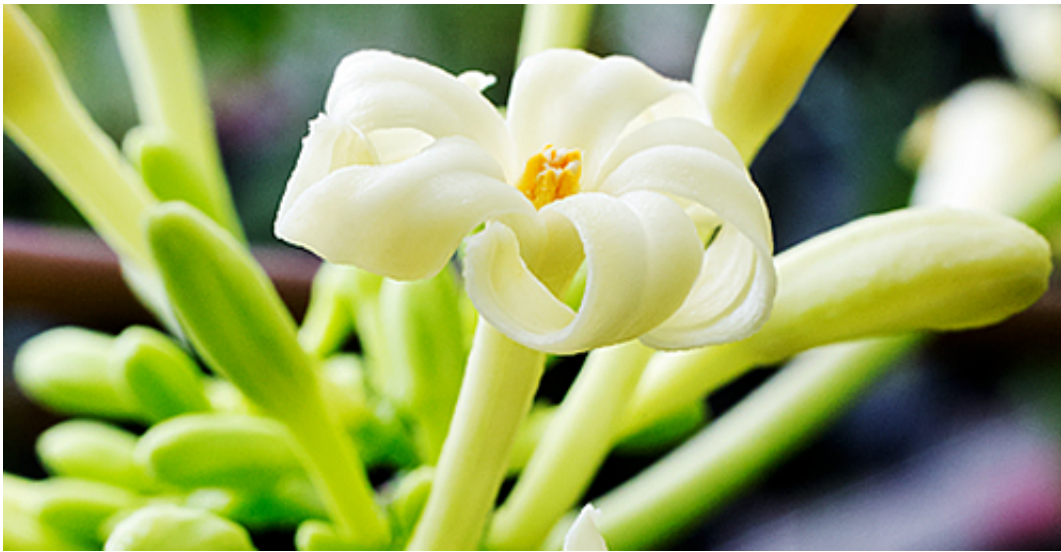


# Cultivated papaya owes a lot to the ancient Maya, research suggests

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Researchers analyzed the sex chromosomes of papaya, which can produce male (pictured), female and hermaphrodite flowers. Credit: Rishi Aryal

A genetic study of papaya sex chromosomes reveals that the hermaphrodite version of the plant, which is of most use to growers, arose as a result of human selection, most likely by the ancient Maya some 4,000 years ago.

The study, reported in the journal *Genome Research*, homes in on a region of [papaya's male sex chromosome](#) that, the study indicates, gave rise to the [hermaphrodite](#) plants.

"This research will one day lead to the development of a papaya that produces only hermaphrodite offspring, an advance that will enhance papaya root and canopy development while radically cutting papaya growers' production costs and their use of fertilizers and water," said University of Illinois plant biology professor Ray Ming, who led the research. Ming is a professor in the Carl R. Woese Institute for Genomic Biology at Illinois.

Papaya plants are either male, female or hermaphrodite. The hermaphrodites produce the desirable fruit that is sold commercially. Growing hermaphrodites is costly and inefficient, however, because one-third of hermaphrodite fruit seeds and one-half of female fruit seeds generate female plants, which are useless to growers. Farmers cannot tell which seeds are hermaphrodites until the plant has flowered, so they plant multiple seeds together to maximize their chances of getting at least one hermaphrodite plant. Once they identify the desired plant, they cut the others down.

The Y chromosome in papaya hermaphrodites, which is called  $Y^h$ , arises from an altered form of the male Y chromosome. Researchers are keen to understand the genetic basis for this alteration, so they can develop "true-breeding" hermaphrodite papaya, which will produce only hermaphrodite offspring, Ming said.

"Identification of an ancestral male population that the modified hermaphrodite  $Y^h$  evolved from will allow us to track down the mutation that caused the male-to-hermaphrodite sex reversal," he said.

The researchers sequenced and compared the "male-specific" and "hermaphrodite-specific" regions of the Y and  $Y^h$  sex chromosomes, respectively, in 24 wild male papaya and 12 cultivated hermaphrodite plants. They found less than half of one percent difference between the male and hermaphrodite sequences, suggesting that the evolutionary

event that caused them to diverge occurred in the not-too-distant past.

"The sex chromosomes in other organisms, such as mammals, are ancient and the genes involved in their initial evolution cannot be identified because many subsequent changes, including gene gains and losses, have occurred," the authors wrote. Human sex chromosomes, for example, are an estimated 167 million years old, while papaya sex chromosomes date to about 7 million years ago. This makes the papaya a good model for understanding sex chromosome evolution in general, Ming said.

Among the male papaya plants, the team identified three distinct wild populations: MSY1, MSY2 and MSY3. Their analysis revealed that the MSY3 population was most closely related to the hermaphrodite [sex chromosome](#). All of the MSY3 plants in the study were from the northwest Pacific coast of Costa Rica.

"Our analyses date the divergence (of male and hermaphrodite papaya) to around 4,000 years (ago), well after the domestication of crop plants in Mesoamerica more than 6,200 years ago, and coinciding with the rise of Maya civilization about 4,000 years ago," the authors wrote.

Given that no wild hermaphrodite papayas have been found in Central America, "this strongly suggests that the (hermaphrodite papaya) resulted from papaya domestication by the Maya or other indigenous groups," the researchers wrote.

**More information:** "Origin and domestication of papaya Yh chromosome," [genome.cshlp.org/content/early ... .183905.114.abstract](http://genome.cshlp.org/content/early/.../183905.114.abstract)

Provided by University of Illinois at Urbana-Champaign

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