Confirmed: Sunflower domesticated in US, not Mexico

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Image: Wikipedia

New genetic evidence presented by a team led by Indiana University biology doctoral graduate Benjamin Blackman confirms the eastern United States as the single geographic domestication site of modern sunflowers. Co-authors on the findings published this week in *Proceedings of the National Academy of Sciences* include Blackman's advisor, IU Distinguished Professor of Biology Loren H. Rieseberg, and four others from Rieseberg's lab, as well as collaborators from Universidad Nacional Autonoma de Mexico and the University of Cincinnati.

Through a comprehensive examination of the geographic diversity in

three recently identified early domestication genes of Helianthus annuus, the researchers also reported finding no DNA evidence to support suggestions based on archaeological evidence that a second, independent domestication event had occurred in Mexico.

"Our results affirm that the eastern United States was an independent center of plant domestication and that all known living cultivated sunflowers shared a common origin there," Blackman said.

Controversy over the domestication of H. annuus began when sunflower seeds were found at pre-Columbian archaeological sites. It was proposed that, along with being domesticated in eastern North America, an independent sunflower domestication occurred in Mexico. Alternatively, sunflower may have been dispersed from eastern North America into Mexico through trade routes established before Spanish colonization.

This new work confirms domestication took place in eastern North America, probably in the Mississippi River Valley in the region of present day Arkansas.

The team analyzed the sequence diversity of three genes -- c4973, HaFT1, and HaGA2ox -- that had been identified as candidates for domestication genes, as well as the diversity of 12 neutral markers, and identified patterns of diversity in Mexican domesticated and wild sunflowers consistent with all other domesticated varieties known to have originated from an eastern North American domestication site. The study looked at 60 sunflower populations from the U.S. and Canada and 31 from Mexico.

"Even though we made extensive new collections of wild and cultivated sunflowers native to Mexico that for the first time provided us with a powerful sample to test for a second origin, our results from multiple types of genetic data found strong evidence for just a single origin,"

Blackman said.

The analysis of hereditary molecular differences in the three sunflower genes shown to have experienced selective sweeps -- the loss or lowering of variation in DNA sequences due to artificial or natural selection -- confirmed that domesticated sunflowers grown in Mexico today are descended from the same cultivated genetic lineage as eastern North America domesticated sunflowers. All of those varieties, whether from Mexico or North America, carried sequences diagnostic for cultivation at the domestication at these loci, and genetic ancestry inferred from neutral markers scattered throughout the genome independently and unambiguously confirmed the same result.

A few qualifications remain, as the team could have missed finding a modern Mexican domesticated version descended from an independent Mexican lineage. There may have also been an ancient Mexican lineage that has since become extinct and for which no modern germplasm has survived. Some scientists have speculated that extinction could have been facilitated by the proposed role colonial Spanish Christians may have taken in eradicating sunflower as an important religious symbol to the solar-worshipping Aztecs, or recently by the substantial influx of seed imports made possible by the North American Free Trade Agreement.

"Although current archaeological finds indicate that ancient Mesoamericans cultivated sunflower before Spanish colonists arrived in the New World, more discoveries are needed to understand where and how quickly sunflower crop development spread in Mesoamerica and eastern North America," Blackman added.

Further insights will come, he said, not only from new archaeological finds but also from new DNA sequencing technologies capable of obtaining data from thousands of genes from these ancient samples.

Such advances would deepen understanding of how nascent sunflower cultivars were related to each other and when newly identified domestication alleles spread throughout eastern North American and Mexico.

Provided by Indiana University