

Scientists unravel the history of cotton domestication

Cotton, the world's most profitable nonfood crop, is used more than any other natural fiber. Known for its comfort and durability, it has been utilized since antiquity in fabrics and other goods. Four species are grown commercially, but one is dominant, accounting for about 90% of global production.

Scientists have now unraveled the domestication history of this important species - called *Gossypium hirsutum*, or upland cotton - with some genomic sleuthing. They determined that it was first domesticated in Mexico in the northwestern part of the Yucatan peninsula. The region at the time was populated by Stone Age farmers, long before the Maya civilization flourished there.

Iowa State University botanist and evolutionary biologist Jonathan Wendel said this domestication occurred at least 4,000 years ago, and perhaps up to 7,000 years ago.

The researchers pinpointed where domestication occurred by comparing the genomes of the domesticated species to wild cotton species found in the Yucatan, Florida and the Caribbean islands of Puerto Rico and Guadeloupe. The domesticated species most closely matched wild Yucatan cotton.

"Wild cotton plants are woody, multibranched shrubs or small trees, long-lived, with relatively sparse flowering and smaller flowers, fruits and seeds than under cultivation," said Wendel, co-senior author of the study published on Monday in the journal *Proceedings of the National Academy of Sciences*.

"Members of some human groups must have taken an interest in the wild forms," Wendel said, setting in motion the process of domestication from which the modern crop form arose over thousands of years of slow and gradual improvement.

"Early farmers saw potential in this sprawling plant with hairy seeds as a source for soft materials. Early weavers could spin fiber by hand and use it for weaving cloth, fish nets, ropes and other goods," Iowa State University geneticist and evolutionary biologist and study co-senior author Corrinne Grover said.

Upland cotton was introduced to the rest of the world following the Spanish conquests in the Americas in the 16th century. China, India, the United States and Brazil are now the world's leading cotton producers.

"Research is showing that the process of domestication, of transforming these short, coarse and brownish fibers into the fine, white and superior textile we know today likely involves many genes operating in a complex symphony,"

Grover said.

"The fibers themselves are just single-celled seed hairs, but are among the most exaggerated and remarkable cells in plants," Wendel said. The study found that the domesticated cotton plant possesses far less genetic diversity - the variety of genetic characteristics within a species - than its wild counterparts. Less genetic diversity can lower the ability of a species to adapt to environmental changes such as exposure to diseases.

"We know that domestication often leads to a loss of genetic diversity as early farmers were selecting for valuable traits, and then to further reductions as crop improvement intensified the selection pressure," Grover said.

"Here, we can see what this means globally for the cotton genome, and how it compares to what still remains in the wild. This wild diversity is important because traits that were inadvertently lost - certain pest resistance, for example - may be valuable in incorporating into our modern cultivars," Grover said.

The invention of the cotton gin, a machine that automated the separation of seeds from cotton fibers, in the United States at the end of the 18th century dramatically increased processing speeds and made cotton farming highly profitable. This drove an expansion of slavery in the U.S. South amid increased demand for labor to plant, pick and harvest the valuable crop.

"Cotton has a complicated history, most notably its association with slavery, exploitation of Indigenous peoples and imperial expansion. But it is also an enduring crop, one that is woven into the lives of people worldwide," Grover said.