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# FRUIT GARDENER

California Rare Fruit Growers



**FESTIVAL 2002**  
**FESTIVAL OF FRUIT**  
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# Puerto Rico's Tropical Agriculture Research Station

## 100 Years of Tropical Research

*Story by Ricardo Goenaga and Sidebar by Larry Shore*  
*Photos courtesy of the Agricultural Research Service*

**T**he Tropical Agriculture Research Station, operated by the USDA's Agricultural Research Service, had its beginning in 1901, when Congress appropriated \$5,000 and directed the Secretary of Agriculture to establish an experiment station in Puerto Rico to study agricultural problems of interest to the island. The Governor of Puerto Rico, cooperating with the island's communities and the U.S. Department of Agriculture, selected the present site of the station at Mayaguez: the farm known as Hacienda Carmen, 235 acres donated by the City of Mayaguez.

At its inception, this facility was known as the Federal Experiment Station. In 1975 it became the Mayaguez Institute of Tropical Agriculture (MITA), and in 1982 was renamed the Tropical Agriculture Research Station (TARS). Since 1961 it has been part of the Agricultural Research Service's Tropical Crops and Germplasm Research Division.

When established, the Federal Experiment Station was the island's only institution for agricultural research, and horticultural research has always been prominent in the station's program. In the past, both tropical- and temperate-zone vegetables, as well as fruit and ornamental cultivars, were introduced from all parts of the world for evaluation in Puerto Rico. The station still maintains an extensive collection of germplasm consisting of about 275 genera and 450 species; this is one of the largest collections of tropical trees available in the Western world. The station's grounds are often visited by botanists, horticulturists and taxonomists from around the globe.

Common on these grounds are exotic plants such as cinnamon, nutmeg, rubber, vanilla, black  
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1. Two main goals of the TARS National Germplasm Repository project are regenerate TARS Research Leader Ricardo Goenaga (left) and Agronomist Edmundo Rivera inspecting the TARS Research Station, (known earlier as the Federal Experiment Station) was founded. Cacao tree in the germplasm collection. 10. Mangosteen, often called the "Queen of Fruits." Research is being done into the effects of minimum tillage and intercropping. 11. Six lychee clones are being evaluated under minimum tillage and intercropping. 12. Leguminous cover crops are intercropped with banana. 13. A study screening papaya cultivars for acid soil tolerance. 14. Under evaluation are intercropped with banana. 15. Cacao tree in the germplasm collection.



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15



4



tion and maintenance of virus- and disease-free banana and plantain clones. **2.** An instrument for measuring photosynthesis in tropical fruit crop production systems research. **3.** Plant Physiologist and ect an early flowering longan tree. **4.** In 1901, the U. S. Congress authorized the establishment and maintenance of an agricultural experiment station in Puerto Rico. Thus TARS, the Tropical Agriculture Originally called Hacienda Carmen, this 235-acre farm was made available jointly by the Puerto Rican government and the city of Mayaguez in 1902. **5.** Longan fruits from an early bearing clone. **6.** ectiveness of varying shade and fertilization treatments in reducing the mangosteen's lengthy juvenile stage. **7.** A cluster of atemoya. Six atemoya clones are currently being evaluated. **8.** A cluster of d with bananas. See also photo 16. **9.** The TARS germplasm collection boasts 28 plantain and 84 banana accessions. **10.** Rambutan fruit, one with exposed pulp. The rambutan clones under evaluation o and 45 avocado accessions. These clones are backups for similar Agricultural Research Service programs in Miami. **12.** Nine carambola clones are being evaluated on various soils and along with ce. Each plot was differentially limed to obtain a variety of soil aluminum concentrations. **14.** Agronomist Edmundo Rivera (left) and Technician Tomas Miranda examine a young rambutan tree. Clones ollection. **16.** Lychee clones under minimum tillage and intercropped with banana. **17.** Avocados in the germplasm collection. **18.** Young papaya trees under study.



## 100 YEARS

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pepper, citronella, camphor, teak, eucalyptus, palms and Manila hemp. Many of these trees are more than 90 years old. If you travel to Mayaguez, you should visit TARS; we invite you to admire the classical architecture of our beautiful building and enjoy a self-guided tour of our facility, seeing first-hand many of these unusual tropical fruit trees. You will see such things as our experiments with small mangosteen trees to study the need for shade protection during their first year of life. We also boast a diverse bamboo collection consisting of more than 50 species.

The early years of the station, 1901–1930, were devoted primarily to introducing new varieties of crops to meet the agricultural needs of the island. Since 1935, TARS has gradually modified its research program to the point where it is now mostly concerned with problems relating to national and regional agriculture. As of 2001, the station's accomplishments had been documented in about 1,800 publications. Part of TARS' current mission is conducting agricultural research to introduce, preserve, evaluate, regenerate, distribute and develop cultural and management systems for

tropical and subtropical crops of economic importance to the continental and insular U.S.

The increase in America's ethnic diversity and changes in diet habits because of health considerations have opened a large market for tropical and subtropical fruits. Increased production of many tropical fruits, however, is hindered by a lack of basic information on how physiological, horticultural, environmental, entomological and pathological variables affect tropical fruit-production systems and influence yields. So in 1997, projects devoted to evaluating clones of tropical fruit crops for yield, fruit quality and tolerance to pests, diseases and abiotic stresses were established at TARS. Puerto Rico is an ideal location to conduct research on tropical fruit crops. It has 300 different soil series, representing 10 of 12 major soil groups. Rainfall ranges from 35 inches in the southern semiarid region to more than 80 inches in the northeast.

Fruit crops under study include bananas and plantains (*Musa* spp.), papaya (*Carica papaya*), mangosteen (*Garcinia mangostana*), rambutan (*Nephelium lappaceum*), mamey sapote (*Pouteria sapota*), and sapodilla (*Manilkara zapota*), among others.

## Bananas and Plantains

Bananas (*Musa acuminata* Colla) and plantains (*M. acuminata* x *M. balbisiana*) are rhizomatous perennial herbs that can reach a height of 50 feet. Both belong to the Musaceae family and have origins in Indochina and Southeast Asia. Edible clones are classified as to the relative contribution of *M. acuminata* and *M. balbisiana* gene pools (AA, AB, AAA, AAB, ABB, AAAA and ABBB).

The true "stem" of the banana or plantain plant is underground—it is a tuberous rhizome. Both the aerial parts and the root system arise from this rhizome. Suckers grow successively outward from the rhizome and eventually develop into adult plants. Morphologically, there are two types of suckers: "sword suckers" with narrow leaves and broad rhizome bases, and "water suckers" with broad leaves and narrow rhizome bases.

Sword suckers have a strong connection with the mother plant, and therefore develop strong thick rhizomes of their own. For this reason, they are preferred as ratoon crops. The first leaves produced from the central meristem of a developing sucker are scale leaves, followed by narrow sword leaves, and finally broader leaves with

### How I Discovered the Tropical Agriculture Research Station

Larry Shore

After tasting a mangosteen for the first time on a trip several years ago to Thailand, I was so taken by this exquisite fruit that upon returning home I contacted the USDA Agricultural Research Service in Beltsville, Maryland. I wanted to ascertain the possibilities of importing them to my hometown Safeway. If that was not possible, I wanted to import mangosteen trees and grow them, or at least import seeds so adventurous fruit explorers might try growing mangosteen in their own backyards.

#### First, I Set Out to Be a Mangosteen Entrepreneur

I placed an advertisement in the *Fruit Gardener*, eliciting interest among readers from Florida to Texas. My girlfriend, who imports palm seeds worldwide, has major customers and growers in Thailand; one of them offered to help me obtain the seeds, which have very limited viability. Everything seemed all set for the venture.

#### But the USDA Didn't Think That Was a Good Idea

The first packet of seeds was intercepted by the USDA, who said "this is a no-no," and my enterprise fizzled. A few years earlier, the USDA had allowed mangosteen

importing from Ecuador until the fruit became infested with insects that are similar to the Mediterranean fruit fly, whereupon all importation ceased. Canada, however, has no such restriction on importation; last September while in Vancouver, British Columbia, I found mangosteen sold in produce stands along the street and in the Oriental sections of town.

#### They Say Old Dreams Die Hard, But Mine Lived On

I continued to nurture a dream that someday I would behold a mangosteen tree growing on U.S. soil. During a recent trip to Kauai, Hawaii, in Smith's Tropical Garden I saw my dream realized. Unfortunately the tree I saw is one of only a few prized mangosteen trees in Hawaii, so tasting its fruit was impossible.

#### Then I Paid a Fateful Visit to Puerto Rico; the Rest, as They Say, is History

In December 2001, I visited Puerto Rico. Upon arrival I called the USDA-ARS Tropical Agriculture Research Station and spoke to the director, Dr. Ricardo Goenaga, who graciously invited me to visit the facility. He also asked how long I would be in Puerto Rico and wondered if I could delay my return flight in order to attend a celebration early the following week: the 100th anniversary of the station's establishment. I told him that I could not, but that I had rented a car specifically for the purpose of seeing the island on my drive to Mayaguez. Dr. Goenaga set me up to meet with one of his key associates, Dr. Heber Irizarry, to tour the station's

gradually widening laminae. Mature, full-sized leaves are produced about six months after planting. After production of 30–40 leaves, leaf production stops and floral initiation begins—instead of leaves, flower bracts appear.

The resulting fruit is developed in a bunch consisting of a series of “hands,” or ranks, of fruits attached to a thick peduncle. Fruits are ready to harvest about 100 days after flowering.

Bananas and plantains grow best in humid tropics or subtropics. The ideal soils for them are deep, well-drained loams with high inherent fertility and organic matter content, and an absence of compaction, excessive clay, acidity or salinity. Both crops require a lot of water throughout their growth cycle for maximum productivity.

There are 28 plantain and 83 banana accessions in the TARS collection. Our researchers have made noteworthy contributions toward the introduction, selection and evaluation of superior plantain and banana clones and the proper management of these crops under differing environments.

We also collaborate with other international institutions to introduce and evaluate newly released black sigatoka-resistant plantain and banana hybrids developed

by the International Institute of Tropical Agriculture in Nigeria, Africa, and for the Fundación para la Investigación Agrícola in Honduras, Central America.

Black sigatoka, caused by the fungus *Mycosphaerella fijiensis* Morelet, is the most destructive disease of plantain and banana. It attacks plant leaves, preventing the fruits from filling and causing drastic yield reductions. Though the disease is not present in Puerto Rico, it occurs in some neighboring Caribbean countries and has been reported in South Florida.

### Papaya (*Carica papaya* L.)

The species belongs to the Caricaceae family, and is believed to be native to Tropical America. Currently, this crop is cultivated throughout all tropical regions. Optimum plant growth is attained at temperatures between 72° and 80°F with relative humidity greater than 60%. It adapts to various soil types and variations in pH from 5.5 to 7.0.

Papaya fruit is known for its high content of vitamins C and A. The skin is green when immature and orange when ripe. The flesh is yellow to red, soft, and has a distinctive sweet flavor. Ripe papaya is normally eaten as dessert but can also be processed

into puree, juice, sauce, nectar, jam or jelly.

The tree grows as high as 25 feet and can be induced to produce branches by topping it. The flowers, male and female, can be either on the same plant (monoecious) or on separate plants (dioecious)—or as the male and female parts on the same flower (hermaphrodite). The fruit of the female tree is round; fruit develops in an oblong shape on the hermaphrodite tree.

Several national and international breeding programs have been established and focus on the development of cultivars with desirable fruit traits and resistance to diseases. This research effort has contributed toward the development of well-known commercial cultivars and on hybrids such as Solo and Sunrise Solo from Hawaii; Cariflora from Florida; Tainung hybrids 1 and 2, and Red Lady from Taiwan; and PR 6-65 and PR 7-65 from Puerto Rico.

Plants usually bear heavily during the first two years, then production declines. Commercial plantings are replanted after 3 to 4 years, depending on virus infestation. The fruit may be harvested at the first indication of color change from green to yellow, and attains maximum flavor when the skin is about 80% colored. Commercial pro-

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experimental farm at Isabela.

During a difficult departure from my hotel in San Juan—it took me two hours to get out of town and on the right highway to Isabela—Heber was very patient, even offering to come fetch me. This turned out to be unnecessary, and within two hours I was in Isabela. We got into Heber's pickup and headed for the plantings. What I saw that day made a big impression on me. My experiences and pleasant associations with Ricardo and Heber got me to thinking that a lot of folks in CRFG besides me might well be interested in learning about this amazing yet obscure rare-fruit research.

#### I Suggested that I Might Want to Write an Article About the Station

Then Dr. Goenaga, who incidentally is a CRFG member, offered to write about tropical and subtropical fruits cultivated at the station. He is far better qualified than I to impart such information, and I daresay that if you have turned to this page, you have already found his article quite interesting. The work these scientists do in Isabela and Mayaguez benefits development of rare fruits for the benefit of all enthusiasts.

#### Wet Weather Did Not Deter Me From Seeing the Fruit

As my visit ended in a tropical downpour, Heber took me to a fenced enclosure. He unlocked the gate and we went in, slipping around on the muddy road until he put his pickup into four-wheel drive; then we easily slid through the potholes, down to an orchard of about 40 giant mangosteen trees—a beautiful sight to my eyes. I tried to

take pictures but in the downpour it didn't work. Earlier in the day, Heber had showed me a stand of papaya trees loaded with yellow-orange fruit that begged to be eaten, some weighing perhaps four pounds. Heber graciously picked one for me, and I took it with me to the hotel that Dr. Goenaga's secretary had arranged.

#### My Adventure Concluded with a Taste of Heaven

After getting into my room and shedding muddy clothes, I settled in and cut into the fruit that Heber picked for me. It was luscious, more tasty than the large Mexican papaya that we get in our produce markets and more flavorful than a 'Solo' Hawaiian-type papaya—and certainly much better than the Babaco papaya tree that I was growing in my garden in San Rafael, which had fruited for me the previous year with 10 large papayas around four pounds each. I gave those to 10 friends and family for a taste test. Nine called it awful, the worst papaya they had ever tasted. The 10th guinea pig, my sister-in-law, Marilyn, said to me, “Oh my, what an exotic, unusual, tropical taste.” She actually liked the Babaco papaya, whose taste I have likened to a combination of paint thinner and furniture polish.

#### But Now a New Dream Lives On

Anyway, that night I fell asleep nurturing a new dream: that if it were up to Ricardo and Heber, true plant explorers of the 21st century, the United States would soon be blessed with many orchards of producing mangosteens and other delicious tropical fruit.

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duction can range from 30,000 to 61,000 pounds per acre.

Several methods or techniques have been developed to preserve and/or extend the storage-life of the fruit. The standard decay-control method for green and yellow-green papaya consists of submerging the fruit in water at 120°F for 20 minutes, followed by a rinse in cool water. This hot-water bath combined with either fungicide-waxing, gamma irradiation or storage with a low oxygen concentration at 55° to 60°F can extend the shelf life for up to 21 days.

The major threat to the papaya industry is virus diseases. Among these, the most important are the mosaic and ringspot viruses transmitted by aphids. Bunchy-top is also a serious disease caused by a bacterium and transmitted by leafhoppers. TARS researchers are conducting studies to evaluate yield and fruit-quality traits of new commercial hy-

brids of papaya grown in various agro-environments. They are also studying the papaya-aphid-ringspot virus complex and testing the efficacy of reflective mulch to repel aphids, the vector of the ringspot virus in papaya.

**Mangosteen (*Garcinia mangostana* L.)**

The “queen of fruits,” as it was praised by ancient travelers and Queen Victoria of England in the 1800s, belongs to the Clusiaceae (Guttiferae) family, which comprises about 400 species and 30 to 40 genera. The mangosteen is indigenous to the Sundra Islands and the Malay peninsula in Southeast Asia, where it grows under humid conditions: about 98 inches of annual rainfall. The tree is strictly tropical in climate and soil requirements. It does not tolerate temperatures below 41°F, and thrives on deep-drained clay soils. It acclimates to an elevation of 300 to 5,000 feet.

There are no known commercial clones

selected per se; the commercial method of propagation is by “seeds”—not true seeds, but adventitious embryos. Therefore, seedlings derived from these “seeds” are identical to the mother plant. A major limitation to the development of a mangosteen industry is the long time (7 to 15 years) before growers can realize a return in their investment because of the plant’s slow rate of development, particularly when young.

In Puerto Rico the mangosteen is ready for harvest from July to November. Mangosteen fruits are spherical and relatively small, ranging from 1.5 to 3 inches in diameter. The fruit weighs between 2.5 and 5 ounces, depending on the age of the tree and its geographical location. The pericarp or skin of the fruit is smooth, purple-violet or deep brown-purple externally and purple-violet inside, and contains a yellow, bitter, resinous latex. The white, edible pulp (aril) consists of several segments, some of which contain a seed; fruits seldom contain more than two seeds. The pulp is juicy and exquisitely flavored. A number of bumps resembling the petals of a rose will be evident on the pericarp at the base of the fruit. This reflects the number of segments inside. Six “petals” at the base of the fruit indicate that the aril is divided into six segments.

When mangosteen trees are propagated by seed, the yield and fruit size vary from tree to tree and are affected by tree age. Yields that should be anticipated from the first crop are 200 to 300 fruits per tree. Yield steadily increases up to the 30th year of bearing, when crops of 1,000–2,000 fruits per tree are expected. Picking may be carried out when fruits are underripe but fully mature; otherwise they will not ripen. The ripe mangosteen fruit can be preserved for three to four weeks in storage at 40° to 55°F. Post-harvest fruit decay is evident when the rind becomes hard rather than soft. Few known pests and diseases affect the mangosteen.

All mangosteen trees at TARS come from seed of two trees that were planted in 1903. These trees remain alive and healthy. In the early 1940s a mangosteen orchard was established here and has yielded between 650 and 1,400 fruits per tree. TARS researchers have tried to speed the growth of mangosteen seedlings by grafting it to

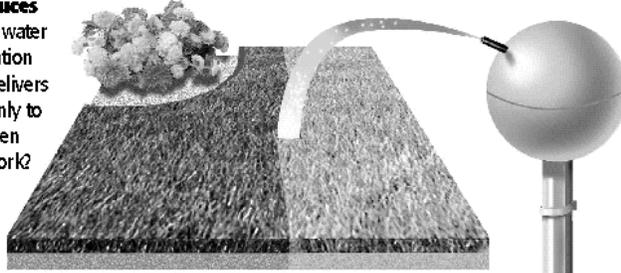
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other species of *Garcinia*. Unfortunately, scion-rootstock incompatibility has always resulted. However, preliminary data from a study on the interaction of shade and fertilization have shown that these factors can have a positive influence in speeding the growth of seedlings.

### Sapodilla (*Manilkara zapota*)

Sapodilla is a member of the Sapotaceae family and is native to Southern Mexico and Northeastern Guatemala. The species is not strictly tropical; it grows from sea level to an elevation of 9,000 feet and the mature tree can withstand freezing temperatures for several hours. It thrives on sandy, clay, organic or calcareous soils, and tolerates drought conditions. Sapodilla trees are among the most ornamental tropical fruit trees for landscapes. Foliage is evergreen, leaves are glossy pointed and alternate.

The fruit have a skin coated with sandy-brown scurf until ripe, and the fruit shape varies from round, to oblate, to oval, to ellipsoid. Sapodilla flesh is sweet and juicy, and its color ranges from yellowish to dark-brown. About 12 superior cultivars are available; five of them, Jamaica 8, Jamaica 10, Larsen, Prolific and Russell, have been evaluated on the semiarid coast of Puerto Rico for yield, chemical composition and panel acceptance.

The most reliable method of propagation to preserve desirable traits is grafting. Because the plant profusely exudes gummy latex, grafting is cumbersome. In Florida, however, budding, cleft and side-veneer grafting techniques have been used with moderate success. Vegetative propagation promotes tree dwarfing, early bearing and increased yield. Trees originated from seeds are slow-growing and take 6 to 8 years to bear the first crop. Because of high variability in yield and fruit quality, seedlings are seldom used for commercial production.

Sapodilla does not require pruning; however, in older trees pruning facilitates harvest. The fruit matures 4 to 6 months after flowering; some cultivars produce fruits year-round. It is somewhat difficult to determine when fruits are ready for harvest. At maturity some cultivars shed much of their skin "scurf" and the skin color turns slightly yellow. In other cultivars it is nec-

essary to rub the scurf to get it loose and scratch the fruit beneath the skin to be sure that it is not green. Additional maturity indicators are: easy separation of the fruit from the stem, absence of the oozing latex from the cut, and the presence of black or dark-brown seeds in the fruit. Mature-hard sapodilla fruits will ripen in 9 to 10 days at room temperature. The shelf life can be extended for about 15 days if the fruit is ripened at 68°F. Lowering the temperature to prolong the storage life will retard ripening at the expense of reducing quality. If the fully ripe fruit is frozen at 32°F it can be kept for about a month.

Pests and diseases are not major problems in production. Some years in Florida, however, leaf miners and rust and leaf spot may damage foliage during the winter and spring. The overripe fruits are favorable hosts of the Caribbean and Mexican fruit flies. In addition to the establishment of a sapodilla germplasm collection, TARS researchers are conducting experimenta-

tion to evaluate 16 sapodilla rootstocks for scion/rootstock compatibility, dwarfism, early yield and fruit-quality traits as well as susceptibility to fruit flies.

### Mamey Sapote (*Pouteria sapota*)

The species belongs to the Sapotaceae family. The Mamey sapote is indigenous to Central America, particularly to southern Mexico and northern Nicaragua, but is well-known throughout Central America, the Caribbean and Florida.

The tree grows well from sea level to 3,000 feet and with an annual rainfall of 70 inches. It adapts to a wide range of soil types, including sandy or deep-heavy clay soils but it does not withstand short dry periods.

Mamey sapote trees are large, erect-to-spreading and may reach a height of 40 to 60 feet, depending upon location. The leaves are obovate and pointed at both ends. The heavy fruit is ovoid, ellipsoid or round

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## SANTA BARBARA FESTIVAL (from page 11)

### Paul Thomson and Pitahaya

The highlight of the Festival of Fruit was a presentation made by Paul Thomson. As many readers know, Paul is one of the two founders of CRFG. After being introduced by another CRFG pioneer, George Emerich, Paul spoke on pitahayas. For the last 15 years or so, Paul has been working on this succulent fruit—known as “dragon fruit” in the Asian community—and he covered all the different types he has cultivated. The book he has recently published, *Pitahaya: A Promising New Fruit Crop for Southern California*, is very informative and contains many wonderful illustrations. Pitahaya will soon be available in California markets.

### Lunchtime Taste Treats

The lunch hour proved to be a special treat for all in attendance. In addition to free samples of exotic-fruit ice cream, endless samples of delicious rare fruit were offered;

among the offerings were mangoes, mamey sapote—donated by Melissa’s; peaches, capulin cherries, nectarines, black sapote—donated by George Emerich; jaboticaba, macadamias, cherimoya pulp—donated by the California Cherimoya Association and, finally, lucuma ice cream—donated by Amazonas. Among the not-so-rare-but-nevertheless-tasty fruits that disappeared quickly were figs and pluots, nance cherries, and, in honor of the Year of the Bananas, there were bananas to taste. This cornucopia of fruits was made possible by the efforts of four CRFG chapters: Los Angeles, Santa Barbara, Riverside and Santa Clara. What teamwork the Los Angeles chapter displayed—not only in a beautiful display, but in the generous way they shared their fruits with the members.

### Banana Bread Contest Winners

The winners of the Banana Bread Contest were Patricia Pastrana and David McK-inney from the North San Diego County

chapter. The problem seemed to be that all of the banana bread was disappearing at a rate that threatened the judging.

### Fruit Shoot Photo Contest Winners

The photo winners of this year’s Fruit Shoot were beautifully displayed, thanks to the CRFG Development Fund Committee, who wishes to thank all of those who submitted photos. Watch for the winning photos, and the names of those who submitted them, to be displayed in the Jan/Feb 2003 issue of the *Fruit Gardener*. The committee already anticipates seeing next year’s entries, so start taking those winning pictures now.

It is remarkable how, year after year, the different CRFG chapters continue to put on such wonderful festivals. What a great opportunity to learn more about growing fruit. What a wonderful stimulus to attendees, many of whom return home all fired up to try growing something they may have otherwise not even considered.

Best of all, this is a rare chance to social-

## 100 YEARS (from page 19)

and is often pointed at the apex. Fruit size varies from 3 to 10 inches in length and 3 to 6 inches thick. The pulp of mature fruits is salmon, orange or reddish-brown with a sweet, almond-like flavor. Usually, the fruit contains one large seed.

About 20 cultivars have been evaluated or commercially cultivated in Florida, Guatemala, Dominican Republic and Puerto Rico. Fruits of these cultivars vary in size and color of flesh, earliness and tree-growth habit.

The commercial method of propagation is grafting. Chip-budding produces good results but side-veneer grafting is the most reliable technique. The success of this technique in one-year-old rootstock is 80 to 90 percent. Grafted trees should be ready for field planting about one year later, and will bear a commercial crop in three to four years. Seedlings should be grown only for use as rootstocks or for the selection of

desirable characters in a plant improvement program.

A replicated germplasm collection of mamey sapote consisting of 24 clones was recently established at the TARS research farm. These clones will be evaluated for yield and fruit-quality traits.

### Rambutan (*Nephelium lappaceum* L.)

The rambutan belongs to the family Sap-indaceae, which includes other close relatives such as lychee, longan and pulasan. The tree is native to Malaysia and is commonly cultivated throughout Southeast Asia.

The tree’s soil and climate requirements are strictly tropical. It flourishes from sea level to about 1,600 feet elevation, on well-drained heavy clay soils that receive about 70 inches of annual rainfall. Rambutan does not grow well on sandy soils, but in heavy soils the tree can tolerate dry spells lasting three months.

Seven clones possessing desirable fruit traits are recommended for general planting

in the U.S. These cultivars and their commercial names are: R134 from Singapore, R156 (Muar Gading), R162 (Daun Hijau), R167 (Chai Tow or Cheng), R170 (Deli Cheng), Rongrien and R193 (Deli Baling).

From seed propagation the female-to-male tree ratio is about 1:1.4; therefore vegetative propagation is essential. The tree can be propagated by patch-budding, inarching and air-layering. Patch-budding is the most effective technique, averaging 70 to 80 percent success in vigorous 1- to 2-year-old seedlings. Among the three recommended techniques, air-layering has the lowest survival percentage in our nursery. Budded trees flower 2.5 to 3 years after field planting.

The tree is very sensitive to iron deficiency, which is associated with foliage chlorosis. Although the tree can withstand drought lasting three months, supplemental irrigation is recommended during the dry season. Pruning to remove water shoots and to open the tree canopy is advised.



## Festival Snapshots

1 Jozseph Schultz "measures" ingredients during his amazing fruit-cooking demonstration. 2 Smiles reflect Schultz's comic patter and quick sense of humor. 3 Fruit fritters Schultz made being quickly gobbled down by CRFGers. 4 and 5 Plant sellers doing brisk business well before the Festival got underway. 6 and 7 Coffee plant and banana plants at Norman Beard's farm during Sunday tours. 8 Skyline at Condor Ridge Ranch. 9 Group of CRFGers at Condor Ridge Ranch tour.

ize with my fellow members and hear about the different experiences they are having in their gardens. I hope to see all of you next year, at the 2003 Festival of Fruit. 📷

Many thanks to CRFG member and pitahaya/passiflora expert **Edgar Valdivia** and his wife, **Patricia Valdivia**, for putting together this enthusiastic report on the Festival. Thanks also to the Valdivias and to the Arizona chapter's **Monte Palmer** for great photographic support.



The word "rambutan" is derived from the Malay word "rambut" or hair, which describes the numerous, acute, soft, long, spine-like protuberances (spinterns) on the surface of the fruit. In the Philippines, flowering occurs from late March to early May and fruits are ready for harvest from July to November, when they turn red or yellow depending on the clone. At harvest the entire cluster is cut from the branch. The expected yield during the first fruiting year is 970 pounds per acre, and for a 10-year-old orchard 9,700 to 12,900 pounds per acre. The shelf-life of rambutan fruit is very short; fruits must arrive in the market within three days after picking. Storing in sealed polyethylene bags at 50°F and 95% relative humidity preserves the fruit in fresh condition for 12 days. Few pest and disease problems have been reported by growers.

In our experimental sites, rambutan trees are intercropped with 'Grande Nain' banana. This association not only protects young rambutan trees from wind damage,

it also provides growers with income from bananas before rambutan trees bear fruits commercially for the first time.

## The Work Continues

Many cultivars of these crops are being evaluated in replicated plots in various agroenvironments to determine yield and fruit-quality traits, nutrient requirements and nutrient utilization efficiency, water use efficiency, scion-rootstock compatibility, acid/alkaline soil tolerance, best methods for in-vitro propagation and effectiveness of environmentally friendly compounds/practices for insect and disease control.

The Tropical Agriculture Research Station is the official national germplasm repository for cacao (*Theobroma cacao*), plantains and bananas, *Annona* spp. (cherimoya, atemoya, sugar apple), *Garcinia* spp., sapodilla, mamey sapote and tropical and temperate bamboos. The station also maintains backup collections of avocado (*Persea americana*) and mango (*Mangifera indica*). As a germplasm

repository the station is responsible for the distribution, evaluation, regeneration, and characterization of these crops. 📷

**Dr. Ricardo Goenaga** is the research leader and location coordinator of the USDA-ARS Tropical Agriculture Research Station in Mayaguez, Puerto Rico, where he devotes his time to research on tropical and subtropical fruit crops, particularly in physiology and horticulture. Readers can contact him by phone at 787-831-3435, or e-mail at [mayrg@ars-grin.gov](mailto:mayrg@ars-grin.gov). **Larry Shore** may be best known by readers for his past contributions of tasting information about new fruit cultivars, for publication in the *Fruit Gardener*. He has a history of cultivating a large number of fruit trees, including tropicals, grapes and berries. Ricardo Goenaga and Larry Shore are CRFG members.

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