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A UH-led international team of 85 scientists has deciphered the genetic code of a disease-resistant papaya. Posing with some of the papayas used in research at Snyder Hall on the University of Hawaii-Manoa campus are scientists Maqs Alam, left, Qingyi Yu and Shaobin Hou; papaya farmer Ken Kamiya; scientist Dennis Gonsalves; business development manager Tak Sugimura; and Stephanie Whalen of the Hawaii Agriculture Research Center.

## Papaya genome decoded

**UH scientists take part in the research, which is expected to benefit the state's economy**

By Helen Altonn  
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University of Hawaii-Manoa researchers have decoded the genome of the genetically modified "SunUp" papaya with a team of more than 85 scientists from 22 institutions.

It is the first fruit species and first transgenic crop to be sequenced -- an achievement expected to have far-reaching agricultural and economic effects.

Initially, "nobody believed we could do that work," said Maqsudul Alam, director of the UH Center for Advanced Studies in Genomics, Proteomics and Bioinformatics, lead institute in the International Papaya Genome Consortium.

"With our local resources and local funding, we were able to create infrastructure comparable to any top-notch genomic institute," Alam said in an interview.

The papaya genome findings are featured in the cover story of today's issue of the British journal Nature. Co-lead authors are Shaobin Hou, with the UH genomics center, and Ray Ming, University of Illinois professor of plant biology. Ming spent 11 years in Hawaii as a UH graduate student and Hawaii Agricultural Research Center researcher.

Unraveling the papaya's genetic makeup is expected to facilitate Japan's approval of disease-resistant Rainbow papayas for consumption and significantly expand the industry. Only Canada and the mainland accept the biotech fruit now.

Rainbow papaya, making up more than 70 percent of Hawaii's total papaya production, is a hybrid between the transgenic SunUp and nontransgenic Kapoho varieties.

The papaya ringspot virus was demolishing the industry in the 1990s until Dennis Gonsalves and associates developed the SunUp strain. He was then at Cornell University and now directs the U.S. Department of Agriculture's Pacific Basin Agricultural Research Center in Hilo.

Alam said the international collaboration "creates a platform now that we can actually make major breakthroughs in this area." Researchers will mine the data for anti-cancer compounds and antioxidants, he said.

The consortium also is getting requests from institutions around the world to collaborate on other genome projects, Alam said, such as the plant fiber jute in Malaysia and a microbial genome that can be used for biofuel in New Zealand. UH and Nankai University in China are continuing to work on a microbial genome for fungus-producing antibiotics, he said.

Increased medical, cosmetic and biotechnological uses of papaya also are forecast because of the genome project. The highly nutritious fruit already is popular for uses ranging from meat tenderizer to beer brewing because of the enzyme papain.

Major partners with UH and Nankai University were the Maui High Performance Computing Center, Hawaii Agricultural Research Center, Pacific Telehealth and Technology Hui and the U.S. Pacific Basin Agricultural Research Center.

"This clearly puts us on the map in terms of genomic research," said Tak Sugimura, manager of business development at the computing center. It shows "big science" can be done in an isolated place like Hawaii, he said.

The researchers began talking about a project in 2004 and formed the Hawaiian Papaya Genome Consortium in 2005.

"It was a pretty daunting task," Sugimura added. "Maqs Alam was the driver on this. We made a number of wrong turns, but we learned a lot."

Sugimura said a private company is being created to take advantage of the papaya genome and applications other than agriculture.

"The more you know about the thing you're looking at, the easier it is to identify and make use of it," said Gonsalves, who created the transgenic varieties with Richard Manshardt, Maureen Fitch and Jerry Slightom.

Ming said the papaya is only the fifth flowering plant to be sequenced, and little was known about what genes control the flavor, flesh and color. Now, with more than 90 percent of the genetic code deciphered, he said, "We have all the genes in our hand, and we can sort it out what genes are controlling what.

"It gives us the ability to develop papaya's resistance to disease so farmers don't have to use pesticides and other chemicals," Ming said. "It's a safer, more nutritious papaya for consumers."

House Agriculture Chairman Cliff Tsuji (D, South Hio-Panaewa-Puna-Keaau-Kurtistown) said the state had great hopes that papaya would be a major contributor to the state economy after sugar folded. Then the state was invaded by the papaya ringspot virus.

"This is really a transition period of our recovery of a highly viable industry," said Tsuji, saying he has met

with officials in Japan and is optimistic that the genome will satisfy their concerns about transgenic papaya. "This is a market we in Hawaii can really look forward to."

### **Papaya facts**

- » Papayas are Hawaii's second-largest fruit crop, with an estimated value of \$18 million.
- » Hawaii County had 125 papaya farms in August, the same as August 2006, with a total 1,905 acres in papaya production.
- » Honolulu, Kauai and Maui counties had 53 growers last August -- up from 45 since August 2006 -- with a total 230 acres in papayas.
- » Transgenic Rainbow papayas accounted for 75 percent of production on the Big Island last year; the nontransgenic Kapoho variety, 19 percent, and other varieties, 6 percent.
- » The papaya industry was the verge of collapse by 1997, with a 40 percent drop in production because of the deadly ringspot virus.
- » Plant biotechnology is credited for saving the industry. Researchers inserted a gene in the papaya that made it resistant to the virus, similar to the way a vaccine protects people from disease.
- » Within four years after the creation of the genetically modified disease-resistant varieties, papaya production was back to levels before the ringspot virus attack.
- » The biotechnology represented 20 years of work by Cornell University and University of Hawaii scientists. The Cornell Research Foundation and Papaya Administrative Committee have the license for the genetically improved papaya seeds. Hawaii farmers are allowed to use them for free.

Sources: The Papaya Genome Project and state Department of Agriculture