

New Options for Lychee and Longan Fans and Farmers

Maybe you've eased into an elegant dinner with a bowl of chilled lychee soup or lingered over a delicious dessert of lychee ice cream. This tropical delicacy and its smaller cousin, longan, are intriguing ARS scientists in Hawaii. Based at the U.S. Pacific Basin Agricultural Research Center in Hilo, these ARS experts are investigating ways to help growers bring more of these exotic fruits to you.

Hot Bath Foils Insect Foes

Packinghouse managers must ensure that the fruit they ship isn't harboring live lychee fruit moths or oriental fruit flies;

PEGGY GREB (K10891-1)



Fruit flies deposit their eggs through the thin skin of a lychee, causing juice to ooze out and stain the surface. But lychee is a poor host, and fruit fly larvae rarely develop in the fruit.

PEGGY GREB (K10893-1)



Peter Follett (left) and tropical fruit grower Michael Strong installed the first hot water immersion quarantine treatment unit for lychee and longan, shown here, at Kahili Farms on the Island of Kauai.

such stowaways could wreak agricultural havoc. Irradiation, one option for disinfesting the fruit, doesn't comply with organic produce standards.

ARS entomologist Peter Follett and colleagues have developed an alternative that may help growers expand their markets. The team designed, built, and tested a twin-tank system that provides a hot-water bath to kill these insects, followed by a cooling dip to protect the fruit's delectable qualities.

The unit features submerged, articulated plastic conveyor belts studded with rubber cleats. These tracks take fruit smoothly in and out of the heating and cooling tanks. The hot-water tank is calibrated precisely to meet federal standards: The fruit is submerged for 20 minutes in water heated to 120°F. The subsequent trip through the cooling tank helps prevent spoilage. Neither bath harms the pleasant fragrance or appetizing, slightly firm texture of the fruit.

Follett worked with Glenn McHam of MMG Manufacturing, Inc., a Fresno, California, commercial equipment fabricator; John White, a Fresno-based designer of agricultural equipment; and Mike Strong, owner of Kahili Farms, Kilauea, Hawaii, one of the state's premier growers and packers of tropical fruit. Kahili Farms, where Follett is fine-tuning and demonstrating a commercial prototype of the dual-tub process, is in the final stages of obtaining federal approval for the unit.

Fusing the Ancient With the Modern

Quirks in timing of lychee and longan flowering and, therefore, fruiting lead to either boom or bust harvests. Explains ARS horticulturist Tracie Matsumoto, "Growers are left with too much fruit one year and too little the next. Ideally, lychee and longan crop yields would be even and predictable, like apple harvests."

In her Hilo laboratory, Matsumoto is currently fusing ancient knowledge of Chinese firecracker ingredients with contemporary discoveries from a plant called thale cress, *Arabidopsis thaliana*.

Chinese firecrackers, used for more than 500 years in religious celebrations and other events, enter the picture through a fascinating phenomenon noted in Taiwan.

"Longan trees growing near temples in that country," says Matsumoto, "were found to form flowers and then bear fruit shortly after religious ceremonies in which fireworks were used. This occurred even outside the typical growing season."

Studies reported in 2000 by Chung-Ruey Yen of the National Pingtung University of Science and Technology in Taiwan suggested that a chemical in the ashes of the firecrackers settled in soil around the trees and triggered flowering.

So how does thale cress fit into the Hawaii experiments?

Scientists find thale cress to be a perfect subject for studies of the structure and function of plant genes. That's because thale cress has very few genes, making the task significantly

PEGGY GREB (K10885-1)



Entomologist Peter Follett inspects a panicle of ripening lychee fruit for insect damage.

PEGGY GREB (K10895-1)



Horticulturist Tracie Matsumoto observes a flowering longan tree.

less complex. While examining the plant, researchers at several labs found that one of its genes, *flc*, represses flowering. Yet by some unknown mechanism, other thale cress genes are able to overcome *flc* to induce the plant to bloom.

“We want to see whether a repressor gene, like *flc* in thale cress, exists in crops such as lychee or longan,” explains Matusmoto. “And we want to find out whether a firecracker chemical somehow interacts with the repressor gene or other genes to overcome the antiflowering effect. Once we know that, we might be able to take advantage of this phenomenon by

PEGGY GREB (K10889-1)



Lychee, *Litchi chinensis*, was first introduced into Hawaii 100 years ago but has been cultivated in China for nearly 4,000 years. Peeled before eaten, the fruit is whitish colored, as seen above.

using a less-explosive version of the fireworks chemical to cue flowering.

“The lychee and longan industry in Hawaii is still quite small, with just a few farms and some productive backyard trees,” she says. “But growers are planting more and more trees. We want to help these farmers succeed.”

Savvy Scientists Share Lychee Expertise

In the meantime, growers do have some tactics at their disposal to help them sidestep the problem of unpredictable harvests. “Growing Lychee in Hawaii,” a popular leaflet published by the University of Hawaii in 1999, presents guidelines on everything from how to select the best-performing trees to how to properly prune, fertilize, and irrigate them.

Francis Zee, horticulturist and curator of ARS’s tropical fruit and nut collection at Hilo, developed some of these techniques in experiments with lychee trees planted near his laboratory

and at an orchard in Kona, some 120 miles away. Then he teamed with other specialists in Hawaii to summarize everyone's recommendations and present them in the text, tables, and diagrams that make up the leaflet. "From running a lychee repository for more than a decade, we've learned a lot of secrets about how to grow this crop," says Zee.

World's Lychees Safeguarded

The repository that Zee manages serves as a botanical library. Living examples of lychee, longan, and about a dozen other tropical crops are preserved for the future and are available today for use by scientists, growers, and farm advisors. This treasury is part of the nationwide network of ARS-managed plant collections.

"The lychee and longan collections here at Hilo are among the best outside of China and southeast Asia," says Zee. "Some lychees were brought from southern China in the 1940s by Dr. George Groff, and were donated to us by the University of Hawaii, where Groff was a professor.

"Dr. Philip Ito and I obtained more recent acquisitions, added in the late 1980s and throughout the 1990s. Before he retired from the university, we collected in Thailand, China, and Taiwan. We also received additional specimens by exchanging material with scientists of those countries," Zee adds.

In 2002, Zee made a preliminary exploration of a wild lychee forest on China's Hainan Island, southwest of Hong Kong in the Gulf of Tonkin. He established contacts with some of China's leading horticulturists and is making plans to return.

The ARS repository at Hilo houses many kinds of lychee that are grown in Hawaii. These boast a delightful range of shapes, colors, and sizes. Hak Ip, for example, has thin, smooth, dull-red skin; round- to heart-shaped fruit; and a single, large seed inside. Chen's Purple has bright, purplish-red skin and elliptical fruit. No Mai Tsz, the world's most sought-after lychee because of its exceptional flavor, often has only a single, shriveled seed inside, nicknamed a "chicken tongue" for its odd appearance.

The collection also includes India's Bengal; Kwai May Pink, developed in Australia; and Groff and Kaimana, selected from other candidate lychee trees for their adaptability to Hawaii's soils and climates. All are descendants of China's *Litchi chinensis*, the source of every domesticated lychee on the planet.

Luscious Longan from Around the Globe

The longan collection at Hilo is composed of varieties from China, where it is native, and from other locales. "We have Tiger Eye and Ta u Yu from China; Si Chompoo and Biew Kiew from Thailand; and Kohala from Hawaii," Zee explains.

"The Thai specimens are more suitable for Hawaii, and are more consistently productive here, than those from China, probably because Thailand's climate is more nearly like that of Hawaii. Our collection includes Hawaii's own, unique longan variety, Egami, selected by Dr. Ito. We also have the *malesianus* subspecies, which bears a soft, soapy-tasting fruit. It has bumpy, light-mustard-yellow skin instead of the smooth, dark-mustard-brown peel of its relative, *Dimocarpus longan*—the domesticated fruit."

Zee is collaborating with a team led by ARS plant physiologist Paul Moore at Aiea, Hawaii, to probe the genetic makeup of lychee and longan. The intent? To verify work done in 1995 by the repository staff to sort out exactly who's who among these fruit varieties. That early work untangled some of the confusion that, understandably, resulted when traditional names of lychee and longan varieties were translated from the original Chinese into English. Now, Moore's team is using newer, more precise DNA-analysis techniques that, earlier, weren't as available to the repository investigators.

"Collecting, preserving, and classifying lychee and longan trees is especially critical," Zee emphasizes. "It's urgent that this happen before old lychee and longan forests in Asia are destroyed for development or before older varieties are displaced—in commercial groves—by new ones.

"With the help of our collaborators here and overseas, we can continue to expand the collection and contribute to the knowledge about these fruit species. That way, we can improve the care of these wonderful gifts that the world has inherited from China.—By **Marcia Wood**, ARS.

This research is part of Plant, Microbial, and Insect Genetic Resources, Genomics, and Genetic Improvement, an ARS National Program (#301) described on the World Wide Web at www.nps.ars.usda.gov.

To reach the scientists named in this article, contact Marcia Wood, USDA-ARS Information Staff, 5601 Sunnyside Ave., Beltsville, MD 20705; phone (301) 504-1662, fax (301) 504-1641, e-mail marciawood@ars.usda.gov. ★

PEGGY GREB (K10896-1)



Tracie Matsumoto collects a sample from a longan tree to isolate the genes involved in flowering.