

# Genetics reveal ancient trade routes of Four Corners potato

July 18 2024, by Lisa Potter

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Four Corners potato tubers in a basket. Credit: Alastair Bistoí

A new study shows that a native potato species was brought to southern Utah by Indigenous people in the distant past, making it a candidate for the only culturally significant plant species to have been domesticated in

the southwestern U.S.

The team of researchers, led by Red Butte Garden and the Natural History Museum of Utah (NHMU) at the University of Utah, used [genetic analysis](#) to reveal how and where tubers of the Four Corners potato (*Solanum jamesii*) had been collected, transported and traded throughout the Colorado Plateau. The findings support the assertion that the tuber is a "lost sister," joining maize, beans and squash—commonly known as the three sisters—as a staple of crops ingeniously grown across the arid landscape.

"Transport is one of the early crucial steps in the domestication of native plants into crops," said Dr. Lisbeth Louderback, curator of archaeology for NHMU, associate professor of anthropology at the U and co-author of the study. "Domestication of a plant species can begin with people gathering and replanting propagules in a new location."

The authors collected DNA samples from modern Four Corners potato populations near archaeological sites and from non-archaeological populations within the potato's natural range in the Mogollon Rim of central Arizona and New Mexico. The findings indicate that the potato was transported and cultivated, likely by the ancestors of modern Pueblo (Hopi, Zuni, Tewa, Zia), Diné, Southern Paiute and Apache tribes.

"The Four Corners potato, along with maize, cacao, and agave, reflects the significant influence of humans on plant diversity in the landscape over millennia," said Dr. Bruce Pavlik, former director of conservation at Red Butte Garden and lead author of the study.

The paper [appears](#) in the *American Journal of Botany*.

*S. jamesii* has twice the protein, calcium, magnesium and iron content of an organic red potato, and a single tuber can grow to yield up to 600

small tubers in just four months. The nutritious crop would have been a highly valued trade item and crucial in the lean winter months. While the unique distribution of the Four Corners potato came as a surprise to scientists and researchers, local Tribal members had suspected this all along.





Solanum jamesii plant, the Four Corners potato. Credit: Tim Lee / NHMU

## The lost sister

The Mogollon Rim region encompasses south-central Arizona, extending east and north into the Mogollon Mountains of New Mexico. Jagged limestone and sandstone cliffs break up the ponderosas, pinyons and junipers scattered across the high-altitude terrain. *S. jamesii* is widely distributed across the Rim—the plants thrive in conifer woodlands, and thousands of small tubers can grow beneath a single pinyon pine canopy. These "non-archaeological" populations lack an association with artifacts, grow to be quite large, and are continuously distributed across the habitat.

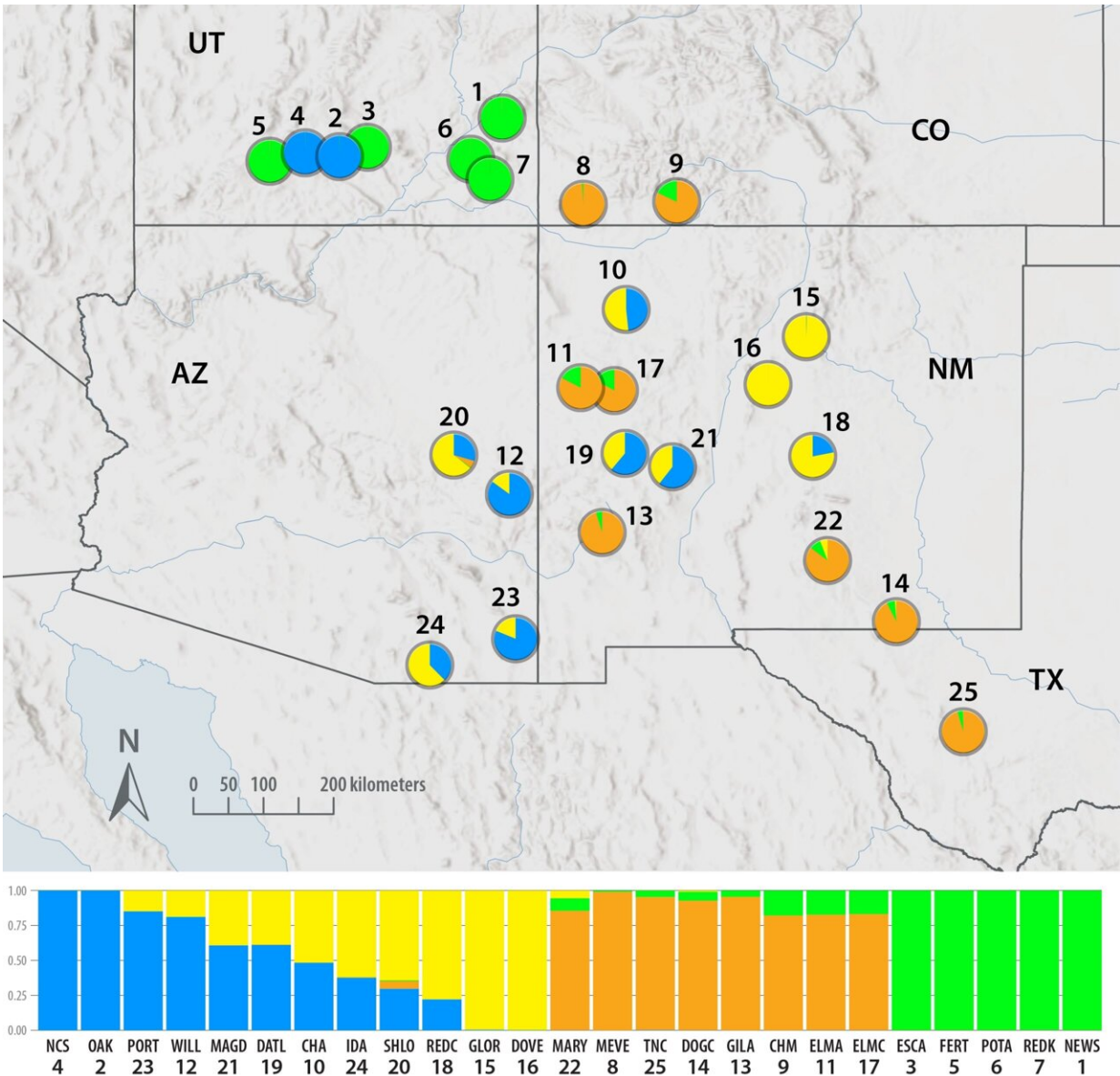
In contrast, "archaeological populations" of the potato occur within 300 meters of ancient habitation sites and tend to be smaller than in the central distribution of the species. The sparse, isolated populations across the Colorado Plateau exhibit a genetic makeup only explained by human gathering and transport.

To reproduce sexually—that is, to create viable seeds—flowers must receive pollen from a different plant with specific, compatible genetic factors. Without the right companion, plants will clone themselves by sprouting from underground stems to create a genetically identical daughter plant. Its cloning capability allows *S. jamesii* to persist even when conditions are far from ideal. It also provides a genetic stamp marking where each [population](#) originated. This signature is common in potatoes carried to locations with few other individuals and persists for hundreds of generations.

Researchers collected DNA samples from 682 individual plants across 25 populations of the Four Corners potato—14 populations were near archaeological sites, while 11 were from non-archaeological areas in its natural distribution. The results showed that the most genetically diverse populations of *S. jamesii* were concentrated around the Mogollon Rim. Conversely, populations from archaeological sites exhibited reduced genetic diversity because the transported tubers may have only contained a fraction of the available genes.

## **Tracing the origins of archaeological populations**

The authors found that populations of *S. jamesii* in Escalante Valley in Southern Utah have two different origins—one directly from the Mogollon Rim region and one related to Bears Ears, Mesa Verde and El Morro. These [archaeological sites](#) form a genetic corridor suggesting ancient people transported the tubers.



Map showing genetic structure by ancestry. Each bar represents the genetic composition of a given potato population and shows where the genes came from. Credit: *American Journal of Botany* (2024). DOI: 10.1002/ajb2.16365

Despite being close geographically, four archaeological populations around Escalante Valley show distinct origins. The genetic signatures could indicate that people transported potatoes to new locations multiple

times in the distant past in a pattern likely corresponding to ancient trade routes.

"The potato joins a large assemblage of goods that were traded across this vast cultural landscape," said Louderback. "For millennia, people of the southwest participated in social networks, migration and trade routes in the region."

What is clear is that the species has been transported and grown far from its center of natural distribution. Scientists from the USDA Potato Gene Bank have been sampling the genetics of the Four Corners potato for decades and were intrigued by the diversity of genetic patterns along the geographic range.

"We used to wonder about the patterns of [genetic diversity](#) distribution of *Solanum jamesii*," said Dr. Alfonso del Rio, plant geneticist at the University of Wisconsin-Madison and the U.S. Department of Agriculture Potato Genebank and co-author of the study. "It wasn't clear to us that humans had altered its range, but now we have evidence confirming just that."

The researchers interpret the transport of the Four Corners potato as early stages of domestication. However, they plan to analyze specific gene sequences to learn more about *S. jamesii*'s frost tolerance, taste and ability to sprout, and more, to understand whether the [potato](#) was truly domesticated.

"We'd like to look at specific genetic markers for certain desirable traits such as tuber size and frost tolerance," said Pavlik. "It's entirely possible that Indigenous people were preferring certain traits and thus trying to encourage favorable genes."

**More information:** Bruce M. Pavlik et al, Evidence for human-caused

founder effect in populations of *Solanum jamesii* at archaeological sites:  
II. Genetic sequencing establishes ancient transport across the Southwest  
USA, *American Journal of Botany* (2024). [DOI: 10.1002/ajb2.16365](https://doi.org/10.1002/ajb2.16365)

Provided by University of Utah

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