren't planting 5000 hectares per year is that there is not enough seed of spineless germplasm. We are currently evaluating peach palm for heart of palm here in Hawaii.

Q: Could a sapucaia fruit by itself here?

A: I don't think so. The Brazil nut is self-incompatible, and the sapucaia, being in the same family, probably is too. You would probably need a couple seedling trees.

Q: How do you determine if a tree has been domesticated from ancient times?

A: You have to look at a series of populations of that species. We started looking at the peach palm in this way about 10 years ago. We noticed that there were some populations that were immensely variable, and this is a sign of domestication. We noticed fruits that were 10 times larger than another population of commercially usable peach palms. Later, we found that there were still wild peach palms, with tiny fruits. The clinching factor to say that the plant is a full domesticate is to determine if the plant can survive in the wild. By chance, I have seen over a 15-year period that an abandoned planting of peach palm near our institute in Amazonia has stopped flowering after the canopy closes over the palms, making it essentially sterile.

Q: I have seen the South American sapote here flowering but not bearing fruit.

A: This is essentially self-incompatible also. I executed about 100 self-pollinations on six trees in the Amazon, and I got one to take. At Malama Ki, where the trees are fruiting, there are three or four together, so they are exchanging pollen.

Q: I have read that Brazil nut plantations weren't viable because pollinators weren't present, and they would only produce fruit in the jungle; is that true?

A: Almost. No large-scale plantations were put in until this recent, 3000-hectare planting. There had been a few small plantations created in different parts of the Amazon over the last 50 years. They became isolated from the jungle, and when that happened they stopped producing. The principal pollinator is a very large, solitary bee which needs other hosts during the periods when Brazil nuts are not flowering. The recent large plantation is actually planted in strips through the jungle. They open a 50-meter wide swath through the jungle and plant it solid with Brazil nut. These swaths are separated by a couple hundred meters of jungle, which maintains the solitary bee pollinator.

Q: How long does it take the sapucaia nut to bear.

A: There are two situations. The sapucaia is indigenous to the uplands, and as a seedling tree it takes 10 to 15 years. It can be grafted, in which case it takes probably about five years. The other situation is that it has been taken down to the floodplains and planted in the open as a dooryard tree, where there are much better soil conditions. Upland soils are essentially just sterile support, while floodplain soils are very rich. On the

floodplain, seedling trees start flowering in five years. So this is a tree that can respond to good management.

Q: Are there any attempts to grow starfruit or other types of exotic fruits in the Amazon?

A: Our institute has been involved in introducing some of the Asian fruits, like carambola and rambutan. These aren't really commercial as yet, but have been planted mostly in backyards and small plantations of a hectare or so. They are just starting to appear in the markets. I'm just talking about the Amazon now. Brazil is a major tropical fruit exporter, and in the developed parts of Brazil

they have a tropical fruit agriculture that is on par with Hawaii. The Amazon is almost another country, and it is a very underdeveloped country. Right now there is some interest in developing exotics, but it is the cupuassu that is really taking off.

Q: Is the cupuassu the one that tends to form a jungle?

A: No, that's the bacuri, the *Platonia insignis*. Once you get that into your orchard, you can't get rid of it again, so you have to know what you are doing when you plant it.



Domestication of peach palm has included selection for larger fruit (photo: Charles Clement).

Atemoya Cultural Practices and Market Development

Mike Strong

I am a farmer from Kauai, and I am going to discuss my topic in the context of how, historically, we got to where we are. I graduated from Cal Poly, San Luis Obispo, in 1973, and came to Kauai right afterward. At that point the 15,000-acre pineapple business on Kauai had just gone down, and the Kilauea sugar plantation had also, so there was a lot of land and labor available. The county hired about 200 workers, so that was their answer to that problem.

At the time, I couldn't believe the price of food in this state, and I couldn't believe how few people were farming, and I noticed that most of the people that were farming were old. My first job in agriculture on Kauai was to pick guavas for 5¢ per pound for a few months. I leased about 5 acres of land. I worked for some rich people who had a psychotherapy operation and needed some farming to qualify for some housing. I had about 7 acres altogether and grew trellised cucumbers, tomatoes, and did intensive small-vegetable cropping. I learned a lot from the old-time Japanese farmers around there, who helped us out a lot.

In 1977 a lot of land was opened up in the former Kilauea sugar plantation, and we were able to get 25 acres of land in fee. We made a partnership arrangement with an adjacent landowner, so we had 50 acres. In 1980 we got another 70 acres through another partnership. From 1977 to 1982 we grew mostly bell peppers, papayas, and bananas. One year we produced about 5 million pounds of papayas, which was the biggest mistake I ever made. We were trying to make stepping stones out of stumbling blocks. We learned that it's not how much you produce, it's how much money you make. That sounds pretty simple, but it wasn't so simple for me to learn it. We were making about 5¢/lb except when the containers didn't make it; then you would have to work for another six weeks just to break even because you lost the one container. Believe me, in the export business you lose containers; I don't care how careful or smart you are or how good everybody is between you and the market, there are going to be problems.

1984 was a big marketing debacle, because in 1982 we got hit by a hurricane. Up until that point, Kauai had produced about 10 percent of the state's papayas. In 1980-81 we had 14 months of

rain, which killed all the papayas on Kauai. Everyone planted their papayas back, and the hurricane in 1982 wiped them all out again. In the interim, the guys on the Big Island started planting out to make that other 10 percent, and then they increased a bit beyond that, as people will do. So when Kauai came back into the market in 1983-84, there wasn't any room in the market, and nobody had expanded the market. In 1984 you couldn't give papayas away. We tried it; on the mainland we tried to give people papayas just to get them out of the containers so we could give the containers back, and so we didn't have to pay for the dumping charge, plus the shipping charge, plus the holding-onto-container charge! These are some of the lessons that I have tried to remember as I have gotten into these other crops.

So we were pretty tired in this big farming operation. We could produce the fruit, no problem. But the goal is to make a living, preferably a good one. We started at the very bottom, living in tents on our land for a year. I only got electricity about seven years ago. We put every dime back into our farm. After all these debacles, in 1983 I went to see Dr. Phil Ito and asked him which tropical crops we should grow. He said he was growing carambola and atemoya. I figured if anybody should know, he should. We were continuing to farm small amounts of papayas, and we had kept our bulk up in our banana operations, but we still had some land to start atemoyas with (which, now, turns out to have been marginal land).

We had developed some requirements through all our problems. For example, we noticed after the hurricane that a lot of the tree crops were still standing, whereas all the bananas, papayas, and peppers had gone down, and that made a big impression on us. All our experiences had forced us into some conclusions, which were that we needed, first, something which was going to give us some money, more than 5¢ return. We had made money from our bell peppers and bananas, but every day that a semi truck left our farm with 20,000 pounds of papayas, we lost \$5,000; we would have been better off if the truck had just broken down.

Another requirement was to grow something that people would eat. That sounds simple, doesn't

it? Well, it's not that simple. You want something that is not an acquired taste, to break into a market. I have to take my hat off to the people who developed the avocado. It is not like anything else; it's pretty bizarre . . . it's not sweet, it has no texture . . . those guys did a good job.

So, high return, something people eat, not an acquired taste, something that will grow on Kauai; also, we wanted something that would take some cultural finesse, something that you can't just stick in the ground and produce, because that leads to too much competition, which we had enough of. We also needed something that had available literature and an existing industry outside of Hawaii, someplace where we could learn. Also, something that was not already being grown here. And, we had gone really gung-ho into our other crops, working 12 hours a day, seven days a week, and we were tired of doing that.

We settled on atemoyas because we knew there were long-standing industries in South Africa, Australia, and Israel. Atemoya, as you probably know, is a cross between *Annona cherimola* and *A. squamosa*, and it was designed to bring cherimoya down to the lowlands. Atemoya had languished on experiment stations all over the world since the 1890s, but it had only been a commercial fruit in a few areas. That threw us for a while; we were concerned that there was some hidden kicker.

We went to Australia in 1983 to learn about atemoya from growers and the Department of Primary Industries. The main two commercial varieties were 'Pinks Mammoth' and 'African Pride'; at that point, the newer growers were growing 'African Pride', and the older growers were sticking with 'Pinks Mammoth', and everyone had their different opinions. The 'Pinks Mammoth' didn't set fruit as well and was really grotesque looking; 'African Pride' was more regularly formed but it had some internal problems. After that, in 1984, we went to Florida where they grow 'Gefner', which is the parent of all these others. The 'Gefner' is *maybe* from Israel; the 'African Pride' is *maybe* from South Africa. The 'Gefner' grown in Florida is much more regularly shaped and, to my taste, much more attractive than any of the other atemoyas or cherimoyas. They were getting \$2.25/lb in Florida, to the farmer; that really got our attention.

In Australia, on an experiment station, a guy made a comment that if you want to produce flowers on cherimoyas, you pinch the end and strip the leaves off. They had fooled around with

defoliating like they do to cycle guavas. This was going to give us the ability to control the market by when we produced our fruit and how much we produced. One of our advantages over other places where they were currently growing them is we don't have winter. In Florida, atemoyas aren't available after November.

For us, everything centers from who's going to buy this fruit and why they're going to give you that money, and works backwards. Because what I'm in this thing for is to make a living for myself and my family. So controlling the flowering was a very important point.

The variation in rootstocks used in all these different places was something we had to sort out. In Queensland, which is almost like Santa Barbara, California, they used cherimoya rootstock, which was good there because it's cold, but for Hawaii cherimoya rootstock is very vigorous. Even though the white cherimoya rootstock is supposed to have resistance to phytophthora and some of the bacteria, for us it was just too vigorous; you had to wait too long; you could strip leaves and they wouldn't produce flowers. We tried all these rootstocks. It was suggested to us in Australia that we should use atemoya, but when you use atemoya seed you have a genetic problem, because 25 percent of it wants to go to one parent, sugar apple, 25 percent wants to go cherimoya, and 50 percent wants to go atemoya. That leaves you trying to look at little seedlings to figure out which way it's going to go. In Florida, they use the sugar apple, which has benefits in that it is true to type, it produces more fruit earlier, more regular-shaped fruit. In Australia, sugar apple wasn't a good performer. Over the years, we have come up with better sugar apple types from Southeast Asia that are more tolerant of wet, and we have come to understand that you have to filter every bit of information from elsewhere when you bring it to Hawaii.

Here on the Big Island they use pond apple, which is another annona; they interstock cherimoya, and put atemoya on top of that. If you are going to interstock, you need to use an interstock of cherimoya 18-24 inches long grafted to the pond apple rootstock at a minimum height of 8-12 inches above soil level. The pond apple is very resistant to swampy soils. On Kauai, when we used pond apple rootstock we got grotesque fruit, and in our conditions, which aren't swampy, it is too vigorous.

These are some of the details that we dealt with. There aren't any big secrets. Nobody is going

to want to collect the pollen every evening and pollinate flowers the next morning, but that's what you have to do to control the flowering. I saw at Frank Sekiya's place in Mililani, which is in the midst of pineapple fields, that these beetles came from the pineapples and mobbed his flowers and he got 100 percent pollination. We don't have the pineapple fields. We take pineapples and throw them under the trees, hang them from the branches, but this seems to be a lazy beetle.

There are so many little problems, like in the fall when we go to collect the pollen, honeybees, for some reason, go ahead of us and take all the pollen. But apparently they can't bother to get up into the flowers to pollinate. The down side of the 'Gefner' is it doesn't hang on the tree. When they're ready, you have maybe seven days to two weeks from when they can first be picked. The 'African Pride' has about a month from when you can first pick it and have it ripen satisfactorily until it turns yellow and gets stung by fruit flies.

The basic, major problem of the atemoyas is tree decline. We saw this first in Australia and again in Florida. These are not strong trees. That's why they like pond apple and cherimoya rootstock, but you have to weigh tree decline against precociousness, how early you are going to get fruit. It doesn't do us any good to wait six years for a tree on cherimoya to start its 20-year bearing period, when we can be making money in two years from trees on sugar apple. That has become the trend in California with starfruit and so on; people are not looking at 25-30 years. We want to make money in two or three years, because we don't know what's going to happen! EPA could outlaw oranges in 10 years, or whatever. It's a sad commentary, but it's the truth: we have to make money, right now.

We've been through bacteria, phytophthora, and pythium. In Florida they don't have phytophthora but they have pythium. In Australia they have bacteria. In Hawaii, we have all of them. Those are the basic problems with the tree; all the other things are treatable, but when the tree dies, that's it. And then of course you have hurricanes. I just went through my second one, and it was an experience.

Another criteria we had was we wanted to get away from spraying, because we are right next to town. Chemicals are being outlawed, so we need to do something that doesn't require chemicals. The amount of chemicals it takes to grow rambutan, atemoya, or lychee is small compared to what it takes to grow papaya or vegetables. We do have

the black twig borer, which you may have seen in avocado; it causes limbs to die. It is generally not a problem unless the tree is stressed or you've recently pruned it. Most of the problems focus around the fruit. Ants bring up mealy bugs. Mites and thrips get inside the flower. Fruit flies are controllable with border sprays; if you spray borders twice a week, you can control the oriental fruit fly.

To control the market, the technique of chemically defoliating blocks of trees as they come out of dormancy will lengthen the market by making the fruit set begin earlier than if the trees had not been defoliated. For example, out of 500 trees, defoliate 100 trees every week. To lengthen the market at the end of the season, the limbs that have no fruit can be hand-stripped of leaves to produce flowers for a second, "late" crop all the way into March. Of course, all the flowers are hand pollinated. Our market lasts from September to March. If we didn't defoliate, our market would last from October to maybe December.

We field-plant our rootstock and graft in the field with plastic bags over them, and we have seen that this helped to some degree during the hurricane.

We produced a videotape to show in the supermarket to promote atemoya. But do you think people shopping, like moms with two kids in tow, are going to stop and spend five minutes watching that tape? No. This conference is the best venue I have had for that tape in four years. It is a great tape, but.... The moms like to leave their kids to watch the tape; the kids eat all your free samples and watch the movie over and over again, but the kids aren't buying too many \$4-a-piece atemoyas. So we edited the tape down to about 20 seconds, saying the fruit tastes great, here's how to prepare it, and here's why it costs so much. That's important. We wholesale at \$1.25/lb. The markets end up, in their wisdom, selling it for \$3.50. We try to get them to sell it for \$3. It is not like people fall all over themselves to pay you \$3 and \$4 for one fruit, that they don't even know what it tastes like. We targeted two basic markets, ethnic and, for want of a better word, yuppie. People who have some money, and people who are already used to eating this kind of fruit. People in Asia and Central America are used to paying money for fruit! We are used to getting fruit for practically nothing.

When I started marketing atemoya, I had been selling produce for 12 or 13 years in Hawaii, to two major wholesalers and one minor wholesaler, and I thought I had, you know, *connections* in

Honolulu. Wrong. These guys took one look at the atemoya box, and wanted nothing to do with it. Then they ate it: "It's too sweet. It's too ugly." I had thought they would be excited to have something *new*, something nobody else has; that wasn't the case. They had enough problems with things that were old. I'm trying to sell them something new, that can't have ethylene around it because if it's in with ripening bananas it will turn black, and a whole list of handling instructions. But I told them I would go to the stores, pay for demonstrations, provide the fruit, get the girls to demonstrate, call the stores, do the follow-up . . . all they had to do was drive the stuff to the store. They still didn't want to do it. They were afraid that if the stores were unhappy with this, they wouldn't want to take their tomatoes, whatever. What we needed was someone that was hungry, like we were. We had needed something new, and we needed somebody like us, but in the selling market.

The problem with Honolulu is, in a town about the same size, like Sacramento, there are 20-30 wholesalers. In Honolulu, there are about 95, and everyone's got their little niche except for a few of the big boys, and nobody wants to rock the boat. I just love it when another boatload of Chinese jumps off the dock at the pier and runs for Chinatown: we just got another 40 customers! But that's a hard way to get them. The point is, a lot of these wholesalers sell to a *really* ethnic niche, and they have contacts, usually relatives, in markets all over the world. We've sold atemoyas through our wholesalers to Vancouver and Hong Kong. The wholesalers we work with are really motivated, and they have the same motivation we do.

Our fruit requires special attention in order to get to the marketplace and sell for a good price. The presentation of the fruit is important. I was appalled to see the way rambutans are sold in Australia; as soon as they are unpacked, they start desiccating, especially in an air conditioned store. That's why we pack our rambutans in plastic pint containers with air holes for circulation; they have hard plastic tops and hold ½ pound of fruit. This way, with no postharvest treatment, the rambutans retain good color, and there is no desiccation of spines for two weeks. The American retailer likes packages, likes units, doesn't like messy things. Messy is like the tissue paper we packed with before we got these socks. Messy is lots of recipe cards in the box. You have to put recipe cards where somebody wants a recipe card. We spent \$2,500 on these recipe cards; we don't want them

littering Chinatown.

In Hawaii, it is going to be a while before a lot of our crops reach their potential, or saturate the markets, and we are going to be able to get good returns on them for a while. We have a totally untapped market, a market for us now and in the future, and that's in the tourist business. Lychees are common in Hawaii when the crop comes in, but I defy you to find a tourist who gets a lychee in their mouth. Maybe they eat a mango in some kind of fruit salad where they don't even know what it is. We have to make a concerted effort to reach these tourist groups. I don't know how to get to the people in that industry, but when I was involved with papayas, the UH did a good study on papayas and our customers on the mainland, and they found out that 85 percent of those who bought papayas first tasted it in Hawaii. That's important. If we can reach the millions of tourists that come here every year, we are sowing seeds for the future market. We have to start now. The rest of the world is not standing around; they have the same problems we do. Their sugarcane isn't getting any better price than ours.

As growers and individuals, we have to force some action on this fruit fly problem, which has been screwing the state over for a long time. You can't talk about diversified agriculture and not be able to export crops! You can *talk* about it, and that's a lot easier than producing it, but you're not going to create too many farms.

I am on a lot of state committees related to agriculture, and I am constantly amazed. There's a conference coming up on "Agriculture 2000," and fruit flies aren't even on the agenda. Are they kidding? As someone in the trenches, so to speak, I can tell you that if the fruit fly thing isn't cleared up, what are we going to do? You are out there planting trees, and where are we going to sell the fruit? We're not. We soon may have ARS-approved treatment guidelines for carambola, maybe the following year for lychee, but we still have the problem that it takes about two years of testing commercial coolers with probes and so on to prove that the treatment works. We used to count on the University to help us out, like with papaya, but with their cuts in budget I don't know if they will be able to do that. Even then it took two years, and we were dealing with papaya, which you can pick every week.

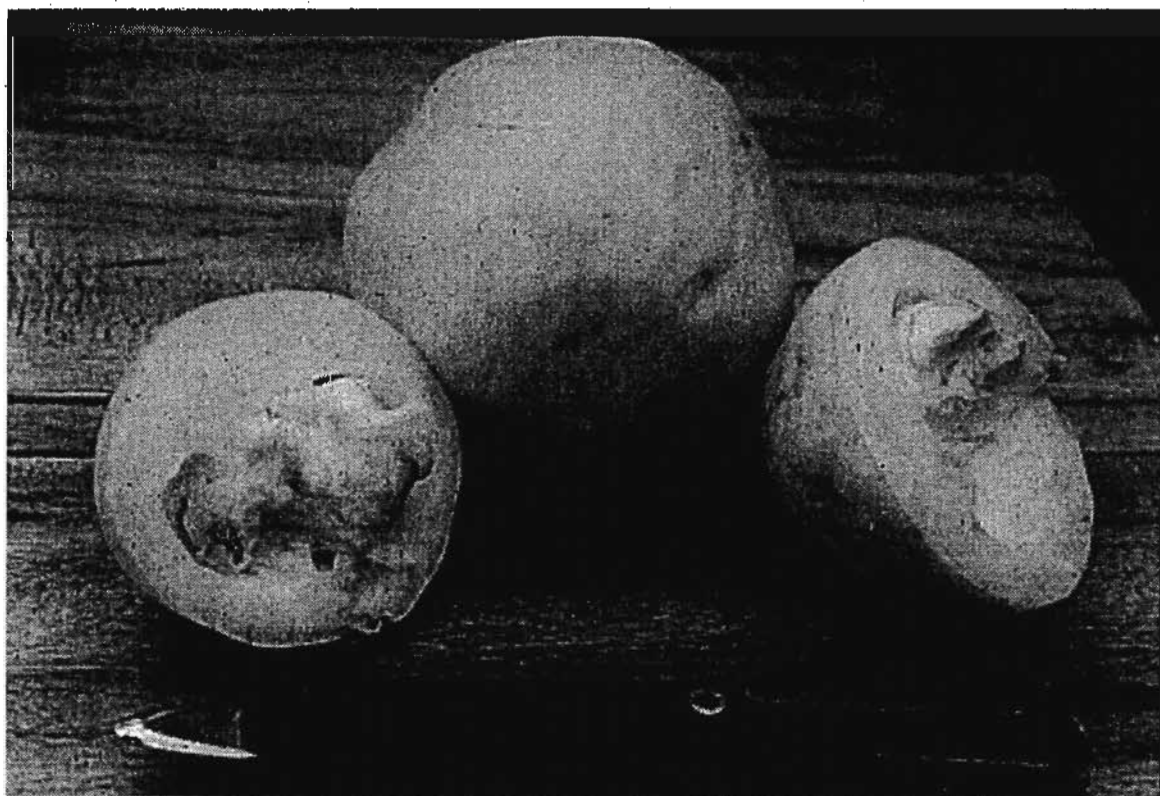
There's another thing I've been working on for eight years. Up until 1969, they allowed fruit from fruit-fly-host countries to be shipped to states north of the Mason-Dixon line - all year, not

just in the winter. USDA-ARS did studies, and there is not a shred of scientific evidence that fruit flies ever moved from north of the Mason-Dixon line to host states like California, Arizona, or Texas. The situation is that they just arbitrarily cut off this market of maybe 80-90 million customers. Florida has the Caribbean fruit fly, but they can ship their citrus all over the country, except they have to put a stamp on it that says "Not to be shipped to California, Texas, or Arizona." Those fruits can go right up to Nevada, but those fruit flies are politically correct: they are not going to go into California! But they don't want our fruit anywhere.

We have a big testing area to prove the veracity of what I am saying. Canada takes fruit from all over the world, untreated, all year. If the premises and the fears of USDA-APHIS and California's quarantine agency are well founded, how can they possibly have a pear, apple, and summer vegetable business in Canada? According to their logic, fruit flies must be everywhere, and those fruit flies will infest all the potential hosts. Then,

of course, like the Huns, rapacious hoards of fruit flies would attack California from the north. But that hasn't happened. That's the fact. Meanwhile our tax dollars are going to Central America in an attempt to find fruit-fly-free zones, treatments for crops, etc., while we are the most restricted entry point in the U.S., the only state with a federal, APHIS embargo as opposed to inter-state embargoes.

There is nothing as exciting as giving people a tropical fruit to eat for the first time . . . lychee, rambutan, atemoya, mangosteen . . . it's great. But we have nowhere to go after the peoples' market in Honolulu; that's it. We are at a stage where we need a multi-pronged approach to the fruit fly problem. We should continue with eradication, we should try to get an irradiator, but meanwhile we have to create an environment for people to go plant the crops. We can't just wish to preserve agricultural land after sugar and somehow expect entrepreneurs to go out there and create something. It's not going to happen. How are they going to make any money?



The araza (*Eugenia stipitata*) from the Peruvian Amazon is used for juice (photo: C. Clement; see p. 26).

Hawaii Agricultural Promotion Association

Eric Weinert

I would like to introduce you to HAPA, the Hawaii Agricultural Promotion Association. It is a group of all the more than 40 various, diverse agricultural commodities that are produced in Hawaii getting together as one unit to promote Hawaii's agricultural products.

I got involved because I am a tropical fruit farmer who had started working on the marketing of Hawaii tropical fruits. We did a "SWOT" analysis with the University of Hawaii. We went to Oahu and brought in all the experts and assessed the relevant strengths, weaknesses, opportunities, and threats. We decided that we don't really know how to market these fruits and that we should open it up, get a good forum, bring in experts from state departments, growers, wholesalers, and retailers. We met together and "brainstormed" how to market. From that, a marketing plan was written for our group. The conclusion of that activity was that we lacked the resources and the volume to implement some of the really good ideas in the plan. That led me on the road to HAPA. We realized that our group's problems were not unique to us but were shared by many other groups, such as avocados, guavas, macadamia nuts, even flower growers. We thought that if we could combine our efforts, we could be more cost-effective and efficient, getting more "bang" for our buck.

This past summer I went to Thailand to a postharvest conference; Leslie Hill and Mike Crowell were also there. What impressed me was the new longan plantings in Chiang Mai. I didn't really see the scope of it until I left on the airplane on a clear day, and saw longan plantings going for miles and miles. Their labor costs are \$1/hr. Thailand is one of the more upscale Asian countries, and the Thais were complaining about the Vietnamese, who were being paid \$1/day. Hawaii is certainly not going to be a low-cost producer competing in this world.

We are going to have to rely on the quality of our product, and we need to associate with our worldwide image as a magical place. Our fresh product, like Mayor Yamashiro said this morning, needs to be a quality product, because we are not going to be the lowest-cost producer.

We also need to work together, as a group. We can't look at ourselves as neighbor vs. neighbor, trying to corner little pieces of the market. We

need to share information amongst ourselves, because it is really Hawaii vs. the rest of the world. It is a shrinking globe, and Hawaii's growers need to work together if we are going to be successful and agriculture is to remain in Hawaii.

I think we need to make the case that agriculture is directly related to tourism. With tourism down, everybody, no matter what job you have, feels the pinch. Look at the green open spaces around us . . . that's why people come to Hawaii, because it is a magical place, it's green, it's different from what they have back home. We need to link together with tourism in marketing our fruit products. If we can be successful, tourism will be successful in the long run, and we need to make that case. Hence, HAPA's goal is to create an identity for the quality, Hawaii products. The Hawaii-HAPA logo uses the Island Fresh logo with the Big Island outline underneath it. HAPA is starting on the Big Island, because that's where a lot of agriculture is. We want all local producers to begin using that logo so that the consumers can begin to identify locally grown products. We need to convince our local population to purchase locally grown products. The dollars stay here and get recirculated. HAPA's goal is to raise that consciousness level, and we're going to start right here, locally. This logo can be adapted to all the other islands. I've seen the Island Fresh logo with "Maui Grown" beneath it.

HAPA is just getting started. We have the Hawaii Agricultural Commodities Service as our executive director. Next month we are going to begin a campaign with the media, local newspapers, local cable television channels, and the radio stations. We will make the case for the local population to purchase and support local products. We are going to try to get the ball rolling, and then let the membership follow. We are starting on our own island, with our own products.

Another goal is to work with the supermarkets. Many individual farmers have difficulties working with supermarkets. I know that when I take my limes to supermarkets, I get the lowest price that is being paid for mainland limes. Regardless of what they are paying me, the retail price never changes. This is not creating a greater demand for my product. Instead of complaining about the supermarkets, we want to enlist them as partners and bring them in to share our visions. We want to

map out the peaks of various products, sit down with the retailers, and promote year-round local products. This will be a win-win situation for farmers and supermarkets, and for local agriculture as a viable option in Hawaii.

HAPA meetings will be held at the Hawaii Island Economic Development Board (HEIDB) meetings at Waimea, Volcano, Hilo, and Kona, once a month, rotating around the island. The meetings are at 5:00 pm on the second Wednesday of every month. Please join and support us.



The ucuye (*Macoubea witotorum*) is an unusual fruit of the northwestern Amazon. Its “pulp” is a sweet liquid, in which its seeds float (photo: Charles Clement; see p. 26).

Marketing Panel

Masa Hanaoka
Marketing Division
Hawaii Department of Agriculture

You have to know the size of your industry before you can start developing a marketing plan. In its second annual tropical specialty fruit survey, the Hawaii Agricultural Statistical Service reported that in 1992, 70 farmers grew tropical fruits on 360 acres throughout the state. Estimated farm value of the 1992 crop was \$365,000, up approximately 80 percent from the previous year. The growth in sales was mainly attributed to an increase in fruit production as planting matured from the previous year. Although Kauai was devastated by Hurricane Iniki in September 1992, its farm sales totaled 196,000 lb, higher than the previous year and tops in the state. Farm value for Kauai sales was estimated at \$155,000, 42 percent of the total sale value for tropical specialty fruits.

The island of Hawaii accounted for 63 percent of the total specialty fruit acreage and generated 29 percent of the total sales volume of 484,000 lb. Expected statewide sales volume for 1993 is estimated to be 725,000 lb. Our survey found 26,200 tropical specialty fruit trees commercially grown in the state, and 9,920 of these were bearing fruits in 1992. Our survey also showed that 5,290 new trees were planted in 1992 and that planting intentions for 1993 was 2,790 new trees. These numbers tell me that the tropical specialty fruit industry in Hawaii is relatively young, but it is growing rapidly.

In marketing emerging crops we found that the supply volume during the industry's early years is always less than the market demand. But in each one of these new, emerging crops that we have dealt with, the supply eventually exceeded the demand and we end up in a buyer's market situation.

I am encouraged that you have a good segment of today's program on marketing. Listening to the speakers today, it is clear that you need to do a lot to get your marketing show on the road.

Speakers today alluded to the tourist industry. We in the Hawaii Department of Agriculture are focusing a lot of our promotional efforts in the tourist market. We have worked with the Hawaii Visitor's Bureau, Hawaii Island Chapter, and they agreed to incorporate a part of our "Island Fresh" logo into their Chapter's identification logo. The Chapter, in one of their promotional materials,

has a section devoted to Hawaii's tropical fruits and flowers. We are working with tourism in trying to get the word out that Hawaii does have beautiful flowers and delicious fruits.

HDOA and the Department of Business, Economic Development and Tourism are sponsoring a series of food festivals, one of which is going on today at Kaiko Mall: the Mac Nut Festival. I think seven million tourists visiting the state annually provides you with a good market potential for your products. Many older local people know a lot of these fruits. I grew up with these fruits, but today I can't find them in the Honolulu supermarkets. I occasionally find them in Chinatown and the Ala Moana farmers' market, only because those two market areas cater to ethnic groups. I think there is a place for your products in the local market. You can forget the mainland market for now because of the USDA's plant quarantine regulation that virtually excludes it as a market for your product. A recent amendment to this quarantine regulation allows tropical fruits from Hawaii to land at a mainland port and be transshipped to a foreign port. Those fruits would have to meet USDA packing and shipping specifications and other conditions. To my knowledge, no one has yet taken advantage of this option.

We in HDOA hope to help your industry. One of the biggest problems you face is the number of varieties or species of fruits that you are producing. Someone put the number at about 100 fruit varieties. I've never seen or tasted at least 90 percent of the fruits in your display. You speak of quality, and in fruit that is usually its external appearance; if it looks good, it must taste good. Some of these fruits are among the ugliest things I have ever seen. So what kind of quality are we talking about? It is going to be a difficult sell, so we would like to work with the industry to help develop quality criteria you can use to sell your products.

We developed a sales kit for the guava industry. It contains generic informational leaflets and was designed so that information and price lists from individual companies may be added to the folder to allow it to be used as a sales kit. We have an export directory that is distributed throughout the world by agricultural attachés in our U. S. Embassies. We receive many inquiries from people using this directory. If you want to be listed

in it, contact us.

One of the problems we have with the directory is that people not ready to be in the exporting business want to be listed. One of the worst things that can happen is for someone to call or write you for sales information or an order and you do not respond. This has happened on several occasions in the past and it does not help Hawaii's image as being a dependable supplier. We try to limit the names listed to those that are actually able to sell in the export market.

You need to determine which varieties you want to promote, and maybe we can develop a poster similar to one we did for the cut flower industry, one which shows pictures of the varieties and gives their names and seasonality. We also developed informational pamphlets on papaya and guava with French and German language text. We developed a poster for a previous ANUGA show that features starfruit, "apple" banana, guava, avocado, pineapple, papaya, macadamia nuts, and Kona coffee. In developing these materials, we always work with the industry, and last year we developed a guava brochure and an avocado brochure in French, a tropical fruit recipe brochure, and a lychee brochure. Several years ago we developed pocket-sized brochures featuring manufactured food products and nursery products to pass out at trade shows. We can help you develop these types of promotional materials. You are considered an emerging industry, and development and publication of these types of printed materials can be funded 100 percent by us. This year, our budget to develop these materials actually has been cut by 50 percent, leaving us with half the money we had two years ago. However, there are many things we can do for you and want to do for you, so don't be afraid to ask.

Morton Bassan, Jr.

Ka'u Gold Oranges

Marketing is a large subject with many variables. I have put some of my ideas down in a handout. [See Appendix 1.] My theme is that you don't want to leave your livelihood, your investment, or your family to blind luck. If you want to make a profit, send your kids to college, buy a new car every once in a while, or take vacations, you want to run your farm like a business.

Masa Hanaoka mentioned about the law to be able to transit goods to the U.S. on their way to a foreign country. I went to Washington, D.C. in 1991 and met with Chauncy Ching in Senator Inouye's office with the purpose of trying to push

this law through. I had tried to do it with correspondence and telephone and tired of that. The personal touch is the only way to go, and that is true with marketing as well. The effort that is required to sell your product is the same as you use growing it, harvesting and packaging it, protecting it from pests, and those kind of things. Don't neglect the final step that determines profitability. Go to the people who buy your product and make a good presentation. Things like point-of-purchase material, in-store sampling, advertised specials, and cooperative advertising are important.

I do a lot of cooperative advertising. The concept is that the grocery store wants to move product, and it doesn't matter which product. If your product is not on the shelf, they will fill it with something else. They can't sell the air where your product should have been.

We have about one million people in Hawaii, not including transients. Canada currently has about 29 million, three million of which are in southwestern British Columbia. If you want to quickly increase your market area, the easiest way is to move into an area like that. The problem we encountered in the past with exporting was that we were not allowed to transit the continental United States, so we had to ship by air from Honolulu to Vancouver, B.C., as an example of an intermediary destination; you could not go through, for example, Seattle. The new law has a nice twist to it, but it also has some demerits. The nice part is you can now ship by ocean directly from Hilo or Kawaihae to Honolulu via Matson, or from Molokai to Honolulu via Young Brothers, and then to Seattle. From Seattle you can truck it, via a corridor determined in your transit permit, to your destination, Blaine. I was trying to get the destination to be Port Angelus, because my primary market focus is Vancouver Island and Victoria, but I was unsuccessful because there are no APHIS inspectors there.

The key in selling this is not just sending it somewhere; you have to make the sale beforehand and have people who want to receive it and will properly promote and handle your product. That is all part of the sales effort. In my organization I use in-store sampling, point-of-purchase material, and then careful supervision of the actual displays. For example, in a chain store on Vancouver Island to which I sent an ocean-going refrigerated container load, I noticed they were putting on decals saying "organic," which it wasn't. This is where your involvement in supervision comes in.

Another problem that arose was that the product didn't get out to the stores fast enough. I scheduled four-hour in-store sampling promotions. The competition, Sunkist, was 28¢/lb at retail; mine was \$1.19/lb, which was quite a discrepancy. Using techniques to *create the demand* is the whole point of marketing. Out of 200 items that this particular chain store tracked, sales of Ka'u Gold oranges were number five, in the face of that lower priced competition and along with all their other products.

You can make a sale of a poor quality product once, but you will never get good volume. We work very hard on quality control.

Peter Merriman

Merriman's Restaurant, Waimea

I am also president of the Hawaii Regional Cuisine Chefs' Association, a nonprofit organization of chefs around the state which primarily promotes Hawaii regional cuisine and contemporary cuisine here in Hawaii and facilitates the juncture of the state's agricultural and culinary communities. For the past 10 years I have been involved with trying to develop sources of locally produced agricultural items, everything from livestock to cheeses to fruits and vegetables.

I have been asked to tell you what chefs expect. Before I try to do that I would like to say some things to new or future producers. The number one question I am asked in situations like this is What do I grow? It is a good question. My short answer is, Grow an impact item. By an impact item I mean something that is really going to affect the ultimate customer, being the diner in my restaurant. For example, I like to use mango and starfruit, things that really don't need much attention from me as a chef, but are really great and can be sliced and served and really make an impact. If I can get items like that, I have a real interest in buying it; Morton's oranges are a classic example, because the quality is so good.

When you think about the very exotic fruits, like people come to me with really weird things from the Amazon or something, I don't think that's the future of cuisine. The cuisine for the 90s is reflecting society as a whole. People are going back to basics, but they are looking for quality. That's why Morton is able to sell the \$1.19 oranges over the 28¢ oranges, because the quality is so good. I personally feel that is the direction in which the entire agriculture industry in Hawaii should go. But I'm getting ahead of myself.

Anything that can be grown in Hawaii can be

grown elsewhere more cheaply. However, it cannot be grown as well as here. When you have an orange grown in Ka'u, my waiters can tell customers that we have these Ka'u oranges that are the best oranges in the world; they look a little weird but they're so incredible. Then the tourists, who are a big portion of my market, get an experience that they cannot get anywhere else. They can't get it in the mainland because of the export restrictions. My personal opinion is that smaller producers should forget about the export market and sell here to the tourist industry and provide a product that can only be bought here. As a restaurant owner, I am willing to pay well for something that cannot be found elsewhere.

I like to use cherimoya as an example of what is not an impact item. As a chef, it takes some processing, the best thing being to remove the seeds, make a pulp, and turn it into a mousse. Then you have already diluted the beautiful qualities of that fruit. If I just slice cherimoya and put it on a plate, it may be the best cherimoya they ever had in their life, but it is also the only one they ever had, so I haven't made a huge impact on my customer, and it doesn't have as much value to me.

Another example might be limes. It seems like everybody grows limes, and they are beautiful limes. But we aren't selling limes; we use limes as a garnish, and they look beautiful, but we can't say, "We have this ice tea, and we're going to put this slice of Ka'u lime in there." That isn't going to make an impact on my guest. Maybe to argue the point, if you had a really juicy lime it could make an impact on the chefs because it would take less limes to produce a quart of juice.

If you are a new producer, how do you approach a chef or a restaurant and start selling your product? I would say that if you are going to show up at a restaurant, make sure you have a business card and a price list, give the chef something to hold that has your phone number on it so they can call you back. This is simple, but it is basic. Also, treat the restaurant as a business. If you are going to come in with your new crop of limes, call, make an appointment, show up with a sample, a business card, and a price list. If you show up in the middle of my day, I might not even have time to talk, even if you have the best limes in the world.

You absolutely must have an answering machine, because chefs are very busy and they don't have a chance to call you twice. Remember that we work the opposite ends of the clock. You

all are out in the field at sunrise, and we are just about going to bed at that hour. Often we'll have growers calling us at, apparently, the end of their workday, around 6:00 in the evening, and that's when we are extremely busy. You should take the marketing perspective and if it needs to be done in mid-day, you have to do that if you want to get the attention of the chefs.

When you have made the initial contact with a chef, find out who to call and what time of day to call them. For example, in my restaurant, I will tell you to call Sandy any day but Tuesday or Wednesday after two o'clock and before five o'clock. Then, you call them, don't wait for them to call you.

What do we expect? "Supply and quality" is everything. I am very willing to pay more money, a lot more, for quality agricultural products. I probably don't represent the majority of chefs in the state right now, but I am certain that I represent the fastest growing segment of chefs. It is becoming so competitive, you have to have quality. Chefs are coming around to understand that they need to pay for the quality. Quality is number one.

In terms of supply, never promise what you can't deliver. If a supplier has a lime tree and tell me they will have limes for the next three weeks, I can plan my menu and purchasing around that. But if they come up one week short, it can really be bothersome to me and I will be hesitant to go back to that supplier again. If they say three weeks and go to four weeks, however, I won't shut that supplier off at the end of three. It is real easy to continue the program in the context of what I am doing, but it is very difficult to switch on short notice. Bigger operators with printed menus are in a real jam if you promise them something that is on their menu and then you don't have it. Don't promise more than you can deliver.

Generally, chefs are real tough up front, because they need to be. You get a lot of quacks coming in the back door of the restaurant. As time goes on, you will develop a relationship with them, and they will work more and more with you. As chefs we have kindred spirit with farmers and people in the agricultural community, and generally you'll find that good relationships develop over time. We will work you a lot; you just have to be straight in the beginning. Don't be afraid to promise too little. It is easy for us to plan around a little, but it is difficult to react to having been promised too much.

Lastly, my feeling is that, regarding the tourism industry with which I am involved in a big

way, what we want to see in the next 10-20 years in this state is the development of a uniquely Hawaiian experience. We see Las Vegas coming on with fancy types of entertainment, and Disneyworld, and so forth. How can we compete? Well, we can't compete, except if we are unique. That is why I believe that one component of our uniqueness can be the food that is available here, just as it is in New Orleans. People go there because of the cuisine, and that can happen in Hawaii, too. I think it is going to happen. You can be in position to take advantage of that if one component of the cuisine is the incredible tropical fruits that are available here.

Q: I would like to make a comment in reaction to some of the things that have been said. I like the idea of using tourism to promote our products, but I think our products can be so good that they can promote tourism. What about a tour for people who want to see a tropical fruit farm? This could be marketed on the mainland, and some people might come here just to have that experience.

Eric Weinert: We have had a number of inquiries about just that. There are some farmers in South Kona now that are charging to go to their farms. We have a cookbook coming out at the beginning of next year, and in the back of it we will list a few farms that are available for tourist visits.

Q: Peter, do you think there would be a market for sorbets on the mainland?

Peter Merriman: I think there is a market, but you have all the problems of transportation costs, etc. I think you can get more money for your mango as a fresh fruit than as a puree, because the qualities of it don't shine as greatly once it has been processed in any form.

Q: What is meant by cooperative advertising?

Morton Bassan: One example is Foodland's "shop for better education," where kids from different schools collect cash register receipts, and the schools can get computers. In that promotion, you pay to participate, and for a certain period of time the store puts a notice by your product indicating that you are participating. Your contribution to the cooperative advertising also will determine the size of your product's advertisement in the store advertisements in the newspaper. You can pick the programs you want

to participate in. Basically, it is paying for, or helping pay for, advertising.

Q: Some of our fruits are available for only a short period of time during the year. We have been wondering how to bring this availability to the attention of tourists, and we thought of having some printed material for restaurant tables advising them that a certain fresh Hawaiian fruit is currently available.

Masa Hanaoka: We have participated in developing table-top items, but some of the classier hotels do not like to have things like that on the table. They want everything on their menu. At one time we tried to develop a program with one of the hotels to offer a Hawaiian breakfast or a Hawaiian lunch. It didn't work, because we couldn't get the supply to satisfy the chefs in that hotel. We chose to work with only one hotel, planning to expand from there to sister hotels on other islands. We tried to come up with table-top announcements, and it didn't pan out.

Peter Merriman: I would not use a table tent in my restaurant. You have to remember who your salesman is, and your salesman is the waiter. If I was going to get daring in my attempt to sell lychee, I would go to the restaurant and request that they track sales of lychees for a month, and whichever waiter sells the most per week will get a case of lychee, or a bottle of wine. When you create incentives for the sales people, you can increase your sales.

Masa Hanaoka: We have also tried to get printed materials placed in hotel rooms. However, when you look at the number of rooms and the numbers of fliers that must be put out every day because of the almost constant turnover in the hotel, it amounts to a big expense. We are finding that the tourist population is a good target market for most of our agricultural products, but it is also a very expensive one to promote. Seven million tourists come here, but they stay maybe five days at the most. The promotion must be constant, throughout the year. With the local population, you just need to remind them every three months or so that your product is on the market. With the tourist population, your promotional materials have to come out almost on a daily basis, and it costs money.

Morton Bassan: In Seattle, where I am from originally, during halibut season there would be heavy radio advertising that the season was on and people should enjoy the benefits of halibut. I don't know if it would be economically feasible for the

lychee industry, but it was effective for moving halibut in Seattle.

Audience: The *This Week* tourist bulletin might include this kind of information for free.

Q: I question the profitability of local fruit growers selling to local restaurants. They may buy one box. If you are selling meat or vegetables, an integral part of their service, they will buy quantity, whereas fresh fruits are going to be more of a supplement or dessert item that not many people will order. The fruit grower may end up driving to restaurants all over the island to get volume. I see the biggest market in direct sales to the public and tourists through fruit stands and supermarkets.

Morton Bassan: The Mauna Lani Bay Hotel buys between 30 and 80 cases of my oranges every week; that's just one restaurant. This can be really profitable. But what you are saying may be true with certain products; if they are buying a case or half a case, you can't afford to deliver to them. But, there may be enough restaurants that do purchase large quantities.

Audience: I know that it can be a hassle to deal in small amounts and to connect with the chef and the buying agent, but for us as small growers with new products, it gives us more recognition, gets the product out to the public, even to local people who go to the hotels and then may buy in the markets when they see the fruits there. It's not just selling one case to a restaurant, it's all the people who will taste it in that restaurant, and hopefully it will grow from that.

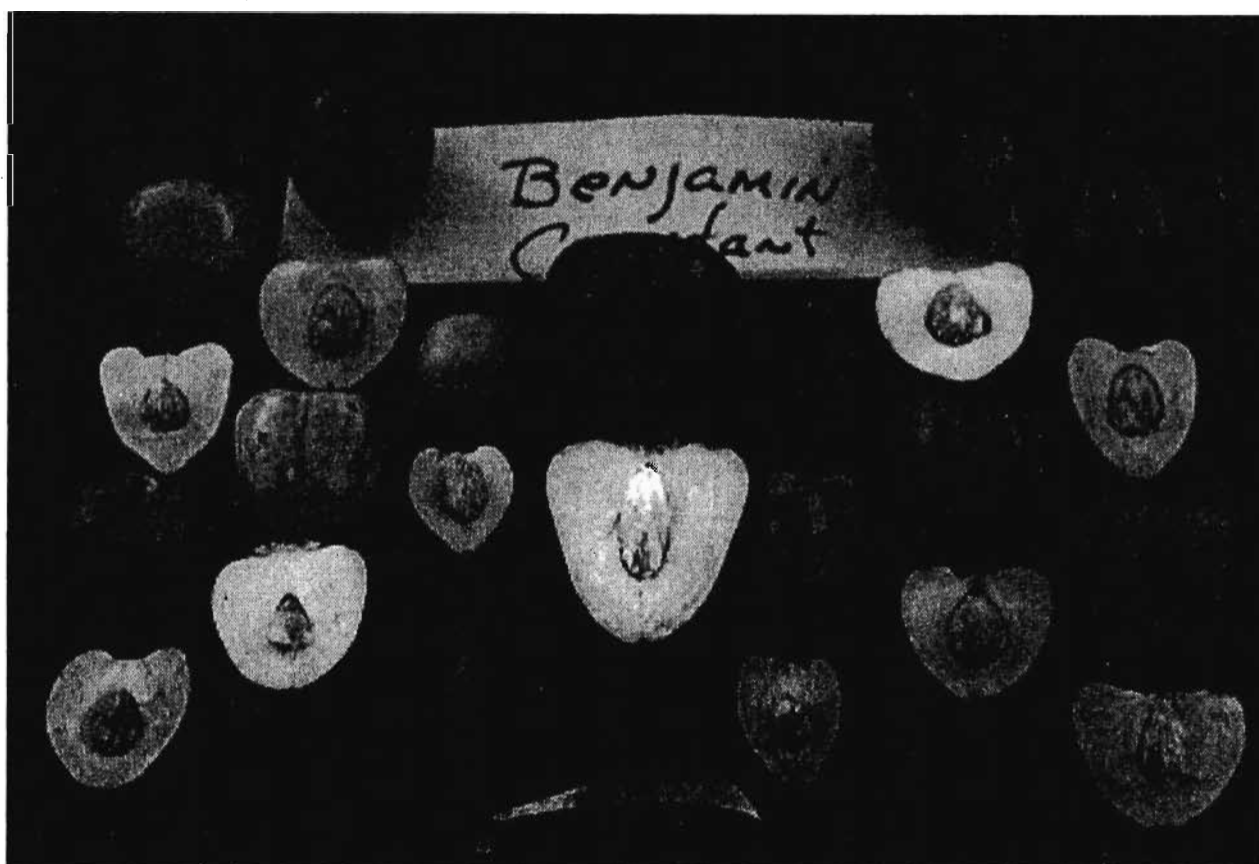
Audience: If we can convince the restaurant staff that our product is edible, that can give us a lot of credibility.

Peter Merriman: Selling to selected restaurants can also be very valuable. It is a leader-and-follower industry, and there are a few restaurants that lead, and everything they do is watched by the entire industry. If you can get into one of those places, it can be really good.

Masa Hanaoka: Morton's oranges were not always that popular. Several years ago he was having a problem marketing his product, and we put him together with the military commissaries and suggested that he have samples given out. All of you know what the Hawaiian "bronze" orange looks like; from a distance it looks like it has a severe attack of mites. But once they started in-store sampling, sales really took off, and Morton later got it out to supermarkets, but initially the food sampling took place in commissaries.

Morton Bassan: I was stuck with about 2,000 cases in Armstrong Produce's lockers that he wanted to give back to me. I remembered the suggestion to go to the Defensive Subsistence Office, Pacific Region. I went there with great trepidation, coming from a farm in the middle of

nowhere to a place where people were running around with guns. There was a great lady there who was born and raised in Kona, and she was the head of the office. Some of the 2,000 cases couldn't be salvaged, but with the sampling, the other 1,800 cases were moved in about five days.



The highly domesticated peach palm (*Bactris gasipaes*) is found in many sizes, shapes, and colors (photo: Charles Clement; see p. 23-28).

Field Trip Excerpts

Les Barclay

Onomea Orchards

This is a nine-acre tropical fruit farm that we started in 1990. In 1989 this was all sugarcane. We get about 130 inches of rain and a lot of sunshine. The soil is about 8 ft deep. Winds are very light here, but we get some damaging north and northwest winds in the winter. We can also get terrible south and southeast winds from tropical storms and near-hurricanes. These opposing directions require good windbreaks, and in the Hamakua area you shouldn't bother to grow most tropical fruits without windbreaks. While they will grow beautifully most of the year, one episode of 50–60 mph winds can damage your trees.

Our windbreaks are *Eucalyptus torelliana*, a species commonly used in Australia. It keeps its low branches and it's a fast grower. If you trim it – hedge the sides – it will grow up and stay fairly compact. You don't want a windbreak that spreads out unless you have lots of land. We don't have any problem with root encroachment. These are about 3½ years old and some are about 35 ft tall; they may get up to 60 ft here. We hedge both sides two or three times a year to keep them dense and growing upright. The Chinese rose beetle loves this species because it has little of the volatile oils that characterize most eucalypts. You have to spray young trees frequently, but as they grow older they out-grow the beetle damage. You always see some feeding damage, but it's not serious once the trees are established. We haven't had a problem with the rose beetle on our fruit trees.

Our abiu trees get green coffee scale infestations badly every spring, and with the honeydew and the black sooty mold on the leaves the trees almost stop growing and don't set fruit. Some of them appear not to have ants, yet the scale still gets really bad. We use horticultural oil sprays frequently, and by summer a natural fungus seems to kill off the scales. We have ants everywhere, but we don't try to control them. We tried tanglefoot, but within a week the ants crawl over debris that sticks to it. The ants haven't been a problem yet, but they may cause a mealybug problem when the rambutans set fruit.

Abiu is a brittle tree, and branches snap off readily. I've been selling a few abiu fruits through health food stores, and they sell well. Abius are inconsistent; from the same tree, some fruits are

sweet and some bland, and I have yet to figure out why they are different.

We are surrounded by mac nuts, taro, and ginger, and there's not much guava or other fruit fly hosts around, so they aren't much of a problem, although a few days of northerly wind can blow some in from a stream nearby that has a lot of rose apple growing along it.

We have two varieties of atemoya, 'African Pride' and 'Gefner', which are grown in Australia. Moving here from California, I knew nothing about growing tropical fruits or growing anything in Hawaii, so I relied heavily on Brian Paxton's advice. He set up his orchard about the same time we did this one, and he recommended the varieties and had the connections in Australia for importing the trees. None of these varieties were available in Hawaii at the time we got started. Certain nurseries had seedling trees, but if you wanted good varieties you had to go outside. Everything in our orchard was grafted in Australia and imported. That's why we built our greenhouse. The trees came as sticks with no leaves and hardly any roots. We had to rush them from the airport and get them into a hot, moist environment to grow them out. We lost a few plants to a fungus in our potting soil, but we stopped that with Ridomil. The only fruit trees that aren't grafted are the mangosteens.

We are hoping for an atemoya crop next year, their fourth year. They are planted at 25 ft between rows and 20 ft in the row. They are all on cherimoya rootstock. Atemoyas in a tropical, moist environment are not supposed to require much hand pollination. I didn't want to have to do that, because it is always raining here in the morning. In poorly drained areas, pond apple is really the only way to go, because cherimoyas and atemoyas don't like poor drainage. These soils drain nicely. Pond apple will result eventually in distorted fruits, and there is some question as to how long the trees will live. The problem with cherimoya rootstock is that the trees are extremely vigorous; they want to keep growing, and it takes them a little longer to settle down and start holding their fruits.

In the winter as they start going deciduous, there is a bark beetle, which also attacks avocado, that bores into the trunk making pinholes and possibly introduces a fungus that kills whole branches. The beetles seem to attack trees that are not so vigorous.

We planted 'Fine de Jete' cherimoya which is the principal variety grown in Spain. It is supposed not to need hand pollination; most cherimoyas do.

We have sapodilla, or chiku, which bears a scruffy, brown fruit which I call the brown-sugar fruit; the ripe fruit is intensely sweet. In Central America they make chicle for gum from the sap that this tree exudes. Grafted trees can bear heavily, but seedling trees may not. The problem with sapodilla is that the fruit looks the same from the time it is formed until it is ready to harvest nearly 10 months later. It is hard to tell when to pick it, but if it gets soft on the tree it is attacked by rats, birds, and fruit flies. I leave them until the fruit has a slight give when it is squeezed, slightly less than rock-hard. Because of the difficulty of telling when they're mature, I just planted eleven along the driveway, so they're easy to check.

I have two varieties of lychee. 'Bosworth 3', which is called 'Kwai May Pink' in China, has a wonderful, spicy flavor. It is very upright growing, not nearly as brittle as the old 'Tai So' variety, which they call 'Kwai Mi' in Hilo. I think I am finding that our lychees are going to have the worst pest problems of all. They get the lychee mite really bad, and 'Bosworth 3' may get it worse than the older types. We have the koa seed worm, or macadamia nut borer, that attacks the green fruit. When the fruit starts to turn red we get the Oriental fruit fly, which "stings" the fruit in order to lay eggs.

We try to mulch as much as we can, because these Hamakua soils are low in organic materials. We have gotten bagasse from the mill, but it is a lot of work to put it around all the trees. Now I am mowing and blowing and raking as much debris under the trees as I can to try to keep the weeds down.

The major tree in the orchard is rambutan, which is probably the most finicky of all to grow. When they were first planted, we had to build a windscreen around each tree because they don't want to grow when they're tattered with wind. It is a true jungle tree; they love lots of rain, heat, and humidity, and no wind. Unless you are willing to make the effort to shelter them, I don't think you will have much success. When I planted them I mulched heavily with bagasse. When they were first planted we used Palm Special, a 11-4-6 fertilizer that contained all the micronutrients. We applied urea also, and a lot of Dynamic Lifter chicken manure. The young rambutans love organic material and manure. Now that they are a little over three years old and have reached the

size where they can hold a crop, we have slowed down and have not fertilized since June, trying to induce a flush of flowering. We planted 12 varieties to extend the fruiting season. Now we are using a custom mix that Brewer makes under Brian Paxton's direction; it is a 15-5-25 with zinc, iron, and magnesium. As they start fruiting we will apply more K and less N for fruit filling.

When these trees get battered by northerly winds, they lose most of their leaves on this side, and it takes months for them to grow back; they really hate defoliation. Winter can be hard on rambutans because we often get dry, cool, and windy periods. The trees can look terrible then; all the leaves have a brown scald that they start showing in December and January, and they'll look terrible until April when the nighttime temperatures warm up and they start flushing out. Hawaii is just marginal for rambutan, especially with the winter nighttime temperatures. We prune to keep the lower branches from dragging on the ground, and we've done a bit of shaping, but the need for that depends on the variety. When they develop fruits, the more gangly varieties will have their branches hanging down and their fruits on the ground. We found that 'Gulah Batu', 'Rongrien', and 'R-7' are gangly types, and they are also the ones we have had more trouble growing during the first two seasons.

We have a problem with the weed wedelia, which you never want to get in your orchard. It is a real headache. We have a desmodium that came in naturally, and it helps crowd out other things. We sprigged some 'Tropic Lalo' paspalum, related to Hilograss, that the Soil Conservation Service provided. It is a wonderful grass that grows very dense, is a nice blue-green, and forms a mat you can drive on. It is lower and tighter than Hilograss, and it really crowds out weeds. Hilograss never forms a real dense mat, and weeds grow up through it.

We tried to do as little pushing of soil as possible when we cleared the cane. We had them disk it to just chop it up, rather than scrape it. Wherever the bulldozer did some scraping and we lost the top few inches of soil, the resulting difference in tree growth is dramatic. SCS made us put these water diversion terraces in to stop upslope water from becoming a flood, but this one is useless; there has never been a drop of water in this, even in the rainiest year in history, 1990. So now we have this big lump to mow over.

SCS also made us bulldoze this sedimentation basin, so that when you have erosion, it will catch

all the soil moving downslope, and theoretically you can recover it when it dries out. When we were trying to set up the orchard, it rarely stopped raining for two years, and the natural waterways that were apparant after clearing the sugarcane started filling in with Hilograss and were doing just fine. But SCS made us bulldoze the waterways to "shape" them, so they were bulldozed completely bare, and of course we had one deluge after another, all the mud came flowing down the hill, and the SCS agent said, "See, the sedimentation basin is working!" In the last year and a half, it hasn't had water in it.

Our 'R156 Yellow' rambutans always have a graft incompatibility. If they snap off in winds I have replaced them with 'R156 Red'. The yellow usually has bad crotch angles, a narrow V shape, and as the tree grows the branches press against each other like a wedge and finally one will snap off. These yellows also have very gangly branches, and the rootstock gets very narrow where it meets the scion. This might be a good back yard cultivar, because I hear it is very sweet, but I don't recommend it for commercial growing. Recommended spacing for rambutan is at least 30 by 30 feet, but we have crowded them in a bit at 30 by 25 feet.

We have put starfruit as temporary trees in between our mangosteens because they are fast growing, but the trouble with starfruits is you have to find a market for them. We have six varieties: 'Sri Kembangan', 'Arkin', 'Kari', 'Fwang Tung', 'B-10', and 'B-17'. A problem with starfruit is they set massive amounts of fruits that snap the branches. In the winter you have to prune them way back to get good tree structure, and during the year you have to tip them back to keep them dense, because their branches get heavy and long and droop down. Then you have to thin fruits so the branches don't break. It's a lot of work, and then you have no market. Most of the fruit lands on the ground and rots. Our major problem with these fruits is birds, the mejiro, or Japanese white-eye, is the worst culprit. We have never had an unpecked, ripe fruit. If they don't peck the fruit they damage the skin with their feet, and earwigs and ants and fungus get in. You can pick them green but they taste like a sour cucumber. Starfruit has to ripen on the tree; it won't ripen once you pick it. I am tempted to rip them all out. I think the future for starfruit is in processing. Carambola juice is delicious, by itself or mixed with passion fruit or orange juice, but trying to get a local processor interested in it is really hard.

There is a little moth that lays eggs that appear

to be synchronized to hatch when new flushes come on our mangosteens. Overnight, half of the new leaves can be eaten, which you really don't want to happen, because mangosteens are so slow growing. You have to be really vigilant. Sometimes I come out with a flashlight and squish the caterpillars. You can spray BT if it's not raining.

I have one grafted duku, a type of langsat, but even a grafted tree takes maybe eight years to start fruiting. There is some salak palm in the windbreak row. I have four varieties of durian, which does very well here, growing very rapidly. Durian is not a fruit fly host, and some predict that it will be profitable to sell in Chinatowns in San Francisco, Los Angeles, and Vancouver.

Another fruit I sell to local stores is starapple or cainito, a relative of the abiu and sapodilla. My trees are all of one variety, 'Haitian', which is very dark purple when ripe. The trees started bearing in their second year and bear abundantly. The branches will snap under the load of a heavy crop if not braced. Tipping back the branches several times during the year will keep the trees denser and more upright. They've had very few pest problems other than one green coffee scale infestation, and the fruits are well liked and sell quickly.

Brian Paxton

Hakalau Tropical Fruit Farm and Nursery

This 14-acre parcel had been in fallow after sugarcane before I purchased it about four years ago. Working with the Soil Conservation Service, I had it cleared, leveled, and grassed. When I laid out the windbreaks I wasn't familiar with the strong winter winds we get on this side of Hilo, or I would have windbreaked a little more efficiently in the center of these blocks. I've chosen not to do it now because my windbreaks are at a height where I'm getting fairly good protection.

Once the windbreaks were laid out, I brought in a lot of plant material from Australia, basing my decisions on variety and cultivar recommendations done by Brian Watson, Kamarunga Station, and the Department of Primary Industries. I worked for DPI for 11 years at Maroochy Research Station. I brought in tested cultivars of rambutan, the best ones at the time of durian, and mangosteen. I'm experimenting with different mango, avocado, and lychee varieties. There has been so little research in varieties and nutrition in Hawaii on a lot of these exotic tropical fruits, and with the state's budget cuts it looks like we growers are going to have to do a lot of this work

ourselves. It is probably going to be another 10 years before we can say, for example, which rambutan varieties will perform well in which locations. We need a good gene pool to work with. I'm basing my work on optimal leaf levels and soil levels recommended by Queensland DPI, although we will have to adjust these levels for our slightly different conditions here.

The Innisfail-Cairns area is comparable to the Hilo area in terms of climate. Hilo probably has the greatest potential in Hawaii for a tropical fruit industry, not only because our land is feasible for agriculture but because we have high enough rainfall, it is spread throughout the year, we have fairly high humidities, and we don't have the dry seasonal winds that they do in North Queensland. A slight disadvantage is that our maximum temperatures are not as high in the summer; this is not a real disadvantage, but I think our fruit filling will take slightly longer. The growth we are getting here is phenomenal. We are getting a growth check with the low temperatures during spring, and with totally tropical trees like rambutan, durian, and mangosteen, the drop in temperature plus a dry period will initiate and increase flowering.

My spacing is close and I will be heavily hedging these trees. My farm is really set up more like an experimental farm to sort out varieties. The permanent spacing here is 30 feet; within the row it's 15 feet, and I'll knock out every second tree when it is necessary. Here in Hawaii our land is very expensive compared to North Queensland, so they can space their trees out a bit more there. At \$15-20 thousand per acre, you need to increase your production, get results fast, and get an income. We may have to do a bit more pruning with the closer spacings.

The rainfall here is 150 inches. Les Barclay has about 130 down at 400-500 feet elevation; we are at about 800-900 feet. There is about a 4-6 week difference in fruit maturity between the two sites. As you go higher in this area you get much higher rainfall, which may not be a problem, but you get a lot less light interception and much cooler temperatures. I think it would be more experimental to try these crops at those elevations. Microclimate is important with these exotic tropics. Efficient windbreaking can increase your temperatures a few degrees. We're trying to make a jungle effect, which is what they're native to.

Mangosteen can handle wet conditions, not continual waterlogging, but areas that water drains onto regularly can be handled by mangosteen

better than rambutan and certainly better than durian. We get tremendous growth here with mangosteen, between four and six flushes a year, and good growth through the wintertime. Mangosteens are grown from seed; there has been work on grafting, but it seems to stunt the tree and you get a lot of suckering below the graft. There's an arboretum block in Hilo with 30-40-year-old mangosteens. I saw up to 1,000 fruits on one of those trees last year, an exceptional crop. I think there is a lot of promise to mangosteen, and I don't think there's a person who would try mangosteen who wouldn't want to eat another one.

We have a lot less pest problems than North Queensland with regard to exotic tropical fruits.

I make tree guards with hog wire and 32 percent shade cloth. I leave them on mangosteens for 12 months; with rambutans I leave them on 4-5 months. If planting before winter, you should leave them on through the period. I hold them down with a single wooden stake and a wire peg to secure the other side. If you want to buy stakes, you should get them from Oregon, because they're very expensive here. The guards are not only for wind protection, but with the mangosteens for sun protection to keep the trunk shaded. In Australia they have to put shade cloth over the tops of the guards, but we don't have burning problems on the tops here, just the sides.

Q: Rather than plant grafted trees when we don't know how the cultivars will do, how about seedlings, with durian, for example, to select cultivars?

A: Definitely not. With the cost of land around here, why go and plant a seedling block unless you are a completely gentleman farmer doing it as a hobby. It is not feasible. If you were a research person being paid by the government, it's great, because you can come up with tremendous varieties. A good example there is the 'Kaimana' lychee bred by the university here. I did most of my work in Maroochy and one of my main crops was lychee, and I have yet to see a lychee that will compare with 'Kaimana'.

My mangosteens are planted at 30 by 25 feet. I am interplanting with sapodilla and carambola to utilize the space better, because mangosteens are slow growing. Abiu is another good one to interplant, because they are not big trees. These can be phased out later on as the mangosteen grows in.

My durians are varieties recommended by Queensland DPI, and we were able to get 'Montong' and 'Chanee', which Australia didn't have at the time, from the university's Poamoho station on Oahu. I have 14 different varieties. We as growers have to test them, because if we don't, who else is going to do it? The ethnic market here seems to want the 'Montong' type durian; that's the main variety grown in Thailand. But in the long term, the other varieties may be more suitable to move into other market areas.

One of the easiest ways to propagate durian is by approach grafting. I bring the seedlings into the field in these poly bags. It takes between six and eight weeks, and a couple weeks later you can plant the tree in the field.

Regarding our grass cover, I initially planted an annual rye to hold the soil, and then volunteer Hilograss, a *Paspalum* species, came in eventually. In the waterways, I sprigged *Paspalum hieronymii*. We have a volunteer, low growing desmodium throughout the orchard.

I use a lot of mulch around the trees. I use a lawn mower and go in circles around them to throw the grass under. It is especially important to protect the rambutans' root systems. I use less mulch with durian and keep it well away from the trunk.

The growth of durian varies a lot with variety. We don't do much pruning at this stage, and definitely never prune the top. I try to let them develop their own shape. You want durian to develop a central leader, with branches coming off horizontally. Durian has more potential than any of the fruits because it is cleared for export to California; it is not a fruit fly host.

I am testing some mango varieties from Southeast Queensland that have resistance to the fungus that attacks at flowering. The Kona side of the island is better for mango plantings, because they have less problem with anthracnose. 'Brooks Late', 'Zill Late', and 'Florigon' are doing well. I think 'Nam Doc Mai' is about the best, but unfortunately it stays green and doesn't color. If you can get varieties that will grow on this side of the island you can make good money, because our mangos are so late compared to the Kona side.

I propagate rambutan with patch budding. After three weeks I remove the plastic from over the buds. A week after that I scratch around the bud, and if it is green, I'll force them. They shoot away really fast, but you have to remove the suckers. Later I transfer them out to a hardening-off area. Mangosteen seedlings are much slower to

propagate; it takes about 1½–2 years to get a saleable plant. I use whip grafting with jackfruit, sapodilla, and mango.

I have a windbreak species, *Eucalyptus dununii*, that is very similar to *E. torelliana* but has the strong eucalyptus oil in its leaves and the rose beetles don't touch it. The trees in that row are five months old and nearly 12–15 feet high.

I consider the abiu a minor tropical fruit. The 'Z-2' and 'Z-4' are much better selections than the 'Gray' because they are thicker skinned. They handle much better without bruising in the marketplace, and they're sweeter. There's a great local market here at present for this fruit; we can sell as much as we can grow. It has two to three crops per year. A farmer might put in half an acre and make some money picking it at times when your other crops aren't coming in.

My lychee and longan are presently spaced at 20 by 15, but they'll end up at 30 by 40, which is the correct spacing.

Lychee is propagated by marcotting, also called airdlayering. I use plastic to cover the marcott in preference to aluminum foil. I'm using a rooting hormone, but I wasn't using it last year and got similar results. I use a fine peat moss instead of sphagnum moss. It is a fairly slow process, maybe six to nine months to get a marketable tree.

Hawaii isn't exactly the proper place to grow lychee, a tree that requires dry cool conditions to initiate flowers. On this wet side, I think there are varieties that have potential. The 'Bosworth 3', or 'Kwai May Pink', fruits well in North Queensland, and we've already had some good crops of that variety. The 'Kaimana' also looks promising over here, but we need to go through at least five years of cropping before we could go into putting in fairly big plantings. I'm testing several other varieties. We need to extend our season with later varieties of lychee in Hawaii; presently the window is very narrow. With lychee, nutrition is critical; you need the right levels of nitrogen at the correct time, and trace elements are more important with lychee than any other crop I've worked with.

I have seven avocado varieties because I used to work with this crop, but I don't recommend going into avocados on this wet side of the island. The 'Hass' variety may have some potential for the dry side of the island, but it has to be managed well. You have to double the amount of fertilizer for a 'Hass' tree with a heavy crop compared to a 'Sharwil'; you also have to increase the irrigation. I selected a rootstock from a 30-year-old Guate-

malan variety I found here that was growing in very wet conditions and was healthy.

Liloa Willard

Hamakua Coast Tropical Fruit Farm

I moved here with my wife, Françoise, from Oahu about 11 years ago after many years of trying to make my fortune as an entrepreneur.

I decided to farm after the economic slump Hawaii experienced in 1974-75, when I was in real estate, or after the United Airlines strike, at which time I was marketing some gimmick or gadget to hotels. I realized that my so-called fortune would never be enough, and if I were able to satisfy my monetary needs it would lead to . . . what? Security. A lifestyle that I could control myself. A farm! But, as those of you who are farmers know, thinking a farm would provide security was really naive.

We were first thinking of an acre of land on Oahu. As we attended various workshops on orchids, aquaculture, kalo, landscape plants, fruit trees, etc., and we looked at land to purchase, our dream began to take a form. After a few years (to make a long story short) we ended up buying 14 acres in Papaikou on the Big Island.

Twenty years previously, our land had been in sugarcane, and had become overgrown with waiawi. Because of the abundant rainfall (135 inches per year) and the fact that we have three streams and a couple of waterfalls, the name Ho'owaiwai Farms seemed appropriate. *Wai* in Hawaiian means water; *waiwai* (an abundance of water) means wealth, either material or spiritual. *Ho'owaiwai* - to enrich or bring prosperity - sounded good to me.

Neither Françoise nor I had any real farm experience. She is from Tahiti, can climb trees, catch fish, dance, and get her hands dirty with glee . . . the perfect farmer! Me, I can climb a tree and get my hands dirty . . . the perfect farming couple. What did we know!

Fortunately, we love the lifestyle and the hard work that goes with farming. In fact, we love the lifestyle so much that my greatest struggle is the realization that a successful farm is one of the toughest businesses you can get into. Because much of my business life was market oriented, I tended to avoid that side of the farm. I just wanted to *farm*, to nurture the land and grow plants, work as hard as I wanted and enjoy a peaceful life in the country with my family. Rude awakening: the market side is what drives the farm.

No matter what your resources are, you never seem to have enough time, money, or land. A farm is a bottomless pit. For me, when I speak of lifestyle, esthetics plays a strong role, and esthetics requires both time and money.

Our first crops were culinary ginger, taro for corm and leaf, and culinary herbs. When we got into ginger the prices were around 75-80¢ per pound, and when we got out three years later we were lucky to get 29¢ per pound. We found that when farming required cultivation every year, in a place with 135 inches a year you lose too much topsoil, and I couldn't live with that. So we next tried cut flowers with heliconia. From the beginning we had an interest in fruits, but the monetary demands of farm operation steered me toward the daily farm activities dealing with the crops we had in the ground. It was difficult to change crops because it would have made a big impact on our cash flow. I see that as a common problem with most farmers. Once you have committed to a certain crop or crops, it is very difficult to change or capitalize another.

While we were marketing cut flowers we began growing palms and landscape materials. A part of the farming process is trying to determine what grows best in your environment, what the market demands, and what you enjoy growing. Trying to bring all those elements together, along with the "lifestyle," surely must be most of what the "art of farming" is all about. We sometimes refer to this as the "art of gardening," just to keep ourselves focused. During that period, my awareness of the potential for tropical fruit was developing, and I saw others, including many of you, making a great investment of time and energy in getting this industry started.

The greatest factor in getting us to actually plant trees was meeting Brian Paxton, who was consulting with a friend of mine in getting his orchards started in Kona. After speaking with Brian, who had his own tropical fruit orchards in Australia and who was developing his own orchards here under the exact same conditions as at Ho'owaiwai, I determined we would make the move by developing 15 acres of retired cane land. We planted our first fruit trees last year and are one of the three largest farms, including Brian's, on the Hamakua Coast.

We are very fortunate that we have been able to take advantage of the pioneering and experience of others who have worked so hard to develop this industry. You might say that we have been able to ride the second or third wave, after

the others had smoothed the way. Once we could see the way things were going toward defining the types of marketable fruits, with Brian's excellent guidance we made the move. This decision also helped to justify the acquisition of more land and contributed to our desire to create a model farm for our business of estate planning and development, which you may have noticed on our business card.

We have approximately five acres each of rambutan, durian, and mangosteen. The durian is interplanted with dracaena stock for export as potted landscape plants. I believe there is an excellent future for exotic tropical fruit trees here in Hawaii. I feel confident that this is the best crop we have developed on this farm to date, and with hard work and lots of luck we have an exciting and prosperous future.

On the other side of the farm, beyond our house, which is designed in what we call "PolynAsian" style, we have what I sometimes call the "Garden of Eat'n," because we have randomly planted a variety of fruit trees in our garden landscape. Much of our farm is a garden, and we recognize that it might be good business to open it for public tours someday to generate cash flow, but for the time being we are enjoying our privacy and will try to generate income through the garden's seed and plant propagation value.

Earlier today you saw the more mature orchards on this coast and had a chance to ask all of your technical questions. This farm visit should be a lighter experience, viewing a farm that reflects a lifestyle struggling to become a business. Please enjoy yourselves and feel free to ask any questions that you like.



Cupuassu (*Theobroma grandiflora*) pulp has a strong, pleasant, sweet-acid flavor for use in juice and ice cream (photo: Charles Clement; see p. 25).

Appendix 1.

Agricultural Business Concepts

Morton Bassan, Jr.
Ka'u Gold Oranges

There are three types of farming: farming as a way of life, farming as a business, or farming as a way of life and as a business. You need to decide what kind of farmer you are. If you chose farming as a way of life, profitability probably doesn't matter. If you are in farming as a business, then cost concepts, sales concepts, and profitability will be important to you.

I will be talking about cost concepts in relation to capital, fixed, and variable costs. Sales concepts are related to quality, both internal (does it eat well?) and external (is it eye-appealing?) and quantity (whether you have pounds or container truck loads). The amount of sales effort you apply is very important. Finally, I will give you a formula for profitability.

I personally believe that farming is the best family life there is, but it must be run with profitability and return on investment in mind. I am hoping that this knowledge will deepen your understanding through personal study. The concepts I am sharing with you are available in books. One of my favorite booklets that will help you is titled *Farm Enterprise Accounting and Management*, published by the Division of Agricultural Sciences, University of California, 1977, Sale Publication 4022.

For better understanding of the three types of farmers you must look at yourself and your peers. When growing a crop, are you projecting costs and considering possible outcomes or are you just hoping for blind luck to lead you to success?

Do you know what it costs to cultivate your crop per case or pound, and is it reasonable? Can you identify and treat growing problems before your crop is damaged? Are you purchasing your supplies as cost-effectively as possible?

Do you know what it costs to harvest your crop per case or pound, and is it reasonable? Are you employing labor-saving techniques? Do you have an efficient harvesting system?

Do you know what it costs to package your crop per case or pound, and is it reasonable? Are you employing labor-saving techniques? Are you purchasing your supplies as cost-effectively as possible?

Do you know what it costs to distribute your crop per case or pound, and is it reasonable? Are you depending on someone else to distribute your product? If you are depending on someone to distribute your product, (1) are they doing a good job? and (2) are you doing anything to help?

Identifying Costs and Functions

The cost concept should be separated into the costs and functions for growing a crop and getting it to market as detailed in the following steps.

Step 1. Capital costs include leasing or purchasing the land, the initial costs of getting the land ready to use, installation of irrigation, and for an orchard crop the cost of getting the trees or vines up to production.

Because capital cost items last many years, you have to think to yourself, How much of this cost is attributable to this crop or this case of crop? For example, if an irrigation system that costs \$10,000 lasts 10 crop cycles until it is virtually worthless, the capital cost of using that irrigation system is \$1,000 per crop cycle. Interest on money used for capital improvements also increases the real cost, but for simplicity and ease of calculations I am ignoring all costs other than the purchase price. The cost of that capital cost per case of product decreases as production increases as follows:

Crop cycle	Production in cases	\$1,000 divided by cases produced
1	1,000	\$1.00
2	2,000	.50
3	4,000	.25

Step 2. The next step is the cost of growing the individual crop cycles, which is a fixed cost. This concept is that based on the same acreage, the cost of each crop will remain fairly constant whether you have good or bad production. This is from planting the seed for row crops or from inducing flowering in orchard/vineyard crops up until harvesting. With orchard/vineyard crops where you may be fertilizing while harvesting, the continual fertilizing may be considered part of the

growing cost for the next crop cycle. The system of cost separation gets tricky, as you may be paying growing costs for the next crop while you are also harvesting the current crop. The total growing costs are divided by the number of cases produced. The cost of growing declines with increased production, similar to the example of the cost of the irrigation system.

Step 3. The next step is the cost of harvesting. This is a variable cost that increases as a total dollar amount but should remain the same per case. You may want to separate this into harvesting, trucking to the packaging place, packaging, and distribution costs. The idea here is to get the cost per case or sales unit, as in the following example;

Description of cost	Cost per case
Harvest labor + benefits	\$1.00
Picking supplies	.10
Box cost with staples	2.00
Miscellaneous	1.00
Total	4.10

Based on 2,000 cases, the gross cost is \$8,200 and \$4.10/case. Based on 5,000 cases the gross cost is \$20,500 and \$4.10/case.

To be a successful farmer it is important that you understand the nature of your costs so you can sell your product at a profit. Fixed and capital cost items are usually about the same amount for each crop cycle, but as your production increases you have more cases to spread the cost over. On the other hand, variable costs remain the same per case while the actual dollar amount increases or decreases with your production. To tie the costs together is now simple, as in this example;

Description of cost	Cost per case
Capital costs (as an example)	\$1.26
Growing (fixed) costs	.86
Harvesting (variable) costs	4.10
Total	6.22

Now that you know what your costs are you can decide if you (1) can sell profitably to continue farming, and (2) are making a reasonable return on your investment.

The sales concepts require you to ask yourself many questions about your product quality, as follows: How are you going to make your crop taste good? How are you going to make your crop

eye-appealing? How are you going to make your crop good for peoples' health? How are you going to get your crop on store shelves? Once your product is on the store shelves, what is its shelf life? These questions are the problems profitable farmers address, understand, and solve as it applies to them.

This brings us to "quality and quantity." You can always make a one-time sale of something that is no good. Because a no-good product will not have repeat customers, you will not have repeat orders. It is imperative to understand that to be a successful farmer you must have repeat sales.

Repeat sales to satisfied customers means moving truckloads instead of pounds. As a result of this concept you must gear your operation, by yourself or with colleagues of similar thinking, to provide the quantity of quality product that is demanded. Do you think a grocery store wants to move a few dollars worth of merchandise or several hundred thousands or millions of dollars on its shelves? Now you must progress past thinking about yourself, your product, and the ultimate consumer to the profitability of the grocery store. If you make the grocery store profitable then the grocery store will make you profitable.

You are probably asking yourselves, How can I even get the shelf space in the grocery store to try? This is called the sales effort. You have to go talk to the applicable department managers in the stores. This doesn't take the "salesman's touch" and it is not magical, but you have to make the effort.

What are you doing to sell the product, which you so carefully and painstakingly grew, to the consumer? Most farmers fail at this task by making no sales effort. Do you want to be like most or do you aspire to greater heights? What is it that you are trying to accomplish? Are you only trying to produce a product that nobody wants or that nobody tries? Are you trying to produce a product that everybody wants? This is up to you to decide based on your willingness to promote. What are you going to do? Are you going to sit on your *okole*? Are you going to reach out? You have to decide.

Reaching out to the customer is a key concept. Any store wants to sell lots of any of its products. This is called sales dollars per square foot of shelf space. Items with good sales volume have large displays, while items with bad sales volume have small displays. Not everyone is going to like and pay the money for your product. You need to

reach out to the consumer, saying, "This product is good – buy me."

What are the techniques for reaching out to the consumer who will buy your product? Everyone has seen in-store samplers. Everyone has seen advertised, chain-wide specials. Everyone has seen in-store specials. Everyone has seen special packaging. Everyone has seen point-of-purchase material. These and many more are old-time, proven techniques of getting the consumer to try and like a product. What are you going to do?

The next concept is profitability in relationship

to sales and operational costs, fixed and variable, and capital improvement costs. I am going to give you a formula that you can study at your leisure. I have spent a lot of time coming up with this and other formulas. To understand this formula you will have to spend a lot of time. If you spend a lot of time with an open mind and humility then you will have opened the door to great understanding.

$$\text{Net income per case} = [\text{Sales price per case} \\ - (\text{fixed cost} / \text{cases produced}) - (\text{capital cost} \\ / \text{cases produced}) - \text{variable cost}]$$

Appendix 2.

Permaculture for a Sustainable Future

Michael S. Howden
Maui Permaculture 'Ohana

Other than Bill Mollison's genius for collation of numerous disparate ideas and concepts and his ability to ground these principles based on the breadth of his practical experience, there is nothing new about the conceptual basis for permaculture, which can as well be known as a mimicking of both natural and traditional systems. What is extraordinary about the functioning of permaculture is the profound emphasis on the integration of the elements of an enduring functional design.

Please understand that permaculture as a concept derives from the means used by indigenous peoples throughout history, as well as the contemporary writings of the great Japanese agriculturist Masanobu Fukuoka and the practice of "Nature Farming," etc.

When we entered informal discussions with Kali Montero of the Cooperative Extension Service on Molokai to teach permaculture concepts there, all discussion was predicated on the basic premise of teaching only in conjunction and association with *kupuna* rooted in Hawaiian and other Asian sustainable methods. Among these would of course be Masa "Cowboy" Otsuka.

I would open with a reference to the writing of the Tibetan Lama Tsang Kha Pha, as quoted in Gary Snyder's *Earth Household*: "This is a Buddha-Realm of infinite beauty. All men are

divine, are subjects. Whatever we own or use are vehicles of worship." All traditional cultures are based on an ethic of earth-care, and societies wanting to endure must also address these issues. Without an appreciation (and honoring) of the sacramental nature of the earth, we lose our spiritual foundation and enter ever more deeply into a materialism which feeds from future generations.

It is needless to engage in a polemic against contemporary agribusiness and its methods of "soil mining." What needs to concern us are the means to heal (and feed) our own communities, as well as the larger island community. In our use of biocides and other chemical pollutants (and carcinogens), we affect the lives of those around us. Streams throughout East Maui, especially along the Hana coast, are nearly stagnant from diversion of water to sugar and pineapple – and development – in Central Maui. State Health Department signs warning against leptospirosis at the Keanae Arboretum are somber warnings against the ill health of our habitat.

As none of us are truly isolated from one another, our *'opala* has nowhere to go but to be used here on our islands, which seem to be growing smaller, yet giving off great waste and less and less space; we have little choice but to work together toward solutions which will be beneficial

to all of us.

Kanahena Farm & Nursery in 'Ulupalakua, Maui, is a foundation model of a formative dryland permaculture. We receive about 15 inches of rain a year, and have limited access to county water. Buildings are small but functional. Kitchens are communal (two, total). Our population varies from one person to six or seven, depending on season and, as we are a teaching facility, number of interns present.

We carry more than 70 species of fruit- and nut-bearing trees and shrubs. There are also substantial plantings of nitrogen fixing trees, agroforestry, and native plants. There are 34 water impoundments on the 'aina, with a capacity of about 250,000 gallons. The ponds are also used for the production of water plants (water hyacinth, azolla, water lettuce, and others), as well as gambusisae, grass carp, Chinese catfish, and two species of tilapia. Emphasis is on dryland species assemblies, among which are collections of the (Burbank) spineless panini (*Opuntia indica*), pollinators for the night-blooming cereus, about 30 cultivars of mangos and avocados, as well as substantial selections of mulberries, figs, white sapotes, and chikus (sapodillas).

As you can see, much of our work centers around the restoration of habitat. Successions of nitrogen fixing trees and tropical hardwoods as nurse trees and formative canopy for fruit- and

nut-bearing trees, in return followed by the replanting of native mesic dryland forest, with such trees as 'iliahi, lama, koa'ia, kauila, 'uhi-'uhi, and others, which will take generations to mature.

Within a mixed habitat, generative interface among design elements abounds, and "product" increases geometrically. Less and less are we dependent on market fluctuations, or the decisions of multinational corporations. I would suggest that we turn the attention of our universities and other research facilities, including those presently run by the U.S. Department of Agriculture, to the interests and needs of the smallholder. If indeed we can return enough people to the 'aina, especially those already expert in agriculture, we then have a strong and enduring foundation for our local economies. Unless we stand firm now, our children and grandchildren may face an even more uncertain future. Well-reasoned and thoughtful action is incumbent upon us.

If we can be of service to you, or you would simply like to share your *mana'o*, please contact us at Maui Permaculture 'Ohana, P.O. Box 667, Kula, Maui, Hawaii 96790. Tel: (808) 878-3922/3901.

Mahalo for your attention and openness to change.

[Mr. Howden spoke at the 1992 HTFG conference.]



The bacuri (*Platonia insignis*) is an Amazonian fruit in the same botanical family as the mangosteen. The sweet-acid pulp of bacuri is processed for use in ice cream and dessert items (photo: Charles Clement; see p. 25).

[This photograph and others on pages 29, 34, 36, 42, 49, and the cover were processed from transparencies with assistance from Dr. Scott Campbell's database development facility, Dept. of Agronomy and Soil Science, CTAHR, UHML.]

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