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STUDY DECODES PAPAYA GENOME

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Tropical fruit tree's DNA has surprisingly few genes

The tropical tree whose fruit packs a vitamin-rich punch has become the fifth flowering plant to reveal its genome. An international team of researchers has unveiled a draft of the catalog of genetic information needed to make papaya.

It is the first time researchers have compiled the genome of a transgenic fruit crop — the papaya variety had been genetically modified for protection against a virus. The work will help scientists develop a quick way to determine the sex of a papaya tree — plants with both male and female flowers are the only ones farmed for fruit, but currently these plants can't be distinguished from all-male or all-female plants until the trees are 3 to 4 months old. "This will really help the farmers," says Maqsudul Alam, who led the project at the University of Hawaii at Manoa.

The work also sheds light on how the genetic blueprint for plants has changed through evolutionary time and from domestication, comments botanist Elena Kramer of Harvard University. "This will help us understand wild genomes as well," she says.

For the size of its genome — about 372 million letters of DNA code — the papaya has surprisingly few genes — under 25,000, the researchers report in the April 23 *Nature*. Rice, grape and poplar all have genomes roughly the same size, but have 6,000 to 20,000 more genes than papaya. This discrepancy suggests that the papaya didn't experience a duplication of its entire genome, as have many of its relatives, says Ray Ming of the University of Illinois at Urbana-Champaign. But the plant might make up for its lack of some genes by making other genes multitask. The researchers found a surprising number of genes known as MADS-box genes — 171 compared with 78 in rice — management-level genes known for influencing development by turning other genes on and off at just the right times.

As might be expected, the instructions for building and operating a papaya include many genes for making volatiles, the aromatic compounds that make fruits and flowers smell so good. For example, the team found 24 genes just for making limonene, the main stuff of citrus odor, while the genome of the mustard *Arabidopsis* has only four limonene genes. But genes associated with keeping a plant's development in sync with light and dark cycles seem to have fallen by the wayside—papaya has only 49 percent of a poplar tree's genes that respond to light and dark. These genes may be less important in the tropics where light and dark cycles don't change much over the year, the researchers suggest.

Alam's team also scanned the genome for foreign bits of DNA that were inserted when the plant was vaccinated against the dastardly papaya ringspot virus, which ravaged farms in Hawaii through the 1990s. Three of these transgenic bits were found, and none had inserted into functional genes, the scientists report.

Not only will the genome cataloging inform papaya farming efforts, it will also advance investigations of the plant's biosynthetic pathways, which include making the meat-tenderizing enzyme papain. This power enzyme can reportedly digest 35 times its weight of lean meat, and is also used for cleaning decayed flesh from wounds.